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

Agency:	Bureau of Ocean Energy Management, Regulation and Enforcement, US Army Corps of Engineers and US Environmental Protection Agency
Activity:	Cape Wind Energy Project F/NER/2010/03866
Conducted by:	National Marine Fisheries Service Northeast Regional Office
Date Issued:	Dec 30, 2010
Approved by:	[signature]

This constitutes the biological opinion (Opinion) of NOAA's National Marine Fisheries Service (NMFS) on the effects of the construction, operation and decommissioning of Cape Wind Associates LLC (Cape Wind) proposed wind energy facility as authorized by the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEM, formerly known as the Minerals Management Service) on Horseshoe Shoal in federal waters of Nantucket Sound, 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.). BOEM's authority to approve, deny, or modify the proposed action derives from the Outer Continental Shelf Lands Act (43 U.S.C. § 1331 et seq.) as amended by the Energy Policy Act of 2005 (P.L. 109-58). The proposed action also requires the issuance of a permit from the US Army Corps of Engineers for sediment disturbing work, pursuant to Section 10 of the Rivers and Harbors Act and issuance of an Outer Continental Shelf Air Permit from the US Environmental Protection Agency (EPA) pursuant to the Clean Air Act that regulates the pollutants emitted from the preconstruction, construction and operation activities of the proposed wind energy facility. This Opinion is based on information provided in BOEM's Cape Wind Energy Project Nantucket Sound Biological Assessment (BA), the Final Environmental Impact Statement for the project (FEIS), correspondence with the BOEM and EPA, and other sources of information. A complete administrative record of this consultation will be kept on file at the NMFS Northeast Regional Office. Formal consultation was reinitiated on July 16, 2010. This Opinion supersedes the previous Opinion issued on November 13, 2008.

CONSULTATION HISTORY

Cape Wind Associates (Cape Wind) began preliminary work on siting and designing a wind energy project in 2000. In November 2001, Cape Wind sought a permit from the US Army Corps of Engineers (ACOE) to construct and operate a wind-powered electrical generating facility on Horseshoe Shoal in Nantucket Sound, Massachusetts. Informal consultation between NMFS and the ACOE continued throughout 2001-2004. A DEIS was ultimately published by the ACOE in 2004. The DEIS included a draft BA dated May 2004. NMFS provided comments on the DEIS and indicated to the ACOE that consultation pursuant to Section 7 of the ESA would be necessary for the proposed project.

In August 2005, the Energy Policy Act of 2005 was passed which gave the Department of the Interior's (DOI) Minerals Management Service (now BOEM) authority for issuing leases, easements or rights-of-way for alternative energy projects on the Outer Continental Shelf (OCS). At this time, purview over the Cape Wind proposal was transferred from the ACOE to BOEM. BOEM then determined that a new DEIS was required given its different federal approval processes and requirements.

BOEM and NMFS began discussing consultation requirements in January 2006. Throughout 2006 and 2007 NMFS provided technical assistance to BOEM as they drafted a new DEIS and draft BA. The BOEM published a DEIS on January 18, 2008. BOEM provide NMFS with a final BA and request for formal consultation in a letter dated May 19, 2008. Consultation was initiated on May 22, 2008 and completed with the issuance of a Biological Opinion (Opinion) on November 18, 2008. In this Opinion, NMFS concluded that the proposed action was likely to adversely affect but was not likely to jeopardize the continued existence of loggerhead, Kemp's ridley, leatherback or green sea turtles. Additionally, NMFS concluded that the proposed action was not likely to adversely affect right, humpback or fin whales and, therefore, was not likely to jeopardize the continued existence of these whale species. Because no critical habitat is designated in the action area, none will be affected by the proposed action. The Opinion included an Incidental Take Statement exempting the incidental take by acoustic harassment of 3-7 sea turtles during each 4 hour pile driving event (130 events total) and 13-28 sea turtles during the geophysical survey. These takes were expected to be a combination of loggerhead, Kemp's ridley, green and leatherback turtles.

BOEM published the Cape Wind final EIS on January 21, 2009. On April 28, 2010 BOEM released an Environmental Assessment which examined whether there are any "substantial changes in the proposed action that are relevant to environmental concerns" or "significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts" that either were not fully discussed or did not exist at the time the FEIS was prepared in January 2009. In the EA, BOEM concluded that there were not any substantial changes or significant new circumstances or information warranting addition or modification to the 2009 EIS. Also on April 28, 2010, Department of Interior Secretary Salazar announced the availability of the Record of Decision (ROD) for the Cape Wind Project. The ROD documented BOEM's decision to select the Preferred Alternative at Horseshoe Shoal in Nantucket Sound as described in the final EIS.

In the spring of 2010, over 90 North Atlantic right whales were observed in Rhode Island Sound and nearby waters, including areas to be transited by project vessels originating from the staging site at Quonset, RI. While right whales were not sighted in the area proposed for construction (i.e., the project footprint on Horseshoe Shoal within Nantucket Sound), right whales were observed in nearby areas and along the route that would be used by vessels moving between the project footprint and the project staging area near Quonset, RI. When compared to sightings in previous years, these sightings represent a higher than average number of right whales in the action area and nearby areas. As noted in BOEM's July 13, 2010 letter to NMFS, these sightings represent new information that when analyzed may reveal effects of the action that may affect listed species in a manner or to an extent not previously considered. As such, NMFS concurred with BOEM's determination that reinitiation of consultation was appropriate; specifically, to consider the new information on the presence of right whales in the action area. Consultation was reinitiated on July 26, 2010. On October 6, 2010 a lease was signed by Secretary of the Interior Ken Salazar and Cape Wind Associates President Jim Gordon. The lease has a 33-year term. To date, no construction or other in-water activities have been conducted.

DESCRIPTION OF THE PROPOSED ACTION

The proposed action entails the construction of a wind energy facility (wind facility) consisting of 130 wind turbine generators (WTG) to be located on Horseshoe Shoal in Nantucket Sound, Massachusetts (see Figure 1 for map of project area). The northernmost WTGs would be located approximately 3.8 miles from the dry rock feature offshore near Bishop and Clerks and approximately 5.2 miles from Point Gammon on the mainland; the southernmost part of the Wind Park would be approximately 11 miles from Nantucket Island (Great Point) and the westernmost WTG would be approximately 5.5 miles from the island of Martha's Vineyard (Cape Poge). Installation of the WTGs will comprise of four activities: (1) installation of the foundation monopiles; (2) erection of the wind turbine generators; (3) installation of the submarine cables; and, (4) installation of the scour protection. The 130 WTGs and the ESP piles would occupy a total of 0.67 acres of submerged land. Scour protection for the WTGs would cover an additional 11 - 47.5 acres, depending on whether scour mats or rock armoring was used. During installation of the WTGs, ESP, cable and scour protection, it is anticipated that approximately 867 acres would be temporarily disturbed.

Pre-Construction Geophysical and Geological Survey

Prior to construction, a supplemental geotechnical program may be conducted. Additionally, the applicant may conduct a high resolution marine shallow hazards survey. The geotechnical and geophysical (G&G) field investigations would be designed to collect sufficient information, coupled with previous site-specific field data, to further characterize the surface and subsurface geological conditions within the vertical and horizontal areas of potential physical effects (APPEs), in preparation for final design and construction. These areas include the offshore construction footprints and associated work areas for all facility components, including the WTGs, the ESP, the inner array cables and the 115kV transmission cables to shore. The supplemental geotechnical program would further analyze sediments and physical conditions within the proposed action APPEs, for use in final foundation design and to develop site-specific BMPs for constructability.

The high-resolution geophysical survey program will be conducted prior to construction and may begin as early as Spring of 2011. The survey area includes the entire Wind Turbine Array and 115 kV submarine cable route. The survey vessels will operate during daytime hours only. Daily operations are expected to occur approximately 10 hours per day during relatively calm sea conditions. The applicant anticipates up to 5 months of survey activity to cover the survey area; the total anticipated trackline mileage is estimated at approximately 2,000 nautical miles. Tracklines are approximately 30 meters apart. Two survey vessels may operate at one time and will travel at approximately 3 knots during data acquisition and will transit to and from the survey area from port at approximately 15 knots. The vessels will operate continuously throughout the Project Area during the day and terminate survey activities each day before dark, prior to returning to port.

The applicant will use a boomer and/or chirper to obtain the necessary geophysical data. As required by BOEM, endangered species observers will be present during the survey and will maintain a 500 meter exclusion zone. Additional requirements for operation during the survey are outlined in Appendix A and include a ramp up procedure, continuous visual monitoring of the exclusion zone, and shut down requirements should a listed species enter the exclusion zone.

The supplemental geotechnical program involves the use of coring and boring equipment to collect sediment samples for laboratory analyses, which would disturb the seafloor in small discrete locations. Vibracores would be taken at each WTG location. The vibracores would be advanced from a small (less than 45 feet) gasoline powered vessel. Approximately 130 vibracores are currently planned, with up to 6 collected during each field day. The diameter of the core barrel is approximately 4 inches and the cores are advanced up to a maximum of 15 feet. In addition to the vibracores, additional deep borings would be advanced at selected WTG sites. The borings would be advanced from a truck-mounted drill rig placed upon a jack-up barge that rests on spuds lowered to the seafloor. Each of the four spuds would be approximately 4 feet in diameter, with a pad approximately 10 feet on a side on the bottom of the spud. The barge would be towed from boring location to location by a tugboat. The drill rig would be powered using a gasoline or diesel powered electric generator. Crew would access the boring barge daily from port using a small boat. Borings generally can be advanced to the target depth (100 to 200 feet) within 1 to 3 days, subject to weather and substrate conditions. Drive and wash drilling techniques would be used; the casting would be approximately 6 inches in diameter. Cone Penetrometer Testing (CPT) or an alternative subsurface evaluation technique would be conducted prior to construction, to evaluate subsurface sediment conditions. A CPT rig would be mounted on a jack-up barge similar to that used for the borings. The top of a CPT drill probe is typically up to 3 inches in diameter, with connecting rods less than 6 inches in diameter

Construction of the Wind Energy Facility

Each WTG has an energy generating capacity of approximately 3.6 megawatts (MW) and the proposed action is designated for a maximum electrical energy capacity of 468 MW. In order to generate maximum wind energy production, the WTGs will be arranged in specific parallel rows in a grid pattern. For this area of Nantucket Sound, the wind power density analysis conducted by the applicant determined that operation of the array in a northwest to southeast alignment provides optimal wind energy potential for the WTGs. This alignment will position the WTGs perpendicular to prevailing winds, which are generally from the northwest in the winter and the southwest in the summer.

Each turbine is pitch-regulated with active yaw to allow it to turn into the wind, and has a three-blade rotor. The main components of the WTG are the rotor, transmission system, generator, yaw system, and the control and electrical systems, which are located within the nacelle. The nacelle is the portion of the WTG that encompasses the drive train and supporting electromotive generating systems that produce the wind-generated energy. The nacelle would be mounted on a manufactured tubular conical steel tower supported by a monopole foundation system. A pre-fabricated access platform and service vessel landing (approximately 32 feet from mean lower low water (MLLW) would be provided at the base of the tower. The rotor has three blades manufactured from fiberglass-reinforced epoxy, mounted on the hub. The monopiles would be of two different diameters, depending on the depth of the water. A 16.75 foot (5.1 meter) diameter monopile would be installed for WTGs in water depths of 0 to 40 feet and an 18 foot (5.5 meter) diameter monopile would be installed for WTGs in water depths of 40 to 50 feet.

A jack up barge with a crane would be used for the installation of the monopiles. The jack up barge would have four legs with pads a minimum of four meters on a side. The crane would lift the monopiles from the transport barge and place them into position. The monopiles would be installed into the seabed by means of a pile driving ram or vibratory hammer to an approximate depth of 85 feet. This would be repeated at all WTG locations. Only two pieces of pile driving equipment would be present within the action area at any one time and they will not operate simultaneously. Monopiles to be installed range in length from approximately 122 feet for those installed in the shallowest locations to approximately 172 feet for those to be installed at the deepest sites. The anticipated time to install all of the monopiles is expected to be approximately eight months.

The installation of the WTG itself would be from a specialized vessel configured specifically for this purpose. As noted in the October 2010 Construction and Operations Plan filed by Cape Wind with BOEM, the vessel will be loaded at Quonset, Rhode Island with the necessary components to erect two to four WTGs. Approximately 86 trips over an 11month period will be needed to deliver the material to the work site. Vessels will depart Quonset and travel through Narragansett Bay to Rhode Island Sound, travel north of Martha's Vineyard and to the Nantucket Sound main channel. The vessel would transit from Quonset to the work site and set up adjacent to one of the previously installed monopiles. A jacking system would then stabilize the vessel in the correct location. A transition piece would then be grouted in place to the monopile. The crane would then place the lower half of the tower onto the deck of the transition piece. The upper tower section is then added and then the nacelle, hub and blades are raised to the top of the tower and secured. This process is anticipated to take approximately 30 to 40 hours for each WTG. This process is anticipated to take approximately 9 months to complete. The installation of the WTGs will overlap with the installation of the monopiles.

Each of the 130 WTGs will generate electricity independent of one another. Within the nacelle of each turbine, a wind-driven generator would produce low voltage electricity, which would be "stepped up" by an adjacent transformer to produce 33 kV electrical transmission capacity. Solid dielectric submarine cables from each WTG will interconnect within the grid and terminate at their spread junctions on the electrical service platform (ESP). The ESP will serve as the common interconnection point for all of the WTGs within the wind park. The proposed submarine cable system is approximately 12.5 miles in length from the ESP to the landfall location in Yarmouth, Massachusetts. The submarine cables would travel north to northeast in Nantucket Sound to Lewis Bay past the westerly side of Egg Island, and then make landfall at New Hampshire Avenue. The proposed onshore cable route to its intersection with the NSTAR Electric Right of Way (ROW) would be located entirely along existing paved ROWs where other underground utilities already exist.

As the monopiles and WTGs are completed, the submarine inner-array cables (see below) would be laid in order to connect each string of wind turbines, and then the scour control system would be installed on the seabed around each monopile. The scour control system would help to prevent underwater currents from eroding the substrate adjacent to the WTG foundation. The scour system would consist of either a set of six scour-control mats arranged to surround the monopile, or rock armoring. Each scour-control mat is 16.5 feet by 8.2 feet with eight anchors that securely tie to the seabed. It is anticipated that the process of completing one string of WTGs (10 WTGs with associated inner-array cable and scour mats) would take up to one month (approximately 13 months total). The scour mats are placed on the seabed by a crane or davit onboard the support vessel. Final positioning is performed with the assistance of divers. After the mat is placed on the bottom, divers use a hydraulic spigot gun fitted with an anchor drive spigot to drive the anchors into the seabed. In the event that scour mats are found to be less effective, rock armoring will be used. The rock armor scour control design requires the use of filter layer material and rock armor stones. The rock armor and filter material would be placed so that the final elevations approximate pre-installation bottom contours so that mounds of material would not be created. The rock armor stones would be placed on top of this filter material which is used to fill the majority of the scour hole that is predicted to develop after installation of each WTG and the ESP. The filter layer would also minimize the potential for the underlying natural sediment material to be removed by the wave action and would also minimize the potential for rock armor to settle into the underlying sediment material. The armor stones will be sized so that they are large enough not to be removed by the effects of the waves and current conditions, while being small enough to prevent the stone fill material placed underneath it from being removed. If it were used, the rock armor and filter layer (i.e., smaller stone fill) would be placed on the seabed using a clamshell bucket or chute.

An Electric Service Platform (ESP) will be installed and maintained within the approximate center of the WTG array. It would serve as the common interconnection point for all of the WTGs within the wind park. Each WTG would interconnect with the ESP via a 33 kV submarine cable system. These cable systems would interconnect with circuit breakers and transformers located on the ESP in order to transmit wind-generated power through the 115 kV shore-connected submarine cable systems. The inner-array cables would be arranged in strings, each of which would connect up to approximately 10 WTGs to a 33 kV circuit breaker on the ESP. The ESP would provide electrical protection and inner-array cable sectionalizing capability in the form of circuit breakers. It would also include voltage step-up transformers to step the 33 kV inner-array transmission voltage up to the 115 kV voltage level of the submarine cable connection to the land based system. The ESP would include a helipad to allow personnel access when conditions preclude vessel transport, and for emergency evacuation.

The ESP would be a fixed template type platform consisting of a jacket frame with six 42-inch driven piles to anchor the platform to the ocean floor. The six piles would be driven through pile sleeves to design tip elevation of approximately 150 feet below the surface of the sea bottom. The piles would be vibrated and hammered as required. The platform jacket and superstructure will be fully fabricated on shore and delivered to the work site by barges, where it will be installed. The platform would consist of a 100 foot by 200 foot steel superstructure. The installation of the ESP is anticipated to take approximately one month to complete. The platform would be placed approximately 39 feet above MLLW. Water depth at the site of the ESP installation is 28 feet. In addition to the electrical equipment, the ESP would include fire protection, battery backup units, and other ancillary systems. Maintenance and service access to the ESP would normally be by service boat. A boat landing dock consisting of a fender structure with ladder will be attached to the ESP to allow boat landing and transfer of personnel and equipment and temporary docking of the service craft. A crane will be mounted to the ESP to facilitate the transfer of equipment.

The submarine cable system interconnecting the WTGs with the ESP (the inner-array) would be of solid dielectric AC construction, using a three-conductor cable with all phases under a common jacket. The cables would be arranged in strings, each of which would connect up to approximately 10 WTGs to a 33 kV circuit breaker on the ESP. There would be a total of approximately 66.7 miles of inner-array cabling throughout the wind park. The proposed method of installation of the submarine cable is by the Hydroplow embedment process, commonly referred to as jet plowing. The cable laying barge would be loaded at the staging area (most likely in Quonset, RI) and then towed to the project site. This would be repeated as required to deliver and install all the required cable. This method involves the use of a positioned cable barge and a towed hydraulically-powered jet plow device that simultaneously lays and embeds the submarine cable in one continuous trench from WTG to WTG and then to the ESP. The barge would propel itself along the route with the forward winches, and the other moorings holding the alignment during the installation. The six point mooring system would allow a support tug to move anchors while the installation and burial proceeds uninterrupted on a 24-hour basis. The inner-array cables would be installed six feet below the seafloor. It is anticipated that three different cable sizes would be used with diameters ranging from 5.19 to 6.45 inches.

Jet plow equipment uses pressurized sea water from water pump systems on board the cable laying vessel to fluidize sediments. The jet plow device is typically fitted with hydraulic pressure nozzles that create a direct downward and backward “swept flow” force inside the trench. This provides a down and back flow of re-suspended sediments within the trench, thereby “fluidizing” the in situ sediment column as it progresses along the submarine cable route such that the submarine cable settles into the trench under its own weight to the planned depth of the burial. A skid/pontoon-mounted jet plow, towed by the cable-laying barge, is proposed for the submarine installation. This jet plow has no propulsion of its own. The cable system is deployed from the vessel to the funnel of the jet plow device. The jet plow blade is lowered onto the seabed, pump systems are initiated, and the jet plow progresses along the cable route, creating a fluidized sediment trench approximately 4 to 6 feet wide (top width) to a depth of 8 feet below the present bottom into which the cable system settles through its own weight. The jet plow does not create an open trench of these dimensions but rather fluidizes the sediment with enough injected water that the cable can settle into the "soupy" sediments to a minimum depth of 6 feet below the bottom. The installation of the submarine transmission cable is expected to take two to four weeks to complete.

The transition of the interconnecting 115 kV submarine transmission cables from water to land would be accomplished through the use of horizontal directional drilling (HDD) methodology. The HDD would be staged at the onshore landfall area and would involve the drilling of the boreholes from land toward the offshore exit point. Conduits would then be installed the length of the boreholes and the transmission cable would be pulled through the conduits from the seaward end toward the land. A transition manhole/transmission cable splicing vault would be installed using conventional excavation equipment at the onshore transition point where the submarine and land transmission cables would be connected.

Two 115 kV transmission circuits would interconnect the ESP with the existing NSTAR Electric transmission grid serving Cape Cod. Each of the two circuits consists of two three-conductor cables, resulting in a total of four cables. The four submarine transmission cables would be installed as two circuits by bundling two cables per circuit together during installation and installing the two circuits. The overall diameter of the cable is 7.75 inches. The submarine transmission cables would transition to the onshore transmission cable by using HDD methodologies to a transition vault positioned at the end of New Hampshire Avenue in Yarmouth, MA. Transmission cables would be installed six feet below the seafloor.

Based on Cape Wind's October 2010 Construction and Operations Plan, during construction, Quonset Point, Rhode Island will serve as the primary staging area. Vessels will transit between Quonset Point and the project site to carry large equipment, components, personnel and supplies. During the operation phase, supplies, equipment and maintenance vessels are likely to be staged out of New Bedford and/or Falmouth. As noted above, approximately 43 trips are anticipated to move the monopiles to the work site. Additionally, two crew support vessels will travel to the work site each day.

It is anticipated that the main operation center for the wind park would be located in the Town of Yarmouth, MA. Cape Wind would operate a remote monitoring and command center where operational decisions could be made. Service and maintenance personnel would be stationed at one of two additional onshore locations: one for the parts storage and larger maintenance supply vessels and the second located closer to the site for crew transport. The maintenance operation would likely be based in New Bedford, Massachusetts and may also deploy several crew boats out of Falmouth, Massachusetts. The New Bedford facility would likely be located on Popes Island and would include dock space for two 50 foot maintenance vessels, as well as a warehouse for parts and tool storage, and crew parking. An off-site warehouse would also be utilized to increase parts storage. Maintenance vessels would be loaded with small containers at the Popes Island facility and transported to either the WTG or the ESP where the containers would be unloaded. Additional dock space would likely be rented in Falmouth Inner Harbor from which work crews would be deployed to either the WTG and/or the ESP in 35 and 45 foot long crew boats. In addition, a high speed emergency response boat (20 to 25 foot long) would be maintained in Falmouth Inner Harbor ready to respond whenever there is marine activity taking place.

Routine maintenance will occur on all WTGs once they become operational. Most planned preventative service and maintenance is expected to occur during the summer months when weather is most favorable. Routine service is usually a two day exercise and would include 3 to 4 crew members. Unplanned maintenance is carried out to any part of the WTG in response to a breakdown or failure. This could occur at any time of year but is unlikely to occur when wave heights exceed 5 feet. Cape Wind has estimated that each WTG may require up to 5 days of maintenance each year. As such, it is expected that two crew vessels will transit to and from the project site from New Bedford, MA each day that weather conditions are favorable. Crew vessels will be up to 50 feet long and will operate at speeds of up to 21 knots.

The ESP could be serviced by vessel or by helicopter. This would allow for maintenance crews to be deployed to the ESP during periods when wind and wave conditions are unsuitable for boat transfers.

The anticipated schedule for the action, assuming all Federal and state permitting and approval processes are completed in the first quarter of 2011, is as follows: (1) during the winter of 2011-2012 the onshore ductbanks, landfall transition and the temporary cofferdam will be installed; (2) during the third and fourth quarter of 2012 and first quarter of 2013 the ESP, the submarine 115 kV cables, and the onshore 115 kV cables will be installed; and (3) beginning the first quarter of 2013, the WTGs the inner-array cables and the scour mats will be erected and installed.

Decommissioning

The WTGS have a stated design life span of twenty years. However, as this estimate is based on experience generated from land-based machines where winds are more turbulent, it is possible that the WTGs may be operational beyond the minimum design life of twenty years.

In the event that the proposed action ceases operations or at the end of its useful life, a decommissioning plan will be implemented to remove and, to the greatest degree possible, recycle equipment and associated materials, thereby returning the area essentially to pre-existing conditions, to the extent practicable. Any decision by the proposed action's owners to cease operation of individual WTGs or the entire proposed action and to decommission and remove the proposed action's components would require consultation with BOEM. BOEM would then consult with the FWS and NMFS to determine if reinitiation of section 7 consultation was required based on any decommissioning plans. If the entire proposed action ceases to operate for a period of time of 18 months or more, and during that time the proposed action's owners have made no good-faith effort to restart operation, upgrading or decommissioning, the proposed action may be determined to be inoperative and decommissioning instruments may be accessed by BOEM to initiate decommissioning activities. Decommissioning of the proposed action is largely the reverse of the installation process.

It is anticipated that equipment and vessels similar to those used during installation would be used for decommissioning. For offshore work, this would include a jet plow, crane barges, jack up barges, tugs, crew boats and specialty vessels such as cable laying vessels. An onshore disposal and recycling facility would be used to handle the materials removed from the project site. A facility currently exists in Everett, Massachusetts that could be utilized for this aspect of the decommissioning.

The initial step in the decommissioning process would involve the disconnection of the inner-array cables from the WTGs. The cables would be removed from their embedded position in the seabed. Where necessary, the cable trench would be jet plowed to fluidize the sandy sediments covering the cables, and the cables would then be reeled up onto barges. The cable reels would then be transported to land based facilities for recycling. The WTGs would be prepared for dismantling by draining all fluids and then deconstructing the WTGs. Cranes and vessels would be used to remove the blades, hub, nacelle, and tower. Once the wind turbines and towers have been removed, the foundation components (transition piece, monopile, scour mats and rock armor) would be decommissioned. Sediments inside the monopile would be suctioned out to a depth of 15 feet below the existing sea bottom in order to allow for access for the cutting of the pile in preparation for removal. The sediments would be pumped from the monopile and stored on a barge. All scour mats would be recovered, brought to the surface by crane, placed on a barge and brought to shore. Any rock armoring would be excavated with a clamshell dredge, placed on a barge and disposed of at an upland location. The monopile would then be cut from the inside at approximately 15 feet below grade. The sediments removed from the inner space of the monopile would be returned to the depression left when the monopile is removed.

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 includes the footprint of the energy project where the WTGs and ESP will be installed, the submarine cable route, the route between the staging and operations areas in Falmouth, MA, New Bedford, MA and Quonset Point, RI and the project site, as well as the underwater area where effects of the project (i.e., increases in suspended sediment and underwater noise) will be experienced. The action area is illustrated in Figure 2, and as noted above includes the project site on Horseshoe Shoal in Nantucket Sound and the surrounding waters to be transited by staging and service vessels during construction and throughout the life of the project.

Water depths within Nantucket Sound range from 1 to 70 feet at mean lower low water (MLLW). Depths on Horseshoe Shoal where the WTGs will be installed range from 0.5 feet to 60 feet at MLLW. Along the cable interconnection corridor, between Horseshoe Shoal and the Cape Cod shoreline, water depths vary from 16 to 40 feet MLLW. Water depths within Lewis Bay and Hyannis Harbor range from 8 to 16 feet at MLLW in the center of the bay to less than 5 feet at MLLW along the perimeter and between Dunbar Point and Great Island.

STATUS OF AFFECTED SPECIES

Several species listed under NMFS' jurisdiction occur off of the Massachusetts coast and may occur seasonally within the action area. No critical habitat has been designated within the action area; as such, no critical habitat will be affected by this action.

In Massachusetts, the federally endangered shortnose sturgeon (*Acipenser brevirostrum*) is only known to occur in the Merrimack and Connecticut Rivers, neither of which are in the action area for this consultation (NMFS 1998b). As shortnose sturgeon do not occur in the action area, this species will not be considered further in this biological opinion.

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 Texas. 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. Based on this information, NMFS has determined that hawksbill sea turtles are extremely unlikely to occur in the action area. As this species does not occur in the action area, this species will not be considered further in this consultation.

Sperm, blue and sei whales also occur in Northeast waters. However, all of these species occur in deep offshore waters. As none of these species occur in the action area, these species will not be considered further in this consultation.

NMFS has determined that the action being considered in this biological opinion may affect the following endangered or threatened species under NMFS' jurisdiction:

Cetaceans	
North Atlantic Right whale (*Eubalaena glacialis*)	Endangered
Humpback whale (*Megaptera novaeangliae*)	Endangered
Fin whale (*Balaenoptera physalus*)	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

This section will focus on the status of the various species within the action area, summarizing information necessary to establish the environmental baseline and to assess the effects of the proposed action. Background information on the range-wide status of these species and a

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[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.

description of critical habitat can be found in a number of published documents including recent sea turtle status reviews and stock assessments(NMFS and USFWS 1995, USFWS 1997, TEWG 2000, NMFS SEFSC 2001), Recovery Plans for the humpback whale (NMFS 1991a), right whale (NMFS 2005), fin and sei whale (NMFS 1998a), loggerhead sea turtle (NMFS and USFWS 1991) and leatherback sea turtle (NMFS and USFWS 1992), and the 2007 marine mammal stock assessment reports (Waring et al. 2008).

Status of Large Whales

All of the cetacean species considered in this Opinion were once the subject of commercial whaling which likely caused their initial decline. Commercial whaling for right whales along the U.S. Atlantic coast peaked in the 18th century, but right whales continued to be taken opportunistically along the coast and in other areas of the North Atlantic into the early 20th century (Kenney 2002). World-wide, humpback whales were often the first species to be taken and frequently hunted to commercial extinction (Clapham *et al.* 1999), meaning that their numbers had been reduced so low by commercial exploitation that it was no longer profitable to target the species. Wide-scale exploitation of the more offshore fin whale occurred later with the introduction of steam-powered vessels and harpoon gun technology (Perry *et al.* 1999). Sei whales became the target of modern commercial whalers primarily in the late 19th and early 20th century after populations of other whales, including right, humpback, fin and blues, had already been depleted. The species continued to be exploited in Iceland until 1986 even though measures to stop whaling of sei whales in other places had been put into place in the 1970's (Perry *et al.* 1999). Today, the greatest known threats to cetaceans are ship strikes and gear interactions, although the number of each species affected by these activities does vary.

Information on the range-wide status of each species as it is listed under the ESA is included here to provide the reader with information on the status of each species, overall. Additional background information on the range-wide status of these species can be found in a number of published documents, including recovery plans (NMFS 1991a, b; 2005a), the Marine Mammal Stock Assessment Reports (SAR) (*e.g.*, Waring *et al.* 2009), status reviews (*e.g.*, Conant *et al.* 2009), and other publications (*e.g.* Clapham *et al.* 1999; Perry *et al.* 1999; Best *et al.* 2001).

North Atlantic Right whales

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* species) as two separate endangered species: the North Atlantic right whale (*E. glacialis*) and North Pacific right whale (*E. japonica*) (73 FR 12024; March 6, 2008).

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 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 1991a). 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 Opinion will focus on the North Atlantic right whale (*Eubalaena glacialis*) 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.* 2009). 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).

The distribution of right whales seems linked to the distribution of their principal zooplankton prey, calanoid copepods (Winn *et al.* 1986; NMFS 2005a; Baumgartner and Mate 2005; Waring *et al.* 2009). 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.* 2009). 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). The consistency with which right whales occur in such locations is relatively high, but these studies also highlight the high interannual variability in right whale use of some habitats. Calving is known to occur in the winter months in coastal waters off of Georgia and Florida (Kraus *et al.* 1988). Calves have also been sighted off the coast of North Carolina during winter months suggesting the calving grounds may extend as far north as Cape Fear. 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). Patrician *et al.* (2009) analyzed photographs of a right whale calf sighted in the Great South Channel in June of 2007 and determined the calf appeared too young to have been born in the known southern calving area. Although it is possible the female traveled south to New Jersey or Delaware to give birth, evidence suggests that calving in waters of the Northeastern U.S. is possible. The location of some portion of the population during the winter months remains unknown (NMFS 2005a).

However, recent aerial surveys conducted under the North Atlantic Right Whale Sighting Survey (NARWSS) program have indicated that some individuals may reside in the northern Gulf of Maine during the winter. In 2008 and 2009, right whales were sighted on Jeffrey's and Cashes Ledge, Stellwagen Bank, and Jordan Basin from December to February (Khan *et al*. 2009, 2010).

While right whales are known to congregate in the aforementioned areas, much is still not understood about their seasonal distribution 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 2005a, Waring *et al.* 2009). 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.* 2009). On multiple days in December 2008, congregations of more than forty individual right whales were observed in the Jordan Basin area of the Gulf of Maine, leading researchers to believe this may be a wintering ground (NOAA 2008). 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 *et al.* 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 (1) of only two (2) 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).

Abundance estimates and trends

An estimate of the pre-exploitation population size for the North Atlantic right whale is not available. As is the case with most wild animals, an exact count of North Atlantic right whales cannot be obtained. However, abundance can be reasonably estimated as a result of the extensive study of the western North Atlantic right whale population. 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 1990-2005 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 1990-2005 was 1.8% (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.* 2009). The three calving years (97/98; 98/99; 99/00) prior to this record year provided low recruitment levels with a total of only 11 calves born. The calving seasons from 2000-2007 have been remarkably better with 31, 21, 19, 17, 28, 19, and 23 births, respectively (Waring *et al.* 2009). A calf count for the 2008/2009 season indicates a new record calving season of 39 calves (Zoodsma, pers. comm.). However, the western North Atlantic stock has also continued to experience losses of calves, juveniles and adults.

As is the case with other mammalian species, there is an interest in monitoring the number of females in this western North Atlantic right whale population since their numbers will affect the population trend (whether declining, increasing or stable). Kraus *et al.* (2007) reported that as of 2005, 92 reproductively-active females had been identified and Schick *et al.* (2009) estimated 97 breeding females. 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). Between 1980 and 2005, 16 right whales had produced at least 6 calves each, and 4 cows had at least seven (7) 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 had relatively high calf production and have included additional first time mothers (*e.g.*, eight (8) new mothers in 2000/2001). However, over the same time period there have been continued losses to the western North Atlantic right whale population 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 nine (9) were adult females, three (3) of which were carrying near-term fetuses and four (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), depending on how many calves each female previously had, the deaths of these nine (9) females may 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 (1) 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 2006a). 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 2006a).

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.* 2009). 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 had continued to decline in the 1990s and seemed to greatly affect 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). Despite the preceding, examination of the minimum number alive population index calculated from the individual sightings database, as it existed on 10 October 2008, for the years 1990-2005 suggest 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. Recently, NMFS NEFSC developed a population viability analysis (PVA) to examine the influence of anthropogenic mortality reduction on the recovery prospects for the species (Pace, in review). The PVA evaluated several scenarios on how the populations would fare without entanglement mortalities compared to the status quo. Only 2 of 1000 projections (with the status quo simulation) ended with a smaller total population size than they started and zero projections resulted in extinctions. As described above, the mean growth rate estimated in the latest stock assessment report, for the period 1990-2005, was 1.8% (Waring *et al.* 2009).

Reproductive Fitness

Healthy reproduction is critical for the recovery of the North Atlantic right whale (Kraus *et al.* 2007). Researchers have suggested that the population has been 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 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, and nutritional stress. 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 large whales (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 poisoning (PSP) toxins and domoic acid via trophic transfer through the presence of these biotoxins in prey upon which they feed (Durbin *et al.* 2002, Rolland *et al.* 2007).

Data to indicate whether 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 2002), there is no evidence at present to demonstrate that birth rates and calving intervals are related to food abundance. However, 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 1980s, 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 1980s 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 2003-2007, right whales had the highest proportion of entanglement and ship strike events relative to the number of total events (mortality, entanglement or ship strike) for any species of large whale (Glass *et al.* 2009). 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 2003-2007, the annual mortality and serious injury rate for the North Atlantic right whale averaged 3.0 per year (2.2 in U.S. waters; 0.8 in Canadian waters) (Glass *et al.* 2009, Waring *et al.* 2009). Twenty confirmed right whale mortalities were reported along the U.S. east coast and adjacent Canadian Maritimes from 2003-2007 (Glass *et al.* 2009). These numbers represent the minimum values for human-caused 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 cause of death may be unknown 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 exist 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.* 2009). Of the 20 total, confirmed right whale mortalities (2003-2007) described in Glass *et al.* (2009), 3 were confirmed to be entanglement mortalities (one (1) adult female, one (1) female calf, one (1) male calf) and 9 were confirmed to be ship strike mortalities (6 adult females, one (1) female of unknown age, one (1) male calf, and one (1) yearling male). Serious injury involving right whales was documented for one (1) entanglement event (adult female) and 2 ship strike events (one (1) adult female and one (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 (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.* 2009). 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 (493) 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 (1) 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 (i.e. 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% of the North Atlantic right whale population exhibit signs of injury from vessel strikes. Reports received from 2003-2007 indicate that right whales had the greatest number of ship strike mortalities (n=9) and serious injuries (n=2) compared to other large whales in the Northwest Atlantic (Glass *et al.* 2009). In 2006 alone, four (4) reported mortalities and one (1) serious injury resulted from right whale ship strikes (Glass *et al.* 2009).

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 (8) 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.* 2009). Of particular concern is the death of mature females. Recent mortality records include at least six (6) adult females, three (3) of which were carrying near-term fetuses and four (4) of which were just starting to bear calves (Glass *et al.* 2009).

Over the five-year period 2003-2007, right whales had the highest proportion of entanglements and ship strikes relative to the number of reports for a species: of 58 reports involving right whales, 20 were confirmed entanglements and 17 were confirmed ship strikes. There were 20 verified right whale mortalities, three (3) due to entanglements, and nine (9) due to ship strikes (Glass *et al.* 2009). 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 mortalities in 2004-2005, including a number of adult females, also suggested 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 1990-2005 (Waring *et al.* 2009). 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 Opinion, NMFS believes that the western North Atlantic right whale subpopulation is increasing.

The draft 2010 SAR (Waring *et al.* 2010) for the western stock of North Atlantic right whales reports an increase in the minimum population size (361), the average annual calf production (17.2), and the average growth rate (2.1%). The Draft SAR also assigned a PBR of 0.7 to this stock of right whales. Overall documented serious injury and mortality to right whales decreased to an average rate of 2.8 per year. Incidental fishery entanglement records and ship strike records for the period 2004 through 2008 averaged of 0.8 (U.S. waters 0.6) and 2.0 (U.S. waters, 1.6) respectively per year. The preliminary data from the Draft 2010 SAR is consistent with the 2009 SAR and provides additional indications of an increasing population size of and positive growth rate for North Atlantic right whales.

Humpback Whales

Humpback whales inhabit all major ocean basins from the equator to subpolar latitudes. With the exception of the northern Indian Ocean population, 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 as endangered 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.* 2008). Within the Pacific Ocean, 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 minimum population for the eastern North Pacific stock is 1,391 whales (Carretta *et al.* 2009). The central North Pacific stock is minimally at 4,005 animals (Allen and Angliss 2010), and various studies report that it appears to have increased in abundance at rates between 6.6%-10% per year (Allen and Angliss 2010). 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 (Allen and Angliss 2010).

The Northern Indian Ocean population of Humpback whales consists of a resident stock in the Arabian Sea, which apparently do not migrate (Minton *et al.* 2008). The lack of photographic matches with other areas suggests this is an isolated subpopulation. The Arabian Sea subpopulation of humpback whales is geographically, demographically and genetically isolated, reside year round in sub-tropical waters of the Arabian Sea (Minton *et al.* 2008). Although potentially an underestimate due to small sample sizes and insufficient spatial and temporal coverage of the population's suspected range, based on photo-identification, the abundance estimate off the coast of Oman is 82 animals [95% confidence interval CI)](Minton *et al.* 2008).

The Southern Hemisphere population of humpback whales are known to feed mainly in the Antartic, although some have been observed feeding in the Benguela Current ecosystem on the migration route west of South Africa (Reilly *et al.* 2008a). The IWC Scientific Committee recognizes seven major breeding stocks, some of which are tentatively further subdivided into substocks. The seven major breeding stocks, with their repective breeding ground estimates in paranthesis, include Southwest Atlantic (6,251), Southeast Atlantic (1,594), southwestern Indian Ocean (5,965), southeastern Indian Ocean (10,032), Southwest Pacific (7,472), central South Pacific (not available), and southeast Pacific (2,917) (Reilly *et al.* 2008a). The total abundance estimate of 36,600 humpback whales for the Southern Hemisphere is negatively biased due to no available abundance estimate for the central South Pacific subpopulation and only a partial estimate for the Southeast Atlantic subpopulation. Additionally, these abundance estimates have been obtained on each subpopulations wintering grounds, and the possibility exists that the entire population does not migrate to the wintering grounds (Reilly *et al.* 2008a).

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). The Gulf of St. Lawrence, Newfoundland/Labrador, western Greenland, Iceland and northern Norway are the other regions that represent relatively discrete subpopulations. Sightings are most frequent from mid-March through November between 41^{o}N and 43^{o}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 1991b).

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 but less precise estimate of 10,400 whales (95% CI = 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.* 2009). 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 2003 through 2007, the minimum annual rate of human-caused mortality and serious injury to the Gulf of Maine humpback whale stock averaged 4.4 animals per year (U.S. waters, 4.0; Canadian waters, 0.4) (Glass *et al.* 2009, Waring *et al.* 2009). Between 2003 and 2007 humpback whales were involved in 76 confirmed entanglement events and 11 confirmed ship strike events (Glass *et al.* 2009). Over the five-year period, humpback whales were the most commonly observed entangled whale species; entanglements accounted for 4 mortalities and 10 serious injuries (Glass *et al.* 2009). Although ship strikes were relatively uncommon, 8 of the 11 confirmed events were fatal (Glass *et al.* 2009). As of May 2009, all of the available information indicated that the events described here involved animals from the Gulf of Maine stock (Glass *et al.* 2009). There were also many carcasses that washed ashore or were spotted floating at sea for which the cause of death could not be determined. 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 of 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 humpback 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). 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 2006 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.* 2009). 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.

Summary of Humpback Whales Status

The best available population estimate for humpback whales in the North Atlantic Ocean is 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 estimated lower population 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 apparent decline in growth rate is a bias result due to a shift in distribution documented for the period 1992-1995, or whether the population growth rates truly declined due 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. With respect to the species overall, there are also indications of increasing abundance for the eastern and central North Pacific stocks, and Southern Hemisphere stocks: Southwest Atlantic, Southeast Atlantic, Southwest Indian Ocean, Southeast Indian Ocean, and Southwest Pacific. Trend data is lacking for the western North Pacific stock, the central South Pacific and Southeast Pacific subpopulations of the southern hemisphere humpback whales, and the northern Indian Ocean humpbacks. Therefore, given the best available information, for the purposes of this biological opinion, NMFS believes the humpback whale population is increasing.

Compared to the final 2009 SAR, the draft 2010 SAR (Waring *et al.* 2010) for the Gulf of Maine stock of humpback whales reports the same minimum population size, average annual calf production, average growth rate, and PBR. Overall documented serious injury and mortality to humpback whales increased by 0.2 to an average rate of 4.6 per year over the time period 2004 through 2008. Incidental fishery entanglement records and ship strike records for the period 2004 through 2008 averaged of 3.0 (U.S. waters, 2.8) and 1.6 (U.S. waters, 1.6) respectively per year. Consistent with the 2009 final SAR, the draft 2010 SAR concludes that the Gulf of Maine humpback whale stock is steadily increasing in size.

Fin Whale

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

Pacific Ocean

Within US waters of the Pacific, fin whales are found seasonally off the coast of North America and Hawaii and in the Bering Sea during the summer (Allen and Angliss 2010). 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

(Allen and Angliss 2010). A provisional population estimate of 5,700 was calculated for the Alaska stock west of the Kenai Peninsula by adding estimates from multiple surveys (Allen and Angliss 2010). 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 (Allen and Angliss 2010). An annual population increase of 4.8% between 1987-2003 was estimated for fin whales in coastal waters south of the Alaska Peninsula (Allen and Angliss 2010). 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 (Allen and Angliss 2010). 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.* 2009). 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). Photo-identification 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. The Scientific Committee of the International Whaling Commission (IWC) has proposed stock boundaries for North Atlantic fin whales. Fin whales off the eastern United States, Nova Scotia and southeastern coast of Newfoundland are believed to constitute a single stock of fin whales under the present IWC scheme (Donovan 1991). However, it is uncertain whether the proposed boundaries define biologically isolated units (Waring *et al.* 2009).

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 6-10 years of age in males and 7-12 years in females (Jefferson *et al.* 2008), although physical maturity may not be reached until 20-30 years (Aguilar and Lockyer 1987). Conception is believed to occur in tropical and subtropical areas during the winter with birth of a single calf after a 11-12 month gestation (Jefferson *et al.* 2008). 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).

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 minimum annual rate of confirmed human-caused serious injury and mortality to North Atlantic fin whales from 2003-2007 was 2.8 (Glass *et al.* 2009). During this five year period, there were 13 confirmed entanglements (3 fatal; 3 serious injuries) and 11 ship strikes (8 fatal) (Glass *et al.* 2009). 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 aboriginal subsistence whaling hunt in Greenland (Gambell 1993, Caulfield 1993). However, Iceland reported a catch of 136 whales in the 1988/89 and 1989/90 seasons (Perry *et al.* 1999), and 7 in 2006/07. 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 2009 Stock Assessment Report (SAR) gives a best estimate of abundance for fin whales in the western North Atlantic 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). There are insufficient data at this time to determine population trends for the fin whale (Waring *et al.* 2009).

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 and 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 still occurs.

The Draft 2010 SAR (Waring *et al.* 2010) for the western North Atlantic fin whale stock reports an increase in the estimated population size (3,985), minimum population size (3,269), and PBR (6.5). The Draft SAR reported an increase in overall documented serious injury and mortality to fin whales to an average rate of 3.2 per year. Incidental fishery entanglement records and ship strike records for the period 2004 through 2008 averaged of 1.2 (U.S. waters, 1.0) and 2.0 (U.S. waters, 1.4) respectively per year.

Status of Sea Turtles

Sea turtles continue to be affected by many factors occurring on the nesting beaches and in the water. Poaching, habitat loss, and nesting predation by introduced species affect hatchlings and nesting females while on land. Fishery interactions, vessel interactions, and (non-fishery) dredging operations, for example, affect sea turtles in the neritic zone (defined as the marine environment extending from mean low water down to 200m (660 foot) depths, generally corresponding to the continental shelf (Lalli and Parsons 1997; Encyclopedia Britannica 2008)). Fishery interactions also affect sea turtles when these species and the fisheries co-occur in the oceanic zone (defined as the open ocean environment where bottom depths are greater than 200m (Lalli and Parsons 1997))2. As a result, sea turtles still face many of the original threats that were the cause of their listing under the ESA.

Sea turtles are listed under the ESA at the species level rather than as subspecies or distinct population segments (DPS). Therefore, information on the range-wide status of each species is included to provide the reader with information on the status of each species, overall. Additional background information on the range-wide status of these species can be found in a number of published documents, including sea turtle status reviews and biological reports (NMFS and USFWS 1995; Hirth 1997; USFWS 1997; Marine Turtle Expert Working Group (TEWG) 1998; TEWG 2000; NMFS and USFWS 2007a; 2007b; 2007c; 2007d; Leatherback TEWG 2007), and recovery plans for the loggerhead sea turtle (NMFS and USFWS 1991a), leatherback sea turtle (NMFS and USFWS 1992; NMFS and USFWS 1998a;), Kemp's ridley sea turtle (USFWS and

2 As described in Bolten (2003), oceanographic terms have frequently been used incorrectly to describe sea turtle life stages. In turtle literature the terms benthic and pelagic were used incorrectly to refer to the neritic and oceanic zones, respectively. The term benthic refers to occurring on the bottom of a body of water, whereas the term pelagic refers to in the water column. Turtles can be "benthic" or pelagic" in either the neritic or oceanic zones.

NMFS 1992), and green sea turtle (NMFS and USFWS 1991b; NMFS and USFWS 1998b).

Loggerhead sea turtle

Loggerhead sea turtles are found in temperate and subtropical waters and occupy a range of habitats including offshore waters, continental shelves, bays, estuaries, and lagoons. The loggerhead is the most abundant species of sea turtle in U.S. waters. Genetic differences exist between loggerhead sea turtles that nest and forage in the different ocean basins (Bowen 2003; Bowen and Karl 2007). Differences in the maternally inherited mitochondrial DNA also exist between loggerhead nesting groups that occur within the same ocean basin (TEWG 2000; Pearce 2001; Bowen 2003; Bowen *et al.* 2005; Shamblin 2007). Site fidelity of females to one or more nesting beaches in an area is believed to account for these genetic differences (TEWG 2000; Bowen 2003). However, loggerhead sea turtles are currently listed under the ESA at the species level rather than as subspecies or distinct population segments (DPS). The ESA requires NMFS to ultimately conclude whether the action under consultation, in light of the Environmental Baseline (Section 4.0) and Cumulative Effects (Section 5.0), is likely to jeopardize the species as it is listed. Therefore, information on the range-wide status of the species is included as follows.

Pacific Ocean. In the Pacific Ocean, major loggerhead nesting grounds are generally located in temperate and subtropical regions with scattered nesting in the tropics. The abundance of loggerhead sea turtles at nesting colonies throughout the Pacific basin has declined dramatically over the past ten to twenty years. Loggerhead sea turtles in the Pacific Ocean are represented by a northwestern Pacific nesting group (located in Japan) and a smaller southwestern Pacific nesting group that occurs in eastern Australia and New Caledonia. Data from 1995 estimated the Japanese nesting group at 1,000 adult females (Bolten *et al.* 1996). More recent information suggests that nest numbers have increased gradually over the period of 1998-2004 (NMFS and USFWS 2007a). However, this time period is too short to make a determination of the overall trend in nesting (NMFS and USFWS 2007a). Genetic analyses of loggerhead females nesting in Japan indicate the presence of genetically distinct nesting colonies (Hatase *et al.* 2002).

In Australia, long-term census data have been collected at some rookeries since the late 1960s and early 1970s, and nearly all the data show marked declines in nesting since the mid-1980s. The nesting group in Queensland, Australia is now less than 500 adult females, which represents an 86% reduction in the size of the annual nesting population in 23 years (Limpus and Limpus 2003).

Pacific loggerhead sea turtles are captured, injured, or killed in numerous Pacific fisheries including gillnet, longline, pound net, and trawl fisheries in the western and/or eastern Pacific Ocean (NMFS and USFWS 2007a). In Australia, where sea turtles are taken in bottom trawl and longline fisheries, efforts have been made to reduce fishery bycatch (NMFS and USFWS 2007a). Loggerheads in the Pacific are also impacted by a reduction in nesting habitat from erosion and extensive beach use, predation (by humans and animals), boat strikes, and marine pollution.

Indian Ocean. Loggerhead sea turtles are distributed throughout the Indian Ocean, along most mainland coasts and island groups (Baldwin *et al.* 2003). Throughout the Indian Ocean, loggerhead sea turtles face many of the same threats as in other parts of the world including loss of nesting beach habitat, fishery interactions, and predation and/or egg harvesting.

In the southwestern Indian Ocean, loggerhead nesting has shown signs of recovery in South Africa where protection measures have been in place for decades. However, in other southwestern areas (*e.g.*, Madagascar and Mozambique) loggerhead nesting groups are still affected by subsistence hunting of adults and eggs (Baldwin *et al.* 2003). The largest known nesting group of loggerheads in the world occurs in Oman in the northern Indian Ocean. Each year, an estimated 20,000-40,000 females nest at Masirah, the largest nesting site within Oman, each year (Baldwin *et al.* 2003). In the eastern Indian Ocean, all known nesting sites are found in western Australia (Dodd 1988). Nesting numbers are disproportionate within the area with the majority of nesting occurring at a single location; Dirk Hartog Island hosts approximately 70%-75% of the nesting loggerheads in the southeastern Indian Ocean (Baldwin *et al.* 2003). The depletion of nesting at other Western Australia sites may, however, be the result of longstanding red fox predation on eggs (Baldwin *et al.* 2003).

Mediterranean Sea. Nesting in the Mediterranean Sea is confined almost exclusively to the eastern basin (Margaritoulis *et al.* 2003). The greatest numbers of nests in the Mediterranean are found in Greece with an average of 3,050 nests per year (Margaritoulis *et al.* 2003; NMFS and USFWS 2007a). Turkey has the second largest number of nests with 2,000 nests per year (NMFS and USFWS 2007a). There is a long history of exploitation of loggerheads in the Mediterranean (Margaritoulis *et al.* 2003). Although much of this is now prohibited, some directed captures still occur (Margaritoulis *et al.* 2003). Loggerheads in the Mediterranean also face the threat of habitat degradation, incidental fishery interactions, vessel strikes, and marine pollution (Margaritoulis *et al.* 2003). Longline fisheries, in particular, are believed to catch thousands of juvenile loggerheads each year (NMFS and USFWS 2007a), although genetic analyses indicate that only a portion of the loggerheads captured originate from loggerhead nesting groups in the Mediterranean (Laurent *et al.* 1998).

Atlantic Ocean. Ehrhart *et al.* (2003) provided a summary of the literature identifying known nesting habitats and foraging areas for loggerheads within the Atlantic Ocean. Detailed information is also provided in the 5-year status review for loggerheads (NMFS and USFWS 2007a) and the final revised recovery plan for loggerheads in the Northwest Atlantic Ocean (NMFS and USFWS 2008), which is a second revision to the original recovery plan that was approved in 1984 and subsequently revised in 1991.

Briefly, nesting occurs on island and mainland beaches on both sides of the Atlantic and both north and south of the Equator (Ehrhart *et al.* 2003). By far, the majority of Atlantic nesting occurs on beaches of the southeastern U.S. (NMFS and USFWS 2007a). Annual nest counts for loggerhead sea turtles on beaches from other countries are in the hundreds with the exception of Brazil, where a total of 4,837 nests were reported for the 2003-2004 nesting season (Marcovaldi and Chaloupka 2007; NMFS and USFWS 2007a), and Mexico, where several thousand nests are estimated to be laid each year. For example, the Yucatán nesting population had a range of 903-2,331 nests per year from 1987-2001 (Zurita *et al.* 2003; NMFS and USFWS 2008). In both the eastern and western Atlantic, waters as far north as 41°N to 42°N latitude are used for foraging by juveniles as well as adults (Shoop 1987; Shoop and Kenney 1992; Ehrhart *et al.* 2003; Mitchell *et al.* 2003).

In U.S. Atlantic waters, loggerheads commonly occur throughout the inner continental shelf from Florida to Cape Cod, Massachusetts and in the Gulf of Mexico from Florida to Texas, although their presence varies with the seasons due to changes in water temperature (Shoop and Kenney 1992; Epperly *et al.* 1995a, 1995b; Braun and Epperly 1996; Epperly and Braun-McNeill 2002; Mitchell *et al.* 2003). Loggerheads have been observed in waters with surface temperatures of 7° to 30°C, but water temperatures ≥11°C are most favorable (Shoop and Kenney 1992; Epperly *et al.* 1995b). The presence of loggerhead sea turtles in U.S. Atlantic waters is also influenced by water depth. Aerial surveys of continental shelf waters north of Cape Hatteras, North Carolina indicated that loggerhead sea turtles were most commonly sighted in waters with bottom depths ranging from 22 to 49 m deep (Shoop and Kenney 1992). However, more recent survey and satellite tracking data support that they occur in waters from the beach to beyond the continental shelf (Mitchell *et al.* 2003; Braun-McNeill and Epperly 2004; Blumenthal *et al.* 2006; Hawkes *et al.* 2006; McClellan and Read 2007).

Loggerhead sea turtles occur year round in ocean waters off North Carolina, South Carolina, Georgia, and Florida. In these areas of the South Atlantic Bight, water temperature is influenced by the proximity of the Gulf Stream. As coastal water temperatures warm in the spring, loggerheads begin to migrate to inshore waters of the Southeast U.S. (*e.g.*, Pamlico and Core Sounds) and also move up the U.S. Atlantic coast (Epperly *et al.* 1995a, 1995b, 1995c; Braun-McNeill and Epperly 2004), occurring in Virginia foraging areas as early as April/May and on the most northern foraging grounds in the Gulf of Maine in June (Shoop and Kenney 1992). The trend is reversed in the fall as water temperatures cool. The large majority leave the Gulf of Maine by mid-September but some turtles may remain in Mid-Atlantic and Northeast areas until late fall. By December, loggerheads have migrated from inshore and more northern coastal waters to waters offshore of North Carolina, particularly off of Cape Hatteras, and waters further south where the influence of the Gulf Stream provides temperatures favorable to sea turtles (Shoop and Kenney 1992; Epperly *et al.* 1995b; Epperly and Braun-McNeill 2002).

In the southeastern U.S., loggerheads mate from late March to early June, and eggs are laid throughout the summer, with a mean clutch size of 100-126 eggs (Dodd 1988). Individual females nest multiple times during a nesting season, with a mean of 4.1 nests per individual (Murphy and Hopkins 1984). Nesting migrations for an individual female loggerhead are usually on an interval of 2 to 3 years, but can vary from one to seven years (Dodd 1988; NMFS and USFWS 2008). Age at sexual maturity for loggerheads has been estimated at 32 to 35 years (NMFS and USFWS 2008).

For the past decade or so, the scientific literature has recognized five distinct nesting groups, or subpopulations, of loggerhead sea turtles in the Northwest Atlantic, divided geographically as follows: (1) a northern group of nesting females that nest from North Carolina to Northeast Florida at about 29°N latitude; (2) a South Florida group of nesting females that nest from 29°N latitude on the East coast to Sarasota on the West coast; (3) a Florida Panhandle group of nesting females that nest around Eglin Air Force Base and the beaches near Panama City, Florida; (4) a

Yucatán group of nesting females that nest on beaches of the eastern Yucatán Peninsula, Mexico (Márquez 1990; TEWG 2000); and (5) a Dry Tortugas group that nests on beaches of the islands of the Dry Tortugas, near Key West, Florida (NMFS SEFSC 2001). Genetic analyses of mitochondrial DNA, which a sea turtle inherits from its mother, indicate that there are genetic differences between loggerheads that nest at and originate from the beaches used by each of the five identified nesting groups of females (TEWG 2000). However, analyses of microsatellite loci from nuclear DNA, which represents the genetic contribution from both parents, indicates little to no genetic differences between loggerheads originating from nesting beaches of the five Northwest Atlantic nesting groups (Pearce and Bowen 2001; Bowen 2003; Bowen *et al.* 2005; Shamblin 2007). These results suggest that female loggerheads have site fidelity to nesting beaches within a particular area, while males provide an avenue of gene flow between nesting groups by mating with females that originate from different nesting groups (Bowen 2003; Bowen *et al.* 2005). The extent of such gene flow, however, is unclear (Shamblin 2007).

The lack of genetic structure makes it difficult to designate specific boundaries for the nesting subpopulations based on genetic differences alone. Therefore, the Loggerhead Recovery Team recently used a combination of geographic distribution of nesting densities, geographic separation, and geopolitical boundaries, in addition to genetic differences, to reassess the designation of these subpopulations to identify recovery units in the 2008 recovery plan.

In the 2008 recovery plan, the Loggerhead Recovery Team designated five recovery units for the Northwest Atlantic population of loggerhead sea turtles based on the aforementioned nesting groups and inclusive of a few other nesting areas not mentioned above. The first four of these recovery units represent nesting assemblages located in the Southeast U.S. The fifth recovery unit is composed of all other nesting assemblages of loggerheads within the Greater Caribbean, outside the U.S., but which occur within U.S. waters during some portion of their lives. The five recovery units representing nesting assemblages are: (1) the Northern Recovery Unit (NRU: Florida/Georgia border through southern Virginia), (2) the Peninsular Florida Recovery Unit (PFRU: Florida/Georgia border through Pinellas County, Florida), (3) the Dry Tortugas Recovery Unit (DTRU: islands located west of Key West, Florida), (4) the Northern Gulf of Mexico Recovery Unit (NGMRU: Franklin County, Florida through Texas), and (5) the Greater Caribbean Recovery Unit (GCRU: Mexico through French Guiana, Bahamas, Lesser Antilles, and Greater Antilles).

The Recovery Team evaluated the status and trends of the Northwest Atlantic loggerhead population for each of the five recovery units, using nesting data available as of October 2008 (NMFS and USFWS 2008). The level and consistency of nesting coverage varies among recovery units, with coverage in Florida generally being the most consistent and thorough over time. Since 1989, nest count surveys in Florida have occurred in the form of statewide surveys (a near complete census of entire Florida nesting) and index beach surveys (Witherington *et al.* 2009). Index beaches were established to standardize data collection methods and maintain a constant level of effort on key nesting beaches over time.

From the beginning of standardized index surveys in 1989 until 1998, the PFRU, the largest nesting assemblage in the Northwest Atlantic by an order of magnitude, had a significant increase in the number of nests. However, from 1998 through 2008, there was a 41% decrease in annual nest counts from index beaches, which represent an average of 70% of the statewide nesting activity (NMFS and USFWS 2008). From 1989-2008, the PFRU had an overall declining nesting trend of 26% (95% CI: -42% to -5%; NMFS and USFWS 2008). In 2008, an increase in nest counts from the previous four years was reported, but this did not alter the declining trend. The Loggerhead Recovery Team acknowledged that this dramatic change in status for the PFRU is a serious concern and requires immediate attention to determine the cause(s) of this change and the actions needed to reverse it. The NRU, the second largest nesting assemblage of loggerheads in the U.S., has been declining at a rate of 1.3% annually since 1983 (NMFS and USFWS 2008). The NRU dataset included 11 beaches with an uninterrupted time series of coverage of at least 20 years; these beaches represent approximately 27% of NRU nesting (in 2008). Overall, there is strong statistical data to suggest the NRU has experienced a long-term decline. Evaluation of long-term nesting trends for the NGMRU is difficult because of changed and expanded beach coverage. However, the NGMRU has shown a significant declining trend of 4.7% annually since index nesting beach surveys were initiated in 1997 (NMFS and USFWS 2008). No statistical trends in nesting abundance can be determined for the DTRU because of the lack of long-term data. Similarly, statistically valid analyses of long-term nesting trends for the entire GCRU are not available because there are few long-term standardized nesting surveys representative of the region. Additionally, changing survey effort at monitored beaches and scattered and low-level nesting by loggerheads at many locations currently precludes comprehensive analyses (NMFS and USFWS 2008).

Sea turtle census nesting surveys are important in that they provide information on the relative abundance of nesting each year, and the contribution of each nesting group to total nesting of the species. Nest counts can also be used to estimate the number of reproductively mature females nesting annually. The 2008 recovery plan compiled the most recent information on mean number of loggerhead nests and the approximated counts of nesting females per year for four of the five identified recovery units (*i.e*., nesting groups). They are: (1) for the NRU, a mean of 5,215 loggerhead nests per year (from 1989-2008) with approximately 1,272 females nesting per year; (2) for the PFRU, a mean of 64,513 nests per year (from 1989-2007) with approximately 15,735 females nesting per year; (3) for the DTRU, a mean of 246 nests per year (from 1995-2004, excluding 2002) with approximately 60 females nesting per year; and (4) for the NGMRU, a mean of 906 nests per year (from 1995-2007) with approximately 221 females nesting per year. For the GCRU, the only estimate available for the number of loggerhead nests per year is from Quintana Roo, Yucatán, Mexico, where a range of 903-2,331 nests per year was estimated from 1987-2001 (NMFS and USFWS 2007a). There are no annual nest estimates available for the Yucatán since 2001 or for any other regions in the GCRU, nor are there any estimates of the number of nesting females per year for any nesting assemblage in this recovery unit. Note that the above values for average nesting females per year were based upon 4.1 nests per female per Murphy and Hopkins (1984).

Unlike nesting surveys, in-water studies of sea turtles typically sample both sexes and multiple age classes. In-water studies have been conducted in some areas of the Northwest Atlantic and provide data by which to assess the relative abundance of loggerhead sea turtles and changes in abundance over time (Maier *et al.* 2004; Morreale *et al.* 2005; Mansfield 2006; Ehrhart *et al.*

2007; Epperly *et al.* 2007). The 2008 loggerhead recovery plan includes a full discussion of in-water population studies for which trend data have been reported, and a brief summary will be provided here. Maier *et al.* (2004) used fishery-independent trawl data to establish a regional index of loggerhead abundance for the southeast coast of the U.S. (Winyah Bay, South Carolina to St. Augustine, Florida) during the period 2000-2003. A comparison of loggerhead catch data from this study with historical values suggested that in-water populations of loggerhead sea turtles along the Southeast U.S. coast appear to be larger, possibly an order of magnitude higher than they were 25 years ago, but the authors caution a direct comparison between the two studies given differences in sampling methodology (Maier *et al.* 2004). A comparison of catch rates for sea turtles in pound net gear fished in the Pamlico-Albemarle Estuarine Complex of North Carolina between the years 1995-1997 and 2001-2003 found a significant increase in catch rates for loggerhead sea turtles for the latter period (Epperly *et al.* 2007). A long-term, on-going study of loggerhead abundance in the Indian River Lagoon System of Florida found a significant increase in the relative abundance of loggerheads over the last 4 years of the study (Ehrhart *et al.* 2007). However, there was no discernible trend in loggerhead abundance during the 24-year time period of the study (1982-2006) (Ehrhart *et al.* 2007). At St. Lucie Power Plant, data collected from 1977-2004 show an increasing trend of loggerheads at the power plant intake structures (FPL and Quantum Resources 2005).

In contrast to these studies, Morreale *et al.* (2005) observed a decline in the percentage and relative numbers of loggerhead sea turtles incidentally captured in pound net gear fished around Long Island, New York during the period 2002-2004 in comparison to the period 1987-1992, with only two (2) loggerheads (of a total 54 turtles) observed captured in pound net gear during the period 2002-2004. This is in contrast to the previous decade's study where numbers of individual loggerheads ranged from 11 to 28 per year (Morreale *et al.* 2005). No additional loggerheads were reported captured in pound net gear through 2007, although 2 were found cold-stunned on Long Island bay beaches in the fall of 2007 (Memo to the File, L. Lankshear, December 2007). Potential explanations for this decline include major shifts in loggerhead foraging areas and/or increased mortality in pelagic or early benthic stage/age classes (Morreale *et al.* 2005). Using aerial surveys, Mansfield (2006) also found a decline in the densities of loggerhead sea turtles in Chesapeake Bay over the period 2001-2004 compared to aerial survey data collected in the 1980s. Significantly fewer loggerheads ($p<0.05$) were observed in both the spring (May-June) and the summer (July-August) of 2001-2004 compared to those observed during aerial surveys in the 1980s (Mansfield 2006). A comparison of median densities from the 1980s to the 2000s suggested that there had been a 63.2% reduction in densities during the spring residency period and a 74.9% reduction in densities during the summer residency period (Mansfield 2006). The decline in observed loggerhead populations in Chesapeake Bay may be related to a significant decline in prey, namely horseshoe crabs and blue crabs, with loggerheads redistributing outside of Bay waters (NMFS and USFWS 2008).

The diversity of a sea turtle's life history leaves them susceptible to many natural and human impacts, including impacts while they are on land, in the neritic environment, and in the oceanic environment. Recent studies have established that the loggerhead's life history is more complex than previously believed. Rather than making discrete developmental shifts from oceanic to neritic environments, research is showing that both adults and (presumed) neritic stage juveniles continue to use the oceanic environment and will move back and forth between the two habitats (Witzell 2002; Blumenthal *et al.* 2006; Hawkes *et al.* 2006; McClellan and Read 2007). One of the studies tracked the movements of adult post-nesting females and found that differences in habitat use were related to body size with larger adults staying in coastal waters and smaller adults traveling to oceanic waters (Hawkes *et al.* 2006). A tracking study of large juveniles found that the habitat preferences of this life stage were also diverse with some remaining in neritic waters and others moving off into oceanic waters (McClellan and Read 2007). However, unlike the Hawkes *et al.* (2006) study, there was no significant difference in the body size of turtles that remained in neritic waters versus oceanic waters (McClellan and Read 2007). In either case, the research demonstrates that threats to loggerheads in both the neritic and oceanic environments are likely impacting multiple life stages of this species.

The 5-year status review and 2008 recovery plan provide a summary of natural as well as anthropogenic threats to loggerhead sea turtles (NMFS and USFWS 2007a, 2008). Amongst those of natural origin, hurricanes are known to be destructive to sea turtle nests. Sand accretion, rainfall, and wave action that result from these storms can appreciably reduce hatchling success. Other sources of natural mortality include cold stunning, biotoxin exposure, and native species predation.

Anthropogenic factors that impact hatchlings and adult females on land, or the success of nesting and hatching include: beach erosion, beach armoring, and nourishment; artificial lighting; beach cleaning; beach pollution; increased human presence; recreational beach equipment; vehicular and pedestrian traffic; coastal development/construction; exotic dune and beach vegetation; removal of native vegetation; and poaching. An increased human presence at some nesting beaches or close to nesting beaches has led to secondary threats such as the introduction of exotic fire ants, feral hogs, dogs, and an increased presence of native species (*e.g.*, raccoons, armadillos, and opossums) which raid nests and feed on turtle eggs (NMFS and USFWS 2007a, 2008). Although sea turtle nesting beaches are protected along large expanses of the Northwest Atlantic coast (in areas like Merritt Island, Archie Carr, and Hobe Sound National Wildlife Refuges), other areas along these coasts have limited or no protection. Sea turtle nesting and hatching success on unprotected high density East Florida nesting beaches from Indian River to Broward County are affected by all of the above threats.

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

A 1990 National Research Council (NRC) report concluded that for juveniles, subadults, and breeders in coastal waters, the most important source of human caused mortality in U.S. Atlantic waters was fishery interactions. Of the many fisheries known to adversely affect loggerheads, the U.S. South Atlantic and Gulf of Mexico shrimp fisheries were considered to pose the greatest threat of mortality to neritic juvenile and adult age classes of loggerheads, accounting for an estimated 5,000 to 50,000 loggerhead deaths each year (NRC 1990). Significant changes to the

South Atlantic and Gulf of Mexico shrimp fisheries have occurred since 1990, and the effects of these shrimp fisheries on ESA-listed species, including loggerhead sea turtles, have been assessed several times through section 7 consultation. There is also a lengthy regulatory history with regard to the use of Turtle Excluder Devices (TEDs) in the U.S. South Atlantic and Gulf of Mexico shrimp fisheries (Epperly and Teas 2002; NMFS 2002a; Lewison *et al.* 2003). Section 7 consultation on shrimp trawling in the southeastern U.S. was reinitiated in 2002, in part, to consider the effect of a new rulemaking that would require increasing the size of TED escape openings to allow larger loggerheads (as well as green and leatherback sea turtles) to escape from shrimp trawl gear. The resulting Opinion was completed in December 2002 and concluded that, as a result of the new rule, annual loggerhead mortality from capture in shrimp trawls would decline from an estimated 62,294 to 3,948 turtles assuming that all TEDs were installed properly and that compliance was 100% (Epperly *et al.* 2002; NMFS 2002a). The total annual level of take for loggerhead sea turtles as a result of the U.S. South Atlantic and Gulf of Mexico shrimp fisheries was estimated to be 163,160 loggerhead interactions (the total number of turtles that enter a shrimp trawl, which may then escape through the TED or fail to escape and be captured) with 3,948 of those takes being lethal (NMFS 2002a). On February 21, 2003, NMFS issued the final rule in the *Federal Register* to require the use of the larger opening TEDs (68 FR 8456, February 21, 2003). The rule also provided the measures to disallow several previously approved TED designs that did not function properly under normal fishing conditions, and to require modifications to the trynet and bait shrimp exemptions to the TED requirements to decrease mortality of sea turtles.

In addition to improvements in TED designs and TED enforcement, interactions between loggerheads and the shrimp fishery have also been declining because of reductions in fishing effort unrelated to fisheries management actions. The 2002 Opinion take estimates are based in part on fishery effort levels. In recent years, low shrimp prices, rising fuel costs, competition with imported products, and the impacts of recent hurricanes in the Gulf of Mexico have all impacted the shrimp fleets; in some cases reducing fishing effort by as much as 50% for offshore waters of the Gulf of Mexico (GMFMC 2007). As a result, loggerhead interactions and mortalities in the Gulf of Mexico have been substantially less than projected in the 2002 Opinion. Currently, the estimated annual number of interactions between loggerheads and shrimp trawls in the Gulf of Mexico shrimp fishery is 23,336, with 647 (2.8%) of those interactions resulting in mortality (Memo from Dr. B. Ponwith, Southeast Fisheries Science Center [SEFSC] to Dr. R. Crabtree, Southeast Region [SERO], PRD, December 2008).

Loggerhead sea turtles are also known to interact with non-shrimp trawl, gillnet, longline, dredge, pound net, pot/trap, and hook and line fisheries. The NRC (1990) report stated that other U.S. Atlantic fisheries collectively accounted for 500 to 5,000 loggerhead deaths each year, but recognized that there was considerable uncertainty in the estimate. The first estimate of loggerhead sea turtle bycatch in U.S. Mid-Atlantic bottom otter trawl gear was completed in September 2006 and later updated in November 2008 (Murray 2006, 2008). Observers reported 66 loggerhead sea turtle interactions with bottom otter trawl gear from 1994-2004 of which 38 were reported as alive and uninjured and 28 were reported as dead, injured, resuscitated, or of unknown condition (Murray 2006, 2008). Fifty percent of observed sea turtle interactions occurred on vessels targeting summer flounder , 27% on vessels targeting Atlantic croaker, 11%

on vessels targeting weakfish, 8% on vessels targeting long-finned squid, 3% on vessels targeting groundfish, and 1% on vessels targeting short-finned squid. Based on observed interactions and fishing effort as reported on VTRs, the average annual loggerhead bycatch in bottom otter trawl during 1996-2004 was estimated to be 616 sea turtles (CV=0.23, 95% CI over the 9 year period: 367-890)(Murray 2006, 2008).

The 2008 update also reported loggerhead bycatch from 2000-2004 by main species (fish or invertebrate) group landed. The average annual bycatch estimate of loggerhead sea turtles from 2000-2004 (based on the rate from 1994-2004) over FMP groups identified by NERO was 411 turtles, with an additional 77 estimated bycatch events unassigned. An estimated 192 (47%) takes occurred annually in the summer flounder/scup/black sea bass group, 62 (15%) in the Atlantic mackerel/squid/butterfish group, 43 (10%) in the Northeast multispecies group, and 41 (10%) in the Atlantic croaker group. A total of 20 loggerheads (4.8%) were estimated as having been taken annually in bottom otter trawl gear catching sea scallops, which is in addition to the estimated 81-191 loggerheads reported by Murray (2007) as being caught annually in trawl gear designed specifically to harvest scallops based on data from 2004-2005 (Murray 2008).

There have been several published estimates of the number of loggerheads taken annually as a result of the dredge fishery for Atlantic sea scallops, ranging from a low of zero in 2005 (Murray 2007) to a high of 749 in 2003 (Murray 2004). An estimate of the number of loggerheads taken annually in U.S. Mid-Atlantic gillnet fisheries has recently been published in Murray (2009a). From 1995-2006, the average annual bycatch of loggerheads in U.S. Mid-Atlantic gillnet gear was estimated to be around 350 turtles (95% over the 12 year period CI: 234 to 504). Bycatch rates were correlated with latitude, sea surface temperature, and mesh size. The highest predicted bycatch rates occurred in warm waters of the southern Mid-Atlantic in large-mesh gillnets (Murray 2009a).

The U.S. tuna and swordfish longline fisheries that are managed under the Highly Migratory Species (HMS) FMP are estimated to capture 1,905 loggerheads (no more than 339 mortalities) for each 3-year period starting in 2007 (NMFS 2004a). NMFS has mandated gear changes for the HMS fishery to reduce sea turtle bycatch and the likelihood of death from those incidental takes that would still occur (Garrison *et al.* 2009). In 2008, there were 82 observed interactions between loggerhead sea turtles and longline gear used in the HMS fishery. All of the loggerheads were released alive, but the vast majority with injuries (Garrison *et al.* 2009). Most of the injured loggerheads had been hooked in the mouth or beak or swallowed the hook (Garrison *et al.* 2009). Based on the observed take, an estimated 771.6 (95% CI: 481.4-1236.6) loggerhead sea turtles are estimated to have been taken in the longline fisheries managed under the HMS FMP in 2008 (Garrison *et al.* 2009). The 2008 estimate is higher than that in 2007 and is consistent with historical averages since 2001 (Garrison *et al.* 2009). This fishery represents just one of several longline fisheries operating in the Atlantic Ocean. Lewison *et al.* (2004) estimated that 150,000-200,000 loggerheads were taken in all Atlantic longline fisheries in 2000 (including the U.S. Atlantic tuna and swordfish longline fisheries as well as others).

Summary of Status for Loggerhead Sea Turtles

Loggerheads are a long-lived species and reach sexual maturity relatively late at around 32-35 years in the Northwest Atlantic (NMFS and USFWS 2008). The species continues to be affected by many factors occurring on nesting beaches and in the water. These include poaching, habitat loss, and nesting predation that affects eggs, hatchlings, and nesting females on land, as well as fishery interactions, vessel interactions, marine pollution, and non-fishery (*e.g*., dredging) operations affecting all sexes and age classes in the water (NRC 1990; NMFS and USFWS 2007a). As a result, loggerheads still face many of the original threats that were the cause of their listing under the ESA.

As mentioned previously, a final revised recovery plan for loggerhead sea turtles in the Northwest Atlantic was recently published by NMFS and FWS in December 2008. The revised recovery plan is significant in that it identifies five unique recovery units, which comprise the population of loggerheads in the Northwest Atlantic, and describes specific recovery criteria for each recovery unit. Based on the most recent information, a decline in annual nest counts has been measured or suggested for three of the five recovery units for loggerheads in the Northwest Atlantic, including the PFRU, which is the largest (in terms of number of nests laid) in the Atlantic Ocean. The nesting trends for the other two recovery units could not be determined due to an absence of long term data.

NMFS convened a new Loggerhead Turtle Expert Working Group (TEWG) to review all available information on Atlantic loggerheads in order to evaluate the status of this species in the Atlantic. A final report from the Loggerhead TEWG was published in July 2009. In this report, the TEWG indicated that it could not determine whether or not the decreasing annual numbers of nests among the Northwest Atlantic loggerhead subpopulations were due to stochastic processes resulting in fewer nests, a decreasing average reproductive output of adult females, decreasing numbers of adult females, or a combination of these factors. Many factors are responsible for past or present loggerhead mortality that could impact current nest numbers; however, no single mortality factor stands out as a likely primary factor. It is likely that several factors compound to create the current decline, including incidental capture (in fisheries, power plant intakes, and dredging operations), lower adult female survival rates, increases in the proportion of first-time nesters, continued directed harvest, and increases in mortality due to disease. Regardless, the TEWG stated that the current levels of hatchling output will no doubt result in depressed recruitment to subsequent life stages over the coming decades (TEWG 2009).

Currently, there are no population estimates for loggerhead sea turtles in any of the ocean basins in which they occur. However, a recent loggerhead assessment prepared by NMFS states that the loggerhead adult female population in the western North Atlantic ranges from 20,000 to 40,000 or more, with a large range of uncertainty in total population size. However, 95% of the distribution of conservative estimates of the adult female population size fell between 18,333 (2.5 percentile) and 68,192 (97.5 percentile) individuals (NMFS SEFSC 2009).

Based on their 5-year status review of the species, NMFS and FWS determined that loggerhead sea turtles should not be delisted or reclassified as endangered. However, it was also determined that an analysis and review of the species should be conducted in the future to determine whether DPSs should be identified for the loggerhead (NMFS and USFWS 2007a). In 2008, NMFS and FWS established a Loggerhead Biological Review Team (BRT) to assess the global loggerhead

population structure to determine whether DPSs exist and, if so, the status of each DPS. The BRT report was completed in August 2009 (Conant *et al.* 2009). In this report, the BRT identified the following nine loggerhead DPSs distributed globally: (1) North Pacific Ocean, (2) South Pacific Ocean, (3) North Indian Ocean, (4) Southeast Indo-Pacific Ocean, (5) Southwest Indian Ocean, (6) Northwest Atlantic Ocean, (7) Northeast Atlantic Ocean, (8) Mediterranean Sea, and (9) South Atlantic Ocean. According to an analysis using expert opinion in a matrix model framework used in the BRT report, all loggerhead DPSs have the potential to decline in the future. The BRT concluded that although some DPSs are indicating increasing trends at nesting beaches (Southwest Indian Ocean and South Atlantic Ocean), available information about anthropogenic threats to juveniles and adults in neritic and oceanic environments indicate possible unsustainable additional mortalities. According to the threat matrix analysis in the BRT report, the potential for future decline is greatest for the North Indian Ocean, Northwest Atlantic Ocean, Northeast Atlantic Ocean, Mediterranean Sea, and South Atlantic Ocean DPSs (Conant *et al.* 2009).
On March 16, 2010, NMFS and USFWS published a proposed rule in the Federal Register to divide the worldwide population of loggerhead sea turtles into nine DPSs, as described in the 2009 Status Review. Two of the DPSs are proposed to be listed as threatened and seven of the DPSs, including the Northwest Atlantic Ocean DPS, are proposed to be listed as endangered. NMFS and the USFWS accepted comments on the proposed rule through September 13, 2010 (75 FR 30769, June 2, 2010).

Leatherback sea turtle

Leatherback sea turtles are widely distributed throughout the oceans of the world, including the Atlantic, Pacific, and Indian Oceans, and the Mediterranean Sea (Ernst and Barbour 1972). Leatherbacks are the largest living turtles and range farther than any other sea turtle species. Their large size and tolerance of relatively low water temperatures allows them to occur in northern boreal waters such as those off Labrador and in the Barents Sea (NMFS and USFWS 1995).

In 1980, the leatherback population was estimated at approximately 115,000 adult females globally (Pritchard 1982). By 1995, this global population of adult females was estimated to have declined to 34,500 (Spotila *et al.* 1996). The most recent population size estimate for the North Atlantic alone is a range of 34,000-94,000 adult leatherbacks (TEWG 2007). Thus, there is substantial uncertainty with respect to global population estimates of leatherback sea turtles.

Pacific Ocean. Leatherback nesting has been declining at all major Pacific basin nesting beaches for the last two decades (Spotila *et al.* 1996, 2000; NMFS and USFWS 1998b, 2007b; Sarti *et al.* 2000). In the western Pacific, major nesting beaches occur in Papua New Guinea, Indonesia, Solomon Islands, and Vanuatu, with an approximate 2,700-4,500 total breeding females, estimated from nest counts (Dutton *et al.* 2007). Leatherback sea turtles disappeared from India before 1930, have been virtually extinct in Sri Lanka since 1994, and appear to be approaching extinction in Malaysia (Spotila *et al.* 2000). For example, the nesting group on Terengganu (Malaysia) - which was one of the most significant nesting sites in the western Pacific Ocean - declined severely from an estimated 3,103 females in 1968 to 2 nesting females in 1994 (Chan and Liew 1996). Nesting groups of leatherback sea turtles along the coasts of the Solomon Islands, which historically supported important nesting groups, are also reported to be declining (D. Broderick, pers. comm., *in* Dutton *et al.* 1999). In Fiji, Thailand, Australia, and Papua New Guinea, leatherback sea turtles have only been known to nest in low densities and scattered colonies.

The largest, extant leatherback nesting group in the Indo-Pacific lies on the North Vogelkop coast of West Papua, Indonesia, with 3,000-5,000 nests reported annually in the 1990s (Suárez *et al.* 2000). However, in 1999, local villagers started reporting dramatic declines in sea turtles near their villages (Suárez 1999). Declines in nesting groups have been reported throughout the western Pacific region where observers report that nesting groups are well below abundance levels that were observed several decades ago (*e.g.*, Suárez 1999).

Leatherback sea turtles in the western Pacific are threatened by poaching of eggs, killing of nesting females, human encroachment on nesting beaches, incidental capture in fishing gear, beach erosion, and egg predation by animals.

In the eastern Pacific Ocean, major leatherback nesting beaches are located in Mexico and Costa Rica, where nest numbers have been declining. According to reports from the late 1970s and early 1980s, beaches located on the Mexican Pacific coasts of Michoacán, Guerrero, and Oaxaca sustained a large portion, perhaps 50%, of all global nesting by leatherbacks (Sarti *et al.* 1996). A dramatic decline has been seen on nesting beaches in Pacific Mexico, where aerial survey data was used to estimate that tens of thousands of leatherback nests were laid on the beaches in the 1980s (Pritchard 1982), but a total of only 120 nests on the four primary index beaches (combined) were counted in the 2003-2004 season (Sarti Martinez *et al.* 2007). Since the early 1980s, the Mexican Pacific population of adult female leatherback turtles has declined to slightly more than 200 during 1998-1999 and 1999-2000 (Sarti *et al.* 2000). Spotila *et al.* (2000) reported the decline of the leatherback nesting at Playa Grande, Costa Rica, which had been the fourth largest nesting group in the world and the most important nesting beach in the Pacific. Between 1988 and 1999, the nesting group declined from 1,367 to 117 female leatherback sea turtles. Based on their models, Spotila *et al.* (2000) estimated that the group could fall to less than 50 females by 2003-2004. An analysis of the Costa Rican nesting beaches indicates a decline in nesting during 15 years of monitoring (1989-2004) with approximately 1,504 females nesting in 1988-1989 to an average of 188 females nesting in 2000-2001 and 2003-2004 (NMFS and USFWS 2007b).

Leatherbacks in the eastern Pacific face a number of threats to their survival. For example, commercial and artisanal swordfish fisheries off Chile, Columbia, Ecuador, and Peru; purse seine fisheries for tuna in the eastern tropical Pacific Ocean; and California/Oregon drift gillnet fisheries are known to capture, injure, or kill leatherbacks in the eastern Pacific Ocean. Given the declines in leatherback nesting in the Pacific, some researchers have concluded that the leatherback is on the verge of extinction in the Pacific Ocean (*e.g.,* Spotila *et al.* 1996, 2000).

Indian Ocean. Leatherbacks nest in several areas around the Indian Ocean. These sites include Tongaland, South Africa (Pritchard 2002) and the Andaman and Nicobar Islands (Andrews *et al.*

2002). Intensive survey and tagging work in 2001 provided new information on the level of nesting in the Andaman and Nicobar Islands (Andrews *et al.* 2002). Based on the survey and tagging work, it was estimated that 400-500 female leatherbacks nest annually on Great Nicobar Island (Andrews *et al.* 2002). The number of nesting females using the Andaman and Nicobar Islands combined was estimated around 1,000 (Andrews and Shanker 2002). Some nesting also occurs along the coast of Sri Lanka, although in much smaller numbers than in the past (Pritchard 2002).

Mediterranean Sea. Casale *et al.* (2003) reviewed the distribution of leatherback sea turtles in the Mediterranean. Among the 411 individual records of leatherback sightings in the Mediterranean, there were no nesting records. Nesting in the Mediterranean is not known or is believed to be extremely rare. Leatherbacks found in Mediterranean waters originate from the Atlantic Ocean (P. Dutton, NMFS, unpublished data).

Atlantic Ocean. Evidence from tag returns and strandings in the western Atlantic suggests that adult leatherback sea turtles engage in routine migrations between boreal, temperate, and tropical waters (NMFS and USFWS 1992). Leatherbacks are frequently thought of as a pelagic species that feed on jellyfish (*e.g.*, *Stomolophus, Chryaora*, and *Aurelia* species) and tunicates (*e.g.*, salps, pyrosomas) in oceanic habitats (Rebel 1974; Davenport and Balazs 1991). However, leatherbacks are also known to use coastal waters of the U.S. continental shelf (James *et al.* 2005a; Eckert *et al.* 2006; Murphy *et al.* 2006) as well as the European continental shelf on a seasonal basis (Witt *et al.* 2007). The waters adjacent to Sandy Point, St. Croix, U.S. Virgin Islands have been designated as critical habitat for the leatherback sea turtle.

The CETAP aerial survey of the outer Continental Shelf from Cape Hatteras, North Carolina to Cape Sable, Nova Scotia conducted between 1978 and 1982 showed leatherbacks to be present throughout the area with the most numerous sightings made from the Gulf of Maine south to Long Island. Leatherbacks were sighted in water depths ranging from one to 4,151 m, but 84.4% of sightings were in waters less than 180 m (Shoop and Kenney 1992). Leatherbacks were sighted in waters within a sea surface temperature range similar to that observed for loggerheads; from 7°-27.2°C (Shoop and Kenney 1992). However, leatherbacks appear to have a greater tolerance for colder waters in comparison to loggerhead sea turtles since more leatherbacks were found at the lower temperatures (Shoop and Kenney 1992). This aerial survey estimated the summer leatherback population for the northeastern U.S. at approximately 300-600 animals (from near Nova Scotia, Canada to Cape Hatteras, North Carolina). However, the estimate was based on turtles visible at the surface and does not include those that were below the surface out of view. Therefore, it likely underestimated the leatherback population for the northeastern U.S. at the time of the survey. Estimates of leatherback abundance of 1,052 turtles (C.V. = 0.38) and 1,174 turtles (C.V. = 0.52) were obtained from surveys conducted from Virginia to the Gulf of St. Lawrence in 1995 and 1998, respectively (Palka 2000). However, since these estimates were also based on sightings of leatherbacks at the surface, the author considered the estimates to be negatively biased and the true abundance of leatherbacks may be 4.27 times the estimates (Palka 2000). Studies of satellite tagged leatherbacks suggest that they spend 10%-41% of their time at the surface, depending on the phase of their migratory cycle (James *et al.* 2005b). The greatest amount of surface time (up to 41%) was recorded when leatherbacks occurred in continental shelf and slope waters north of 38°N (James *et al.* 2005b).

Leatherbacks are a long lived species (>30 years). They were originally believed to mature at a younger age than loggerhead sea turtles, with a previous estimated age at sexual maturity of about 13-14 years for females with 9 years reported as a likely minimum (Zug and Parham 1996) and 19 years as a likely maximum (NMFS SEFSC 2001). However, new sophisticated analyses suggest that leatherbacks in the Northwest Atlantic may reach maturity at 24.5-29 years of age (Avens *et al.* 2009). In the U.S. and Caribbean, female leatherbacks nest from March through July. They nest frequently (up to 7 nests per year) during a nesting season and nest about every 2-3 years. During each nesting, they produce 100 eggs or more in each clutch and can produce 700 eggs or more per nesting season (Schultz 1975). However, a significant portion (up to approximately 30%) of the eggs can be infertile. Therefore, the actual proportion of eggs that can result in hatchlings is less than the total number of eggs produced per season. As is the case with other sea turtle species, leatherback hatchlings enter the water soon after hatching. Based on a review of all sightings of leatherback sea turtles of <145 centimeters (cm) curved carapace length (CCL), Eckert (1999) found that leatherback juveniles remain in waters warmer than 26°C until they exceed 100 cm CCL.

As described in Section 3.1.1, sea turtle nesting survey data is important in that it provides information on the relative abundance of nesting, and the contribution of each population/ subpopulation to total nesting of the species. Nest counts can also be used to estimate the number of reproductively mature females nesting annually, and as an indicator of the trend in the number of nesting females in the nesting group. The 5-year review for leatherback sea turtles (NMFS and USFWS 2007b) compiled the most recent information on mean number of leatherback nests per year for each of the seven leatherback populations or groups of populations that were identified by the Leatherback TEWG as occurring within the Atlantic. These are: Florida, North Caribbean, Western Caribbean, Southern Caribbean, West Africa, South Africa, and Brazil (TEWG 2007). In the U.S., the Florida Statewide Nesting Beach Survey program has documented an increase in leatherback nesting numbers from 98 nests in 1988 to between 800 and 900 nests in the early 2000s (NMFS and USFWS 2007b). An analysis of Florida's index nesting beach sites from 1989-2006 shows a substantial increase in leatherback nesting in Florida during this time, with an annual growth rate of approximately 1.17 (TEWG 2007). The TEWG reports an increasing or stable nesting trend for all of the seven populations or groups of populations with the exception of the Western Caribbean and West Africa. In St. Croix, for example, researchers have noted a declining presence of neophytes (first-time nesters) since 2002 (Garner and Garner 2007). In addition, the leatherback rookery along the northern coast of South America in French Guiana and Suriname supports the majority of leatherback nesting in the western Atlantic (TEWG 2007), and represents more than half of total nesting by leatherback sea turtles worldwide (Hilterman and Goverse 2004). Nest numbers in Suriname have shown an increase and the long-term trend for the Suriname and French Guiana nesting group seems to show an increase (Hilterman and Goverse 2004). In 2001, the number of nests for Suriname and French Guiana combined was 60,000, one of the highest numbers observed for this region in 35 years (Hilterman and Goverse 2004). The TEWG (2007) report indicates that using nest numbers from 1967-2005, a positive population growth rate was found over the 39-year period for French Guinea and Suriname, with a 95% probability that the population was growing.

Nevertheless, given the magnitude of leatherback nesting in this area compared to other nest sites, impacts to this area that negatively affect leatherback sea turtles could have profound impacts on the species, overall.

Tagging and satellite telemetry data indicate that leatherbacks from the western North Atlantic nesting beaches use the entire North Atlantic Ocean (TEWG 2007). For example, leatherbacks tagged at nesting beaches in Costa Rica have been found in Texas, Florida, South Carolina, Delaware, and New York (STSSN database). Leatherback sea turtles tagged in Puerto Rico, Trinidad, and the Virgin Islands have also been subsequently found on U.S. beaches of southern, Mid-Atlantic, and northern states (STSSN database). Animals from the South Atlantic nesting assemblages (West Africa, South Africa, and Brazil) have not been re-sighted in the western North Atlantic (TEWG 2007).

The 5-year status review (NMFS and USFWS 2007b) and TEWG (2007) report provide summaries of natural as well as anthropogenic threats to leatherback sea turtles. Of the Atlantic sea turtle species, leatherbacks seem to be the most vulnerable to entanglement in fishing gear, trap/pot gear in particular. This susceptibility may be the result of their body type (large size, long pectoral flippers, and lack of a hard shell), and their attraction to gelatinous organisms and algae that collect on buoys and buoy lines at or near the surface, and perhaps to the lightsticks used to attract target species in longline fisheries. Leatherbacks entangled in fishing gear generally have a reduced ability to feed, dive, surface to breathe, or perform any other behavior essential to survival (Balazs 1985). In addition to drowning from forced submergence, they may be more susceptible to boat strikes if forced to remain at the surface, and entangling lines can constrict blood flow resulting in tissue necrosis.

Leatherbacks have been documented interacting with longline, trap/pot, trawl, and gillnet fishing gear. For instance, according to observer records, an estimated 6,363 leatherback sea turtles were documented as caught by the U.S. Atlantic tuna and swordfish longline fisheries between 1992-1999 (NMFS SEFSC 2001). Currently, the U.S. tuna and swordfish longline fisheries managed under the HMS FMP are estimated to capture 1,764 leatherbacks (no more than 252 mortalities) for each 3-year period starting in 2007 (NMFS 2004a). In 2008, there were 90 observed interactions between leatherback sea turtles and longline gear used in the HMS fishery. Four (4) of the leatherbacks were dead upon release and one (1) was in unknown condition. The vast majority of leatherbacks that were released alive had injuries due to external hooking (Garrison *et al.* 2009). Based on the observed take, an estimated 381.3 (95% CI: 288.7-503.7) leatherback sea turtles are estimated to have been taken in the longline fisheries managed under the HMS FMP in 2008 (Garrison *et al.* 2009). The 2008 estimate is consistent with the annual numbers since 2005 and remains well below the average prior to implementation of gear regulations (Garrison *et al.* 2009). Since the U.S. fleet accounts for only 5%-8% of the longline hooks fished in the Atlantic Ocean, adding up the under-represented observed takes of the other 23 countries actively fishing in the area would likely result in annual take estimates of thousands of leatherbacks over different life stages (NMFS SEFSC 2001). Lewison *et al.* (2004) estimated that 30,000-60,000 leatherbacks were taken in all Atlantic longline fisheries in 2000 (including the U.S. Atlantic tuna and swordfish longline fisheries as well as others).

Leatherbacks are susceptible to entanglement in the lines associated with trap/pot gear used in several fisheries. From 1990-2000, 92 entangled leatherbacks were reported from New York through Maine (Dwyer *et al.* 2002). Additional leatherbacks stranded wrapped in line of unknown origin or with evidence of a past entanglement (Dwyer *et al.* 2002). More recently, from 2002 to 2007, NMFS received 144 reports of entangled sea turtles in vertical lines from Maine to Virginia, with 96 events confirmed (verified by photo documentation or response by a trained responder; NMFS 2008a). Of the 96 confirmed events during this period, 87 events involved leatherbacks. NMFS identified the gear type and fishery for 42 of the 96 confirmed events, which included lobster, whelk, sea bass, crab, and research pot gear. A review of leatherback mortality documented by the STSSN in Massachusetts suggests that vessel strikes and entanglement in fixed gear (primarily lobster pots and whelk pots) are the principal sources of this mortality (Dwyer *et al.* 2002). Fixed gear fisheries in the Mid-Atlantic have also contributed to leatherback entanglements. For example, in North Carolina, two (2) leatherback sea turtles were reported entangled in a crab pot buoy inside Hatteras Inlet (NMFS SEFSC 2001). A third leatherback was reported entangled in a crab pot buoy in Pamlico Sound off of Ocracoke. This turtle was disentangled and released alive; however, lacerations on the front flippers from the lines were evident (NMFS SEFSC 2001). In the Southeast U.S., leatherbacks are vulnerable to entanglement in Florida's lobster pot and stone crab fisheries as documented on stranding forms. In the U.S. Virgin Islands, where one (1) of five (5) leatherback strandings from 1982 to 1997 were due to entanglement (Boulon 2000), leatherbacks have been observed with their flippers wrapped in the line of West Indian fish traps (R. Boulon, pers. comm. to Joanne Braun-McNeill, NMFS SEFSC 2001).

Leatherback interactions with the U.S. South Atlantic and Gulf of Mexico shrimp fisheries are also known to occur (NMFS 2002a). Leatherbacks are likely to encounter shrimp trawls working in the coastal waters off the U.S. Atlantic coast (from Cape Canaveral, Florida through North Carolina) as they make their annual spring migration north. For many years, TEDs that were required for use in the U.S. South Atlantic and Gulf of Mexico shrimp fisheries were less effective for leatherbacks as compared to the smaller, hard-shelled turtle species, because the TED openings were too small to allow leatherbacks to escape. To address this problem, NMFS issued a final rule on February 21, 2003 to amend the TED regulations (68 FR 8456, February 21, 2003). Modifications to the design of TEDs are now required in order to exclude leatherbacks as well as large benthic immature and sexually mature loggerhead and green sea turtles (see section 3.1.1 above for further information on the shrimp trawl fishery).

Other trawl fisheries are also known to interact with leatherback sea turtles although on a much smaller scale. In October 2001, for example, a fisheries observer documented the take of a leatherback in a bottom otter trawl fishing for *Loligo* squid off of Delaware. TEDs are not currently required in this fishery. In November 2007, fisheries observers reported the capture of a leatherback sea turtle in bottom otter trawl gear fishing for summer flounder.

Gillnet fisheries operating in the waters of the Mid-Atlantic states are also known to capture, injure, and/or kill leatherbacks when these fisheries and leatherbacks co-occur. Data collected by the NEFSC Fisheries Observer Program from 1994-1998 (excluding 1997) indicate that a total of 37 leatherbacks were incidentally captured (16 lethally) in drift gillnets set in offshore waters from Maine to Florida during this period. Observer coverage for this period ranged from 54%-92%. In North Carolina, six additional leatherbacks were reported captured in gillnet sets in the spring (NMFS SEFSC 2001). In addition to these, in September 1995, two (2) dead leatherbacks were removed from an 11-inch (28.2-cm) monofilament shark gillnet set in the nearshore waters off of Cape Hatteras (STSSN unpublished data reported in NMFS SEFSC 2001).

Fishing gear interactions can occur throughout the range of leatherbacks. Entanglements occur in Canadian waters where Goff and Lien (1988) reported that 14 of 20 leatherbacks encountered off the coast of Newfoundland/Labrador were entangled in fishing gear including salmon net, herring net, gillnet, trawl line, and crab pot line. Leatherbacks are known to drown in fish nets set in coastal waters of Sao Tome, West Africa (Castroviejo *et al.* 1994; Graff 1995). Gillnets are one of the suspected causes for the decline in the leatherback sea turtle population in French Guiana (Chevalier *et al.* 1999), and gillnets targeting green and hawksbill sea turtles in the waters of coastal Nicaragua also incidentally catch leatherback sea turtles (Lagueux *et al.*1998). Observers on shrimp trawlers operating in the northeastern region of Venezuela documented the capture of six (6) leatherbacks from 13,600 trawls (Marcano and Alio-M. 2000). An estimated 1,000 mature female leatherback sea turtles are caught annually in fishing nets off of Trinidad and Tobago with mortality estimated to be between 50%-95% (Eckert and Lien 1999). Many of the sea turtles do not die as a result of drowning, but rather because the fishermen cut them out of their nets (NMFS SEFSC 2001).

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

Summary of Status for Leatherback Sea Turtles

In the Pacific Ocean, the abundance of leatherback sea turtles on nesting beaches has declined dramatically over the past 10 to 20 years. Nesting groups throughout the eastern and western Pacific Ocean have been reduced to a fraction of their former abundance by the combined effects of human activities that have reduced the number of nesting females and reduced the reproductive success of females that manage to nest (for example, egg poaching) (NMFS and USFWS 2007b). No reliable long term trend data for the Indian Ocean populations are currently available. While leatherbacks are known to occur in the Mediterranean Sea, nesting in this region is not known to occur (NMFS and USFWS 2007b).

Nest counts in many areas of the Atlantic Ocean show increasing trends, including for beaches in

Suriname and French Guiana which support the majority of leatherback nesting (NMFS and USFWS 2007b). The species as a whole continues to face numerous threats in nesting and marine habitats. As with the other sea turtle species, fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like pollution and habitat destruction account for an unknown level of other mortality. The long term recovery potential of this species may be further threatened by observed low genetic diversity, even in the largest nesting groups like French Guiana and Suriname (NMFS and USFWS 2007b).

Based on its 5-year status review of the species, NMFS and USFWS (2007b) determined that endangered leatherback sea turtles should not be delisted or reclassified. However, it was also determined that an analysis and review of the species should be conducted in the future to determine whether DPSs should be identified (NMFS and USFWS 2007b).

Kemp's ridley sea turtles

The Kemp's ridley is one of the least abundant of the world's sea turtle species. In contrast to loggerhead, leatherback, and green sea turtles, which are found in multiple oceans of the world, Kemp's ridleys typically occur only in the Gulf of Mexico and the northwestern Atlantic Ocean (USFWS and NMFS 1992).

The majority of Kemp's ridleys nest along a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963; USFWS and NMFS 1992; NMFS and USFWS 2007c). There is a limited amount of scattered nesting to the north and south of the primary nesting beach (NMFS and USFWS 2007c). The number of nesting adult females reached an estimated low of fewer than 250 in 1985 (USFWS and NMFS 1992; TEWG 2000; NMFS and USFWS 2007c). Conservation efforts by Mexican and U.S. agencies have aided this species by eliminating egg harvest, protecting eggs and hatchlings, and reducing at-sea mortality through fishing regulations (TEWG 2000). From 1985 to 1999, the number of nests observed at Rancho Nuevo and nearby beaches increased at a mean rate of 11.3% (95% CI slope = 0.096-0.130) per year (TEWG 2000). An estimated 5,500 females nested in the State of Tamaulipas over a 3-day period in May 2007 and over 4,000 of those nested at Rancho Nuevo (NMFS and USFWS 2007c). There is limited nesting in the U.S., most of which is located in South Texas. In 2006, approximately 100 nests were laid in Texas (NMFS and USFWS 2007c).

Kemp's ridleys mature at 10-17 years (Caillouet *et al.* 1995; Schmid and Witzell 1997; Snover *et al.* 2007; NMFS and USFWS 2007c). Nesting occurs from April through July each year with hatchlings emerging after 45-58 days (USFWS and NMFS 1992). Once they leave the nesting beach, neonates presumably enter the Gulf of Mexico where they feed on available S*argassum* and associated infauna or other epipelagic species (USFWS and NMFS 1992). The presence of juvenile turtles along both the U.S. Atlantic and Gulf of Mexico coasts, where they are recruited to the coastal benthic environment, indicates that post-hatchlings are distributed in both the Gulf of Mexico and Atlantic Ocean (TEWG 2000).

The location and size classes of dead turtles recovered by the STSSN suggests that benthic immature developmental areas occur along the U.S. coast and that these areas may change given resource quality and quantity (TEWG 2000). Developmental habitats are defined by several characteristics, including coastal areas sheltered from high winds and waves such as embayments and estuaries, and nearshore temperate waters shallower than 50 m (NMFS and USFWS 2007c). The suitability of these habitats depends on resource availability, with optimal environments providing rich sources of crabs and other invertebrates. Kemp's ridleys consume a variety of crab species, including *Callinectes* species, *Ovalipes* species, *Libinia* species, and *Cancer* species, mollusks, shrimp, and fish are consumed less frequently (Bjorndal 1997). A wide variety of substrates have been documented to provide good foraging habitat, including seagrass beds, oyster reefs, sandy and mud bottoms, and rock outcroppings (NMFS and USFWS 2007c).

Foraging areas documented along the U.S. Atlantic coast include Charleston Harbor, Pamlico Sound (Epperly *et al.* 1995c), Chesapeake Bay (Musick and Limpus 1997), Delaware Bay, and Long Island Sound (Morreale and Standora 1993). For instance, in the Chesapeake Bay, where the seasonal juvenile population of Kemp's ridley sea turtles is estimated to be 211-1,083 individuals, Kemp's ridleys frequently forage in submerged aquatic grass beds for crabs (Musick and Limpus 1997). Upon leaving Chesapeake Bay in autumn, juvenile Kemp's ridleys migrate down the coast, passing Cape Hatteras in December and January (Musick and Limpus 1997). These larger juveniles are joined by juveniles of the same size from North Carolina sounds and smaller juveniles from New York and New England to form one of the densest concentrations of Kemp's ridleys outside of the Gulf of Mexico (Epperly *et al.* 1995a, 1995b; Musick and Limpus 1997).

Adult Kemp's ridleys are found in the coastal regions of the Gulf of Mexico and southeastern U.S., but are typically rare in the northeastern U.S. waters of the Atlantic (TEWG 2000). Adults are primarily found in near-shore waters of 37 m or less that are rich in crabs and have a sandy or muddy bottom (NMFS and USFWS 2007c).

Kemp's ridleys face many of the same natural threats as loggerheads, including destruction of nesting habitat from storm events, natural predators, and oceanic events such as cold-stunning. Although cold-stunning can occur throughout the range of the species, it may be a greater risk for sea turtles that utilize the more northern habitats of Cape Cod Bay and Long Island Sound. For example, as reported in the national STSSN database, in the winter of 1999/2000, there was a major cold-stunning event where 218 Kemp's ridleys, 54 loggerheads, and 5 green sea turtles were found on Cape Cod beaches. Annual cold stun events do not always occur at this magnitude; the extent of episodic major cold stun events may be associated with numbers of turtles utilizing Northeast U.S. waters in a given year, oceanographic conditions, and the occurrence of storm events in the late fall. Although many cold-stunned turtles can survive if found early enough, cold-stunning events can represent a significant cause of natural mortality.

Like other sea turtle species, the severe decline in the Kemp's ridley population appears to have been heavily influenced by a combination of exploitation of eggs and impacts from fishery interactions. From the 1940s through the early 1960s, nests from Ranch Nuevo were heavily exploited, but beach protection in 1966 helped to curtail this activity (USFWS and NMFS 1992). Following World War II, there was a substantial increase in the number of trawl vessels, particularly shrimp trawlers, in the Gulf of Mexico where adult Kemp's ridley sea turtles occur. Information from fishermen helped to demonstrate the high number of turtles taken in these shrimp trawls (USFWS and NMFS 1992). Subsequently, NMFS has worked with the industry to reduce sea turtle takes in shrimp trawls and other trawl fisheries, including the development and use of TEDs. As described in Section 3.1.1 above, there is lengthy regulatory history with regard to the use of TEDs in the U.S. South Atlantic and Gulf of Mexico shrimp fisheries (Epperly and Teas 2002; NMFS 2002a; Lewison *et al.* 2003). The Biological Opinion on shrimp trawling in the southeastern U.S. completed in 2002 concluded that 155,503 Kemp's ridley sea turtles would be taken annually in the fishery with 4,208 of the takes resulting in mortality (NMFS 2002a).

Although modifications to shrimp trawls have helped to reduce mortality of Kemp's ridleys, this species is also affected by other sources of anthropogenic impacts (fishery and non-fishery related) similar to those discussed above. For example, in the spring of 2000, a total of five (5) Kemp's ridley carcasses were recovered from the same North Carolina beaches where 275 loggerhead carcasses were found. The cause of death for most of the turtles recovered was unknown, but the mass mortality event was suspected by NMFS to have been from a large-mesh gillnet fishery for monkfish and dogfish operating offshore in the preceding weeks (67 FR 71895, December 3, 2002). The five (5) Kemp's ridley carcasses that were found are likely to have been only a minimum count of the number of Kemp's ridleys that were killed or seriously injured as a result of the fishery interaction, since it is unlikely that all of the carcasses washed ashore.

Summary of Status for Kemp's ridley Sea Turtles

The majority of Kemp's ridleys nest along a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963; USFWS and NMFS 1992; NMFS and USFWS 2007c). The number of nesting females in the Kemp's ridley population declined dramatically from the late 1940s through the mid 1980s, with an estimated 40,000 nesting females in a single *arribada* in 1947 and fewer than 250 nesting females in the entire 1985 nesting season (USFWS and NMFS 1992; TEWG 2000). However, the total annual number of nests at Rancho Nuevo gradually began to increase in the 1990s (NMFS and USFWS 2007c). Based on the number of nests laid in 2006 and the remigration interval for Kemp's ridley sea turtles (1.8-2 years), there were an estimated 7,000-8,000 adult female Kemp's ridley sea turtles in 2006 (NMFS and USFWS 2007c). The number of adult males in the population is unknown, but sex ratios of hatchlings and immature Kemp's ridleys suggest that the population is female biased, suggesting that the number of adult males is less than the number of adult females (NMFS and USFWS 2007c).

As with the other sea turtle species, fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like dredging, pollution, and habitat destruction account for an unknown level of other mortality. Based on their 5-year status review of the species, NMFS and USFWS (2007c) determined that Kemp's ridley sea turtles should not be reclassified as threatened under the ESA.

Green sea turtles

Green sea turtles are distributed circumglobally, and can be found in the Pacific, Indian, and

Atlantic Oceans as well as the Mediterranean Sea (NMFS and USFWS 1991; Seminoff 2004; NMFS and USFWS 2007d). In 1978, the Atlantic population of the green sea turtle was listed as threatened under the ESA, except for the breeding populations in Florida and on the Pacific coast of Mexico, which were listed as endangered. As it is difficult to differentiate between breeding populations away from the nesting beaches, in water all green sea turtles are considered endangered.

Pacific Ocean. Green sea turtles occur in the western, central, and eastern Pacific. Foraging areas are also found throughout the Pacific and along the southwestern U.S. coast (NMFS and USFWS 1998c). In the western Pacific, major nesting rookeries at four sites including Heron Island (Australia), Raine Island (Australia), Guam, and Japan were evaluated and determined to be increasing in abundance, with the exception of Guam which appears stable (NMFS and USFWS 2007d). In the central Pacific, nesting occurs on French Frigate Shoals, Hawaii, which has also been reported as increasing with a mean of 400 nesting females from 2002-2006 (NMFS and USFWS 2007d). The main nesting sites for the green sea turtle in the eastern Pacific are located in Michoacan, Mexico and in the Galapagos Islands, Ecuador (NMFS and USFWS 2007d). The number of nesting females per year exceeds 1,000 females at each site (NMFS and USFWS 2007d). However, historically, greater than 20,000 females per year are believed to have nested in Michoacan alone (Cliffton *et al.* 1982; NMFS and USFWS 2007d). Thus the current number of nesting females is still far below what has historically occurred. Again, the Pacific Mexico green turtle nesting population (also called the black turtle) is considered endangered.

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

Indian Ocean. There are numerous nesting sites for green sea turtles in the Indian Ocean. One of the largest nesting sites for green sea turtles worldwide occurs on the beaches of Oman where an estimated 20,000 green sea turtles nest annually (Hirth 1997; Ferreira *et al.* 2006). Based on a review of the 32 Index Sites used to monitor green sea turtle nesting worldwide, Seminoff (2004) concluded that declines in green sea turtle nesting were evident for many of the Indian Ocean Index Sites. While several of these had not demonstrated further declines in the more recent past, only the Comoros Island Index Site in the western Indian Ocean showed evidence of increased nesting (Seminoff 2004).

Mediterranean Sea. There are four nesting concentrations of green sea turtles in the Mediterranean from which data are available, including those in Turkey, Cyprus, Israel, and Syria. Currently, approximately 300-400 females nest each year—about two-thirds of which nest in Turkey and one-third in Cyprus. Loggerheads are depleted from historic levels in the Mediterranean Sea (Kasparek *et al.* 2001), nesting data gathered since the early 1990s in Turkey, Cyprus, and Israel show no apparent trend in any direction. However, a declining trend is apparent along the coast of Palestine/Israel, where 300-350 nests were deposited each year in the

1950s (Sella 1982) compared to a mean of 6 nests per year from 1993-2004 (Kuller 1999; Y. Levy, Israeli Sea Turtle Rescue Center, unpublished data). A recent discovery of green sea turtle nesting in Syria adds roughly 100 nests per year to green sea turtle nesting activity in the Mediterranean (Rees *et al.* 2005). That such a major nesting concentration could have gone unnoticed until recently (the Syria coast was surveyed in 1991, but nesting activity was attributed to loggerheads) bodes well for the ongoing speculation that the unsurveyed coast of Libya may also host substantial nesting.

Atlantic Ocean. As has occurred in other oceans of its range, green sea turtles were once the target of directed fisheries in the U.S. and throughout the Caribbean. In 1890, over one million lbs of green sea turtles were taken in the Gulf of Mexico green sea turtle fishery (Doughty 1984). However, declines in the turtle fishery throughout the Gulf of Mexico were evident by 1902 (Doughty 1984).

In the western Atlantic, green sea turtles range from Massachusetts to Argentina, including the Gulf of Mexico and Caribbean (Wynne and Schwartz 1999). Green sea turtles occur seasonally in Mid-Atlantic and Northeast waters such as Chesapeake Bay and Long Island Sound (Musick and Limpus 1997; Morreale and Standora 1998; Morreale *et al.* 2005), which serve as foraging and developmental habitats.

Some of the principal feeding areas in the western Atlantic Ocean include the upper west coast of Florida, the Florida Keys, and the northwestern coast of the Yucatán Peninsula. Additional important foraging areas in the western Atlantic include the Mosquito and Indian River Lagoon systems and nearshore wormrock reefs between Sebastian and Ft. Pierce Inlets in Florida, Florida Bay, the Culebra archipelago and other Puerto Rico coastal waters, the south coast of Cuba, the Mosquito Coast of Nicaragua, the Caribbean coast of Panama, and scattered areas along Colombia and Brazil (Hirth 1971). The waters surrounding the island of Culebra, Puerto Rico, and its outlying keys are designated critical habitat for the green sea turtle.

Age at maturity for green sea turtles is estimated to be 20-50 years (Balazs 1982; Frazer and Ehrhart 1985; Seminoff 2004). As is the case with the other sea turtle species described above, adult females may nest multiple times in a season (average 3 nests/season with approximately 100 eggs/nest) and typically do not nest in successive years (NMFS and USFWS 1991; Hirth 1997).

As is also the case for the other sea turtle species described above, nest count information for green sea turtles provides information on the relative abundance of nesting, and the contribution of each nesting group to total nesting of the species. Nest counts can also be used to estimate the number of reproductively mature females nesting annually. The 5-year status review for the species identified eight geographic areas considered to be primary sites for threatened green sea turtle nesting in the Atlantic/Caribbean, and reviewed the trend in nest count data for each (NMFS and USFWS 2007d). These include: (1) Yucatán Peninsula, Mexico, (2) Tortuguero, Costa Rica, (3) Aves Island, Venezuela, (4) Galibi Reserve, Suriname, (5) Isla Trindade, Brazil, (6) Ascension Island, United Kingdom, (7) Bioko Island, Equatorial Guinea, and (8) Bijagos Achipelago, Guinea-Bissau (NMFS and USFWS 2007d). Nesting at all of these sites is considered to be stable or increasing with the exception of Bioko Island, which may be declining, and the Bijagos Archipelago, which may be stable; however, the lack of sufficient data precludes a meaningful trend assessment for either site (NMFS and USFWS 2007d).

Seminoff (2004) reviewed green sea turtle nesting data for eight sites in the western, eastern, and central Atlantic, including all of the above threatened nesting sites with the exception that nesting in Florida was reviewed in place of Isla Trindade, Brazil. Seminoff (2004) concluded that all sites in the central and western Atlantic showed increased nesting with the exception of nesting at Aves Island, Venezuela, while both sites in the eastern Atlantic demonstrated decreased nesting. These sites are not inclusive of all green sea turtle nesting in the Atlantic Ocean. However, other sites are not believed to support nesting levels high enough that would change the overall status of the species in the Atlantic (NMFS and USFWS 2007d).

By far, the most important nesting concentration for green sea turtles in the western Atlantic is in Tortuguero, Costa Rica (NMFS and USFWS 2007d). Nesting in the area has increased considerably since the 1970s and nest count data from 1999-2003 suggest nesting by 17,402-37,290 females per year (NMFS and USFWS 2007d). The number of females nesting per year on beaches in the Yucatán, at Aves Island, Galibi Reserve, and Isla Trindade number in the hundreds to low thousands, depending on the site (NMFS and USFWS 2007d).

The status of the endangered Florida breeding population was also evaluated in the 5-year review (NMFS and USFWS 2007d). The pattern of green sea turtle nesting shows biennial peaks in abundance, with a generally positive trend since establishment of the Florida index beach surveys in 1989 to 2006. This is perhaps due to increased protective legislation throughout the Caribbean (Meylan *et al.* 1995), as well as protections in Florida and throughout the U.S. (NMFS and USFWS 2007d).

The statewide Florida surveys (2000-2006) have shown that a mean of approximately 5,600 nests are laid annually in Florida, with a low of 581 in 2001 to a high of 9,644 in 2005 (NMFS and USFWS 2007d). Most nesting occurs along the east coast of Florida, but occasional nesting has been documented along the Gulf coast of Florida, at Southwest Florida beaches, as well as the beaches in the Florida Panhandle (Meylan *et al.* 1995). More recently, green sea turtle nesting occurred on Bald Head Island, North Carolina (just east of the mouth of the Cape Fear River), on Onslow Island, and at Cape Hatteras National Seashore.

Green sea turtles face many of the same natural threats as loggerhead and Kemp's ridley sea turtles. In addition, green sea turtles appear to be susceptible to fibropapillomatosis, an epizootic disease producing lobe-shaped tumors on the soft portion of a turtle's body. Juveniles appear to be most affected in that they have the highest incidence of disease and the most extensive lesions, whereas lesions in nesting adults are rare. Also, green sea turtles frequenting nearshore waters, areas adjacent to large human populations, and areas with low water turnover, such as lagoons, have a higher incidence of the disease than individuals in deeper, more remote waters. The occurrence of fibropapilloma tumors may result in impaired foraging, breathing, or swimming ability, leading potentially to death (George 1997).

As with the other sea turtle species, incidental fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches. Sea sampling coverage in the pelagic driftnet, pelagic longline, Southeast shrimp trawl, and summer flounder bottom trawl fisheries has recorded takes of green sea turtles. Other activities like dredging, pollution, and habitat destruction account for an unknown level of other mortality. Stranding reports indicate that between 200-400 green sea turtles strand annually along the eastern U.S. coast from a variety of causes most of which are unknown (STSSN database).

Summary of Status of Green Sea Turtles

A review of 32 Index Sites3 distributed globally revealed a 48%-67% decline in the number of mature females nesting annually over the last three generations4 (Seminoff 2004). An evaluation of green sea turtle nesting sites was also conducted as part of the 5-year status review of the species (NMFS and USFWS 2007d). Of the 23 threatened nesting groups assessed in that report for which nesting abundance trends could be determined, 10 were considered to be increasing, 9 were considered stable, and 4 were considered to be decreasing (NMFS and USFWS 2007d). Nesting groups were considered to be doing relatively well (the number of sites with increasing nesting were greater than the number of sites with decreasing nesting) in the Pacific, western Atlantic, and central Atlantic (NMFS and USFWS 2007d). However, nesting populations were determined to be doing relatively poorly in Southeast Asia, eastern Indian Ocean, and perhaps the Mediterranean. Overall, based on mean annual reproductive effort, the report estimated that 108,761 to 150,521 females nest each year among the 46 threatened and endangered nesting sites included in the evaluation (NMFS and USFWS 2007d). However, given the late age to maturity for green sea turtles, caution is urged regarding the status for any of the nesting groups since no area has a dataset spanning a full green sea turtle generation (NMFS and USFWS 2007d).

Seminoff (2004) and NMFS and USFWS (2007d) made comparable conclusions with regard to nesting for four nesting sites in the western Atlantic that indicate sea turtle abundance is increasing in the Atlantic Ocean. Each also concluded that nesting at Tortuguero, Costa Rica represented the most important nesting area for green sea turtles in the western Atlantic and that nesting had increased markedly since the 1970s (Seminoff 2004; NMFS and USFWS 2007d).

However, the 5-year review also noted that the Tortuguero nesting stock continued to be affected by ongoing directed take at their primary foraging area in Nicaragua (NMFS and USFWS 2007d). The endangered breeding population in Florida appears to be increasing based upon index nesting data from 1989-2006 (NMFS and USFWS 2007d).

As with the other sea turtle species, fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like dredging,

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

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

pollution, and habitat destruction account for an unknown level of other mortality. Based on its 5-year status review of the species, NMFS and USFWS (2007d) determined that the listing classification for green sea turtles should not be changed. However, it was also determined that an analysis and review of the species should be conducted in the future to determine whether DPSs should be identified (NMFS and USFWS 2007d).

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 biological opinion includes the effects of several activities that occur in the action area that may affect the survival and recovery of threatened and endangered species. The activities that shape the environmental baseline in the action area of this consultation include vessel operations, fisheries, and recovery activities associated with reducing those impacts.

The past impacts of each state, Federal, and private action or other human activity in the action area can not be particularized in their entirety. However, to the extent they have manifested themselves at the population level, such past impacts are subsumed in the information presented on the status and trends of the species in the Status of the Species sections, recognizing that the benefits to sea turtles as a result of recovery activities already implemented may not be evident in the status and trends of populations for years given the relatively late age to maturity for sea turtles, and depending on the age class(es) affected.

Federal Actions that have Undergone Formal or Early Section 7 Consultation

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

Vessel Operations

Potential adverse effects from federal vessel operations in the action area of this consultation include operations of the US Navy (USN) and the US Coast Guard (USCG), which maintain the largest federal vessel fleets, the EPA, the National Oceanic and Atmospheric Administration (NOAA), and the ACOE. NMFS has conducted formal consultations with the USCG, the USN, EPA and NOAA on their vessel operations. 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. Refer to the biological opinions for the USCG (September 15, 1995; July 22, 1996; and June 8, 1998) and the USN (May 15, 1997) for detail on the scope of vessel operations for these agencies and conservation measures being implemented as standard operating procedures.

Federal Fishery Operations
Formal ESA section 7 consultation has been conducted on the fisheries authorized under the Atlantic mackerel, squid, and butterfish, monkfish, multispecies, skate, spiny dogfish, and summer flounder, scup, black sea bass FMP's as well as for the American lobster fishery. Given the size of the action area compared to the broad area of operation for these fisheries, only a small portion of the fishing effort for each of these is expected to occur within the action area of this consultation.

ESA-listed cetaceans and sea turtles are known to be killed and injured as a result of being struck by vessels on the water. However, the operation of fishing vessels used in the aforementioned fisheries will have discountable effects on these species. Fishing vessels operate at relatively slow speeds, particularly when towing or hauling gear. Thus, large cetaceans and sea turtles in the path of a fishing vessel would be more likely to have time to move away before being struck.

Gear used in the federal fisheries described below is expected to have an insignificant effect on sea turtle prey or the bottom habitat utilized by sea turtles. As explained above, 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. Nevertheless, 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.

Sea turtle prey items such as horseshoe crabs, other crabs, and whelks are removed from the marine environment as fisheries bycatch in one or more of the aforementioned fisheries. None of these are typical prey species of leatherback sea turtles or of neritic juvenile or adult green sea turtles (the age classes anticipated to occur in continental shelf waters where the fisheries operate) (Rebel 1974; Mortimer 1982; Bjorndal 1985; USFWS and NMFS 1992; Bjorndal 1997). Therefore, the aforementioned fisheries will not affect the availability of prey for leatherback and green sea turtles in the action area.

Neritic juveniles and adults of both loggerhead and Kemp's ridley sea turtles are known to feed on species that are caught as bycatch in numerous fisheries (Keinath *et al.* 1987; Lutcavage and Musick 1985; Dodd 1988; Burke *et al.* 1993; Burke *et al.* 1994; Morreale and Standora 2005; Seney and Musick 2005). Some of the bycatch is expected to be returned to the water alive, while the remainder will be returned to the water dead or injured to the extent that the organisms will shortly die. Injured or deceased bycatch would still be available as prey for sea turtles which are known to eat a variety of live prey as well as scavenge dead organisms (Keinath *et al*. 1987; Lutcavage and Musick 1985; Dodd 1988; Burke *et al*. 1993; Morreale and Standora 2005). Additionally, with respect to Kemp's ridley sea turtles, increased nesting by this species for the last several years strongly suggests that the species is not food limited. Given the time it takes for Kemp's ridley sea turtles to mature and nest, fishing effort was likely greater during the time that current nesters were maturing then it is presently. Therefore, any effects of the fisheries on the availability of Kemp's ridley prey should be evident at this time if such were occurring.

Gear used in the federal fisheries described below is believed to have the potential to adversely affect bottom habitat in the action area (NMFS 2003). A panel of experts have previously concluded that the effects of even light weight otter trawl gear would include: (1) The scraping or plowing of the doors on the bottom, sometimes creating furrows along their path, (2) sediment suspension resulting from the turbulence caused by the doors and the ground gear on the bottom, (3) the removal or damage to benthic or demersal species, and (4) the removal or damage to structure forming biota. The panel also concluded that the greatest impacts from otter trawls occur in high and low energy gravel habitats and in hard clay outcroppings, and that sand habitats were the least likely to be impacted (NREFHSC 2002). The action area for this consultation does not include gravel habitats or hard clay outcroppings. For these reasons and the lack of any evidence that fishing practices affect habitats in degrees that harm or harass ESA-listed species, NMFS finds that while continued aforementioned fishing efforts may potentially alter benthic habitats, these alterations will be insignificant to ESA-listed species.

Factors affecting food availability for leatherbacks are likely to be oceanographic conditions rather than bottom habitat. As is the case of leatherback sea turtles, prey availability (*i.e.*, copepods, schooling fish) for foraging right, humpback, fin and sei whales is associated with oceanographic conditions rather than bottom habitat (Baumgartner *et al.* 2003; IWC 1992; Pace and Merrick 2008; Perry *et al.* 1999) that may be temporarily disturbed by the use of bottom fishing gear.

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. Sea turtles are known to be killed and injured as a result of being struck by vessels on the water. However, for the following reasons, the operation of fishing vessels used in the aforementioned fisheries will have discountable effects on loggerhead sea turtles. First, fishing vessels operate at relatively slow speeds, particularly when towing or hauling gear. Thus, sea turtles in the path of a fishing vessel would be more likely to have time to move away before being struck. Fishing effort for all of the federal fisheries within the action area is constrained in some way --- either through a limited access permit system or by fishing quotas, thus limiting the amount of time that vessels are on the water. Listed sea turtles occur seasonally in waters along the East Coast so that a portion of the fishing in these waters occurs at times when sea turtles are not likely to be present. Finally, sea turtles do not occur strictly at the water surface or strictly within close proximity of the water surface (Morreale 1999) meaning that sea turtles spend part of their time at depths out of range of a vessel collision with boats.

Listed species may also be affected by fuel oil spills resulting from fishing vessel accidents. 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 likely to have an insignificant effect on listed species. Larger spills may result from accidents, although these events would be rare and involve small areas. No direct effects on listed species resulting from fishing vessel fuel spills have been documented.

The American lobster, Atlantic bluefish, Atlantic mackerel/squid /butterfish, Atlantic sea scallop, highly migratory species, monkfish, red crab, skate, spiny dogfish, summer flounder/scup/black sea bass and tilefish fisheries employ gear in a time/area/manner that has been known to capture, injure, and kill sea turtles. Some of these fisheries also use gear known to injure and/or kill right, humpback, fin, or sei whales as a result of entanglements in the gear (Johnson *et al.* 2005; Waring *et al.* 2009; Glass *et al.* 2009). A summary of the impacts of each of these fisheries that has been subject to section 7 consultation is provided below.

The only fishery that has been determined by NMFS to reduce the reproduction, numbers, or distribution of ESA-listed sea turtles, and reduce appreciably their likelihood of survival and recovery, is the pelagic longline component of the Atlantic highly migratory species fishery. On June 14, 2001, NMFS released an Opinion that found that the continued operation of the Atlantic pelagic longline fishery was likely to jeopardize the continued existence of both loggerhead and leatherback sea turtles. To avoid jeopardy to these species, a Reasonable and Prudent Alternative (RPA) was developed. The RPA required the closure of the Northeast Distant (NED) Statistical Area of the Atlantic Ocean to pelagic longlining and the enactment of a research program to develop or modify fishing gear and techniques to reduce sea turtle interactions and mortality associated with such interactions. On June 1, 2004, NMFS released another Opinion on the Atlantic pelagic longline fishery which stated that the fishery was still likely to jeopardize the continued existence of leatherback sea turtles. Another RPA was then developed to attempt to remove jeopardy. The RPA required that NMFS (1) reduce post-release mortality of leatherbacks, (2) improve monitoring of the effects of the fishery, (3) confirm the effectiveness of the hook and bait combinations that are required as part of the proposed action, and (4) take management action to avoid long-term elevations in leatherback takes or mortality. The Opinion specified an RPA that allows the continuation of the Atlantic highly migratory species fishery without jeopardizing ESA-listed species.

Formal ESA section 7 consultation has been conducted on the following fisheries which occur in the action area: Skate, Multispecies, Monkfish, Summer Flounder/Scup/Black Sea Bass, Mackerel/Squid/Butterfish, Lobster and Spiny Dogfish fisheries. These consultations are summarized below. These fisheries overlap with the action area to varying degrees.

Section 7 consultation on the *Skate FMP* was completed in October 2010, and concluded that the continued operation of the skate fishery within the constraints of the current Skate FMP, may adversely affect, but is not likely to jeopardize, the continued existence of right, humpback, fin, and sei whales or loggerhead, leatherback, Kemp's ridley, and green sea turtles. The ITS exempts the take of 39 loggerhead turtles (25 in trawls, 11 lethal; 15 in gillnets, 6 lethal), 4 leatherbacks, 4 Kemp's ridley and 5 green sea turtles annually. No incidental take of right, humpback, fin, or sei whales was exempted because the incidental take of ESA-listed whales has not been authorized under section 101(a)(5) of the MMPA.

The *Northeast Multispecies fishery* operates throughout the year with peaks in spring, and from

October through February. Multiple gear types are used in the fishery. However, the gear type of greatest concern is sink gillnet gear that can entangle whales and sea turtles (*i.e.*, in buoy lines and/or net panels). Data indicate that sink gillnet gear has seriously injured or killed North Atlantic right whales, humpback whales, fin whales, loggerhead and leatherback sea turtles. The most recent reinitiation of the Northeast Multispecies consultation was completed in October 2010, and concluded that continued implementation of the Multispecies FMP may adversely affect, but is not likely to jeopardize, the continued existence of right, humpback, fin, and sei whales or loggerhead, leatherback, Kemp's ridley, and green sea turtles. The ITS exempts the take of 46 loggerhead turtles (43 in trawls, 19 lethal; 3 in gillnets, 2 lethal), 4 leatherbacks, 4 Kemp's ridley and 5 green sea turtles annually. No incidental take of right, humpback, fin, or sei whales was exempted because the incidental take of ESA-listed whales has not been authorized under section 101(a)(5) of the MMPA.

The federal *Monkfish fishery* occurs in all waters under federal jurisdiction from Maine to the North Carolina/South Carolina border. The monkfish fishery uses several gear types that may entangle protected species. The most recent reinitiation of the monkfish consultation was completed in October 2010, and concluded that continued implementation of the Monkfish FMP may adversely affect, but is not likely to jeopardize, the continued existence of right, humpback, fin, and sei whales or loggerhead, leatherback, Kemp's ridley, and green sea turtles. The ITS exempts the take of 173 loggerhead turtles (2 in trawls, 1 lethal; 171 in gillnets, 69 lethal), 4 leatherbacks, 4 Kemp's ridley and 5 green sea turtles annually. No incidental take of right, humpback, fin, or sei whales was exempted because the incidental take of ESA-listed whales has not been authorized under section 101(a)(5) of the MMPA.

The *Summer Flounder, Scup and Black Sea Bass fisheries* are known to interact with sea turtles. The most recent reinitiation of this consultation was completed in October 2010, and concluded that continued authorization of this fishery may adversely affect, but is not likely to jeopardize, the continued existence of right, humpback, fin, and sei whales or loggerhead, leatherback, Kemp's ridley, and green sea turtles. The ITS exempts the take of 205 loggerhead turtles (192 in trawls, 79 lethal; 12 in gillnets, 5 lethal; 1 in pot/trap (lethal or non-lethal), 6 leatherbacks, 4 Kemp's ridley and 5 green sea turtles annually. No incidental take of right, humpback, fin, or sei whales was exempted because the incidental take of ESA-listed whales has not been authorized under section 101(a)(5) of the MMPA.

The primary gear types for the *Spiny dogfish fishery* are sink gillnets, otter trawls, bottom longline, and driftnet gear. Sea turtles can be incidentally captured in all gear sectors of this fishery. The most recent reinitiation of this consultation was completed in October 2010, and concluded that continued authorization of this fishery may adversely affect, but is not likely to jeopardize, the continued existence of right, humpback, fin, and sei whales or loggerhead, leatherback, Kemp's ridley, and green sea turtles. The ITS exempts the take of 2 loggerhead turtles (1 in trawls; 1 in gillnets), 4 leatherbacks, 4 Kemp's ridley and 5 green sea turtles annually. No incidental take of right, humpback, fin, or sei whales was exempted because the incidental take of ESA-listed whales has not been authorized under section 101(a)(5) of the MMPA.

The *American lobster trap fishery* has been identified as a source of gear causing serious injuries and mortality of endangered whales and leatherback sea turtles. American lobster occur within U.S. waters from Maine to Virginia. They are most abundant from Maine to New Jersey with abundance declining from north to south (ASMFC 1997). An Interstate Fishery Management Plan (ISFMP) developed through the ASMFC provides management measures for the fishery that are implemented by the states. NMFS has issued regulations for the Federal waters portion of the fishery based on recommendations from the ASMFC. Of the seven lobster management areas (LMAs), only LMA 3 occurs entirely within Federal waters. The action area for this consultation overlaps with a portion of LMA 2. LMAs 1, 2, 4, 5, and the Outer Cape include both state and Federal waters (NMFS 1999; 2002b). Therefore, management of the Federal waters portion of LMAs 1, 2, 4, 5, and the Outer Cape must be consistent with management in the state waters portion of those areas to meet the objectives of the Lobster ISFMP. Management measures include a limited access permit system, gear restrictions, and other prohibitions on possession (*e.g.*, of berried or scrubbed lobsters), landing limits for lobsters caught by non-trap gear, a trap tag requirement, and trap limits. These measures include reduction of effort and capping of effort. The commercial lobster fishery is frequently described as an inshore fishery (typically defined as within state waters; 0-3 nautical miles from shore) and an offshore fishery (typically defined as nearshore Federal waters and the deepwater offshore fishery) (NMFS 1999).

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

The most recent reinitiation of the lobster fishery consultation was completed in October 2010, and concluded that continued authorization of this fishery may adversely affect, but is not likely to jeopardize, the continued existence of right, humpback, fin, and sei whales or loggerhead or leatherback sea turtles. The ITS exempts the take of 1 loggerhead turtle and 5 leatherback sea turtles annually. No incidental take of right, humpback, fin, or sei whales was exempted because the incidental take of ESA-listed whales has not been authorized under section 101(a)(5) of the MMPA.

Non-Federally Regulated Actions

Private and Commercial Vessel Operations

Private and commercial vessels, including fishing vessels, operating in the action area of this consultation also have the potential to interact with listed species. 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. The Sea Turtle Stranding and

Salvage Network (STSSN) also reports regular incidents of likely vessel interactions (e.g., propeller-type injuries) with sea turtles. Interactions with these types of vessels and sea turtles could occur in the action area, and it is possible that these collisions would result in mortality. The effects of fishing vessels, recreational vessels, or other types of commercial vessels on listed species may involve disturbance or injury/mortality due to collisions or entanglement in anchor lines. It is important to note that minor vessel collisions may not kill an animal directly, but may weaken or otherwise affect it so it is more likely to become vulnerable to effects such as entanglements. Listed species may also be affected by fuel oil spills resulting from vessel accidents. 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 oil spills may result from accidents, although these events would be rare and involve small areas. No direct adverse effects on listed sea turtles resulting from fishing vessel fuel spills have been documented.

In addition to commercial traffic and recreational pursuits, private vessels also participate in high speed marine events. As these events require a Marine Event permit from the US Coast Guard, there is a federal action which may trigger section 7 consultation. While in some areas of the US these events may occur regularly, high speed marine events permitted by the USCG appear to be a relatively infrequent occurrence in the action area. NMFS is only aware of one such event that has occurred in the recent past in the action area (i.e., a high speed boat race sponsored by the Cape Cod Chamber of Commerce and held off Yarmouth, MA in September 2004). Endangered species observers were present on scene and no interactions with listed species were observed during this two day event.

Non-Federally Regulated Fishery Operations

Very little is known about the level of interactions with listed species 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. Nearshore entanglements of turtles have been documented; however, information is not currently available on whether the vessels involved were permitted by the state or by NMFS. 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, 3 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.

Other Potential Sources of Impacts in the Action Area
Sources of human-induced mortality, injury, and/or harassment of turtles in the action area that are reasonably certain to occur in the future include incidental takes in state-regulated fishing activities, vessel collisions, ingestion of plastic debris, and pollution. While the combination of these activities may affect populations of endangered and threatened sea turtles, preventing or slowing a species' recovery, the magnitude of these effects is currently unknown. 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 previous dredging projects, 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.

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

Sources of contamination in the action area include atmospheric loading of pollutants, stormwater runoff from coastal development, groundwater discharges, and industrial development. Chemical contaminants may also have an effect on sea turtle reproduction and survival. While the effects of contaminants on turtles is relatively unclear, pollution may be linked to the fibropapilloma virus that kills many turtles each year (NMFS 1997). If pollution is not the causal agent, it may make sea turtles more susceptible to disease by weakening their immune systems.

Pollution and Water Quality
Human activities in the action area causing pollution are reasonably certain to continue in the future, as are impacts from them on listed species. However, the level of impacts cannot be projected. Little data is available on water quality and pollutant levels in Nantucket Sound (Rivera 2007). Like other coastal waters, water quality in Nantucket Sound is influenced by pollution resulting from atmospheric loading of pollutants, storm water runoff from the coast, groundwater discharges and sewage treatment effluent. Concerns have been recently raised related to the effects of nutrient loading from land-based sources (Rivera 2007) which stimulate plankton blooms and result in eutrophication and lowered dissolved oxygen.

Marine debris (*e.g.*, discarded fishing line or lines from boats) can entangle turtles in the water and drown them. Turtles commonly ingest plastic or mistake debris for food. Chemical contaminants may also have an effect on sea turtle reproduction and survival. Excessive turbidity due to coastal development and/or construction sites could influence sea turtle foraging ability. As mentioned previously, turtles are not very easily affected by changes in water quality or increased suspended sediments, but if these alterations make habitat less suitable for turtles and hinder their capability to forage, eventually they would tend to leave or avoid these less desirable areas (Ruben and Morreale 1999). Noise pollution has been raised, primarily, as a concern for marine mammals but may be a concern for other marine organisms, including sea turtles. As described above, global warming is likely to negatively affect sea turtles – affecting when females lay their eggs, the survival of the eggs, sex ratios of offspring, and the stability of the Gulf Stream. To the extent that air pollution, for example from the combustion of fossil fuels by vessels, contributes to global warming, then it is also expected to negatively affect sea turtles.

NMFS and the US Navy have been working cooperatively to establish a policy for monitoring and managing acoustic impacts from anthropogenic sound sources in the marine environment. Acoustic impacts can include temporary or permanent injury, habitat exclusion, habituation, and disruption of other normal behavior patterns. It is expected that the policy on managing anthropogenic sound in the oceans will provide guidance for programs such as the use of acoustic deterrent devices in reducing marine mammal-fishery interactions and review of federal activities and permits for research involving acoustic activities.

Private and commercial vessels, including fishing vessels, operating in the action area of this consultation also have the potential to interact with sea turtles. The effects of fishing vessels, recreational vessels, or other types of commercial vessels on listed species may involve disturbance or injury/mortality due to collisions or entanglement in anchor lines. It is important to note that minor vessel collisions may not kill an animal directly, but may weaken or otherwise affect it so it is more likely to become vulnerable to effects such as entanglements. Listed species may also be affected by fuel oil spills resulting from vessel accidents. 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 oil spills may result from accidents, although these events would be rare and involve small areas. No direct adverse effects on listed sea turtles resulting from fishing vessel fuel spills have been documented.

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 - frequently referred to in layman's terms as "global warming." 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.

Sea Turtles

The effects of global climate change on sea turtles is typically viewed as being detrimental to the species (NMFS and USFWS 2007a; 2007b; 2007c; 2007d). It is believed that increases in sea level, approximately 4.2 mm per year until 2080, have the potential to remove available nesting beaches, particularly on narrow low lying coastal and inland beaches and on beaches where coastal development has occurred (Church *et al.* 2001; IPCC 2007; Nicholls 1998; Fish *et al.* 2005; Baker *et al.* 2006; Jones *et al.* 2007; Mazaris *et al.* 2009). Additionally, global climate change may affect the severity of extreme weather (*e.g.*, hurricanes), with more intense storms expected, which may result in the loss/erosion of or damage to shorelines, and therefore, the loss of potential sea turtle nests and/or nesting sites (Goldenburg *et al.* 2001; Webster *et al.* 2005; IPCC 2007). The cyclical loss of nesting beaches resulting from extreme storm events may then result in a decrease in hatching success and hatchling emergence (Martin 1996; Ross 2005; Pike and Stiner 2007; Prusty *et al.* 2007; Van Houton and Bass 2007). However, there is evidence that, depending on the species, sea turtles species with lower nest site fidelity (*i.e.*, leatherbacks) would be less vulnerable to storm related threats than those with a higher site fidelity (*i.e.*, loggerheads). In fact, it has been reported that sea turtles in Guiana are able to maintain successful nesting despite the fact that between nesting years some beaches they once nested on have disappeared, suggesting that sea turtle species may be able to behavioral adapt to such changes (Pike and Stiner 2007; Witt *et al.* 2008; Plaziat and Augustinius 2004; Girondot and Fretey 1996; Rivalan *et al.* 2005; Kelle *et al.* 2007).

Changes in water temperature are also expected as a result of global climate change. Changes in water temperature are expected affect water circulation patterns perhaps even to the extent that the Gulf Stream is disrupted, which would have profound effects on every aspect of sea turtle life history from hatching success, oceanic migrations at all life stages, foraging, and nesting. (Gagosian 2003; NMFS and USFWS 2007a; 2007b; 2007c; 2007d; Rahmstorf 1997, 1999; Stocker and Schmittner 1997). Thermocline circulation patterns are expected to change in intensity and direction with changes in temperature and freshwater input at the poles (Rahmstorf 1997; Stocker and Schmittner 1997), which will potentially affect not only hatchlings, which rely on passive transport in surface currents for migration and dispersal but also pelagic adults (*i.e.*, leatherbacks) and juveniles, which depend on current patterns and major frontal zones in obtaining suitable prey, such as jellyfish (Hamann *et al*. 2007; Hawkes *et al.* 2009).

Changes in water temperature may also affect prey availability for species of sea turtles. Herbivorous species, such as the green sea turtle, depend primarily on seagrasses as their forage base. Seagrasses could ultimately be negatively affected by increased temperatures, salinities, and acidification of coastal waters (Short and Neckles 1999; Bjork 2008), as well as increased runoff due the expected increase in extreme storm events as a result of global climate change. These alterations of the marine environment due to global climate change could ultimately affect the distribution, physiology, and growth rates of seagrasses, potentially eliminating them from particular areas. However, the magnitude of these effects on seagrass beds, and therefore green sea turtles, are difficult to predict, although some populations of green sea turtles appear to specialize in the consumption of algae (Bjorndal 1997) and mangroves (Limpus and Limpus 2000) and as such, green sea turtles may be able to adapt their foraging behavior to the changing availability of seagrasses in the future. Omnivorous species, such as Kemp's ridley and loggerhead sea turtles, may face changes to benthic communities as a result of changes to water temperature; however, these species are probably less likely to suffer shortages of prey than species with more specific diets (*i.e.*, green sea turtles) (Hawkes *et al*. 2009).

Several studies have also investigated the effects of changes in sea surface temperature and air temperatures on turtle reproductive behavior. For loggerhead sea turtles, warmer sea surface temperatures in the spring have been correlated to an earlier onset of nesting (Weishampel *et al.*

2004; Hawkes *et al*. 2007), shorter internesting intervals (Hays *et al*. 2002), and a decrease in the length of the nesting season (Pike *et al*. 2006). Green sea turtles also exhibited shorter internesting intervals in response to warming water temperatures (Hays *et al*. 2002).

Air temperatures also play a role in sea turtle reproduction. In marine turtles, sex is determined by temperature in the middle third of incubation with female offspring produced at higher temperatures and males at lower temperatures within a thermal tolerance range of 25-35° C (Ackerman 1997). Based on modeling done of loggerhead sea turtles, a 2° C increase in air temperature is expected to result in a sex ratio of over 80% female offspring for loggerhead nesting beaches in the vicinity of Southport, NC. Farther to the south at Cape Canaveral, Florida, a 2°C increase in air temperature would likely result in production of 100% females while a 3°C increase in air temperature would likely exceed the thermal threshold of turtle clutches (*i.e*., greater than 35° C) resulting in death (Hawkes *et al*. 2007). Glen *et al*. (2003) also reported that, for green sea turtles, incubation temperatures also appeared to affect hatchling size with smaller turtles produced at higher incubation temperatures; however, it is unknown whether this effect is species specific and what impact it has on the survival of the offspring. Thus changes in air temperature as a result of global climate change may alter sex ratios and may reduce hatchling production in the most southern nesting areas of the U.S. (Hawkes *et al*. 2007; Hamann *et al.* 2007). Given that the south Florida nesting group is the largest loggerhead nesting group in the Atlantic (in terms of nests laid), a decline in the success of nesting as a result of global climate change could have profound effects on the abundance and distribution of the loggerhead species in the Atlantic, including the action area; however; variation of sex ratios to incubation temperature between individuals and populations is not fully understood and as such, it is unclear whether sea turtles will (or can) adapt behaviorally to alter incubation conditions to counter potential feminization or death of clutches associated with water temperatures (*e.g*., choosing nest sites that are located in cooler areas, such as shaded areas of vegetation or higher latitudes; nesting earlier or later during cooler periods of the year) (Hawkes *et al*. 2009).

Ocean acidification related to global warming would also reasonably be expected to negatively affect sea turtles. The term "ocean acidification" describes the process of ocean water becoming corrosive as a result of carbon dioxide (CO_2) being absorbed from the atmosphere. The absorption of atmospheric CO_2 into the ocean lowers the pH of the waters. Evidence of corrosive water caused by the ocean's absorption of CO_2 was found less than 20 miles off the West coast of North America during a field study from Canada to Mexico in the summer of 2007 (Feely *et al.* 2008). This was the first time "acidified" ocean water was found on the continental shelf of western North America. While the ocean's absorption of CO_2 provides a great service to humans by significantly reducing the amount of greenhouse gases in the atmosphere and decreasing the effects of global warming, the resulting change in ocean chemistry could adversely affect marine life, particularly organisms with calcium carbonate shells such as corals, mussels, mollusks, and small creatures in the early stages of the food chain (*e.g.*, plankton). A number of these organisms serve as important prey items for sea turtles.

Although potential effects of climate change on sea turtle species are currently being addressed, fully understanding the effects of climate change on listed species of sea turtles will require development of conceptual and predictive models of the effects of climate change on sea turtles, which to date are still being developed and will depend greatly on the continued acquisition and maintenance of long-term data sets on sea turtle life history and responses to environmental changes. Until such time, the type and extent of effects to sea turtles as a result of global climate change are will continue to be speculative and as such, the effects of these changes on sea turtles cannot, for the most part, be accurately predicted at this time.

Marine Mammals

Marine mammals are also expected to be affected by global climate change. 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 the potential decline of forage.

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 affect 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). The indirect effects to marine mammals, that may be associated with sea level rise, is 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 CO2 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 a reduction in 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. 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). Similarly to sea turtles, 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. However, fully understanding the effects of climate change on listed species of marine mammals will require development of conceptual and predictive models of the effects of climate change on marine mammals, which to date are still being developed and will depend greatly on the continued aquistion and maintenance of long-term data sets on marine mammal life history and responses to environmental changes. Until such time, the type and extent of effects to marine mammals as a result of global climate change are will continue to be speculative and as such, the effects of these changes on marine mammals cannot, for the most part, be accurately predicted at this time.

Conservation and Recovery Actions Reducing Threats to Listed Species

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

Reducing threats of vessel collision on listed whales

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

Northeast Implementation Team (NEIT)

The Northeast Large Whale Recovery Plan Implementation Team (NEIT) was founded in 1994 to help implement the right and humpback whale recovery plans developed under the ESA. The

NEIT provided advice and expertise on the issues affecting right and humpback whale recovery, and was comprised of representatives from federal and state regulatory agencies and private organizations, and was advised by a panel of scientists with expertise in right and humpback whale biology. The Ship Strike Committee (SSC) was one of the most active committees of the NEIT, and NMFS came to recognize that vessel collisions with right whales was the recovery issue needing the most attention. As such, the NEIT was restructured in May 2004 to focus exclusively on right whale ship strike reduction research and issues and providing support to the NMFS Right Whale Ship Strike Working Group.

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

Regulatory Actions to Reduce Vessel Strikes

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

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

A key component of NOAA's right whale ship strike reduction strategy is the proposed implementation of speed restrictions for vessels transiting the US Atlantic in areas and seasons where right whales predictably occur in high concentrations. The NEIT-funded "Recommended Measures to Reduce Ship Strikes of North Atlantic Right Whales" found that seasonal speed and routing measures could be an effective means of reducing the risk of ship strike along the US east coast. Based on these recommendations, NMFS published an Advance Notice of Proposed Rulemaking (ANPR) in June 2004 (69 FR 30857), and subsequently published a proposed rule on June 26, 2006 (71 FR 36299). NMFS published a final rule on October 6, 2008. The final rule implements a speed restriction of 10 knots in areas and at times when right whales are present.

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

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

Right Whale Sighting Advisory System

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

Education and Outreach Activities

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

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

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

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

Reducing the Threat of Entanglement on Whales

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

Regulatory Measures to Reduce the Threat of Entanglement on Whales

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

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

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

Large Whale Disentanglement Network
In recent years, NMFS has greatly increased funding for the Whale Disentanglement Network, purchasing equipment caches to be located at strategic spots along the Atlantic coastline, supporting training for fishers and biologists, purchasing telemetry equipment, etc. This has resulted in an expanded capacity for disentanglement along the Atlantic seaboard including offshore areas. The Center for Coastal Studies (CCS), under NMFS authorization, has responded to numerous calls since 1984 to disentangle whales entrapped in gear, and has developed considerable expertise in whale disentanglement. NMFS has supported this effort financially since 1995. Memorandum of Understandings developed with the USCG ensure their participation and assistance in the disentanglement effort. Hundreds of Coast Guard and Marine Patrol workers have received training to assist in disentanglements. As a result of the success of the disentanglement network, NMFS believes that many whales that may otherwise have succumbed to complications from entangling gear have been freed and survived the ordeal. Humpback and right whales are two species that commonly become entangled due to fishing gear. Over the past five years the disentanglement network has been involved in many successes and has assisted many whales shed gear or freed them by disentangling gear from 35 humpback and 11 right whales (CCS web site).

Sighting Advisory System
Although the Sighting Advisory System (SAS) was developed primarily as a method of locating right whales and alerting mariners to right whale sighting locations in a real time manner, the SAS also addresses entanglement threats. Fishermen can obtain SAS sighting reports and make necessary adjustments in operations to decrease the potential for interactions with right whales. Some of these sighting efforts have resulted in successful disentanglement of right whales.

Education and Outreach
Education and outreach activities are considered one of the primary tools to reduce the threats to all protected species from human activities, including fishing activities. Outreach efforts for fishermen under the ALWTRP are fostering a more cooperative relationship between all parties

interested in the conservation of threatened and endangered species. NMFS has also been active in public outreach to educate fishermen regarding sea turtle handling and resuscitation techniques. NMFS has conducted workshops with longline fishermen to discuss bycatch issues including protected species, and to educate them regarding handling and release guidelines. NMFS intends to continue these outreach efforts in an attempt to increase the survival of protected species through education on proper release techniques.

Reducing Threats to ESA-listed Sea Turtles
NMFS has implemented multiple measures to reduce the capture and mortality of sea turtles in fishing gear, and other measures to contribute to the recovery of these species. While some of these actions occur outside of the action area for this consultation, the measures affect sea turtles that do occur within the action area.

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

Sea Turtle Entanglements and Rehabilitation
A final rule (70 FR 42508) published on July 25, 2005, allows any agent or employee of NMFS, the USFWS, the U.S. Coast Guard, or any other Federal land or water management agency, or any agent or employee of a state agency responsible for fish and wildlife, when acting in the course of his or her official duties, to take endangered sea turtles encountered in the marine environment if such taking is necessary to aid a sick, injured, or entangled endangered sea turtle, or dispose of a dead endangered sea turtle, or salvage a dead endangered sea turtle that may be useful for scientific or educational purposes. NMFS already affords the same protection to sea turtles listed as threatened under the ESA (50 CFR 223.206(b)).

Education and Outreach Activities
Education and outreach activities do not directly reduce the threats to ESA-listed sea turtles. However, education and outreach are a means of better informing the public of steps that can be taken to reduce impacts to sea turtles (*i.e.*, reducing light pollution in the vicinity of nesting beaches) and increasing communication between affected user groups (*e.g.*, the fishing community). For the HMS fishery, NMFS has been active in public outreach to educate fishermen regarding sea turtle handling and resuscitation techniques. For example, NMFS has conducted workshops with longline fishermen to discuss bycatch issues including protected species, and to educate them regarding handling and release guidelines. NMFS intends to continue these outreach efforts in an attempt to increase the survival of protected species through education on proper release techniques.

Sea Turtle Stranding and Salvage Network (STSSN)
As is the case with education and outreach, the STSSN does not directly reduce the threats to

sea turtles. However, the extensive network of STSSN participants along the Atlantic and Gulf of Mexico coasts not only collects data on dead sea turtles, but also rescues and rehabilitates live stranded turtles. Data collected by the STSSN are used to monitor stranding levels and identify areas where unusual or elevated mortality is occurring. These data are also used to monitor incidence of disease, study toxicology and contaminants, and conduct genetic studies to determine population structure. All of the states that participate in the STSSN tag live turtles when encountered (either via the stranding network through incidental takes or in-water studies). Tagging studies help provide an understanding of sea turtle movements, longevity, and reproductive patterns, all of which contribute to our ability to reach recovery goals for the species.

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

Cumulative Effects
Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this Opinion. 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, injury, and/or harassment of cetaceans and sea turtles in the action area that are reasonably certain to occur in the future include incidental takes in state-regulated fishing activities, vessel collisions, ingestion of plastic debris, pollution, global climate change, coastal development, and catastrophic events. While the combination of these activities may affect populations of ESA-listed cetaceans and sea turtles, preventing or slowing a species' recovery, the magnitude of these effects is currently unknown.

State Water Fisheries - Fishing activities are considered one of the most significant causes of death and serious injury for sea turtles. A 1990 National Research Council report estimated that 550 to 5,500 sea turtles (juvenile and adult loggerheads and Kemp's ridleys) die each year from all other fishing activities besides shrimp fishing. Fishing gear in state waters, including bottom trawls, gillnets, trap/pot gear, and pound nets, take sea turtles each year. NMFS is working with state agencies to address the take of sea turtles in state-water fisheries within the action area of this consultation where information exists to show that these fisheries take sea turtles. Action has been taken by some states to reduce or remove the likelihood of sea turtle takes in one or more gear types. However, given that state managed commercial and recreational fisheries along the Atlantic coast are reasonably certain to occur within the action area in the foreseeable future, additional takes of sea turtles in these fisheries are anticipated. There is insufficient information by which to quantify the number of sea turtle takes presently occurring as a result of state water fisheries as well as the number of sea turtles injured or killed as a result of such takes. While actions have been taken to reduce sea turtle takes in some state water fisheries, the overall effect of these actions on reducing the take of sea turtles in state water fisheries is unknown, and the future effects of state water fisheries on sea turtles cannot be quantified.

Right and humpback whale entanglements in gear set for state fisheries are also known to have occurred. As described above, recent entanglements include entanglements in gear set for the state lobster pot/trap fishery, and entanglement in croaker sink gillnet gear (Waring *et al.* 2007; Glass *et al.* 2008). Actions have been taken to reduce the risk of entanglement to large whales, although more information is needed on the effectiveness of these actions. State water fisheries continue to pose a risk of entanglement to large whales to a level that cannot be quantified.

Vessel Interactions – NMFS' STSSN data indicate that vessel interactions are responsible for a large number of sea turtles strandings within the action area each year. Such collisions are reasonably certain to continue into the future. Collisions with boats can stun or easily kill sea turtles, and many stranded turtles have obvious propeller or collision marks (Dwyer *et al.* 2003). However, it is not always clear whether the collision occurred pre- or post-mortem. NMFS believes that sea turtles takes by vessel interactions will continue in the future. An estimate of the number of sea turtles that will likely be killed by vessels is not available from data at this time.

Collisions of ESA-listed right, humpback, fin and sei whales with large vessels are known to occur, and are a source of serious injury and mortality for these species. As described above, NMFS has implemented a ship strike reduction program to reduce the number of right whale strikes by large vessels causing serious injuries and death. The program consists of both regulatory and non-regulatory components, such as requiring vessels to reduce speed in certain areas at certain times when right whales are likely to be present. The program is not specific to areas or times when other species of large whales are likely to be present in the vicinity of large ports of shipping lanes. The program does not require reduced speeds in all areas where right whales may occur. Although these measures are designed to reduce take of ESA-listed whales as a result of vessel interaction, the risk of takes has not been fully removed since interactions may still occur at times when large whales and vessels occupy the same areas.

Pollution and Contaminants – Human activities in the action area causing pollution are reasonably certain to continue in the future, as are impacts from them on cetaceans and sea turtles. However, the level of impacts cannot be projected. Marine debris (*e.g.*, discarded fishing line or lines from boats) can entangle turtles in the water and drown them. Turtles commonly ingest plastic or mistake debris for food. Chemical contaminants may also have an effect on sea turtle reproduction and survival. Excessive turbidity due to coastal development and/or construction sites could influence sea turtle foraging ability. As mentioned previously, turtles are not very easily affected by changes in water quality or increased suspended sediments, but if these alterations make habitat less suitable for turtles and hinder their capability to forage, eventually they would tend to leave or avoid these areas (Ruben and Morreale 1999).

Contaminant studies have confirmed that right whales are exposed to and accumulate contaminants. 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 for their effects on right whales (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). The 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 have discovered that right whales are being exposed to measurable quantities of paralytic shellfish poisoning (PSP) toxins and domoic acid via trophic transfer through the copepods upon which they feed (Durbin *et al.* 2002; Rolland *et al.* 2007; Leandro *et al.* 2009). Other large whales are likely similarly affected. Between November 1987 and January 1988, at least 14 humpback whales died after consuming Atlantic mackerel containing a dinoflagellate saxitoxin (Geraci *et al.* 1989; Waring *et al.* 2009). In July 2003, dead humpback whales tested positive for low levels of domoic acid (Waring *et al.* 2009). However, the cause of death could not be confirmed to be due to domoic acid poisoning (Waring *et al.* 2009).

Noise pollution has been raised primarily as a concern for marine mammals but may be a concern for other marine organisms, including sea turtles. The potential effects of noise pollution, on marine mammals and sea turtles, range from minor behavioral disturbance to injury and death. The noise level in the ocean is thought to be increasing at a substantial rate due to increases in shipping and other activities, including seismic exploration, offshore drilling and sonar used by military and research vessels (NMFS 2007b). Because under some conditions low frequency sound travels very well through water, few oceans are free of the threat of human noise. While there is no hard evidence of a whale population being adversely impacted by noise, scientists think it is possible that masking, the covering up of one sound by another, could interfere with marine mammals ability to feed and to communicate for mating (NMFS 2007b). Masking is a major concern about shipping, but only a few species of marine mammals have been observed to demonstrate behavioral changes to low level sounds. Concerns about noise in the action area of this consultation include increasing noise due to increasing commercial shipping and recreational vessels.

Global climate change is likely to negatively affect sea turtles and large whales. 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 effects on ESA-listed species are unknown at this time. There are multiple hypothesized affects to sea turtles and cetaceans including changing the range and distribution of ESA-listed species as well as their prey distribution and/or abundance due to water temperature changes. Ocean acidification may also negatively affect marine life particularly organisms with calcium carbonate shells which serve as important prey items for many species. Global climate change may also affect reproductive behavior in sea turtles including earlier onset of nesting, shorter internesting intervals, and a decrease in the length of nesting season. Additionally, air temperature may affect the sex ratio of sea turtle offspring. Water temperature is a main factor affecting the distribution of cetaceans, and with global climate change the range of cetaceans may be altered. Ocean acidification may have an adverse impact on the prey for baleen whales which may result in serious consequences for the marine food web. A decline in reproductive fitness as a result of global climate change could have profound effects on the abundance and distribution of sea turtles and cetaceans in the Atlantic.

Coastal development – Along the Mid-Atlantic coastline, beachfront development, lighting, and beach erosion potentially reduce or degrade sea turtle nesting habitats or interfere with hatchlings movement to sea. Nocturnal human activities along nesting beaches may also discourage sea turtles from nesting sites. Coastal counties are presently adopting stringent protective measures to protect hatchling sea turtles from the disorienting effects of beach lighting. Some of these measures were drafted in response to lawsuits brought against the counties by concerned citizens who charged the counties with failing to uphold the ESA by allowing unregulated beach lighting that results in takes of hatchlings.

Catastrophic events- An increase in commercial vessel traffic/shipping increases the potential for oil/chemical spills. The pathological effects of oil spills have been documented in laboratory studies of marine mammals and sea turtles (Vargo *et al.* 1986). There have been a number of documented oil spills in the northeastern U.S.

Summary and synthesis of the Status of Species, Environmental Baseline, and Cumulative Effects sections

The *Status of the Species*, *Environmental Baseline*, and *Cumulative Effects* Sections, taken together, establish a "baseline" against which the effects of the proposed action are analyzed to determine whether the action, the construction, operation and decommissioning of the Cape Wind project pursuant to the authorizations of BOEM, ACOE and EPA, is likely to jeopardize the continued existence of the species. To the extent available information allows, this "baseline" (which does not include the future effects of the proposed action) would be compared to the backdrop plus the effects of the proposed action. The difference in the two trajectories would be reviewed to determine whether the proposed action is likely to jeopardize the continued existence of the species. This section synthesizes the *Status of the Species, Environmental Baseline*, and *Cumulative Effects* sections as best as possible given that some information on ESA-listed species is quantified, yet much remains qualitative or unknown.

North Atlantic right whales, humpback whales, fin whales, sei whales, leatherback sea turtles and Kemp's ridley sea turtles are endangered species, meaning that they are in danger of extinction throughout all or a significant portion of their ranges. The loggerhead sea turtle is a threatened species, meaning that it is likely to become an endangered species in the foreseeable future throughout all or a significant portion of its range. Green sea turtles in U.S. waters are listed as threatened except for the Florida breeding population which is listed as endangered.

North Atlantic right whales are listed as "endangered" under the ESA. The International Whaling Commission (IWC) recognizes two right whale populations in the North Atlantic: a western and eastern population (IWC 1986). However, 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 2005a). In the western Atlantic, North Atlantic right whales generally occur from the Southeast U.S. (waters off of Georgia, Florida) to Canada (*e.g.*, Bay of Fundy and Scotian Shelf) (Kenney 2002; Waring *et al.* 2009). Research results suggest the existence of six major habitats or congregation areas for western North Atlantic right whales. Results from telemetry studies and photo-id studies have shown extensive right whale movements: (a) over the continental shelf during the summer foraging period (Mate *et al.*1992; Mate *et al.* 1997; Bowman *et al.* 2003; Baumgartner and Mate 2005), (b) between known calving/nursery areas and foraging areas in the winter (Brown and Marx 2000; Waring *et al.* 2009), and (c) into deep water off of the continental shelf (Mate *et al.* 1997).

As of October 10, 2007, there were minimally 345 right whales alive as calculated from the sightings database indicate a significant increase in the number of catalogued whales (Waring *et al.* 2009). Based on counts of animals alive from the sightings database as of October 10, 2008, for the years 1990-2005, the mean growth rate for the period was 1.8% (Waring *et al.* 2009). However, there was significant variation in the annual growth rate due to apparent losses exceeding gains during 1998-1999 and the number of photo-identified and catalogued female North Atlantic right whales numbers less than 200 whales (Waring *et al.* 2007). The current estimate of breeding females is 97 (Schick *et al.* 2009).

There is general agreement that right whale recovery is negatively affected by anthropogenic mortality. Fifty-four (54) right whale mortalities were reported from Florida to the Canadian Maritimes during the period 1970-2002 (Moore *et al.* 2004). For the more recent period of 2003-2007, 20 right whale mortalities were confirmed, three (3) due to entanglements, nine (9) due to ship strikes (Glass *et al.* 2009). Serious injury was documented for an additional three (3) right whales during that timeframe. These numbers represent the minimum values for human-caused mortality for this period since it is unlikely that all carcasses will be observed (Moore *et al.* 2004, Glass *et al.* 2009). 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). Other negative effects to the species may include changes to the environment as a result of global climate change, contaminants, and loss of genetic diversity.

In light of the above NMFS considers the trend for North Atlantic right whales to be increasing. Although the right whale population is believed to be increasing, caution is exercised in considering the overall effect to the species given the many on-going negative impacts to the species across all areas of its range and to all age classes, and information to support that there are fewer than 200 female right whales total (of all age classes) in the population. New measures recently implemented into the ALWTRP and ship strike reduction program are expected to reduce the risk of anthropogenic serious injury and mortality to right whales. The programs are evolving plans and will continue to undergo changes based on available information to reduce the serious injury and mortality risk to large whales.

Humpback whales are listed as “endangered” under the ESA. Humpback whales range widely across the North Pacific during the summer months (Johnson and Wolman 1984, Perry *et al.*

1999). 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 (Anglis and Outlaw 2007, Carretta *et al.* 2007). 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 obtained for 1991-1993 in a previous study (Calambokidis *et al.* 2008). There are indications that some stocks of North Pacific humpback whales increased in abundance between the 1980's -1990's (Anglis and Outlaw 2007; Carretta *et al.* 2009). The abundance estimate for the northern Indian Ocean population of Humpback whales is 82 (Minton *et al.* 2008). The total abundance estimate for the Southern Hemisphere humpback whale population is 36,600 although it is negatively biased due to no available abundance estimates for two stocks. Although they were given protection by the IWC in 1963, Soviet whaling data made available in the 1990's revealed that southern hemisphere humpbacks continued to be hunted through 1980 (Zemsky *et al.* 1995, IWC 1995, Perry *et al.* 1999).

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 but less precise estimate of 10,400 whales (95% CI = 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). 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). The best, recent estimate for the Gulf of Maine stock is 847 whales, derived from the 2006 aerial survey (Waring *et al.* 2009). Population modeling estimates the growth rate of the Gulf of Maine stock to be at 6.5% (Barlow and Clapham 1997). Current productivity rates for the North Atlantic population overall are unknown, although Stevick *et al.* (2003) calculated an average population growth rate of 3.1% for the period 1979-1993 (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. There were 76 confirmed entanglement events and 11 confirmed ship strike events for humpback whales in the Atlantic between 2003-2007, resulting in a total of 12 confirmed mortalities and 10 serious injury determinations (Glass *et al.* 2009). These numbers are expected to be a minimum account of what actually occurred given the range and distribution of humpbacks in the Atlantic. In addition to their potential for being negatively affected by other human related effects such as global climate change and contaminants, humpbacks may be susceptible to consumption of lethal levels of toxic dinoflagellates that can become concentrated in humpback prey such as mackerel. In addition, humpback prey in the Atlantic includes fish species targeted in commercial fishing operations (*i.e.*, herring and mackerel). There is no evidence that current levels of fishing for these species has an effect on humpback survival. However, 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.* 2003, Waring *et al.*

2009).

Fin whales are listed as "endangered" under the ESA. NMFS recognizes three fin whale stocks in the Pacific for the purposes of managing this species under the MMPA. These are: Alaska (Northeast Pacific), Hawaii, and California/Washington/Oregon (Angliss *et al.* 2001). Reliable estimates of current abundance for the entire Northeast Pacific fin whale stock are not available (Angliss *et al.* 2001). Stock structure for fin whales in the southern hemisphere is unknown. Prior to commercial exploitation, the abundance of southern hemisphere fin whales is estimated to have been at 400,000 (IWC 1979, Perry *et al.* 1999). There are no current estimates of abundance for southern hemisphere fin whales.

NMFS recognizes fin whales off the eastern United States, Nova Scotia and the southeastern coast of Newfoundland as a single stock in the Atlantic for the purposes of managing this species under the MMPA (Waring *et al.* 2009). 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 United States continental shelf waters. Previous abundance estimates of fin whales in the western North Atlantic were 2,200 (Palka 1995), 2,814 (Palka 2000), 2,933 (Palka 2006), and 1,925 (Palka 2006) in 1995, 1999, 2002, and 2004 respectively. The 2009 Stock Assessment Report (SAR) gives a best estimate of abundance for the western North Atlantic stock of fin whales as 2,269 (C.V. = 0.37), derived from an aerial survey in 2006 (Waring *et al.* 2009). This estimate is 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). There are insufficient data to determine population trends for this species. Current and maximum net productivity rates are unknown for this stock (Waring *et al.* 2009).

Like right whales and humpback whales, anthropogenic mortality and injury of fin whales include entanglement in commercial fishing gear and ship strikes. From 1999-2003, fin whales had a low proportion of entanglements; of 40 reported events[5], only seven (7) were of entanglements (all confirmed), two (2) of which were fatal (Cole *et al.* 2005). Ten (10) ship strikes were reported, five (5) of which were confirmed and proved fatal. Of 61 fin whale events recorded between 2003 and 2007, eight (8) mortalities were associated with vessel interactions, and three (3) mortalities were attributed to entanglements (Glass *et al.* 2009). In addition to their potential for being negatively affected by other human related effects, commercial whaling, global climate change and contaminants may also adversely affect fin whales.

Loggerhead sea turtles are listed as "threatened" under the ESA. Loggerhead nesting occurs on beaches of the Pacific, Indian, and Atlantic Oceans, and the Mediterranean Sea. Genetic analyses of maternally inherited mitochondrial DNA demonstrate the existence of separate, genetically distinct nesting groups between as well as within the ocean basins (TEWG 2000; Bowen and Karl 2007). The BRT has recently identified the following nine loggerhead DPSs

5 A large whale event includes entanglements, ship strikes, and mortalities.

distributed globally: (1) North Pacific Ocean, (2) South Pacific Ocean, (3) North Indian Ocean, (4) Southeast Indo-Pacific Ocean, (5) Southwest Indian Ocean, (6) Northwest Atlantic Ocean, (7) Northeast Atlantic Ocean, (8) Mediterranean Sea, and (9) South Atlantic Ocean. It should be noted, however, that DPSs can only be designated for regulatory uses through the formal ESA listing process.

It takes decades for loggerhead sea turtles to reach maturity. Once they have reached maturity, females typically lay multiple clutches of eggs within a season, but do not typically lay eggs every season (NMFS and USFWS 2008). There are many natural and anthropogenic factors affecting the survival of loggerheads prior to their reaching maturity as well as for those adults who have reached maturity. As described in sections 3.1 and 4.0, negative impacts causing death of various age classes occur both on land and in the water. In addition, given the distances traveled by loggerheads in the course of their development, actions to address the negative impacts require the work of multiple countries at both the national and international level (NMFS and USFWS 2007a). Many actions have been taken to address known negative impacts to loggerhead sea turtles. However, many remain unaddressed, have not been sufficiently addressed, or have been addressed in some manner but whose success cannot be quantified.

Sea turtle nesting data, in terms of the number of nests laid each year, is collected for loggerhead sea turtles for at least some nesting beaches within each of the ocean basins and the Mediterranean Sea. From this, the number of reproductively mature females utilizing those nesting beaches can be estimated based on the presumed remigration interval and the average number of nests laid by a female loggerhead sea turtle per season. These estimates provide a minimum count of the number of loggerhead sea turtles in any particular nesting group. The estimates do not account for adult females who nest on beaches with no or little survey coverage, and do not account for adult males or juveniles of either sex. The proportion of adult males to females from each nesting group, and the age structure of each loggerhead nesting group is currently unknown. For these reasons, there is a large uncertainty associated with using nest counts to estimate the total population size of a nesting group or trends in the number of nests laid as an indicator of the population (Meylan 1982; Ross 1996; Zurita *et al.* 2003; Hawkes *et al.* 2005; letter to J. Lecky, NMFS Office of Protected Resources, from N. Thompson, NMFS Northeast Fisheries Science Center, December 4, 2007; TEWG 2009).

Nevertheless, nest count data are a valuable source of information for each loggerhead nesting group and for loggerheads as a species since the number of nests laid reflects the reproductive output of the nesting group each year, and also provides insight on the contribution of each nesting group to the species. Based on a comparison of the available nesting data, the world's largest known loggerhead nesting group (in terms of estimated number of nesting females) occurs in Oman in the northern Indian Ocean, where an estimated 20,000-40,000 females nest each year (Baldwin *et al.* 2003). The world's second largest known loggerhead nesting group, the PFRU, occurs along the Southeast coast of the U.S. from the Florida/Georgia border through Pinellas County on Florida's West coast, where approximately 15,735 females nest per year (based on a mean of 64,513 nests laid per year from 1989-2007; NMFS and USFWS 2008). The world's third largest loggerhead nesting group also occurs in the U.S., from the Florida/Georgia border through southern Virginia. However, the approximate number of females nesting annually is 1,272 (based on a mean number of 5,215 nests laid per year from 1989-2008; NMFS and USFWS 2008), which is less than 1/10th the size of the PFRU. Thus, while loggerhead nesting occurs at multiple sites within multiple ocean basins and the Mediterranean Sea, the extent of nesting is disproportionate amongst the various sites and only two geographic areas, Oman and South Florida, account for the majority of nesting for the species worldwide.

Declines in loggerhead nesting have been noted at nesting beaches throughout the range of the species. The 2008 revised recovery plan by NMFS and FWS identified five unique recovery units of loggerheads in the Northwest Atlantic. Based on the most recent information, a decline in annual nest counts has been measured or suggested for three of the five recovery units. These include nesting for the PFRU – the second largest loggerhead nesting group in the world and the largest of all of the loggerhead nesting groups in the Atlantic (Meylan *et al.* 2006; NMFS and USFWS 2008). The final revised plan reviews and discusses the species' ecology, population status and trends, and identifies the many threats to loggerhead sea turtles in the Northwest Atlantic Ocean. It lays out a recovery strategy to address the threats, based on the best available science, and includes recovery goals and criteria. In addition, the plan identifies substantive actions needed to address the threats to the species and achieve recovery. In 2009, TEWG indicated that it could not determine whether or not the decreasing annual numbers of nest amount the Northwest Atlantic loggerhead subpopulations were due to stochastic processes resulting in few nests, a decreasing average reproductive output of adult females, decreasing number of adult females, or a combination of these factors. TEWG noted there were likely several factors contributing to the decline. These factors include incidental capture (in fisheries, power plant intakes, and dredging operations), lower adult female survival rates, increases in the proportion of first-time nesters, continued directed harvest, and increases in mortality due to disease. The current levels of hatchling output will no doubt result in depressed recruitment to subsequent life stages over the coming decades (TEWG 2009).

Although there is an increasing trend at some nesting beaches (Southwest Indian Ocean and South Atlantic Ocean), available information about anthropogenic threats to juveniles and adults in neritic and oceanic environments indicate possible unsustainable additional mortalities. NMFS recognizes that the available nest count data only provides information on the number of females currently nesting, and is not necessarily a reflection of the number of mature females available to nest or the number of immature females that will reach maturity and nest in the future. Also, the trend in the number of nests laid is not a reflection of the overall trend in any nesting group given that the proportion of adult males to females, and the age structure of each loggerhead nesting group is currently unknown. According to the threat matrix analysis in the BRT report, the potential for future decline is greatest for the North Indian Ocean, Northwest Atlantic Ocean, Northeast Atlantic Ocean, Mediterranean Sea, and South Atlantic Ocean DPSs (Conant *et al.* 2009).

Leatherback sea turtles are listed as "endangered" under the ESA. Leatherbacks are widely distributed throughout the oceans of the world, and are found in waters of the Atlantic, Pacific, and Indian Oceans, the Caribbean Sea, Mediterranean Sea, and the Gulf of Mexico (Ernst and Barbour 1972). Leatherback nesting occurs on beaches of the Atlantic, Pacific, and Indian Oceans as well as in the Caribbean (NMFS and USFWS 2007b).

Like loggerheads, sexually mature female leatherbacks typically nest in non-successive years and lay multiple clutches in each of the years that nesting occurs. Leatherbacks face a multitude of threats that can cause death prior to and after reaching maturity. Some activities resulting in leatherback mortality have been addressed. However, many others remain to be addressed. Given their range and distribution, international efforts are needed to address all known threats to leatherback sea turtle survival (NMFS and USFWS 2007b).

There are some population estimates for leatherback sea turtles although there appears to be considerable uncertainty in the numbers. In 1980, the global population of adult leatherback females was estimated to be approximately 115,000 (Pritchard 1982). By 1995, this global population of adult females was estimated to be 34,500 (Spotila *et al.* 1996). However, the most recent population size estimate for the North Atlantic alone is 34,000-94,000 adult leatherbacks (TEWG 2007; NMFS and USFWS 2007b).

Leatherback nesting in the eastern Atlantic (*i.e.,* off Africa) and in the Caribbean appears to be stable, but there is conflicting information for some sites and it is certain that some nesting groups (*e.g.*, St. John and St. Thomas, U.S. Virgin Islands) have been extirpated (NMFS and USFWS 1995). Data collected for some nesting beaches in the western Atlantic, including leatherback nesting beaches in the U.S., clearly indicate increasing numbers of nests (NMFS SEFSC 2001; NMFS and USFWS 2007b). However, declines in nesting have been noted for beaches in the western Caribbean (NMFS and USFWS 2007b). The largest leatherback rookery in the western Atlantic remains along the northern coast of South America in French Guiana and Suriname. More than half the present world leatherback population is estimated to nest on the beaches in and close to the Marowijne River Estuary in Suriname and French Guiana (Hilterman and Goverse 2004). The long-term trend for the Suriname and French Guiana nesting group seems to show an increase (Hilterman and Goverse 2004). In 2001, the number of nests for Suriname and French Guiana combined was 60,000, one of the highest numbers observed for this region in 35 years (Hilterman and Goverse 2004). Studies by Girondot *et al.* (2007) also suggest that the trend for the Suriname - French Guiana nesting population over the last 36 years is stable or slightly increasing.

Increased nesting by leatherbacks in the Atlantic is not expected to affect leatherback abundance in the Pacific where the abundance of leatherback sea turtles on nesting beaches has declined dramatically over the past 10 to 20 years (NMFS and USFWS 2007b). Although genetic analyses suggest little difference between Atlantic and Pacific leatherbacks (Bowen and Karl 2007), it is generally recognized that there is little to no genetic exchange between these turtles.

In addition, Atlantic and Pacific leatherbacks are impacted by different activities (NMFS and USFWS 1992, 1998a). However, the ESA-listing of leatherbacks as a single species means that the effects of a proposed action must, ultimately, be considered at the species level for section 7 consultations. NMFS recognizes that the nest count data available for leatherbacks in the Atlantic clearly indicates increased nesting at many sites, and that the activities affecting declines in nesting by leatherbacks in the Pacific are not the same as those activities affecting leatherbacks in the Atlantic. However, NMFS also recognizes that the nest count data, including data for leatherbacks in the Atlantic, only provides information on the number of females currently nesting, and is not necessarily a reflection of the number of mature females in the Atlantic that are available to nest or the number of immature females that will reach maturity and nest in the future. Also, the number of nests laid is not a reflection of the overall leatherback population given that the proportion of adult males to females and the age structure of the population(s) are unknown.

Kemp's Ridley sea turtles are listed as a single species classified as "endangered" under the ESA. Kemp's ridleys occur in the Atlantic Ocean and Gulf of Mexico. The only major nesting site for Kemp's ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963; USFWS and NMFS 1992; NMFS and USFWS 2007c). Approximately 60% of its nesting occurs here with a limited amount of scattered nesting to the north and south of the primary nesting beach (NMFS and USFWS 2007c).

Age to maturity for Kemp's ridley sea turtles occurs earlier than for either loggerhead or leatherback sea turtles. However, maturation may still take 10-17 years (NMFS and USFWS 2007c). As is the case with the other sea turtle species, adult female Kemp's ridleys typically lay multiple nests in a nesting season but do not typically nest every nesting season (TEWG 2000; NMFS and USFWS 2007c). Although actions have been taken to protect the nesting beach habitat and to address activities known to negatively impact Kemp's ridley sea turtles, Kemp's ridleys continue to be impacted by anthropogenic activities (see sections 3.1.3 and 4.1).

Nest count data provides the best available information on the number of adult females nesting each year. As is the case with the other sea turtles species discussed above, nest count data must be interpreted with caution given that these estimates provide a minimum count of the number of nesting Kemp's ridley sea turtles. In addition, the estimates do not account for adult males or juveniles of either sex. Without information on the proportion of adult males to females, and the age structure of the Kemp's ridley population, nest counts cannot be used to estimate the total population size (Meylan 1982; Ross 1996; Zurita *et al.* 2003; Hawkes *et al.* 2005; letter to J. Lecky, NMFS Office of Protected Resources, from N. Thompson, NMFS Northeast Fisheries Science Center, December 4, 2007). Nevertheless, the nesting data does provide valuable information on the extent of Kemp's ridley nesting and the trend in the number of nests laid. Estimates of the adult female nesting population reached a low of approximately 250-300 in 1985 (USFWS and NMFS 1992; TEWG 2000). From 1985 to 1999, the number of nests observed at Rancho Nuevo and nearby beaches increased at a mean rate of 11.3% per year (TEWG 2000). Current estimates suggest an adult female population of 7,000-8,000 Kemp's ridleys (NMFS and USFWS 2007c).

The most recent review of the Kemp's ridley as a species suggests that it is in the early stages of recovery (NMFS and USFWS 2007b). Nest count data indicate increased nesting and increased numbers of nesting females in the population. NMFS also takes into account a number of recent conservation actions including the protection of females, nests, and hatchlings on nesting beaches since the 1960s and the enhancement of survival in marine habitats through the implementation of TEDs in the early 1990s and a decrease in the amount of shrimping off the coast of Tamaulipas and in the Gulf of Mexico in general (NMFS and USFWS 2007b).

Green sea turtles are listed as both threatened and endangered under the ESA. Breeding colony populations in Florida and on the Pacific coast of Mexico are considered endangered while all others are considered threatened. Due to the inability to distinguish between these populations away from the nesting beach, for this Opinion, green sea turtles are considered endangered wherever they occur in U.S. waters. Green sea turtles are distributed circumglobally and can be found in the Pacific, Indian, and Atlantic Oceans as well as the Mediterranean Sea (NMFS and USFWS 1991; Seminoff 2004; NMFS and USFWS 2007d).

Green sea turtles appear to have the latest age to maturity of all of the sea turtles with age at maturity occurring after 2-5 decades (NMFS and USFWS 2007d). As is the case with all of the other sea turtle species mentioned here, mature green sea turtles typically nest more than once in a nesting season but do not nest every nesting season. As is also the case with the other sea turtle species, green sea turtles face numerous threats on land and in the water that affect the survival of all age classes.

A review of 32 Index Sites distributed globally revealed a 48% to 67% decline in the number of mature females nesting annually over the last three generations (Seminoff 2004). For example, in the eastern Pacific, the main nesting sites for the green sea turtle are located in Michoacan, Mexico, and in the Galapagos Islands, Ecuador, where the number of nesting females exceeds 1,000 females per year at each site (NMFS and USFWS 2007d). Historically, however, greater than 20,000 females per year are believed to have nested in Michoacan alone (Cliffton *et al.* 1982; NMFS and USFWS 2007d). However, the decline is not consistent across all green sea turtle nesting areas. Increases in the number of nests counted and, presumably, the numbers of mature females laying nests were recorded for several areas (Seminoff 2004; NMFS and USFWS 2007d). Of the 32 index sites reviewed by Seminoff (2004), the trend in nesting was described as: increasing for 10 sites, decreasing for 19 sites, and stable (no change) for 3 sites. Of the 46 green sea turtle nesting sites reviewed for the 5-year status review, the trend in nesting was described as increasing for 12 sites, decreasing for 4 sites, stable for 10 sites, and unknown for 20 sites (NMFS and USFWS 2007d). The greatest abundance of green sea turtle nesting in the western Atlantic occurs on beaches in Tortuguero, Costa Rica (NMFS and USFWS 2007d). Nesting in the area has increased considerably since the 1970s and nest count data from 1999-2003 suggest nesting by 17,402-37,290 females per year (NMFS and USFWS 2007d). One of the largest nesting sites for green sea turtles worldwide is still believed to be on the beaches of Oman in the Indian Ocean (Hirth 1997; Ferreira *et al.* 2003; NMFS and USFWS 2007d). However, nesting data for this area has not been published since the 1980s and updated nest numbers are needed (NMFS and USFWS 2007d).

The results of genetic analyses show that green sea turtles in the Atlantic do not contribute to green sea turtle nesting elsewhere in the species' range (Bowen and Karl 2007). Therefore, increased nesting by green sea turtles in the Atlantic is not expected to affect green sea turtle abundance in other ocean basins in which the species occurs. However, the ESA-listing of green sea turtles as a species across ocean basins means that the effects of a proposed action must, ultimately, be considered at the species level for section 7 consultations. NMFS recognizes that the nest count data available for green sea turtles in the Atlantic clearly indicates increased nesting at many sites. However, NMFS also recognizes that the nest count data, including data for green sea turtles in the Atlantic, only provides information on the number of females currently nesting, and is not necessarily a reflection of the number of mature females available to nest or the number of immature females that will reach maturity and nest in the future. Given the late age to maturity for green sea turtles (20 to 50 years) (Balazs 1982; Frazer and Ehrhart 1985; Seminoff 2004), caution is urged regarding the trend for any of the nesting groups since no area has a dataset spanning a full green sea turtle generation (NMFS and USFWS 2007d).

EFFECTS OF THE ACTION

This section of an 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). Several listed species are likely to be present in the action area at various times of the year and may therefore be exposed to effects of the proposed action.

Summary of Information Related to Sea Turtle Presence in the Action Area

Leatherback sea turtles are the most common species of sea turtles in Massachusetts waters with frequent sightings in the summer and fall as this species pursues its preferred jellyfish prey. While in Massachusetts waters, loggerhead turtles feed on a variety of foods including hermit and spider crabs, whelks, blue mussels, and moon snails. During the summer months, Kemp's ridleys forage on mussels and crabs. The green sea turtle frequents Massachusetts waters with some degree of regularity but is not considered common as there are few records for it north of Cape Cod. The green turtles found in Massachusetts are three- to four -year-old subadults, 24-30 inches long, and weigh about 50lbs. Green turtles are the most herbivorous of all the sea turtles and feed mainly on submerged aquatic vegetation (SAV) including seagrasses and macroalgae.

One of the main factors influencing sea turtle presence in northern waters is seasonal temperature patterns (Ruben and Morreale 1999). Temperature is correlated with the time of year, with the warmer waters in the late spring, summer, and early fall being the most suitable for cold-blooded sea turtles. Nantucket Sound is not a concentration area for sea turtles but sea turtles are routinely documented in these waters. Observational data suggests that sea turtles are most common in eastern Nantucket Sound where waters are deepest and nearest to the coastal migratory path towards Cape Cod Bay. Sea turtles are most likely to occur in the action area between June and October, although individuals may be present in the early weeks of November as well.

To some extent, water depth also dictates the number of sea turtles occurring in a particular area. Waters in the action area range from approximately 0 to 70 feet deep. Satellite tracking studies of sea turtles in the Northeast found that foraging turtles mainly occurred in areas where the water depth was between approximately 16 and 49 ft (Ruben and Morreale 1999). This depth was interpreted not to be as much an upper physiological depth limit for turtles, as a natural limiting depth where light and food are most suitable for foraging turtles (Morreale and Standora 1990). Sea turtles are capable of dives to substantial depths (300-1000 m; Eckert et al. 1986 in Stabenau et al. 1991), and chelonid turtles have been found to make use of deeper, less productive channels as resting areas that afford protection from predators because of the low energy, deep water conditions. Leatherbacks have been shown to dive to great depths, often spending a considerable amount of time on the bottom (NMFS 1995).

The action area and the depths preferred by sea turtles do overlap and preferred sea turtle forage items occur in the action area (BOEM 2008), suggesting that leatherbacks, loggerheads, Kemp's ridleys and green sea turtles are likely to be foraging while in the action area. Surveys reported in the BA indicate that there are several areas of SAV within the action area, including concentrations of macroalgae and some sea grass beds. Additionally, surveys indicate that there is a diverse and plentiful benthic community in Nantucket Sound. Sponges, bivalves, crabs, and other crustaceans all occur in the action area. Lazell (1980) confirms that arctic jellyfish, one of the preferred prey of leatherback sea turtles, also occur in Nantucket Sound in the summer months. In addition to foraging in the action area, migrating loggerhead, Kemp's ridley, green or leatherback sea turtles may be found swimming through the action area as they complete northward migrations in the spring and southward migrations in the fall. Sea turtles may also transit the action area while moving into or out of nearby foraging areas (i.e., Cape Cod Bay or Stellwagen Bank), or may be resting on or near the bottom.

While there have been no surveys of Nantucket Sound specifically designed to detect sea turtles, there is recent incidental observation data available for leatherback, loggerhead, Kemp's ridley and green sea turtles as well as historic records for each of these species. For example, several entangled leatherback sea turtles located in Nantucket Sound are reported to NMFS each year (NMFS unpublished data). A review of the OBIS SEAMAP database includes sightings data for all four sea turtle species in Nantucket Sound (OBIS SEAMAP online mapper, accessed on September 5, 2008). Satellite tracking data demonstrates the use of Nantucket Sound by Kemp's ridley, loggerhead and green sea turtles (seaturtle.org database, accessed on September 5, 2008). Lazell (1980) examined the data available on sea turtles in Massachusetts and in Nantucket Sound specifically. The paper includes information which confirms the use of Nantucket Sound by loggerheads, leatherbacks, Kemp's ridley and green sea turtles during the summer months.

More recently, Mass Audubon conducted surveys for terns over an approximately four week period in 2002, 2003 and 2004. Both shipboard and aerial surveys were conducted. In their reports, Mass Audubon includes information on sea turtle sightings. As this information was collected in the action area, it represents important information on the presence of sea turtles in this area. In each of the three study years, aerial surveys were conducted along sixteen fixed, parallel transects oriented north to south. The grid encompassed nearly all the waters south of Cape Cod between Martha's Vineyard and the Monomoy Island National Wildlife Refuge in Chatham (see Figure 3 for map of surveyed area and sea turtle sightings). The transects extended south to an east-west line roughly even with Great Point, Nantucket. Individual transects were positioned at 7,500 foot intervals, and the total combined linear length of all 16 transects was 247.4 miles (approximately 398 linear kilometers). The area surveyed was approximately 888 square kilometers. Flights were conducted at an average altitude of 500 feet on days with good atmospheric clarity (visibility >10 miles). Flights lasted approximately 2.5 hours each day. Several boat surveys also occurred but no sea turtle sightings were reported for these surveys.

In 2002, eleven aerial surveys were conducted between August 19 and September 19. Thirty-four sea turtles were observed (22 unidentified species, 1 Kemp's ridley, 6 leatherbacks and 5 loggerheads). In 2003, three aerial surveys occurred (June 3, July 14 and July 30). During these surveys, 28 sea turtles were observed (16 unidentified species, 8 leatherbacks, and 4 loggerheads). In 2004, eleven aerial surveys were conducted between August 7 and September 24. During these surveys, 53 sea turtles were observed (41 leatherbacks and 12 loggerheads). A total of 115 sea turtles were observed over the course of the three year study.

As sea turtles have been documented in the action area, the habitat is consistent with preferred foraging habitat of these species and forage is available, it is reasonable to expect that sea turtles will be present in the action area when project activities are occurring, most likely between June and October, and that sea turtles may be exposed to effects of the project during that time.

Summary of Information related to listed whales in the Action Area
Endangered whales migrate off the coast of Massachusetts area at various times of the year. North Atlantic right, humpback and fin whales have all been sighted in the near shore waters off Massachusetts with sightings most common in the waters of Stellwagen Bank, Cape Cod Bay and Great South Channel. In general, right whales can be anticipated to be in Massachusetts and Rhode Island waters from December through July, humpback whales can be found in Massachusetts and Rhode Island waters year-round, with peaks between May and August, and fin whales may be in Massachusetts and Rhode Island waters year-round, with peaks during the summer months. The section below summarizes the best available information on the use of Nantucket Sound generally and Horseshoe Shoals specifically (i.e., the project footprint) by large whales as well as the use of nearby waters (i.e., Rhode Island Sound, Narragansett Bay, Buzzards Bay) that will be used by project vessels transiting between staging and maintenance sites and the project site.

Large whales along the transit routes
Project vessels will make transits to the project site in Nantucket Sound from Quonset, Rhode Island, Yarmouth, Massachusetts and New Bedford, Massachusetts. Large whales, including humpback, right and fin whales, are known to occur in portions of these waters. Vessels transiting between Quonset and the project site would travel through Rhode Island Sound while maintenance vessels traveling from New Bedford would transit through Buzzards Bay. Crew support vessels traveling from Yarmouth would occur only within Nantucket Sound.

Rhode Island Sound
The best available information indicates that large whales are seasonally present in Rhode Island Sound. Most whales in this area are making northward or southward migratory movements and their occurrence in Rhode Island Sound is transient. Humpback whales have occasionally been

documented in Rhode Island Sound, with most sightings in the spring and fewer sightings in the summer, fall and winter. Most humpback whales in this area are likely to be migratory, with only a transient presence in the area. Fin whales also occur in Rhode Island Sound year round, with the lowest frequency during the winter months. Right whales have been observed in these waters during all seasons of the year, with most sightings in the spring and fall. Feeding by right whales is occasionally observed in the Rhode Island region, but is likely an opportunistic response to relatively rare occurrences of appropriate prey patches. An aggregation of feeding right whales that persisted for about two weeks was seen just east of Block Island in April 1998. As detailed below, a similar, albeit larger, aggregation of right whales was observed in Rhode Island Sound in April 2010.

On April 20, 2010, a crew from the University of Rhode Island's Department of Natural Resources Science doing an aerial survey for seabirds in Rhode Island Sound and Block Island Sound sighted six or seven North Atlantic right whales and one humpback whale during their survey. The sightings information was transmitted to NOAA survey crews working in nearby areas. According to initial reports through NOAA's Sighting Advisory System (SAS), the NOAA survey crew sighted 96 right whales that day in five separate aggregations, three groups in Rhode Island Sound, one group located further offshore over the inner shelf, and one group at the entrance to Vineyard Sound. The largest group was the most offshore sighting, with 40 whales located approximately 12 nautical miles (nmi) south-southwest of Nomans Land, and 17 more whales were recorded about 12 nmi west of Nomans Land. An aggregation of 22 whales was observed about 15 nmi south of Sakonnet Point in eastern Rhode Island. Fifteen whales were seen about 8 nmi south of Brenton Point. A mother-calf pair was sighted about 2 nmi northwest of Gay Head (the western end of Martha's Vineyard) at the entrance to Vineyard Sound. Feeding behavior was observed in all five aggregations. The NOAA team also sighted 8 fin whales, a humpback, a minke, and 10 white-sided dolphins. These aggregations were short lived, with the whales dispersed from the area by the end of April, as evidenced by only one additional sighting report from the area, a single animal identified as a "probable" right whale, reported by the Coast Guard near the south shore of Rhode Island on May 1, 2010.

Buzzards Bay

Records of large whales in Buzzards Bay are limited. However, large whales, including humpback and right whales, have been documented in the Cape Cod Canal which connects Buzzards Bay to Cape Cod Bay. For example, one humpback whale transited the length of the canal, exiting into Buzzards Bay on June 1, 1998 and another transited the canal on December 3, 2008 (NMFS 1998, NMFS 2008). Right whales have also been documented in the Canal (for example, June 1957, April 15, 2002, May 17, 2002) and based on historical documentation of right whales in the Canal, the Center for Coastal Studies has estimated that right whales enter the Canal once every few years (CCS 2004). Based on the best available information, occasional large whales, including right and humpback whales, are likely to occur in Buzzards Bay and in the waters transited by project vessels traveling between New Bedford, MA and the project site in Nantucket Sound.

Large whales in Nantucket Sound

A review of sightings data compiled by the Northeast Fisheries Science Center, CeTAP study data, the OBIS database, and status of the stock reports indicate that whales are rare visitors to Nantucket Sound, with no sightings of large whales within Horseshoe Shoal. In the Gulf of Maine and Cape Cod regions, humpback whales are found in three major concentration areas: Georges Bank, Stellwagen Bank, and in the northern Gulf of Maine (Waring et al. 2008). In the Gulf of Maine, humpback sightings are most frequent from mid-March through November in the Great South Channel north along the outside of Cape Cod to Stellwagen Bank and Jeffrey's Ledge. Sightings peak in May and August. NMFS Northeast Fisheries Science Center (NEFSC) has compiled humpback whale sightings data since 2002. In this time period, no humpback whales were observed in Nantucket Sound; the nearest observation to the action area was in the vicinity of Monomoy Shoals, near the northeastern tip of Nantucket Island (approximately 20km from the project footprint). Additionally, no humpback whales were sighted in the action area during NEFSC and SEFSC aerial and shipboard surveys (conducted in the summers of 1998, 1999, 2002, 2004, 2006 and 2007) (Waring et al 2010). While sightings data can not be used as absolute documentation of the occurrence of any particular species, it is helpful to determine patterns of occurrence and concentration areas. The best available information indicates that humpback whale occurrence in Nantucket Sound is rare, with transient individuals likely to overlap only sporadically with the eastern extremes of Nantucket Sound (i.e., near Monomoy). The shallow depths of Nantucket Sound and its location outside of the coastal migratory corridor likely minimizes the potential for humpback whales to occur in Nantucket Sound.

Similar to humpback whales, there are no documented occurrences of fin whales in Nantucket Sound (NEFSC unpublished data, and Waring et al. 2010). The nearest observations to Nantucket Sound are one fin whale recorded near the Massachusetts coast near Martha's Vineyard and two fin whales observed near Monomoy Island (approximately 20km from the project footprint). The preferred feeding habitat for fin whales is over deeper waters of the continental shelf (300 to 600 feet). As depths in the action area are considerably shallower than the preferred foraging depths of this species the finding that fin whales are uncommon in Nantucket Sound is consistent with what is known about their habitat preferences. The best available information indicates that fin whale occurrence in Nantucket Sound is rare, with transient individuals likely to overlap only sporadically with the eastern extremes of this area, most likely between April and October.

Sightings data of right whales in the Gulf of Maine and Cape Cod regions indicates that right whales congregate in three areas: Georges Bank, Stellwagen Bank and in the northern Gulf of Maine. Right whales are abundant in Cape Cod Bay between February and March and in the Great South Channel in May and June. They are also frequently sighted on Stellwagen Bank and Jeffrey's Ledge in the spring through fall. Right whale movements in the Gulf of Maine are understood in general; summer (June – October) foraging grounds are located in the Bay of Fundy, late spring (April – June) foraging grounds located in Great South Channel and winter foraging grounds are located in Cape Cod Bay (December – May).

Occasional right whales have been reported off Monomoy and off Great Point, Nantucket (northern tip of the island) but right whales have only rarely been documented in Nantucket Sound (NEFSC unpublished data, Waring et al. 2010), and no right whales have beeb sighted on

Horseshoe Shoal. Only one historical source included information for a whale in Nantucket Sound. Mate et al. (1997) reports data for several North Atlantic right whales outfitted with satellite tags. One right whale female, tagged in the Bay of Fundy on August 24, 1990, transited Nantucket Sound in 1997 accompanied by her calf. However, this whale was only present in Nantucket Sound for a brief period of time (i.e., less than one day) and moved rapidly during that time (i.e., approximately 89.6km/day or 3.7km/hour).

As noted above, in 2010, there were over 90 right whales sighted in Massachusetts and Rhode Island waters over a several day period in April and May 2010. During this time period, several right whales were observed in or near Nantucket Sound (see Figure 2). There was an opportunistic report of three whales, verified by NEFSC, about 1.5 nmi off of Oak Bluffs, Martha's Vineyard in northeastern Nantucket Sound on April 17, 2010 and a mother-calf pair was seen on April 18, 2010 about 5 nmi off of Oak Bluffs by the NOAA aerial survey team. There were also three opportunistic sightings in the north-central part of Nantucket Sound with groups of 4 and 2 whales seen on April 6, 2010 and 1 or 2 whales on April 19, 2010. Right whales were also observed along the south shore of Nantucket on January 31 (opportunistic reports of two groups of 3 whales each), and five groups totaling 14 animals observed by the NOAA aerial survey team on March 7, 2010. However, the January 31 and March 7 sightings were all outside of Nantucket Sound. It is important to note that all whales documented within Nantucket Sound quickly transited the area and there is no evidence of any persistent aggregations of right whales in Nantucket Sound. The best available information indicates that the presence of right whales in Nantucket Sound was related to the presence of forage within Rhode Island Sound and that the whales observed in Nantucket Sound were transiting away from the area. While the number of right whale sightings in Nantucket Sound was unusually high in 2010 there is no evidence to suggest that this is evidence of an increasing trend of usage of the area. Rather, the sightings from 2010 supports the determination that right whales are rare visitors to Nantucket Sound, with usage on the western and eastern extremes of the sound most likely and that these whales are transient in the area. To date, no right whales have been documented within Horseshoe Shoal where the proposed wind facility will be built, with nearly all sightings within Nantucket Sound occurring at least 18 km from the project site. Only one sighting has occurred closer to the project site (April 2010), and still was outside Horseshoe Shoal, approximately 5 km from the project site.

Right whales have been intensely studied in the Gulf of Maine and in Massachusetts waters. It is likely that if right whales were using Nantucket Sound on more than rare, unpredictable occasions, there would be documented sightings. The best available information indicates that like the other large whale species, right whale occurrence in Nantucket Sound is rare, with transient individuals likely to overlap only sporadically with the eastern extremes of the action area between December and June.

In summary, a review of the available scientific literature indicates that the use of Nantucket Sound by any species of whales, including North Atlantic right whales is extremely limited. A review of sightings data compiled by the NEFSC, CeTAP study data, the OBIS database, and status of the stock reports indicate that whales are rare visitors to Nantucket Sound, with no observations within Horseshoe Shoal where the project will be constructed. While occasional whales have been documented near Monomoy Island and Great Point (both near the eastern edge of Nantucket Sound), the satellite tracking data reported by Mate et al. (1997) as well as the sightings in 2010, support the conclusion that right whale use of Nantucket Sound is likely to be rare, sporadic and extremely limited in duration and frequency. Additionally, the habitat within Nantucket Sound is inconsistent with the habitat where right whales are typically found.

As explained above, only rare, transient whales occur in Nantucket Sound, with very few whales documented within Nantucket Sound and none within Horseshoe Shoal. The majority of these sightings were at the eastern and western edges of the Nantucket Sound, near Martha's Vineyard or Monomoy Island. The nearest that a right whale has been observed to the proposed project footprint is approximately 5 km from the northeast corner of the wind farm site with all other sightings of large whales within Nantucket Sound at least 18 km from the footprint of the wind facility. Based on the best available infomraiton outlined above, NMFS has determined that it is extremely unlikely that listed whales would occur within the project footprint and any occurrence of whales in Nantucket Sound is expected to be sporadic and transient. The lack of whales in this area is consistent with the finding that these habitats are shallower than the areas where these whales typically occur and are outside of their normal coastal migratory route. However, as occasional whales have been documented off of Monomoy and Great Point and in waters outside of Nantucket Sound that will be transited by project vessels (i.e., Rhode Island Sound and Buzzards Bay), it is reasonable to expect that these species may be present in those portions of the action area.

Effects of the Project

As explained above, sea turtles may be distributed throughout the action area between June and October each year. Right, humpback and fin whales may occasionally occur near the eastern and western edges of Nantucket Sound, but transits of the sound are extremely rare. Based on the best available information, are likely to be rare within the action area and extremely unlikely to occur in the project footprint (i.e., the WTG site or along the cable routes). However, large whales may occur in the portion of the action area that overlaps with the vessel transit routes. The proposed action involves several stages of activity in various locations (i.e., submarine cable route and the WTG site on Horseshoe Shoal). The sections below will outline potential effects from the following sources: (1) construction of the facility include submarine cables and the WTGs themselves, (2) operation and maintenance of the facility, (3) pre-construction geotechnical and geophysical surveys, and, (4) decommissioning. In addition to these categories of effects, BOEM provided information in the BA and DEIS on non-routine and accidental events. These events include oil spills, cable repair, and vessel collisions with a monopole. Effects of these non-routine and accidental events are also discussed below.

Construction and Operation of the Project

The major construction aspects of the project involve (1) the installation of the inner-array cables; (2) the installation of the submarine cables; and (3) the installation of monopiles associated with the WTGs and the ESP. Other construction activities include the assembly of the WTGs and ESP as well as the connection of the submarine cables to the land based cables at Lewis Bay. This section will also consider the effects of exposure to construction and operation related noise and construction and operation/maintenance vessel traffic.

Interactions with Cable Laying Equipment

Both the inner-array cables and the submarine cable will be installed with a jet plow and cable laying barge. Cables will be laid within the WTG array and from the ESP to Yarmouth, MA. Due to the depths and location within Horseshoe Shoal and towards the south shore of Cape Cod and the lack of evidence of whales occurring in these areas, whales are expected to be extremely rare along the submarine cable route and along the inner-array cable route. As such, NMFS has determined that it is unreasonable to anticipate that a whale would occur along the cable route and subsequently it is unreasonable to expect that a whale would interact with cable laying operations. As such, NMFS has determined that the potential for the cable laying operations to affect whales is discountable.

The jet plow uses jets of water to liquefy the sediment, creating a trench in which the cable is laid. Sea turtles in the path of the cable could theoretically collide with the vessel towing the plow. Cable laying operations proceed at speeds of <1 knot. At these speeds, any sea turtle that is encountered on the bottom is expected to be able to avoid collision or interaction with the cable laying operations. Additionally, as the cable will be taut as it is unrolled and laid in the trench, there is no risk of entanglement. Although any sea turtles present in the vicinity of the cable laying may be displaced from the area, displacement would be temporary for the duration of the jet pass (i.e., several minutes). The cable trench will be no more than 6 feet wide. As such, any displacement would cause a turtle to make a temporary shift in swimming direction for up to several minutes. This is not likely to affect the ability of the individual to complete any essential function (i.e., foraging, resting, migrating) that may take place along the cable route. Based on this information, sea turtles colliding or directly interacting with cable laying and jetting equipment are extremely unlikely to occur and, therefore, discountable. The effects of suspended sediment and noise associated with the cable laying and impacts to benthic resources are discussed in detail below.

Light Pollution

Most construction activities (pile driving, WTG assembly) will be limited to daylight hours. However, cable laying operations would take place 24 hours per day, 7 days a week during installation. The submarine transmission cable will take approximately 2-4 weeks to complete and the inner array cable will be installed over several months. Construction and support vessels would be required to display lights when operating at night and deck lights would be required to illuminate work areas. However, lights would be downshielded to illuminate the deck, and would not intentionally illuminate surrounding waters. If sea turtles 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 and associated seafloor disturbance, turbidity, and noise, listed species and their prey are not likely to be attracted by lighting. As such, NMFS has determined that any effects of project lighting on sea turtles or whales will be insignificant.

In addition to vessel lighting, the WTGs will be lit for navigational and aeronautical safety. Sea turtle hatchlings are known to be attracted to lights and adversely affected by artificial beach lighting, which disrupts proper orientation towards the sea. However, nesting does not occur in

Massachusetts, and hatchlings are not known to be present in Massachusetts waters. If this lighting resulted in the attraction of sea turtles or their prey, no effects to sea turtles would occur as they are not likely to collide with the stationary wind turbine monopile. As such, NMFS has determined that any adverse effects of project lighting on sea turtles or whales will be discountable.

Destruction of Prey Resources/Loss of Foraging Habitat

Activities that disturb the sea floor will also affect benthic communities, and can cause effects to sea turtles by reducing the numbers or altering the composition of the species upon which sea turtles prey. Activities that may affect the sea floor and result in the loss of foraging resources for listed species include:

- Cable installation;
- WTG and ESP installation;
- G and G surveys; and,
- Scour protection (scour mats and rock armoring).

Loss of Benthic Resources/Habitat

The proposed action will result in both the temporary disturbance and permanent loss of benthic habitat. Effects to benthic resources and habitat will be restricted to the area within the project footprint and along the cable route where sediment disturbing activities will occur. As no whales are expected to occur in the project footprint or along the cable route, whales will not be exposed to effects related to the loss of benthic resources or habitat. As such, the discussion below will focus on the effects on sea turtles. As noted above, surveys indicate that suitable depths and forage for leatherback, loggerhead, Kemp's ridley and green sea turtles exist in the action area and that individuals from any of these species are likely to be present in the action area between June and October.

The installation of the submarine transmission and inner-array cables will result in temporary impacts to approximately 866 acres (approximately 5% of the action area). This accounts for the 4-6 foot wide trench that will be jetted along the 12.5 mile submarine transmission cable and the 66.7 miles of inner-array cables. The jetting process will affect benthic resources and habitat in two ways: entrainment of microorganisms and displacement or burial of other benthic resources. This is likely to result in a temporary loss of forage items and a temporary reduction in the amount of benthic habitat available for foraging sea turtles. Impacts associated with cable installation, barge positioning, anchoring, anchor line sweep, and the pontoon on the jet plow device would be temporary and localized. Impacts from anchor line sweep would primarily affect the sediments to a depth of between 3 and 6 inches. Anchoring locations would have disturbances to the sediment to a depth of 4 to 6 feet at each anchor deployment, leaving a temporary irregularity to the seafloor with localized mortality of infauna. Jet plow embedment would directly disturb sediments to a depth of approximately 8 feet.

Modeling was presented by BOEM in the DEIS which estimated seabed scar recovery from jet plow cable burial operations. Using the assumption that 3 percent of the sediments in the jetted cross section could be injected back into the water column and that the coarse sediment column is returned to the trench, it was estimated that the dimensions of the scar left along the cable routes would be 6 feet wide and from 0.75 to 1.7 feet deep. BOEM also estimated approximate recovery times for the trench scars. Based on bedload transport rates for Horseshoe Shoal and throughout Nantucket Sound, recovery rates for jetting scars along the cable route are estimated to be between 0.2 and 38 days. Recovery of jetting scars on Horeshoe Shoal is anticipated to occur within a few days. It is likely that seabed scars from cable burial in Lewis Bay would last months or until a major storm occurs.

Egg and larval stages of demersal species would experience some mortality due to burial. The temporary displacement of benthic habitats is also likely to result in the mortality and/or dispersal of other benthic organism in the footprint of the construction activities. As the jetting and cable laying occurs very slowly, most mobile organisms (i.e., crabs, finfish) are likely to be able to avoid the area where the jet plow is operating. The cable route has been designed to avoid eel grass beds in Lewis Bay. There are very limited areas of submerged aquatic vegetation (SAV), mostly macroalgae as opposed to sea grass, that will be affected by construction on Horseshoe Shoal.

The alteration of benthic habitat and the loss of benthic resources during construction could impact sea turtles. However, most mobile organisms, including most sea turtle prey items, are likely to be able to avoid the jetting. While there is likely to be some loss of sea turtle forage items, the amount of habitat affected represents a very small percentage of the available foraging habitat in Nantucket Sound. Sea turtles may temporarily shift their foraging efforts to other areas within Nantucket Sound or in the most extreme instances leave Nantucket Sound for other undisturbed foraging areas. While this would effect the movements of individual sea turtles it is likely to be temporary and is not likely to affect the ability of the sea turtle to find adequate nourishment or result in any injury or mortality of sea turtles. Recolonization of temporarily disturbed areas is expected to be rapid, with colonization by mobile organisms beginning within days and complete recolonization occurring within 3-12 months. As cable laying will occur over several months and recovery of benthic communities will take another several months, foraging opportunities along the cable route may be reduced for one to two years. However, as only a small percentage of Nantucket Sound will be affected, any movements of sea turtles to other foraging sites are likely to be localized and the benthic disturbance is not likely to cause sea turtles to leave the action area. As whales are not expected to occur in the project footprint or along the cable route, no foraging whales will be affected by the proposed action. Additionally, the action will not result in the loss of potential forage for whales occurring outside of Nantucket Sound.

The installation of the WTG monopiles and the ESP will result in the permanent loss of 0.67 acres of benthic habitat (less than 0.0042% of the project area). Although these impacts would result in permanent loss of 0.67 acres of potential foraging habitat for sea turtles, loss of this habitat is not likely to have a measurable adverse impact on normal sea turtle foraging activity. The total impacted area represents only 0.0042% percent of the over 15,000 acres of similar bottom habitat surrounding the project area. Additionally, there is no evidence to suggest that the WTG or ESP sites offer more favorable foraging habitat for sea turtles than surrounding areas. Sea turtles are likely to find suitable foraging habitat in alternate areas nearby, and any effects from the permanent loss of habitat resulting from the proposed project will be insignificant.

Because the inner-array cables and the two submarine transmission cable circuits will be buried approximately 6 feet (1.8 m) below the seabed they will not pose a physical barrier to migratory animals, including sea turtles. The considerable depth to which the cables will be buried will allow benthic organisms to colonize and demersal fish species to utilize surface sediments without being affected by the cable operation.

Habitat Shift

The presence of 130 monopile foundations, 6 ESP piles and their associated scour control mats in Nantucket Sound has the potential to shift the area immediately surrounding each monopile from soft sediment, open water habitat to a structure-oriented system. This may create localized changes, namely the establishment of "fouling communities" within the Wind Park and an increased availability of shelter among the monopiles. The WTG monopile foundations will represent a source of new substrate with vertical orientation in an area that has a limited amount of such habitat, and as such may attract finfish and benthic organisms, potentially affecting sea turtles by causing changes to prey distribution and/or abundance. While the aggregation of finfish around the monopiles will not attract sea turtles, some sea turtle species may be attracted to the WTGs for the fouling community and epifauna that may colonize the monopiles as an additional food source for certain sea turtle species, especially loggerhead and Kemp's ridley turtles. All four species may be attracted to the monopiles for shelter, especially loggerheads that have been reported to commonly occupy areas around oil platforms (NRC 1996) which also offer similar underwater vertical structure.

More specifically, loggerheads and Kemp's ridleys could be attracted to the monopiles to feed on attached organisms since they feed on mollusks and crustaceans. Loggerheads are frequently observed around wrecks, underwater structures and reefs where they forage on a variety of mollusks and crustaceans (USFWS 2005). Leatherback turtles and green turtles however should be less likely to be attracted to the monopiles for feeding since leatherbacks are strictly pelagic and feed from the water column primarily on jellyfish and green turtles are primarily herbivores feeding on seagrasses and algae. However, if either of these forage items occur in higher concentrations near the monopiles, these species of sea turtles could also be attracted to the monopiles.

Although the monopile foundations would create additional attachment sites for benthic organisms that require fixed (non-sand) substrates and additional structure that may attract certain finfish species, the additional amount of surface area being introduced (approximately 1,200 square feet (111 square meters) per tower, assuming an average water depth of 30 feet (9.1m) below mean high water (MHW)) would be a minor addition to the hard substrate that is already present. Due to the small amount of additional surface area in relation to the total area of the proposed action and Nantucket Sound and the spacing between WTGs (0.34 to 0.54 nautical miles (0.63 to 1.0 km) apart), the new additional structure is not expected to alter the species composition in the action area. While the increase in structure and localized alteration of species distribution in the action area around the WTG monopiles may affect the localized movements of sea turtles in the action area and provide additional sheltering and foraging opportunities in the action area for these species, any effects will be beneficial or insignificant.

Water Quality Degradation and Increased Marine Debris
Construction activities can impact water quality in various ways, including increased turbidity and resuspension of contaminated sediments due to seafloor disturbance.

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

Increased turbidity and resuspension of sediments can be expected from the following activities:

- Cable installation;
- WTG and ESP pile installation; and,
- Vessel anchoring.

Of these activities, cable installation, including jetting and backfill, is expected to generate the most turbidity and disturbance of bottom sediments. Simulations of sediment transport and deposition from jet plow embedment of the submarine cable system and inner array cables were performed and reported in BOEM's BA and DEIS. These simulations used two models (HYDROMAP to calculate currents and SSFATE to calculate suspended sediments in the water column and bottom deposition from the jet plow operations) to estimate the suspended sediment concentrations and deposition that could result from jet plow embedment of the cables. The model results demonstrate that concentrations of suspended sediment in the water column resulting from the jet plow embedment operations are largely below 50mg/L in Nantucket Sound. The modeling results indicate that the suspended sediment concentration levels are short lived due to the tides flushing the plume away from the jetting equipment and the sediments rapidly settling out of the water column. For example, the duration of time when suspended sediment levels will be greater than 10mg/L above background levels is less than 3 hours after the jet plow has passed a given point along the route. In places along and immediately adjacent to the cable route, suspended sediment concentrations are predicted to remain at 100mg/L for 2-3 hours.

In Lewis Bay, suspended sediments are predicted to remain in suspension considerably longer than in Nantucket Sound due to weak tidal currents. Modeling demonstrates that the concentration of suspended sediment in the water column resulting from jet plow operations in Lewis Bay will be below 500mg/L. Suspended sediment concentrations in excess of 100mg/L are generally predicted to remain for less than 2 hours with the exception of some sections along the route where durations may be as long as 6 hours. Suspended sediment concentrations in excess of 10mg/L above background are generally predicted to remain for less than 24 hours after the jet plow has passed a given point, with the exception of the area near the Yarmouth landfall where concentrations in excess of 10mg/L are predicated to remain for up to 2 days after the jet plow passes as a result of very weak currents and fine bottom sediments.

Suspended sediment is most likely to affect sea turtles if a plume causes a barrier to normal behaviors or if sediment settles on the bottom affecting sea turtle prey. As sea turtles are highly mobile they are likely to be able to avoid any sediment plume and any effect on sea turtle movements is likely to be insignificant. Additionally, the TSS levels expected (less than 500mg/L) are below those shown to have an adverse effect on fish (580mg/L for the most sensitive species, with 1,000mg/L more typical; see summary of scientific literature in Burton 1993).

As whales are extremely rare in Nantucket Sound and are not expected to occur at all in Lewis Bay, no whales are expected to be exposed to increased levels of sediment associated with the cable laying operations. Any sea turtles in the area of the cable laying operations would be exposed to an increase in suspended sediment for a short duration (2-48 hours). However, as sea turtles are highly mobile and any suspended sediment plumes will be localized and temporary, it is not likely that sea turtles would be exposed to a high suspended sediment load for a significant amount of time. Sea turtles may temporarily avoid areas with high suspended sediment loads but as any effects will be temporary, there is not likely to be any long term effect or injury associated with these alterations of movement. Any alteration in movements is likely to be temporary and local.

As noted in BOEM' BA, whales and sea turtles bioaccumulate contaminants from their environment, almost exclusively through their food sources. The potential mechanism by which sediments suspended during the proposed action's construction can harm whales is through bioaccumulation of sediment-associated chemicals through ingestion of contaminated prey.

BOEM has reported that analysis of sediment core samples obtained from the area of the proposed action indicate that sediment contaminant levels were below established thresholds in reference Effect Range-Low and Effects-Range-Median marine sediment quality guidelines. Therefore, the temporary and localized disturbance of these sediments during the proposed action's construction activities are not anticipated to result in increased contaminants in lower trophic levels. Therefore, neither sea turtles nor whales are likely to experience increased bioaccumulation of chemical contaminants in their tissues from the consumption of prey items in the vicinity of the proposed action, and any effects to whales or sea turtles from the disturbance of these sediments will be discountable. Since other sources of turbidity and seafloor disturbance (i.e., pile installation and scour protection placement) will be minimal compared to that caused by cable installation, the overall effect of project construction on listed species due to turbidity and exposure to contaminants is insignificant or discountable.

Increased Marine Debris

Personnel will be present onboard the barges throughout construction activities, thus presenting some potential for accidental releases of debris overboard. As noted in the Environmental Baseline section, sea turtles may be adversely affected if they become entangled in or ingest marine debris, particularly plastics that are mistaken for prey items. The discharge and disposal of garbage and other solid debris from vessels by lessees is prohibited by the BOEM (30 CFR 250.300) and the USCG (MARPOL Annex V, Public Law 100-220 [Statute 1458]). The discharge of plastics is strictly prohibited. During construction, individual crew members will be responsible for ensuring that debris is not discharged into the marine environment. Additionally, training of construction crews will include a requirement explaining that the discharge of trash and debris overboard is harmful to the environment, and is illegal under the Act to Prevent Pollution from Ships and the Ocean Dumping Ban Act of 1988. Discharge of debris will be prohibited, and violations will be subject to enforcement actions. Therefore, construction activities are not likely to result in increased marine debris.

Exposure to Electro-magnetic field

The cable system (for both the inner-array cables and each of the submarine cable circuits) is a three-core solid dielectric AC cable design, which was specifically chosen for its minimization of environmental impacts and its reduction of any electromagnetic field. The proposed inner-array and submarine cable systems will contain grounded metallic shielding that effectively blocks any electric field generated by the operating cabling system. Since the electric field will be completely contained within those shields, impacts are limited to those related to the magnetic field emitted from the submarine cable system and inner-array cables. As presented in the DEIS and accompanying Technical Report No. 5.3.2-3 the magnetic fields associated with the operation of the inner-array cables or the submarine cable system are not anticipated to result in any adverse impacts to marine life (ICNIRP 2000; Adai, 1994; Valberg *et al*. 1997 in BOEM 2008).

The research presented in the technical report on EMF indicates that although high sensitivity has been demonstrated by certain species (especially sharks) for weak electric fields, this sensitivity is limited to steady (DC) and slowly-varying (near-DC) fields. The proposed action produces 60-Hz time-varying fields and no steady or slowly-varying fields. Likewise, evidence exists for marine organisms utilizing the geomagnetic field for orientation, but again, these responses are limited to steady (DC) and slowly-varying (near-DC) fields. 60-Hz alternating power-line EMF fields such as those generated by the proposed action have not been reported to disrupt marine organism behavior, orientation, or migration. Based on the body of scientific literature presented by BOEM in the DEIS and BA, there are no anticipated adverse impacts expected from the undersea power transmission cables or other components of the proposed action on the behavior, orientation, or navigation of marine organisms, including listed sea turtle species. Based on this analysis, potential direct impacts to listed sea turtles during the normal operation of the inner-array cables and the two submarine cable circuits will be discountable.

The burial depth of the cables (i.e., 6 feet below the seabed) also minimizes potential thermal impacts from operation of these cable systems. In addition, the inner-array and submarine cable systems utilize solid dielectric AC cable designed for use in the marine environment that does not require pressurized dielectric fluid circulation for insulating or cooling purposes. There will be no direct impacts to sea turtle species during the normal operation of the inner-array or submarine cable systems. There will also be no impacts to prey species of sea turtles during the normal operation of the inner-array or submarine cable systems.

Increased Risk of Vessel Strike

The construction and operation of the project will require the use of a variety of vessels. Vessels will be used to transport materials from the staging areas in Falmouth, MA and Quonset Point, RI to the project site and will also be used to deliver crew to the project site. Additionally, specialized vessels will be used during construction. These vessels will include barges and tugs used for cable installation and pile driving. An additional specialized vessel will be used to stage the assembly of the WTGs. Once construction is complete, maintenance vessels will visit the project site from New Bedford, MA. These vessels will represent an increase in vessel traffic in the action area.

During pile driving activities, it is estimated that 4 to 6 stationary or slow moving vessels would be present in the general vicinity of the pile installation (i.e., on Horseshoe Shoal). Vessels delivering construction materials or crews to the site will also be present in the area between the mainland and the proposed action site (a trip lasting approximately one hour). The barges, tugs and vessels delivering construction material generally will travel at speeds below 10 knots and may range in size from 90 to 400 feet, while the vessels carrying construction crews will be traveling at a maximum speed of 21 knots and will typically be 50 feet in length. While on site, vessels will be slow moving or stationary. Once construction is complete, maintenance vessels will continue to visit the site, with the highest number of maintenance vessels on site in the summer months when the weather is most favorable. As noted in the Description of the Action section above, Cape Wind will maintain two vessels for maintenance activities.

As discussed in the Environmental Baseline, collision with vessels remains a source of anthropogenic mortality for both sea turtles and whales. The proposed project will lead to increased vessel traffic during construction and long-term operation that would not exist but for the proposed action. This increase in vessel traffic will result in some increased risk of vessel strike of listed species. However, due to the limited information available regarding the incidence of ship strike and the factors contributing to ship strike events, it is difficult to determine how a particular number of vessel transits or a percentage increase in vessel traffic will translate into a number of likely ship strike events or percentage increase in collision risk. In spite of being one of the primary known sources of direct anthropogenic mortality to whales, and to a lesser degree, sea turtles, ship strikes remain relatively rare, stochastic events, and an increase in vessel traffic in the action area would not necessarily translate into an increase in ship strike events. No vessel strike events have been reported in the action area. Nonetheless, BOEM and Cape Wind have proposed to implement the following mitigation measures to further reduce the likelihood of a project vessel interacting with a whale or sea turtle (see Appendix A for a complete listing of all mitigation measures):

- All vessels associated with the construction, operation/maintenance and/or decommissioning of the project will be required to abide by the (1) NMFS Northeast Regional Viewing Guidelines, as updated through the life of the project; and (2) BOEM Gulf of Mexico Region’s Notice to Lessee (NTL) No. 2007-G04.

- All vessel operators must undergo training to ensure they are familiar with the above requirements. These training requirements must be written into any contractor agreements.

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. All construction related vessels will be transiting between the project site and Quonset, Rhode Island and maintenance/crew support vessels will be transiting between the project site and Falmouth, Massachusetts or New Bedford, Massachusetts. As explained throughout this document, whales are not expected to occur in the project footprint or along the cable route and only rarely would whales enter Nantucket Sound. However, as outlined above, large whales do occur seasonally in Rhode Island Sound and Buzzards Bay, waters that would be transited by project vessels originating from Quonset, RI or New Bedford, MA. As no whales are expected to occur along the cable route or within the project footprint, the increase in vessel traffic attributable to the proposed project will not increase the likelihood of a whale being struck by a vessel in these areas. Below, NMFS discusses the effects of an increase in vessel traffic in the action area on sea turtles and whales.

Sea Turtles

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

Information is lacking on the type or speed of vessels involved in sea turtle vessel strikes. However, there does appear to be a correlation between the number of vessel struck turtles and the level of recreational boat traffic (NRC 1990). Sea turtles have been reported with injuries consistent with propeller wounds, which are likely from interactions with small, fast moving vessels, such as recreational boats.

Although little is known about a sea turtle's reaction to vessel traffic, sea turtles are thought to be able to avoid injury from slower-moving vessels since the turtle has more time to maneuver and avoid the vessel. Vessels will only travel between 0-4 knots while actually engaged in construction activities, or 1-2 miles in a 24-hour period. At these speeds, vessel movements during construction are not likely to pose a vessel strike risk to sea turtles.

The risk of collision is greatest when vessels are moving at higher speeds when transiting between the staging areas and the project site. As such, the 10 knot speed of the construction vessels is likely to reduce the chance for collision. Crew support vessels may run at higher speeds, with a maximum speed of 21 knots. Lookouts will be posted on all vessel transits. All vessels would follow the vessel strike avoidance procedures discussed above. The presence of an experienced endangered species observer at the construction site who can advise the vessel operator to slow the vessel or maneuver safely when sea turtles are spotted will further reduce the potential for interaction with vessels.

Although the threat of vessel collision exists anywhere listed species and vessel activity overlap, ship strike is more likely to occur in areas where high vessel traffic coincides with high species density. In addition, ship strikes are more likely to occur and more likely to result in serious injury or mortality when vessels are traveling at speeds greater than ten knots. Although most construction vessel transits will occur at speeds of ten knots or less, some vessels may travel at speeds up to 21 knots. 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, and due to the fact that the increase in vessel traffic will be insignificant compared to the number of vessels operating in the action area on a normal basis, NMFS has determined that the increased risk of vessel collision posed by project vessel operation in the action area is insignificant.

Whales

As discussed in the Environmental Baseline, collision with vessels remains a source of anthropogenic mortality for whales. The Cape Wind project will lead to increased vessel traffic during both the construction and maintenance phases that would not exist but for the existence of the wind energy facility. 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. All waters to be utilized by project related vessels are utilized by a large number of commercial and recreational vessels. During construction, barges and crew support vessels will make transits from the staging site in Quonset, RI and the crew base in Yarmouth, MA respectively. During maintenance operations, two crew support vessels will be staged from New Bedford, MA.

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). This same database reports only two ship strikes recorded from Rhode Island waters from 1975-2002. In 1998, a blue whale was observed draped over the bulbous bow of an ocean going tanker as it approached Narraganset, RI. The best available information indicates that this whale was not struck in Rhode Island waters. The only other record of a ship strike in Rhode Island waters is a dead fin whale stranded in 1998 on the Rhode Island coast. The whale had evidence of a strike, but it is unknown where the strike occurred (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.

Construction Traffic from Quonset, RI

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 BOEM and Cape Wind 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 between large vessels operating at speeds of 13-15 knots or greater (Jensen and Silber 2003; Laist *et al*. 2001). An analysis by Vanderlaan and Taggart (2006) showed that the probability of a ship strike resulting in death decreases significantly for vessels traveling at 15 knots compared to 11.8 knots and the probability decreases even further for vessels traveling at 10 knots or less. Taken together, these analyses suggest that the risk of ship strike is significantly reduced when vessels travel at 10 knots or less. 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. All construction related vessels transiting from the staging site at Quonset (i.e., tugs and barges) will transit at speeds of 10 knots or less, regardless of time of year. In addition, all vessels operators and lookouts will receive training on prudent vessel operating procedures to avoid vessel strikes with all protected species.
The barges that will be carrying construction equipment and components of the WTG units to the Nantucket Sound project site will transit areas that are known to be used by large whales, including right whales. However, the risk of vessel strike is reduced by the speed at which these vessels will operate (i.e., 10 knots or less) and the presence of a dedicated lookout. In addition, the number of vessel transits (86 total over a period of 11 months, with no more than two to three trips per day) contributed by the Cape Wind project in this area will constitute an insignificant increase in total traffic in the action area. Combined with the implementation of the ship strike reduction measures described above including the slow speed at which these vessels will operate, 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 a construction vessel associated with the Cape Wind project originating from the Quonset, RI staging site will collide with a whale.

Maintenance/Crew Support Vessels

Cape Wind will maintain two support vessels in New Bedford, MA. These vessels, expected to be approximately 50 feet in length, will be capable of transiting at up to 21 knots. Cape Wind has estimated that each vessel will make one trip to the project site on each day that the weather is suitable. Thus, the maintenance associated with the Cape Wind project will result in up to two additional vessels in the action area each day. The transit route between New Bedford, MA and Nantucket Sound is used by a large number of commercial shipping and fishing vessels and seasonally by a large number of recreational vessels. The small number of additional transits (2 per day) contributed by maintenance support vessels represents a minimal increase in overall vessel traffic in the area. In addition, these transits will be occurring between New Bedford, MA and Nantucket Sound, crossing through Buzzards Ba where whales are infrequent. Lookouts will be posted on all vessels and it is expected that vessel operators will monitor the Northeast US Right Whale Sightings Advisory System, and vessels will reduce speed, increase vigilance, or alter course accordingly if whales are observed along the transit route. Due to the insignificant increase in traffic that these two support vessels represent, the infrequency with which whales are present along this transit route and with the proposed mitigation measures in place, NMFS concludes that the likelihood of the maintenance support vessel resulting in collision with a whale is discountable.

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 large vessels are traveling at speeds greater than ten knots. All large construction related vessels transiting between Quonset, RI and the project site will operate at speeds less than 10 knots. Smaller maintenance support vessels will operate at speeds of up to 21 knots, however, there use is limited to areas where large whales are less frequent. Additionally, the small size (less than 50 feet) and increased maneuverability, and posting of a lookout, further reduces the likelihood of a vessel strike. 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.

Acoustic Effects

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

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

1. Behavioral reactions – Range from brief startle responses, to changes or interruptions in feeding, diving, or respiratory patterns, to cessation of vocalizations, to temporary or permanent displacement from habitat.
2. Masking – Reduction in ability to detect communication or other relevant sound signals due to elevated levels of background noise.
3. Temporary threshold shift (TTS) – Temporary, fully recoverable reduction in hearing sensitivity caused by exposure to sound.
4. Permanent threshold shift (PTS) – Permanent, irreversible reduction in hearing sensitivity due to damage or injury to ear structures caused by prolonged exposure to sound or temporary exposure to very intense sound.
5. Non-auditory physiological effects – Effects of sound exposure on tissues in non-auditory systems either through direct exposure or as a consequence of changes in behavior, e.g., resonance of respiratory cavities or growth of gas bubbles in body fluids.

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

The acoustic effects analysis will:

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

Characterization of Noise Sources

Pile driving with an impact hammer produces impulsive sounds. All other noise sources associated with construction will be non-impulse sounds continuous for the duration of the activity. Sources of noise associated with the proposed project include the following:

- Cable laying and associated activities;
- Pile driving;
- Construction and maintenance vessel transits; and,
- Operation of the WTGs.

Right, Humpback, and Fin Whale Hearing

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

Ketten (1998) summarized that the vocalizations of most animals are tightly linked to their peak hearing sensitivity. Hence, it is generally assumed that baleen whales hear in the same range as their typical vocalizations, even though there are no direct data from hearing tests on any baleen whale. Most baleen whale sounds are concentrated at frequencies less than 1 kHz (Richardson et al. 1995), although humpback whales can produce songs up to 8 kHz (Payne and Payne 1985). Based on indirect evidence, at least some baleen whales are quite sensitive to frequencies below

1 kHz but can hear sounds up to a considerably higher but unknown frequency. Most of the manmade sounds that elicited reactions by baleen whales were at frequencies below 1 kHz (Richardson et al. 1995). Some or all baleen whales may hear infrasounds, sounds at frequencies well below those detectable by humans. Functional models indicate that the functional hearing of baleen whales extends to 20 Hz, with an upper range of 30 Hz. Even if the range of sensitive hearing does not extend below 20-50 Hz, whales may hear strong infrasounds at considerably lower frequencies. Based on work with other marine mammals, if hearing sensitivity is good at 50 Hz, strong infrasounds at 5 Hz might be detected (Richardson et al. 1995). Fin whales are predicted to hear at frequencies as low as 10-15 Hz. The right whale uses tonal signals in the frequency range from roughly 20 to 1000 Hz, with broadband source levels ranging from 137 to 162 dB (RMS) re 1 μPa at 1 m (Parks & Tyack 2005). One of the more common sounds made by right whales is the "up call," a frequency-modulated upsweep in the 50–200 Hz range (Mellinger 2004). The following table summarizes the range of sounds produced by right, humpback, and fin whales (from Au et al. 2000):

Table 1. Summary of known right, humpback, and fin whale vocalizations

Species	Signal type	Frequency Limits (Hz)	Dominant Frequencies (Hz)	Source Level (dB re 1μPa RMS)	References
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)

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

Sea Turtle Hearing

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

Effects of Exposure to Construction Noise – Pile Driving
Sound levels associated with the driving of monopiles have been modeled and results are presented in the BA. Modeling indicates that the source level of the noise (dB re 1uPa at 1 meter) will be 232 dB with a spectral energy of 1Hz to 20 kHz. Underwater noise from the installation of the monopiles has been modeled to be 178 dB re 1uPa at 500m, 172 dB re 1uPa at 1km and 166 dB re 1uPa at 2km. In order to minimize the effects of pile driving on listed species, BOEM will require and Cape Wind has agreed to implement several mitigation measures. These measures are detailed in Appendix A. The most significant of these measures requires that no pile driving occur if any whales or sea turtles are present within 750 meters of the pile to be driven. Outside the 750 m exclusion zone, noise levels are anticipated to be below 178dB re 1 uPa.

Exposure to Injurious Levels of Sound
As explained above, whales are not thought to normally occur in Nantucket Sound. However, right, humpback and fin whales have been documented off of the Northern tip of Nantucket Island and off of Monomoy (16-19 km from the project site). Of the few sightings of large whales within Nantucket Sound, all except one have been more than 18km from the project footprint where piles will be installed. The nearest that a large whale has been observed to the project footprint where piles will be installed is approximately 5 km from the northeast corner of the footprint. Based on the best available information, the use of Nantucket Sound by large whales is expected to be extremely rare, with any use being limited to transient whales present for a short time period. Large whales are extremely rare within Nantucket Sound, as evidenced

by the extremely limited number of sightings and habitat that is inconsistent with areas where these species are typically found.

As explained above, trained endangered species observers will be present during all pile driving activities to visually monitor the exclusion zone. Observers will begin monitoring at least 30 minutes prior to soft start of pile driving and pile driving will not begin until the 750 m exclusion zone is clear of whales and sea turtles for at least 60 minutes. Additionally, BOEM will require and Cape Wind has agreed to implement a plan to monitor the Northeast US Right Whale Sightings Advisory System (SAS). In the unlikely event that right whales are present within Nantucket Sound, the location of whales will be closely monitored through this system. As the location of any right whales within Nantucket Sound would be monitored through the SAS and observers will monitor the exclusion zone for at least 60 minutes prior to the start of pile driving, it is expected that the monitoring of the exclusion zone will be effective to ensure that no pile driving takes place if a whale is within 750 m of the pile to be installed. As such, even in the unlikely event that a whale was present within Nantucket Sound when the monopoles were being installed, no pile driving would occur if any marine mammal is within 750 meters of the pile. As injurious levels of sound (i.e., 180dB re 1uPa) will only be experienced within 500 meters of the pile being driven and no pile driving will occur if a whale were within 750 meters of the pile, no whales will be exposed to sound levels greater than 178 dB and no whales will be exposed to sound levels at which injury could occur (i.e., 180dB re 1uPa).

As sea turtles could occur in the project area while pile driving is occurring, there is the potential for a sea turtle to be exposed to underwater noise resulting from driving the monopoles. As explained above, the 750 m exclusion zone will be monitored by a trained endangered species observer for at least 60 minutes. It is expected that the observer will be able to detect the presence of any sea turtle at the surface within the 750 m exclusion zone. The normal duration of sea turtle dives ranges from 5-40 minutes depending on species, with a maximum duration of 45-66 minutes depending on species (Spotila 2004). As sea turtles typically surface at least every 60 minutes, it is reasonable to expect that monitoring the exclusion zone for at least 60 minutes will the endangered species monitor to detect any sea turtles that may be submerged in the exclusion zone. Sound levels will have dissipated to below the 180 dB threshold within a distance of 500m. As no pile driving will occur if a sea turtle is within 750m of the pile, no sea turtles are likely to be exposed to potentially injurious levels of sound. Thus, sea turtles are not likely to be exposed to levels of construction-related noise that will result in injury.

Exposure to disturbing levels of sound
Although the potential for construction-related sounds to cause injury to whales and sea turtles is extremely low, the analysis below considers the potential for whales and sea turtles to be exposed to disturbing levels of sound produced by these activities. For pile driving, potentially disturbing levels of sound (160-180dB) is expected to propagate over a distance of no more than 3.4km from the source.

Modeling presented by BOEM in Appendix 5-11A (Noise Report) of the DEIS indicates that underwater noise levels may be greater than 160 dB re 1 uPa (i.e., NMFS threshold for behavioral disturbance/harassment from a non-continuous noise source) within approximately

3.4km of the pile being driven. At distances greater than 3.4km from the pile being driven, noise levels will have dissipated to below 160 dB re 1 uPa. As explained above, behavioral disturbance/harassment of whales may occur when individuals are exposed to pulsed noise levels (i.e., non-continuous noise sources such as those generated by an impact pile driver that will be used for monopole installation) greater than 160 dB re 1 uPa. As explained above, large whales are rare within Nantucket Sound and no large whales have been documented within Horseshoe Shoal where pile installation will take place. Of the few sightings of large whales within Nantucket Sound, all except one have been more than 18km from the project footprint where piles will be installed. The one sighting of a large whale closer to the project footprint where piles will be installted than 18km was a right whale approximately 5 km from the northeast corner of the footprint. As explained above, any large whales present within Nantucket Sound are expected to be rare and transiting through the Sound rapidly. For example, the whale tracked by Mate et al. (1997) was present within Nantucket Sounf for less than one day and moved rapidly during that time (i.e., approximately 89.6km/day or 3.7km/hour). Based on the shallow depths within Horseshoe Shoal where pile driving will take place and where noise levels greater than 160dB will be experienced, any whales present within Nantucket Sound are unlikely to travel through this area. This is supported by the lack of any documentation of large whales within Horeshoe Shoal or within the area where noise levels greater than 160 dB may be experienced. As it is extremely unlikely that any whales will be within 3.4km of any pile being driven, it is therefore extremely unlikely that any whales will be exposed to noise levels greater than 160 dB. Additionally, as BOEM will require that Cape Wind monitor the SAS, in the unlikely event that any whales are present within Nantucket Sound, the location of these whales can be monitored and pile driving could be delayed until any whales leave the area. Based on the best available information and the analysis outlined herein, no right, humpback or fin whales will be exposed to noise levels greater than 160 dB. As such, no whales will be exposed to noise levels that could result in behavioral disturbance or harassment.

Since leatherback, green, Kemp's ridley and loggerhead sea turtles are known to occur in Nantucket Sound between June and October and construction will occur during this time period, these species are likely to be exposed to construction-related noise during the construction period.

There is very little information about sea turtle behavioral reactions to levels of sound below the thresholds suspected to cause injury or TTS. However, some studies have demonstrated that sea turtles have fairly limited capacity to detect sound, although all results are based on a limited number of individuals and must be interpreted cautiously. Ridgway et al. (1969) found that one green turtle with a region of best sensitivity around 400 Hz had a hearing threshold of about 126 dB in water. Streeter (in press) found similar results in a captive green sea turtle, which demonstrated a hearing threshold of approximately 125 dB at 400 Hz, but better sensitivity at 200 Hz (110-115 dB threshold). McCauley (2000) noted that dB levels of 166 dB re 1μPa were required before any behavioral reaction was observed.

As noted above, modeling results reported by BOEM indicate that sound levels could be higher than 160 dB within 3.4 km of the pile being driven. As such, any sea turtles occurring within that area would be exposed to potentially disturbing sound levels. The available information on sea turtle behavioral responses to these sound levels indicates that individuals are likely to actively avoid areas with disturbing levels of sound. Avoidance behavior may shorten the exposure period; however, the avoidance behavior could potentially disrupt normal behaviors. Reactions of individual sea turtles to the pile driving is expected to be limited to an avoidance response. Only pile driving occurring during the June – November time frame has the potential to affect sea turtles, as sea turtles are not expected to occur in the action area outside of this time of year.

As explained throughout, there is limited information available specific to sea turtle presence in Nantucket Sound. There have been no systematic surveys to document the number of sea turtles in the action area or Nantucket Sound generally. Leatherback, loggerhead, green and Kemp's ridley sea turtles have all been documented in Nantucket Sound generally and/or the action area specifically (Lazell et al. 1980, Mass Audubon 2002, 2003 and 2004, as well as information at the OBIS and seaturtle.org databases). Sightings data indicate that leatherback sea turtles are the most common species of sea turtle in Massachusetts waters, including Nantucket Sound, followed by loggerheads, with fewer Kemp's ridley and green sea turtles. However, as all four sea turtle species have been documented to occur in Nantucket Sound and sea turtles are highly mobile, NMFS considers that any of these species could be present in the action area. NMFS considered several sources of information in order to estimate the number of sea turtles that could be exposed to sound levels between 160 and 180 dB. As noted above, the area where noise levels will be greater than 160dB extends approximately 3.4km from the pile being driven. This area includes the 750 meter exclusion zone. As no pile driving will take place when sea turtles are present within the exclusion zone, only sea turtles located in the area between 750 meters and 3.4 km from the pile being driven will be exposed to sound levels greater than 160dB. The size of this area is approximately of 160-180 dB will be experienced is limited to a roughly circular area extending from 750 m to 3.4km from the pile being driven. This results in an area of approximately 34.56km^2.

Few researchers have reported on the density of sea turtles in Northeastern waters. However, this information is available from one source (Shoop and Kenney 1992). Shoop and Kenney (1992) used information from the University of Rhode Island's Cetacean and Turtle Assessment Program (CETAP[6]) as well as other available sightings information to estimate seasonal abundances of loggerhead and leatherback sea turtles in northeastern waters. The authors calculated overall ranges of abundance estimates for the summer of 7,000-10,000 loggerheads and 300-600 leatherbacks present in the study area from Nova Scotia to Cape Hatteras. Using the available sightings data (2841 loggerheads, 128 leatherbacks and 491 unidentified sea turtles), the authors calculated density estimates for loggerhead and leatherback sea turtles (reported as number of turtles per square kilometer). These calculations resulted in density estimates of 0.00164 – 0.510 loggerheads per square kilometer and 0.00209 – 0.0216 leatherbacks per square kilometer. It is important to note, however, that this estimate assumes that sea turtles are evenly distributed throughout the waters off the northeast, even though Shoop

6 The CETAP survey consisted of three years of aerial and shipboard surveys conducted between 1978 and 1982 and provided the first comprehensive assessment of the sea turtle population between Nova Scotia, Canada and Cape Hatteras, North Carolina.

and Kenney report several concentration areas where loggerhead or leatherback abundance is much higher than in other areas. Further, the data do not include any sightings from Massachusetts generally, or Nantucket Sound specifically and only considered the presence of leatherback and loggerhead sea turtles. The Shoop and Kenney data, despite considering only the presence of loggerhead and leatherback sea turtles, likely overestimates the number of sea turtles present in the impact zone. This is due to the assumption that sea turtle abundance will be even throughout the Nova Scotia to Cape Hatteras study area, which is an invalid assumption. Sea turtles occur in high concentrations in several areas outside of the action area and the inclusion of these concentration areas in the density estimate skews the estimate for the action area.

As noted above (see pages 70-71), Mass Audubon conducted surveys for terns over an approximately four week period in 2002, 2003 and 2004. Both shipboard and aerial surveys were conducted. In their reports, Mass Audubon includes information on sea turtle sightings. As this information was collected in the action area, it represents important information on the presence of sea turtles in this area. There are limitations to the Mass Audubon data. As noted above, the aerial surveys were not designed to observe sea turtles. However, as the flights were flown at an elevation that is within the range known to be effective for observing sea turtles (i.e., 500 feet; Henwood and Epperly 1999) and flights were only taken on days when visibility was extremely good (i.e., greater than 10 miles), it is likely that the observations represent a reasonable estimate of the number of sea turtles at the surface during the survey. Further, when compared to a calculation made by Witzell and Azarovitz (1996) using aerial survey data where sea turtles were specifically targeted, the number of sea turtles observed per 100 km flown is nearly identical for the month of August (1.15 sea turtles observed per 100km flown in the Mass Audubon surveys and 1.1 sea turtles observed per 100km flown in the surveys reported in Witzell and Azarovitz).

It is likely that the Mass Audubon data underestimates the number of sea turtles present during the surveys. This is due to the fact that observations of sea turtles were incidental to the surveys for terns and other birds. Additionally, as sea turtles spend a considerable amount of time underwater, there were likely additional submerged sea turtles in the survey area that went uncounted. Sea turtles spend a significant amount of time underwater. Specifically, it has been estimated that individual loggerhead sea turtles spend 80-94% of their time submerged, Kemp’s ridleys spend approximately 96% of the time submerged and leatherbacks 74-91% of the time submerged (Lutcavage and Lutz 1997). One study of green sea turtles indicated that individual turtles spent between 81-98% of the time submerged, with an average of 91% (Renaud et al. 1995). It has been estimated that, on average, sea turtles spend only between 3-6% of the time at the surface, and cumulatively spend only approximately one hour a day at the surface (Spotila 2004; Lutcavage and Lutz 1997).

The 115 sea turtle observations occurred over 25 survey days where approximately 888 square kilometers were surveyed. It is important to note that these surveys coincided with the time of year when the highest numbers of sea turtles are expected to occur in the action area (i.e., July – September). Approximately 5 sea turtles were observed during each survey day. This translates into approximately 0.006 sea turtles observed per square kilometer surveyed. Based on the known amount of time that sea turtles spend submerged each day, it is likely that only 3-6% of the sea turtles present in the study area would have been at the surface at the time of the survey. In this case, the actual number of sea turtles present (i.e., submerged and at the surface) in the survey area during the aerial survey was more likely in the range of 83-166 sea turtles (i.e., 5 is 3% of 166 and 6% of 83). Using these estimates, the density of sea turtles per square kilometer can be calculated. The values calculated are 0.09 (which is equivalent to 83 sea turtles/888 square kilometers) and 0.19 (166 sea turtles/888 square kilometers).

Using these calculated densities, an estimate of the number of sea turtles likely to be exposed to noise levels between 160 and 180 dB can be calculated (i.e., number of sea turtles per square kilometer multiplied by 34.56 (the size of the area where noise levels will be between 160 and 180 dB)). This calculation results in an estimate of between 3 and 7 sea turtles likely to be present in any given 34.56 square kilometer area within Nantucket Sound.

Based on the available information it is likely that the number of sea turtles that would be exposed to noise levels between 160 and 180 dB ranges between 3 and 7. These numbers use the Mass Audubon data adjusted for the likely percentage of sea turtles that would have been submerged, and therefore not visible to observers, during the aerial surveys. The number of sea turtles exposed to these sound levels will be influenced by the depth of water at the particular site as well as the amount and type of forage present within the impact zone and the time of year when the pile driving is occurring (i.e., more sea turtles are likely to be present at sites with depths of 16-49 feet, with concentrations of preferred forage items, or during the months of August and September). As noted above, only pile driving occurring between June and November would result in the exposure of sea turtles to disturbing levels of noise.

Sea turtles behaviorally disrupted would be expected to resume their behavior after the pile driving has stopped. As pile driving will occur for approximately 4 hours a day, it is likely that sea turtles will be excluded from the area with disturbing levels of sound for at least this period each day. Available information indicates that sea turtle forage items are available throughout the action area; therefore, while sea turtles may move to other areas within the action area to forage during the times when pile driving is occurring, the ability of individual sea turtles to find suitable forage is not expected to be impacted. Likewise, if sea turtles were resting in a particular area they are expected to be able to find an alternate resting area within the action area. Additionally, if sea turtles are migrating through the action area, they may avoid the area with disturbing levels of sound and choose an alternate route through the action area. However, as at all times there will be areas of Nantucket Sound where noise levels are not at disturbing levels, the ability of sea turtles to migrate through the action area will not be affected. As such, while the movements of individual sea turtles while be affected by the sound associated with the pile driving, these effects will be temporary and localized and sea turtles are not expected to be excluded from Nantucket Sound and there will be only a minimal impact on foraging, migrating or resting sea turtles that will not result in injury or impairment in an individual's ability to complete essential behavioral functions. Major shifts in habitat use or distribution or foraging success are not expected. As changes to individuals movements are expected to be minor and short-term, and are therefore not likely to have population-level effects.

Effects of Noise Associated with Vessel Traffic

Support and vessel transits will occur regularly throughout the construction period. These vessels will be shuttling personnel and supplies between Quonset, RI and Yarmouth, MA and the construction site, and will represent an additional transient source of noise along the transit path. During the construction period several vessels will transit to the work site each day, carrying supplies and equipment. Vessels transmit noise through water and cumulatively are a significant contributor to increases in ambient noise levels in many areas. The dominant source of vessel noise from the proposed action is propeller cavitation, although other ancillary noises may be produced. The intensity of noise from service vessels is roughly related to ship size and speed. Large ships tend to be noisier than small ones, and ships underway with a full load (or towing or pushing a load) produce more noise than unladen vessels. Vessel traffic associated with the proposed action would produce levels of noise of 150 to 170 dB re 1 μPa-m at frequencies below 1,000 Hz. A tug pulling a barge generates 164 dB re 1 μPa-m when empty and 170 dB re 1 μPa-m loaded. A tug and barge underway at 18 km/h can generate broadband source levels of 171 dB re 1 μPa-m. A small crew boat produces 156 dB re 1 μPa-m at 90 Hz.

Vessel noises are within the range of frequencies that whales can detect and as explained above, whales occur in some of the waters to be transited by project vessels. Vessels transiting between Yarmouth, MA and the project site and New Bedford, MA and the project site will be smaller crew boats. The noise produced by these vessels is below the threshold of harassment from a non-continuous noise source (160 dB; while the vessel noise is continuous, whales will not be exposed continuously as the vessels will be transiting and only a small area will be esonified at a given time). As such, any effects from noise associated with crew support vessels transiting from Yarmouth, MA or New Bedford, MA will be discountable. Project related vessel traffic traveling between the construction staging area at Quonset, RI and the project site in Nantucket Sound will consist of tugs and barges. As noted above, the source level for these vessels is approximately 164-171 dB re 1 μPa-m. However, operational noise sources are expected to diminish to below the 160 dB re 1uPa threshold within short distances. Based on the small number of vessel trips (86 over an 11 month period) and operating procedures which limit vessels from approaching within 100 meters of a whale and 500 meters of a right whale, it is extremely unlikely that any project vessel would come close enough to a whale in a manner that would result in exposure to harassing levels of noise. As such, no whales are expected to be exposed to injurious or harassing levels of sound. As no avoidance behaviors are anticipated, the distribution, abundance and behavior of whales in the action area is not likely to be affected by noise associated with construction or maintenance vessels and any effects will be insignificant or discountable.

As noted previously in relation to construction noise, sea turtles are thought to be far less sensitive to sound than marine mammals. Although vessel noises are within the limited range of frequencies they can detect, evidence suggests that sound levels of 110-126 dB re 1μPa are required before sea turtles can detect a sound (Ridgway 1969; Streeter, in press). McCauley (2000) noted that dB levels of 166 dB re 1μPa were required before any behavioral reaction was observed. As all operational noise sources are expected to diminish to below this threshold within very short distances, no sea turtles are expected to be exposed to injurious or harassing levels of sound. As no avoidance behaviors are anticipated, the distribution, abundance and behavior of sea turtles in the action area is not likely to be affected by noise associated with construction or maintenance vessels and any effects will be insignificant or discountable.

Effects of Exposure to Operational Noise Sources

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

- Wind turbine operation
- maintenance and support vessel transits

Wind Turbine Operation

Once installed, the operation of the WTGs is not expected to generate substantial sound levels above baseline sound in the area. Preliminary results from noise studies conducted in the United Kingdom suggest that in general, the level of noise created during the operation of offshore windfarms is very low and does not cause avoidance of the area by marine species (Nedwell, unpub. data, reported in BOEM 2008). Even in the area directly surrounding the wind turbines, noise was not generally found above the level of background noise, resulting in normal activity of marine animals (Nedwell, unpub. data, reported in BOEM 2008).

Acoustic modeling of underwater operational sound at the proposed Cape Wind facility was performed for the design wind condition and reported in the BA and DEIS. Baseline underwater sound levels under the design wind condition are 107.2 dB. The predicted sound level from operation of a WTG is 109.1 dB at 65.6 ft (20 m) from the monopile (i.e., only 1.9 dB above the baseline sound level) and this total sound level falls off to 107.5 dB at 164 ft (50 m) and declines to the baseline level by 361 ft (110 m)). Since the WTGs will be spaced farther apart than 360 ft (110 m) (approximately 629 to 1,000 m or 0.34 to 0.54 nautical miles apart), no cumulative impacts from the operation of the 130 WTGs in the Wind Park are anticipated.

As large whales are extremely rare in Nantucket Sound and the nearest sighting to the project footprint was approximately 4km away, it is extremely unlikely that any whales will occur within 360 feet of any of the WTGs. As no whales are expected to occur within 360 feet of any of the WTGs, no whales will be exposed to operational noise associated with the project. As sea turtles are distributed throughout the project area, sea turtles are likely to be exposed to operational sound of the WTGs. However, as the sound (109.1 dB at 65.6 feet) will be less than 2dB above the baseline underwater noise levels (107.5 dB) and well below harassing noise levels (i.e., 120 dB re 1 uPa for a continuous noise source), the operational noise of the WTGs will not result in injury or disturbance of sea turtles. While sea turtles may be able to hear the noise associated with the operation of the WTGs the noise will not affect the distribution, abundance or behavior of sea turtles in the action area.

Geophysical and Geotechnical Surveys

The applicant will conduct a high resolution geophysical survey prior to construction. The high-resolution geophysical survey would investigate the shallow subsurface for geohazards and sediment conditions, as well as to identify potential benthic biological communities (or habitats) and archaeological resources. BOEM has indicated that the survey will consist of a vessel towing an acoustic source (boomer and/or chirper) about 25 m behind the ship and a 600-m streamer cable with a tail buoy. Surveys will be conducted prior to construction and may begin as early as Spring of 2011. The survey area includes the entire project footprint where wind turbines will be installed and the 115 kV submarine cable route. The survey vessels will operate during daytime hours only. Daily operations are expected to occur approximately 10 hours per day during relatively calm sea conditions. The applicant anticipates up to 5 months of survey activity to cover the survey area, with between 330 and 660 hours of survey effort during this time. Tracklines will be spaced approximately 30 meters apart. Two survey vessels may operate at one time and will travel at approximately 3 knots during data acquisition and will transit to and from the survey area from port at approximately 15 knots. The vessels will operate continuously throughout the Project Area during the day and terminate survey activities each day before dark, prior to returning to port. If two vessels are used, they will work at least 15 miles apart. As such, there will be no overlap of sounds generated by the vessels.

The sound levels at the source (i.e., the boomer and chirper) will depend on the type of equipment used for the survey. Information provided by the applicant indicates that the following equipment will be used:

Table 2. Equipment to be Utilized during HRG Survey

Survey Task	Sample Equipment Model Type	Frequency (kilohertz)	Estimated Sound Pressure Levels at Source (dB re 1µPa RMS at 1m)
Singlebeam Depth Sounder	Innerspace Model 448	200 kHz	202 to 215 dB
Multibeam Depth Sounder	Reson 7101	240 kHz	207 dB
Side Scan Sonar	Klein Dual 3900	445 and 900 kHz	220 dB
Shallow-Penetration Subbottom Profiler (chirper)	EdgeTech chirper	2-16 kHz	201 dB
Medium-Penetration Subbottom Profiler (boomer)	Applied Acoustics boomer	0.5-20 kHz	205 dB

Acoustic energy generated by these survey instruments is directed downward at the seafloor and not directed horizontally. The frequencies of most of the instruments exceed the hearing bandwith of whales and sea turtles that may occur in the action area. As such, with the exception of the subbottom profilers (chirper and boomer), whales and sea turtles would not be capable of perceiving the sound generated by the instruments.

The subbottom profilers generate sound within the hearing thresholds of whales and sea turtles that may occur in the action area. As noted in the table above, the chirper has a sound source level of 201 dB re 1uPa rms with a typical pulse length of 32 milliseconds and a pulse repetition rate of 4 per second. A typical boomer has a sound source level of 215 dB re 1uPa rms with a pulse duration of 150-200 microseconds and a pulse repetition rate of 3 per second. BOEM and the applicant have provided information to NMFS noting that the underwater sound levels dissipate to 180 dB at 16 meters from the source for the chirp and 27 meters for the boomer. BOEM and the applicant have provided information to NMFS noting that the underwater sound levels dissipate to 160 dB isopleths at 227 meters from the source for the chirp and underwater sound levels from the boomer dissipate to 160 dB at 386 meters from the source.

As explained above, whales are extremely unlikely to occur on Horseshoe Shoal, with the nearest sighting being approximately 5 km away from the project footprint; as such, it is extremely unlikely that any whales will be exposed to effects of the geophysical and geotechnical surveys.
Given the known distribution of whales within the action area and that no whales are likely to occur in the area being surveyed and given the likely maximum ranges of the 180 dB and 160 dB isopleths, (maximum 27 meters and 386 meters, respectively) it is highly unlikely that any whales would be exposed to injurious or disturbing sound levels associated with the survey. The risk of exposure is further reduced by the use of an observer which will ensure that the survey equipment is not operated if a whale or sea turtle is within 500 meters of the survey vessel. Additionally, while it is highly unlikely that any whales will occur in the area being surveyed, Cape Wind will monitor the Right Whale SAS and can modify their survey schedule in the unlikely event that whales were present within Nantucket Sound. Therefore, NMFS has determined that no whales are likely to be exposed to potentially injurious or disturbing levels of noise associated with the high resolution geophysical surveys.

If the survey occurred between June and November, listed sea turtles could be exposed to effects of the survey. BOEM is requiring that the applicant maintain a 500 meter exclusion zone during the survey and that this exclusion zone be monitored for at least 60 minutes prior to ramp up of the survey equipment. The normal duration of sea turtle dives ranges from 5-40 minutes depending on species, with a maximum duration of 45-66 minutes depending on species (Spotila 2004). As sea turtles typically surface at least every 60 minutes, it is reasonable to expect that monitoring the exclusion zone for at least 60 minutes will allow the endangered species monitor to detect any sea turtles that may be submerged in the exclusion zone.

Once the survey begins, the survey vessel will be traveling at a speed of 3 knots. The observer will continually monitor the 500 meter exclusion zone and the equipment will be shut down if a sea turtle is observed within the exclusion zone. As the survey vessel travels along the transects it is expected that any sea turtles in the area that are close enough to perceive the sound will swim away from it. As noted above, potentially disturbing levels of noise (i.e., greater than 160 dB) will be experienced within 386 meters of the survey equipment. During the survey, an area of approximately 148 square kilometers will be surveyed. Based on the estimates of sea turtle density in the action area (see above), NMFS estimates that between 13 and 28 sea turtles could be exposed to disturbing levels of noise during the survey. At any given time during the survey, an approximately 0.38 square kilometer area will have noise levels between 160 and 180 dB.

In order for a sea turtle to be exposed to injurious levels of noise, the sea turtle would need to be within 27 meters of the survey equipment. Given the noise levels produced by the survey equipment and given the expected behavioral response of avoiding noise levels greater than 160 dB, it is extremely unlikely that any sea turtles would swim towards the survey vessel. Any sea turtles within 27 meters of the equipment at the beginning of the survey would move away during ramp-up and not be injured. As such, it is extremely unlikely that any sea turtles would be exposed to injurious levels of noise.

Sea turtles whose behavior is disrupted would be expected to resume their behavior after the disturbance has stopped. While the survey will occur approximately 10 hours per day, the time that any particular area will experience elevated sound levels will be significantly shorter. Available information indicates that sea turtle forage items are available throughout the action area; therefore, while sea turtles may move to other areas within the action area to forage during the times when the survey is occurring, the ability of individual sea turtles to find suitable forage is not expected to be impacted. Likewise, if sea turtles were resting in a particular area they are expected to be able to find an alternate resting area within the action area. Additionally, if sea turtles are migrating through the action area, they may avoid the area with disturbing levels of sound and choose an alternate route through the action area. However, as the area that will have disturbing levels of sound at any given time is extremely small (i.e., 0.384 square kilometers) and, as at all times there will be areas of Nantucket Sound where noise levels are not at disturbing levels, the ability of sea turtles to migrate through the action area will not be affected. As such, while the movements of individual sea turtles while be affected by the sound associated with the survey, these effects will be temporary and localized and sea turtles are not expected to be excluded from Nantucket Sound and there will be only a minimal impact on foraging, migrating or resting sea turtles that will not result in injury or impairment in an individual's ability to complete essential behavioral functions. Major shifts in habitat use or distribution or foraging success are not expected. As changes to individuals movements are expected to be minor and short-term, and are therefore not likely to have population-level effects.

While the towed gear (i.e., the airgun, boomer, sparker or chirper) has the potential to result in interaction with sea turtles, the speed of towing (typically about 3 knots) minimizes the potential for entanglement or vessel strikes during the survey as sea turtles would be able to avoid the slow moving gear and survey vessel.

The geotechnical surveys will result in small areas of the seafloor being disturbed, either at the core hole or associated with the coring vessel anchor placements. It is likely that the duration of activity at any one coring location would be no more than a few days. The geotechnical investigations would result in a negligible temporary loss of some benthic organisms (i.e., less than one foot diameter will be disturbed in the areas where cores are sampled), and a localized increase in disturbance due to vessel activity, including noise and anchor cable placement and retrieval. Effects of the disturbance of the seafloor and the effect on foraging sea turtles and whales are discussed in the "Destruction of Prey Resources/Loss of Foraging Habitat" section above. Additionally, the effect of the survey vessels on increasing the risk of vessel strikes is also discussed in the "Vessel Strike" section above. As noted in those sections, effects to listed species from these sources would be insignificant or discountable.

Decommissioning

At the conclusion of the life of the Cape Wind project, components would be retrieved and removed from the site. All components in the water column would be retrieved, including the ESP, WTGs, and submarine cables. At the end of the proposed action's lifespan, removal of the WTG monopile foundations and ESP piles at the time of decommissioning would result in a localized shift from a structure oriented habitat near the WTGs and ESP to the original shoal-oriented habitat present prior to construction to the proposed action. However, as the addition of the monopiles would be a minor addition to the hard substrate that was present prior to the construction of the WTG facility, the removal of the WTGs and ESPs will not cause a great impact in the overall habitat structure. Therefore, sea turtle populations that consume colonizing benthic invertebrate prey are not likely to increase due solely to the presence of the monopiles and hence would not be adversely affected by their removal.

These removal activities are expected to have impacts similar to those discussed above in relation to construction activities, including temporary seafloor disturbance, turbidity, and water withdrawal and discharge associated with flushing of the pipeline. However, all impacts would be of less magnitude than those resulting from construction activities. As such, effects of decommissioning activities will be insignificant or discountable.

Non-routine and Accidental Events

Cable Repair

Many of the types of disturbances that would occur during cable repair activities are smaller and of shorter duration, but of similar type, to those that would occur during cable installation. A relatively short distance along the sea floor would be disturbed by the jetting process used to uncover the cable and allow it to be cut so that the cable ends could be retrieved to the surface. In addition to the temporary loss of some benthic organisms, there would be increased turbidity for a short period, and a localized increase in disturbance due to vessel activity, including noise and anchor cable placement and retrieval. As explained in sections related to the effects of cable installation above, as no whales are expected to occur along the cable route, there would be no effects to whales from a cable repair. Depending on the time of year that the cable repair occurred, sea turtles may be present. However, as explained in the cable installation sections above, all effects of the cable laying process, and similarly, the cable repairing process, would be insignificant or discountable.

Vessel Collision with Monopile

The extent of potential impacts that could result from a vessel collision with a monopile largely depends on the extent of damage to the monopile or vessel. Some smaller vessels would merely strike a glancing blow and possibly suffer some hull damage but not sink. Other vessels may suffer enough damage to sink, causing a small release of fuel and debris. A larger vessel may cause a collapse of the monopile, also resulting in a small release of lubricating fluid. Repair of a damaged or collapsed monopile would create short term and localized disturbances to the benthos, water column, and pelagic organisms similar to the construction and decommissioning of a single monopile, albeit in reverse order and combined in a single event. The effects of a vessel collision on listed species are difficult to predict. However, as no whales are expected to occur in the action area, any effects of a vessel collision with a monopile with whales are discountable. Effects to sea turtles from a vessel collision with a monopile are more likely to be attributable to the debris that enters the water and effects of any repair activities. As any effects are likely to be on a small scale and temporary, any effects, if adverse, will be insignificant.

Oil Spill

Oil spills could occur either as a release from the ESP storage tank or from a vessel collision with a monopile. An oil spill would be an unintended, unpredictable event. Marine animals, including whales and sea turtles, are known to be negatively impacted by exposure to oil and other petroleum products. Without an estimate of the amount of oil released it is difficult to predict the likely effects on listed species. The applicant is required to develop an oil spill response plan which would ensure rapid response to any spill. As the effects of a spill are likely to be localized and temporary, sea turtles and whales are not likely to be exposed to oil and any effects would be discountable. Additionally, should a response be required by the US EPA or the USCG, there would be an opportunity for NMFS to conduct a consultation with the lead Federal agency on the oil spill response which would allow NMFS to consider the effects of any oil spill response on listed species in the action area.

Electricity Production

The purpose of the Cape Wind project is to generate electricity. Electricity will travel from the WTGs to the ESP and then by submarine cable to on-land cables in Yarmouth, Massachusetts. From this point, electricity generated at the WTGs would be distributed to the New England Power Grid. Electricity will then be used to support existing uses. The total generating capacity in the New England power system in the year 2004 was 30,940 megawatts (MW; reported in BOEM 2008). The maximum electric output of the Cape Wind project is predicted to be 468 MW, with an average output of 182.6 MW. Effects to listed species from the distribution and use of electricity generated by the Cape Wind project can not be predicted. However, as the electricity generated will support existing uses, any effects of these uses on sea turtles or whales are expected to have been captured in the Status of the Species and Environmental Baseline sections above.

In the DEIS, BOEM estimated that if the amount of energy produced by the proposed project was to be produced by fossil-fuel powered plants instead, it would result in about 0.88 million tons of carbon dioxide emitted per year. The projected increase in energy needs in New England between 2005 and 2014 would result in an increase of about 84 tons per year of carbon dioxide if the power were to be produced by fossil-fuel power plants. BOEM estimated that the potential reduction in the growth of carbon dioxide emissions due to operation of the proposed project would be about 1 percent of the total projected increase. Whether there would be effects to listed species from a reduction in the growth of carbon dioxide emissions is unknown, as is what any such effect might be.

Air Emissions from Project Vessels Operating on the OCS

As explained in the Description of the Proposed Action, EPA is proposing to issue a permit to Cape Wind to authorize the emissions from project vessels operating on the OCS. This permit covers air emissions from the construction equipment and vessels operating at the project site on the OCS. EPA has stated that Cape Wind's highest emission rates are short-lived and occur only during the first year of construction. The emissions and associated air impacts during the second year of construction and during commercial operations are far less. EPA has also explained that the project's peak emissions will not result in any exceedance of any currently attained primary or secondary National Ambient Air Quality Standards (NAAQS). Primary NAAQS are set to protect public (human) health with an adequate margin of safety, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary NAAQS set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings. EPA has also explained that while eastern Massachusetts (and all of southern New England) is not currently attaining the ozone NAAQS, Cape Wind's air emissions will not exacerbate regional ozone concentrations because ozone precursor (NOx) emissions will be offset at a 1.26:1 ratio. As such, any effects to air quality from the proposed action are likely to be insignificant. At this time, there is no information on the effects of air quality on listed species that may occur in the action area. However, as the emissions regulated by EPA will have insignificant effects on air quality, it is reasonable to conclude that any effects to listed species from these emissions will also be insignificant.

INTEGRATION AND SYNTHESIS OF EFFECTS

In the effects analysis outlined above, NMFS considered potential effects from the following sources: (1) construction of the facility including the submarine cables and the WTGs, (2) operation and maintenance of the facility, (3) pre-construction geotechnical and geophysical surveys, and, (4) decommissioning. In addition to these categories of effects, NMFS considered the effects of non-routine and accidental events including oil spills, cable repair, and vessel collisions with a monopole.

Right, humpback, and fin whales

As explained in sections above, only rare transient whales occur in Nantucket Sound, and whales are extremely unlikely to occur on Horseshoe Shoal where the wind facility will be constructed. The analysis contained above demonstrates that all effects of the project, with the exception of the transit of project vessels, will be contained within areas where large whales are extremely unlikely to occur; as such, while noise associated with pile driving will extend several kilometers from the pile being driven, no whales are likely to be exposed to injurious or harassing sound levels. Additionally, as no whales will occur along the cable laying route, no interactions with cable laying activities are likely. Similarly, whales are extremely unlikely to occur in the area where the pre-construction survey will take place and no whales are likely to be exposed to injurious or harassing levels of underwater noise resulting from this survey. The analysis also concludes that while large whales may occasionally be present along the routes transited by construction vessels staged from Quonset, RI and maintenance vessels transiting from New Bedford, MA, interactions between project vessels and large whales are extremely unlikely to occur. Additionally, any exposure to vessel noise will result in insignificant effects. As all effects to whales from the proposed project are likely to be insignificant or discountable, this action is not likely to adversely affect listed whales in the action area.

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

As noted in sections above, the physical disturbance of sediments and associated benthic resources from various aspects of the project including cable laying and monopile installation, could reduce the availability of sea turtle prey in the affected areas, but these reductions will be localized and temporary, and foraging turtles are not likely to be limited by the reductions.

BOEM will require several mitigation measures that will reduce the likelihood of interactions between sea turtles and project vessels, including the presence of observers. Based on the analysis presented above, the increase in risk of a vessel strike to a sea turtle in the action area is insignificant.

Marine animals are known to be injured and harassed by anthropogenic noise sources. In the Effects of the Action section above, NMFS has determined that any effects of exposure to construction and maintenance vessel noise, cable laying activities, and operation of the WTGs will be insignificant or discountable. However, sea turtles are likely to be exposed to disturbing levels of noise during pile driving and the high resolution shallow hazards survey.

Mitigation measures implemented during impact pile driving minimize the potential for acoustic-related injuries to sea turtles. As explained above, a 750 meter exclusion zone will be maintained around any pile being driven. The exclusion zone will be monitored for 60 minutes which is designed to account for the average dive/surface time for sea turtles in the area. As such, any sea turtle in the 750 meter exclusion zone area is expected to surface within the 60 minute monitoring period and be detected by the observer. Based on the analysis presented above, no sea turtles are likely to be exposed to potentially injurious levels of sound. However, sea turtles may be exposed to potentially disturbing levels of sound during pile driving activities. Any sea turtles located within 3.4km of a pile being driven are likely to be disturbed and exhibit avoidance behavior. As explained on page 90, NMFS has estimated that between 3 and 7 sea turtles are likely to be exposed to disturbing levels of noise during each 4 hour pile driving event that occurs between June and November.

Similarly to pile driving operations, mitigation measures implemented during the high resolution geophysical survey will minimize the potential for acoustic-related injuries to sea turtles. Based on the analysis presented above, no sea turtles are likely to be exposed to potentially injurious levels of sound resulting from the survey. However, sea turtles may be exposed to potentially disturbing levels of sound during the high resolution geophysical survey.

Any sea turtles located within 227 meters from the chirp and 386 meters from the boomer will be exposed to potentially disturbing levels of noise. At any given time during the survey, an approximately 0.38 square kilometer area will have noise levels between 160 and 180 dB. NMFS has estimated that, in total, between 13 and 28 sea turtles would be exposed to disturbing levels of noise during the survey.

Avoidance behavior may shorten the exposure period; however, the avoidance behavior could potentially disrupt normal behaviors. Sea turtles behaviorally disrupted would be expected to resume their behavior after the noise producing activity (i.e., pile driving or high resolution survey) has stopped. As pile driving will occur for approximately 4-6 hours a day, it is likely that sea turtles will be excluded from the area with disturbing levels of sound for at least this period each day. Likewise, during the time the high resolution geophysical survey is ongoing, sea turtles would be excluded from the area with disturbing levels of sound (estimated at 0.384 square kilometers at any given time during the survey). While sea turtles may move to other areas within the action area to forage during the times when pile driving or the high resolution geophysical survey is occurring, the ability of individual sea turtles to find suitable forage is not expected to be impacted. Likewise, if sea turtles were resting in a particular area they are expected to be able to find an alternate resting area within the action area. Additionally, if sea turtles are migrating through the action area, they may avoid the area with disturbing levels of sound and choose an alternate route through the action area. However, as at all times there will be areas of Nantucket Sound where noise levels are not at disturbing levels, the ability of sea turtles to migrate through the action area will not be affected. As such, while the movements of individual sea turtles while be affected by the sound associated with the pile driving and the high resolution geophysical survey, these effects will be temporary and localized and sea turtles are not expected to be excluded from Nantucket Sound and there will be only a minimal impact on foraging, migrating or resting sea turtles that will not result in injury or impairment in individuals' ability to complete essential behavioral functions. Major shifts in habitat use or distribution or foraging success are not expected. Changes to individuals' movements are expected to be minor and short-term, and are, therefore, not likely to reduce numbers, reproduction or distribution. All other effects of the proposed project are expected to be insignificant or discountable and are not expected to reduce numbers, reproduction or distribution.

While the action may affect the distribution of sea turtles in the action area during the approximately four to six hours a day while pile driving is occurring (as sea turtles will avoid the 34.56 square kilometer impact zone), and during the high resolution geophysical survey (as sea turtles will avoid the 0.38 square kilometer area with disturbing levels of noise), the effect on distribution will be temporary and localized. As such, the action will not affect the overall long-term distribution of loggerhead, Kemp's ridley, green or leatherback sea turtles in the action area or throughout their range.

While the proposed action may temporarily affect the movement of individual sea turtles in the action area, NMFS has determined that this will not affect the overall distribution or abundance of sea turtles in the action area. Nor will it affect the ability of any individual sea turtles to complete any essential behavioral function such as foraging, resting or migrating. Therefore, the temporary disturbance caused by noise associated with pile driving will not negatively affect any sea turtles' chances of survival. Their ability to reproduce would be the same as for a sea turtle that had not been exposed to pile driving noise.

As no sea turtles will be injured or killed by the proposed action, either directly, through loss of prey and/or habitat, or other means, the action will not reduce the number of loggerhead, Kemp's ridley, green or leatherback sea turtles. Additionally, as the action will not affect the reproductive success of any individual turtle, it will not reduce the reproduction of loggerhead, Kemp's ridley, green or leatherback sea turtles. Therefore, the proposed action will not affect the numbers, reproduction or distribution of sea turtles in the western north Atlantic, and will not reduce their likelihood of survival. Since the proposed action has no direct or indirect effects on sea turtles that occur elsewhere in the Atlantic or outside of the Atlantic, the proposed action will not appreciably reduce the likelihood of survival of any species of sea turtle.

Section 4(a)(1) of the ESA requires listing of a species if it is in danger of extinction throughout all or a significant portion of its range (i.e., "endangered"), or likely to become in danger of extinction throughout all or a significant portion of its range in the foreseeable future (i.e., "threatened") because of any of the following five listing factors: (1) The present or threatened destruction, modification, or curtailment of its habitat or range, (2) overutilization for commercial, recreational, scientific, or educational purposes, (3) disease or predation, (4) the inadequacy of existing regulatory mechanisms, (5) other natural or manmade factors affecting its continued existence. Recovery of a species occurs when listing it as an endangered or threatened species is no longer warranted. The proposed action will not appreciably reduce the likelihood of recovery of any sea turtle species because it will not affect the numbers, reproduction or distribution of loggerhead, Kemp's ridley, green or leatherback sea turtles. Also, it is not expected to modify, curtail or destroy the range of the species since it does not reduce the number of loggerhead, Kemp's ridley, green or leatherback sea turtles in any geographic area or nesting group and since it will not affect the overall distribution of sea turtles other than to cause minor temporary adjustments in movements in the action area. The proposed action will not utilize loggerhead, Kemp's ridley, green or leatherback sea turtles for recreational, scientific or commercial purposes, affect the adequacy of existing regulatory mechanisms to protect any of these species of sea turtles, or affect their continued existence. The effects of the proposed action will not hasten the extinction timeline or otherwise increase the danger of extinction since the action will not result in mortality of loggerhead sea turtles or their ability to survive and reproduce. Therefore, the proposed action will have no effect on the ESA listing factors or the likelihood that loggerhead, Kemp's ridley, green or leatherback sea turtles can be brought to the point at which they are no longer listed as endangered or threatened. In light of the conclusions of the effect of the action relative to the ESA-listing factors, the proposed action will not appreciably reduce the likelihood of recovery for any of the sea turtle species.

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, it is NMFS' biological opinion that the proposed action may adversely affect but is not likely to jeopardize the continued existence of the loggerhead, Kemp's ridley, leatherback or green sea turtles. Additionally, NMFS has concluded that the proposed action is not likely to adversely affect right, humpback or fin whales and, therefore, is not likely to jeopardize the continued existence of these whale species. NMFS has also concluded that the action will not affect hawksbill turtles, shortnose sturgeon, or sperm, blue or sei whales as these species do not occur in the action area. Because no critical habitat is designated in the action area, none will be affected by the proposed action.

Proposed Rule to List Loggerhead Sea Turtles

As explained in *Status of Listed Species* section of this Opinion, on March 16, 2010, NMFS published a proposed rule to list two DPSs of loggerhead sea turtles as threatened and seven DPSs of loggerhead sea turtles as endangered. This rule, when finalized, would replace the existing listing for loggerhead sea turtles. Currently, the species is listed as threatened range-wide. Once a species is proposed for listing, the conference provisions of the ESA apply. As stated at 50 CFR 402.10, "Federal agencies are required to confer with NMFS on any action which is likely to jeopardize the continued existence of any proposed species or result in the destruction or adverse modification of proposed critical habitat. The conference is designed to assist the Federal agency and any applicant in identifying and resolving potential conflicts at an early stage in the planning process."

As described in this Opinion, the proposed action is not anticipated to result in the mortality of any loggerhead sea turtles, but will result in the acoustic harassment of a number of loggerhead sea turtles during pile driving activities and the geophysical survey. In this Opinion, NMFS concludes that this level of take is not likely to reduce appreciably the likelihood of both the survival and recovery of the species in the wild by reducing the reproduction, numbers, or distribution of that species and that, therefore, the action is not likely to jeopardize the continued existence of loggerhead sea turtles. As the proposed action will not result in the injury or mortality of any loggerhead sea turtles, it is reasonable to expect that the conclusions reached for the Northwest Atlantic population and current range-wide listing would be the same as for the proposed Northwest Atlantic DPS. A conference is only required when an action is likely to jeopardize the continued existence of any proposed species, and, based on the above information it is unlikely that the effects of the proposed action would result in jeopardy for the proposed Northwest Atlantic DPS. Thus, a conference is not required for this proposed action. Additionally, as the ITS included with this Opinion contains all terms and conditions and reasonable and prudent measures necessary and appropriate to minimize and monitor take of loggerhead sea turtles, it is unlikely that a conference would identify or resolve additional conflicts or provide additional means to minimize or monitor take of loggerhead sea turtles.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits the take of endangered species. 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. NMFS interprets the term "harm" as an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it 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). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. The term "harass" has not been defined by NMFS; however, it is commonly understood to mean to annoy or bother. In addition, 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). 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 this Incidental Take Statement.

Amount or Extent of Incidental Take

The proposed action has the potential to directly affect loggerhead, Kemp's ridley, green and leatherback sea turtles by causing them to be exposed to potentially harassing levels of sound during pile driving and the high resolution geophysical survey. As explained in the "Effects of the Action" section of the accompanying Opinion, only sea turtles located within a 34.56 square km area surrounding the pile being driven will be exposed to noise levels between 160 and 180 dB. As explained on page 90 of the "Effects of the Action" section, NMFS has estimated that between 3 and 7 sea turtles are likely to be exposed to disturbing levels of noise during each 4 hour pile driving event. As pile driving will occur for approximately four to six hours per pile over a period of approximately eight months, the potential for exposure will be limited to that time period only. As explained in the "Effects of the Action" section, during the high resolution geophysical survey program, any sea turtles located within 227 meters from the chirp and 386 meters from the boomer will be exposed to noise levels between 160 and 180 dB. During the survey, an area of approximately 148 square kilometers will be surveyed. Based on the estimates of sea turtle density in the action area (explained on page 90), NMFS estimates that between 13 and 28 sea turtles would be exposed to disturbing levels of noise during the survey. At any given time during the survey, an approximately 0.384 square kilometer area will have noise levels between 160 and 180 dB.

Exposure of sea turtles to sound levels greater than 160 dB will be considered harassment because that level of noise will disturb sea turtles and their normal behaviors (i.e., resting, foraging or migrating through the area) will be interrupted. Any sea turtles located within 3.4km of the pile being driven will be exposed to these disturbing noise levels and are likely to exhibit avoidance behavior which would cause the alteration of normal behaviors. As loggerhead, Kemp's ridley, green and leatherback sea turtles are likely to be present in the action area and exposed to potentially harassing sound levels, harassment of any of these species could occur and NMFS anticipates that the 3-7 sea turtles exposed to harassing noise levels during each pile driving event and the 13-28 sea turtles exposed to harassing levels of noise during the geophysical survey will be a combination of these species. As sea turtles are only likely to occur in the action area between June and November, only pile driving occurring during these months will result in the harassment of sea turtles. Similarly, effects to sea turtles from the high resolution geophysical survey would only occur if the survey took place between June and November. Incidental take via harassment will be limited to the spatial and temporal extent indicated above.

NMFS believes this level of incidental take is reasonable given the likely seasonal distribution and abundance of sea turtles in the action area and the modeling results provided by BOEM in the BA and DEIS. In the accompanying biological opinion, NMFS determined that this level of anticipated take is not likely to result in jeopardy to the species. As explained above, any incidental take will be limited to: the time period when pile driving is occurring and be limited to a 34.56 square kilometer area surrounding the pile being driven and the time period when the high resolution geophysical survey is occurring and be limited to a 0.384 square kilometer area at any given time during the survey.

Reasonable and prudent measures

Reasonable and prudent measures are those measures necessary and appropriate to minimize and monitor incidental take of a listed species. These reasonable and prudent measures are in addition to the mitigation measures proposed by BOEM and agreed to by Cape Wind that will become a part of the proposed action (see Appendix A of the accompanying Biological Opinion). NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize and monitor impacts of incidental take of sea turtles:

1. BOEM must ensure that any endangered species monitors contracted by Cape Wind are approved by NMFS.
2. During the conduct of pile driving activities related to turbine monopile and Electrical Service Platform (ESP) installation, the 750 meter exclusion zone must be monitored by a NMFS-approved endangered species monitor for at least 60 minutes prior to pile driving.
3. During the conduct of the high resolution geophysical survey, the 500 meter exclusion zone must be monitored by a NMFS-approved endangered species monitor for at least 60 minutes prior to the survey.
4. Acoustic measurement of the first pile being driven must be conducted to confirm the sound levels modeled by BOEM and reported in the BA.
5. Prior to decommissioning, BOEM must provide to NMFS a complete plan for decommissioning activities.

Terms and conditions

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

1. To implement RPM #1, BOEM shall provide NMFS with the names and resumes of all endangered species monitors to be employed at the project site at least 30 days prior to the start of construction. No observer shall work at the project site without written approval of NMFS. If during project construction or operations, additional endangered species monitors are necessary, BOEM will provide those names and resumes to NMFS for approval at least 10 days prior to the date that they are expected to start work at the site.

2. To implement RPM #2, observers must begin monitoring at least 60 minutes prior to soft start of the pile driving. Pile driving must not begin until the zone is clear of all sea turtles for at least 60 minutes. Monitoring will continue through the pile driving period and end approximately 60 minutes after pile driving is completed.

3. To implement RPM #2 and #3, adequate lighting must be provided on all vessels used for endangered species observation to ensure that observers can monitor the exclusion zone for listed sea turtles. If sufficient lighting can not be provided, activities must be limited to daylight hours.

4. To implement RPM #3, observers must begin monitoring at least 60 minutes prior to the start of the high resolution geophysical survey. The survey must not begin until the zone is clear of all sea turtles for at least 60 minutes. Monitoring will continue through the survey period and end approximately 60 minutes after the survey is completed.

5. To implement RPM #4, acoustic monitoring must be conducted to verify that sound levels at 3.4km from the pile being driven is less than 160 dB. Results of this monitoring must be reported to NMFS prior to the driving of any subsequent piles.

6. To implement RPM #5, if the project is to be decommissioned, BOEM must provide a complete decommissioning plan and analysis of effects on listed species to NMFS. NMFS would then review the plan to determine if reinitiation of this consultation is necessary.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize and monitor the impact of incidental take that might otherwise result from the proposed action. Specifically, these RPMs and Terms and Conditions will ensure that no listed species are exposed to injurious levels of sound and will verify the modeling results provided by BOEM based on which NMFS has made conclusions regarding take.

RPM and Term and Condition #1 is necessary and appropriate because it is specifically designed to ensure that all endangered species monitors employed by the applicant are qualified to conduct the necessary duties. Including this review of endangered species monitors by NMFS staff is only a minor change because it is not expected to result in any delay to the project and will merely enforce the qualifications of the endangered species monitors that are already required by BOEM.

RPM and Term and Condition #2 as well as RPM#3 and Term and Condition #4 are necessary and appropriate to provide adequate monitoring by extending the time that monitoring of the exclusion zone must occur from the 30 minutes required by BOEM to 60 minutes. The normal duration of sea turtle dives ranges from 5-40 minutes depending on species, with a maximum duration of 45-66 minutes depending on species (Spotila 2004). As sea turtles can stay submerged for longer than 30 minutes, but typically surface at least every 60 minutes, it is reasonable to require that monitoring occur for at least 60 minutes to allow the endangered species monitor to detect any sea turtles that may be submerged in the exclusion zone. Increasing the time to 60 minutes is only a minor change because the observer will be on location already and an additional 30 minutes of observation is not expected to result in any effects to the project schedule. Term and Condition #3 is necessary and appropriate to provide adequate monitoring of the exclusion zone as if lighting is poor the endangered species monitors will not be able to effectively survey the exclusion zone. Requiring adequate lighting is only a minor change because the vessels will already have some lighting and the addition of extra lighting is not expected to be more than a minor cost and not cause any delay of the project. If sufficient lighting can not be provided and activities must be curtailed during the dark, the delay in project schedule will be only a few hours and this is not expected to result in more than a minor cost and minor effect on overall project schedule.

RPM #4 and Term and Condition #5 are necessary and appropriate because they are designed to verify that the sound levels modeled by BOEM are valid and that the 3.4km zone where sound levels are expected to be greater than 160dB is accurate. This RPM and Term and Condition does not cause more than minor changes because Cape Wind is already required by BOEM to conduct monitoring of underwater sound levels associated with the driving of the first three piles. These measurements must be taken at 100m, 500m and 750m in two directions either west, east, south or north of the pile driving site. The addition of one additional monitoring site for one pile driving event will not cause delays to the project or add a significant cost. RPM #5 and Term and Condition #6 is necessary and appropriate as way to help monitor the proposed action and incidental take by ensuring that the effects of any decommissioning activities on listed species have been adequately analyzed. As it is impossible to predict the exact decommissioning scenario and the status of listed species at the time of decommissioning it is necessary to review the decommissioning plan when it is developed.

These RPMs and Terms and Conditions in conjunction with the mitigation measures proposed by BOEM and agreed to by Cape Wind that will become a part of the proposed action will serve to minimize and monitor incidental take of listed species.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities 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. NMFS has determined that the proposed action is not likely to jeopardize the continued existence of any listed species. To further reduce the adverse effects of the proposed actions, NMFS recommends that BOEM work with the applicant, Cape Wind Associates, to implement the following conservation recommendations.

1. To the extent practicable, pile driving should be minimized during the June – October timeframe when sea turtles are expected to occur in the action area.
2. As there is limited data on use of Nantucket Sound by listed sea turtles, BOEM and/or Cape Wind should support additional survey effort. This could include aerial surveys of the action area specifically targeting sea turtles.

REINITIATION OF CONSULTATION

This concludes formal consultation with BOEM, ACOE and EPA regarding the proposed construction, operation and future decommissioning by Cape Wind Associates LLC of a wind energy project on Horseshoe Shoal. 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, the BOEM must immediately request reinitiation of formal consultation.

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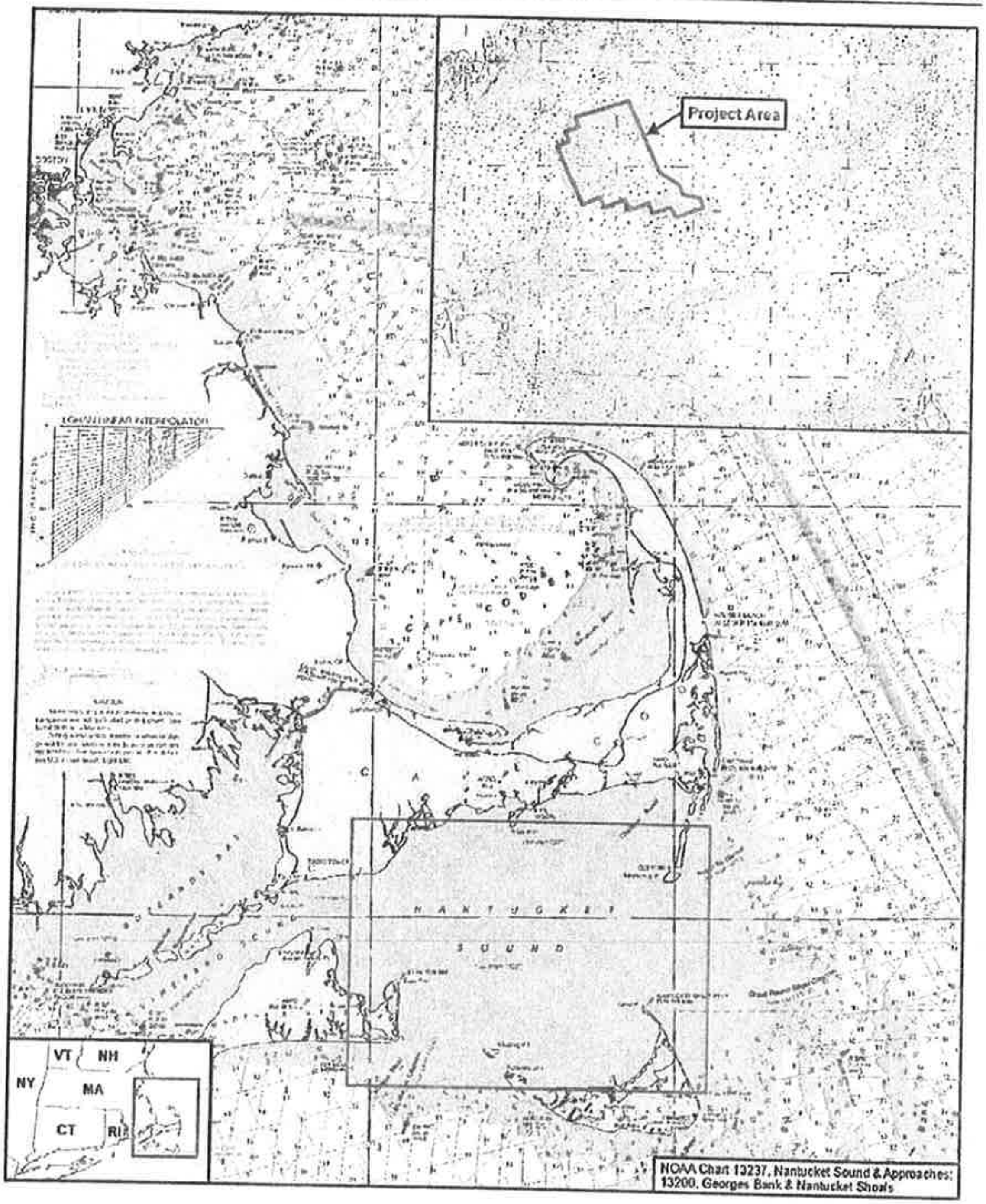
Figure 1. Project Area



CAPE WIND ENERGY PROJECT

Figure BA-1
Project Locus Map

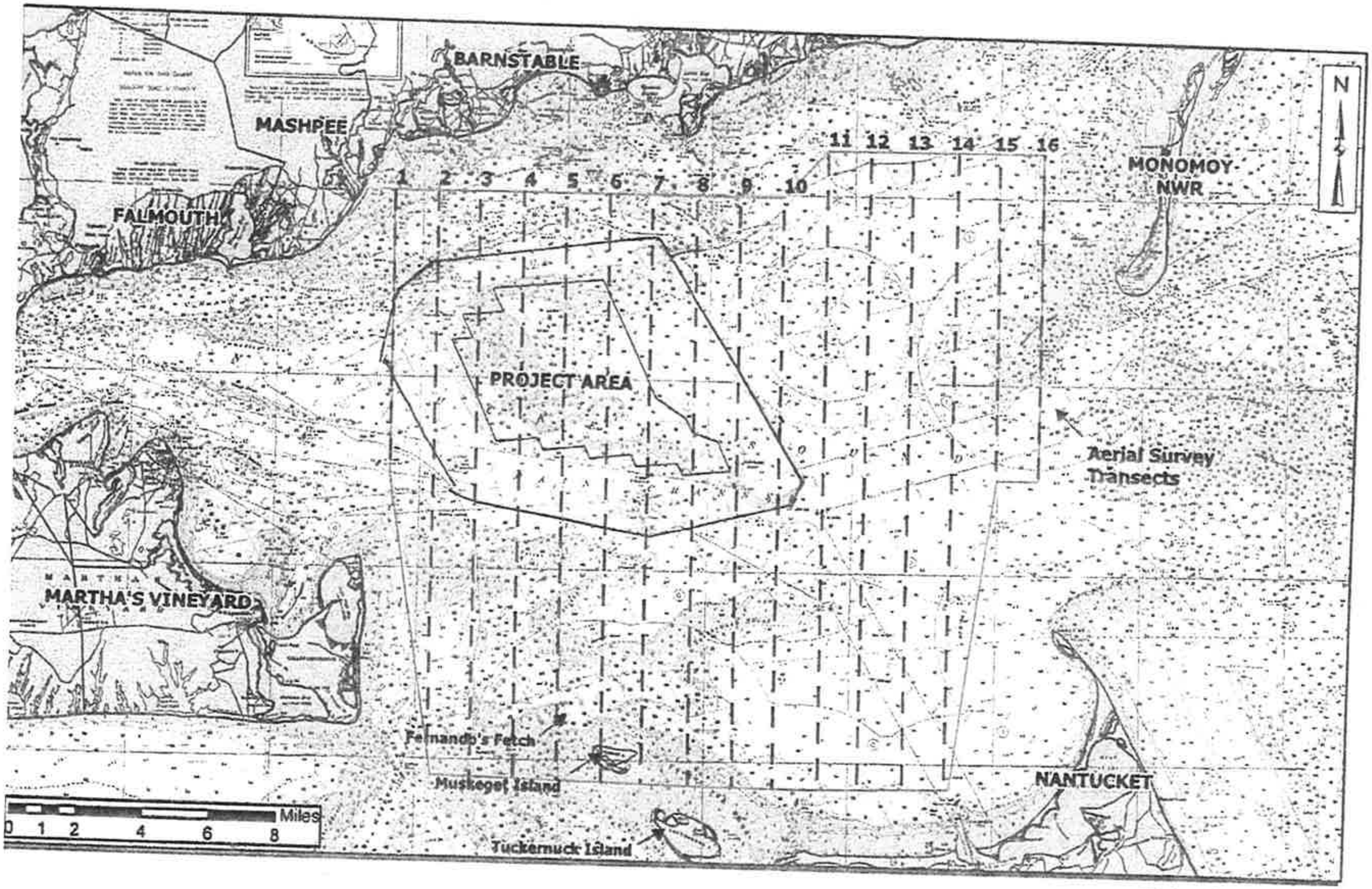
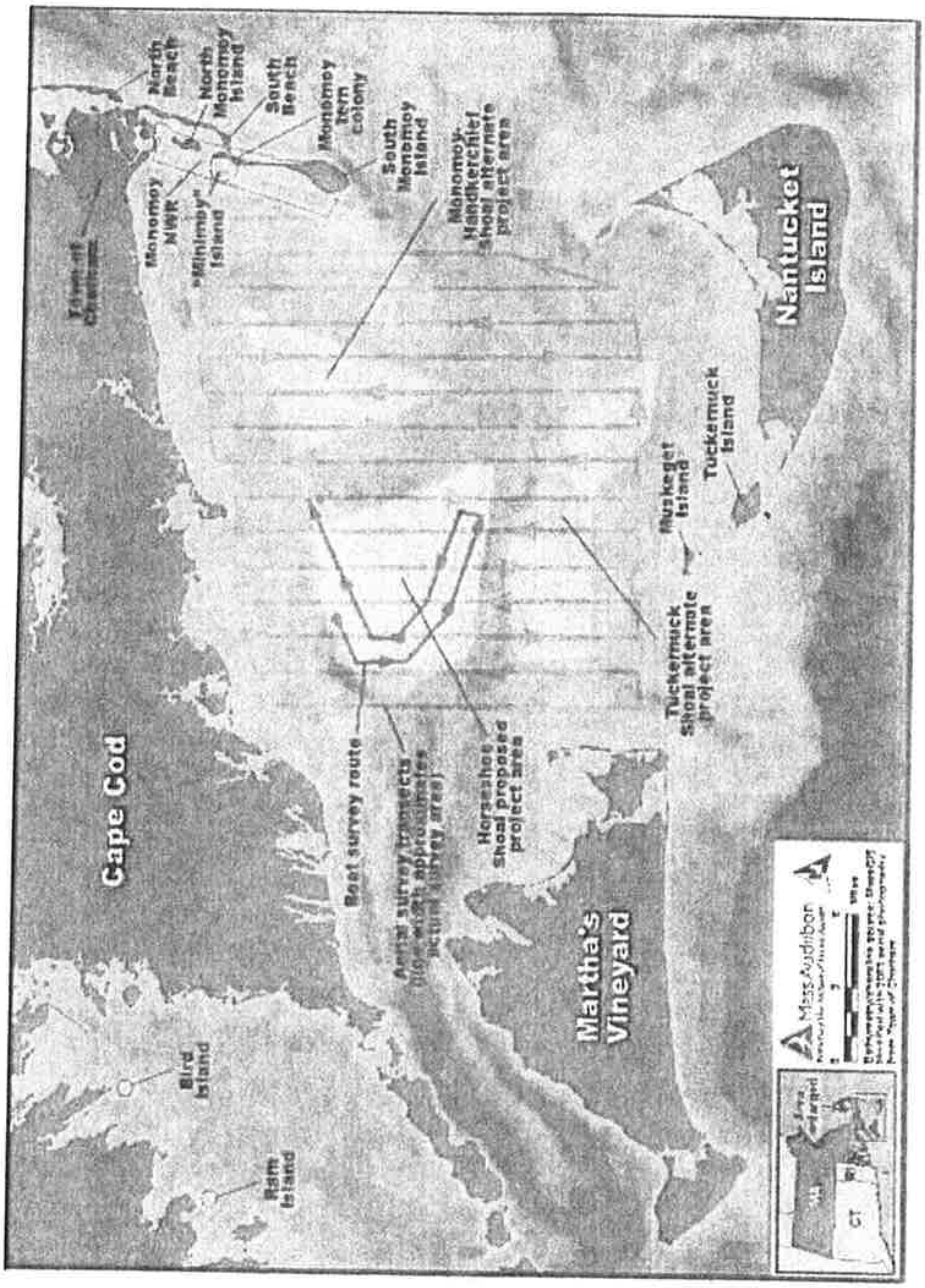


Figure 2
Project Area

Figure 3
Mass Audubon
aerial survey area



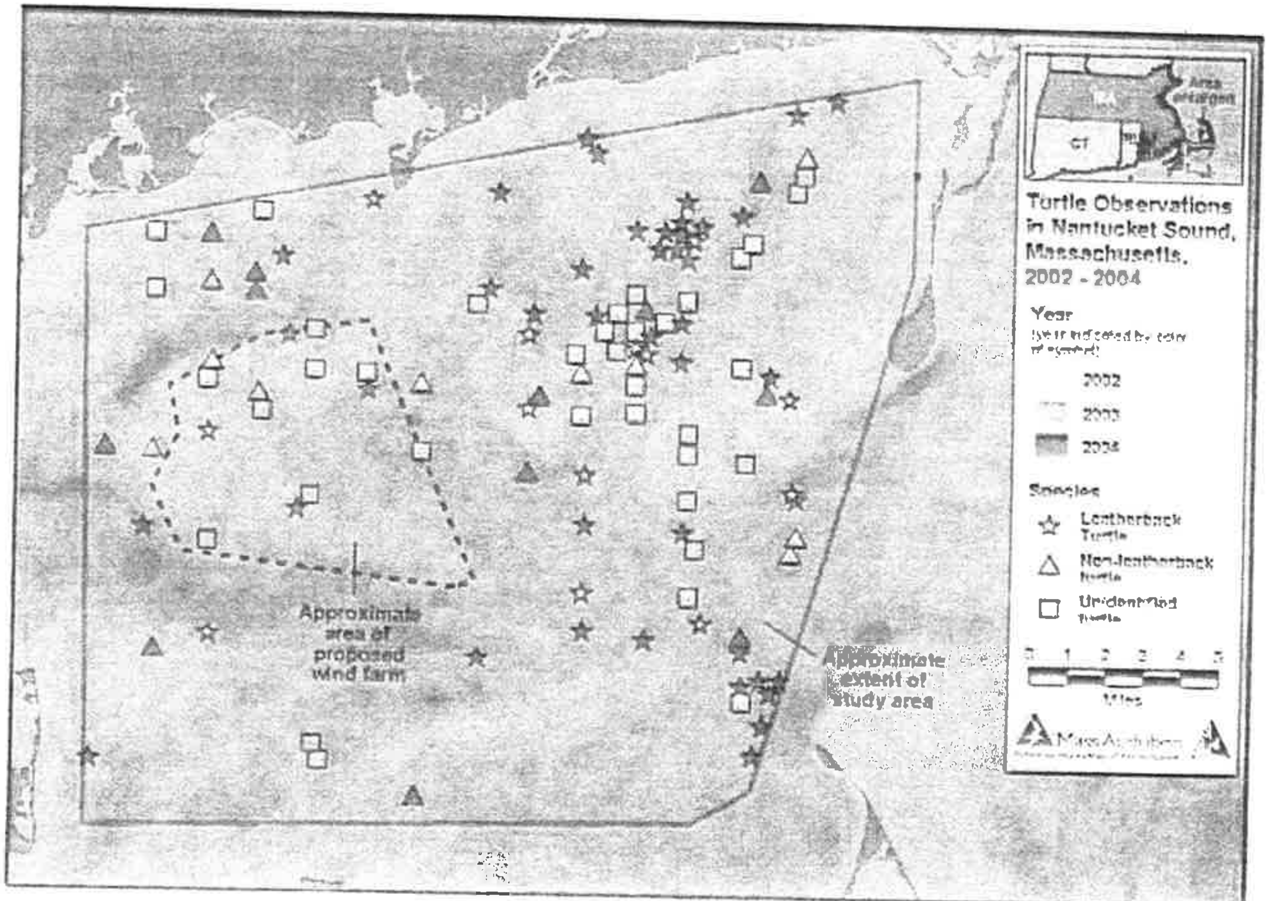


Figure 4
Mass Audubon
sea turtle sightings

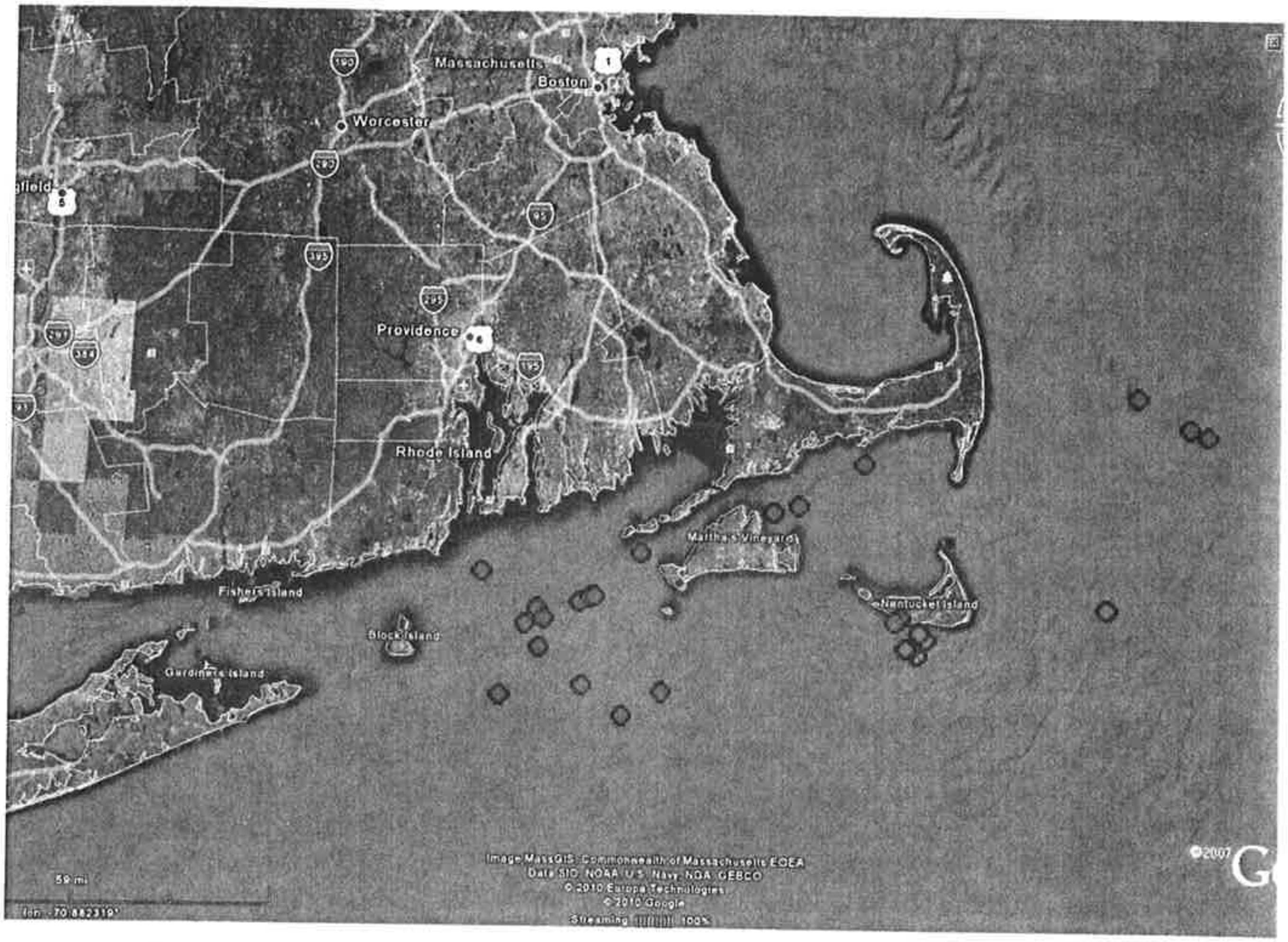


Figure 5. Right Whale Sightings ~~A~~ near Nantucket 2010 Spring

APPENDIX A
From MMS BA dated May 2008

8.0 MITIGATION, MONITORING AND REPORTING REQUIREMENTS FOR ESA LISTED SPECIES

This section outlines the specific mitigation, monitoring and reporting measures built into the proposed action to minimize or eliminate potential impacts to ESA-listed species of whales, sea turtles and birds. Any additional mitigation, monitoring or reporting measures may be added during the Federal ESA Section 7 process or through any issued MMS leases or other authorizations.

8.1 Measures for ESA-Listed Marine Mammals and Sea Turtles

The following measures are part of the proposed action and are meant to minimize or eliminate the potential for adverse impacts to ESA-listed whales and sea turtles. They are divided into the five sections: (1) those required during all phases of the project; (2) those required during pre-construction site assessment: (3) those required during construction; (4) those required during operation/maintenance; and (5) those required during decommissioning. These measures and those that may ultimately be required through the ESA consultation process will be included as requirements in any MMS lease or other authorization, if issued, for the proposed activity.

The applicant has informed MMS that it intends to seek authorization from NMFS under the MMPA. Therefore, MMS will require that the MMPA authorization be completed and a copy provided to MMS before activities are allowed to commence under any MMS issued lease or other authority that may result in the taking of marine mammals. This also includes any amended ESA incidental take statement, if issued, to include marine mammals. Any measures contained within any MMPA authorization, if issued, that are more conservative than those measures built into this proposed action will take precedence.

8.1.1 Requirements for All Phases of Project

As noted in Section 2.3 of the DEIS, the construction phase of the proposed action will temporarily increase the number of vessels within the vicinity of the construction area, especially in the route between Quonset, Rhode Island and the proposed action area. Several shipping lanes and two navigational channels exist within the vicinity of the proposed action area, normally producing vessel traffic within the vicinity of the proposed action area. During construction activities, especially during pile driving activities, it is estimated that 4 to 6 stationary or slow moving vessels would be present in the general vicinity of the pile installation. Vessels delivering construction materials or crews to the site will also be present in the area between the mainland and the proposed action site. The barges, tugs and vessels delivering construction materials generally will travel at speeds below 10 knots (18.5 km/h) and may range in size from 90 to 400 ft (27.4 to 122 m), while the vessels carrying construction crews will be traveling at a maximum speed of 21 knots (39 km/h) and will typically be 50 ft (15 m) in length. The additional traffic from construction vessels may increase the chance of a strike or harassment of marine mammals or sea turtles.

Sections 2.3, 2.4 and 2.5 of the DEIS provides detail on the vessel and aircraft activity associated with the operations/maintenance and decommissioning phases of the project.

The following specific measures are meant to reduce the potential for vessel harassments or collisions with listed whales or sea turtles during all phases of the project.

- All vessels and aircraft associated with the construction, operation/maintenance and/or decommissioning of the project will be required to abide by the: (1) NOAA Fisheries Northeast Regional Viewing Guidelines, as updated through the life of the project (http://www.nmfs.noaa.gov/pr/pdfs/education/viewing_northeast.pdf); and (2) MMS Gulf of Mexico Region's Notice to Lessee (NTL) No. 2007-G04 (http://www.gomr.mms.gov/homepg/regulate/regs/ntls/2007NTLs/07-g04.pdf).

- All vessel and aircraft operators must undergo training to ensure they are familiar with the above requirements. These training requirements must be written into any contractor agreements.

- All vessel operators, employees and contractors actively engaged in offshore operations must be briefed on marine trash and debris awareness elimination as described in the MMS Gulf of Mexico Region's NTL No. 2007-G03 (http://www.gomr.mms.gov/homepg/regulate/regs/ntls/2007NTLs/07-g03.pdf). MMS will not require the applicant to undergo formal training or post placards, as described under this NTL. The applicant will be required to ensure that its employees and contractors are made aware of the environmental and socioeconomic impacts associated with marine trash and debris and their responsibilities for ensuring that trash and debris are not intentionally or accidentally discharged into the marine environment. The above referenced NTL provides information the applicant may use for this awareness training.

8.1.2 Requirements During Pre-Construction Site Assessment Geophysical Surveys

Section 2.7 of the DEIS describes the marine shallow hazards surveys and geotechnical program the applicant would undertake should MMS issue a lease for the proposal. These geophysical and geotechnical (G&G) field investigations would be conducted prior to construction.

The following mitigation, monitoring and reporting requirements will be implemented during the conduct of all high-resolution seismic surveying work proposed by the applicant. Additional detail on how these measures will be implemented is described in the MMS Gulf of Mexico (GOM) Notice to Lessee (NTL) No. 2007-G02 (see http://www.gomr.mms.gov/homepg/regulate/regs/ntls/2007NTLs/07-g02.pdf). Although this NTL focuses on seismic surveying with air guns in the GOM, the methodologies described in the NTL for exclusion zone monitoring, ramp up and shut down as the same as those that will be required under this proposed action.

- *Establishment of Exclusion Zone*: A 250 m (820.2 ft) radius exclusion zone for listed whales and sea turtles will be established around the seismic survey source vessel in order to reduce the potential for serious injury or mortality of these species.

- *Visual Monitoring of Exclusion Zone*: The exclusion zone around the seismic survey source vessel must be monitored for the presence of listed whales or sea turtles before, during and after any pile driving activity. The exclusion zone will be monitored for 30 minutes prior to the ramp up (if applicable) of the seismic survey sound source. If the exclusion zone is obscured by fog or poor lighting conditions, surveying will not be initiated until the entire exclusion zone is visible for the 30 minute period. If listed whales or sea turtles are observed within the zone during the 30 minute period and before the ramp up begins, surveying will be delayed until they move out of the area and until at least an additional 30 minutes have passed without a listed whale or sea turtle sighting. Monitoring of the zone will continue for 30 minutes following completion of the seismic surveying.

  Monitoring of the zones will be conducted by one qualified NMFS approved observer[3]. Visual observations will be made using binoculars or other suitable equipment during daylight hours. Data on all observations will be recorded based on standard marine mammal observer collection data. This will include: dates and locations of construction operations; time of observation, location and weather; details of marine mammal sightings (e.g., species, numbers, behavior); and details of any observed taking (behavioral disturbances or injury/mortality). Any significant observations concerning impacts on listed whales or sea turtles will be transmitted to NMFS and MMS within 48 hours. Any observed takes of listed whales or sea turtles resulting in injury or mortality will be immediately reported to NMFS and MMS.

- *Implementation of Ramp Up*: A "ramp up" (if allowable depending on specific sound source) will be required at the beginning of each seismic survey in order to by allowing them to vacate the area prior to the commencement of activities. Seismic surveys may not commence (i.e., ramp up) at night time or when the exclusion zone cannot be effectively monitored (i.e., reduced visibility).

- *Shut Down*: Continuous (day and night) seismic survey operations will be allowed. However, if a listed whale or sea turtle is spotted within or transiting towards the exclusion zone surrounding the sub-bottom profiler and the survey vessel, an immediate shutdown of the equipment will be required. Subsequent restart of the profiler will only be allowed following clearance of the exclusion zone and the implementation of ramp up procedures (if applicable).

- *Compliance with Equipment Noise Standards*: All seismic surveying equipment will comply as much as possible with applicable equipment noise standards of the U.S.

[3] Observer qualifications will include direct field experience on a marine mammal/sea turtle observation vessel and/or aerial surveys in the Atlantic Ocean/Gulf of Mexico. All observers will receive NMFS-approved marine mammal observer training and be approved in advance by NMFS after a review of their qualifications.

Environmental Protection Agency, and all equipment will have noise control devices no less effective than those provided on the original equipment.

- *Reporting for Seismic Surveys Activities*: The following reports must be submitted during the conduct of seismic surveys:

  - A report will be provided to MMS and NMFS within 90 days of the commencement of seismic survey activities that includes a summary of the seismic surveying and monitoring activities and an estimate of the number of listed whales and sea turtles that may have been taken as a result of seismic survey activities. The report will include information, such as: dates and locations of operations, details of listed whale or sea turtle sightings (dates, times, locations, activities, associated seismic activities), and estimates of the amount and nature of listed whale or sea turtle takings.

  - Any observed injury or mortality to a listed whale or sea turtle must be reported to NMFS and MMS within 24 hours of observation. Any significant observations concerning impacts on listed whales or sea turtles will be transmitted to NMFS and MMS within 48 hours.

8.1.3 Requirements During Construction

Acoustic harassment from construction activities hold the greatest potential for disturbance and impacts to listed whales and sea turtles due to the size and number of piles and the timeframe needed to complete the installation of all piles. Section 2.5.1 of the BA and Sections 2.3.2.2 of the DEIS describe the pile driving process in detail. Section 5.0 of the BA and Sections 5.3.2.9.1 of the DEIS outline the potential effects of pile driving activities on listed whales and sea turtles.

MMS has included the following specific measures as part of the proposed action and are meant to reduce or eliminate the potential for adverse impacts on listed whales or sea turtles during the construction phase of the project:

- *Pre-Construction Briefing*: Prior to the start of construction, a briefing will be held between the construction supervisors and crews, the marine mammal and sea turtle visual and acoustic observer(s) (see further below), and Cape Wind Associates. The purpose of the briefing will be to establish responsibilities of each party, define the chains of command, discuss communication procedures, provide an overview of monitoring purposes, and review operational procedures. The Resident Engineer will have the authority to stop or delay any construction activity, if deemed necessary. New personnel will be briefed as they join the work in progress.

- *Requirements for Pile Driving*: The following measures will be implemented during the conduct of pile driving activities related to turbine monopile and Electrical Service Platform (ESP) installation:

- Establishment of Exclusion Zone: A preliminary 750 m (2,461 ft)[4] radius exclusion zone for listed whales and sea turtles will be established around each pile driving site in order to reduce the potential for serious injury or mortality of these species. Once pile driving begins, the actual generated sound levels will be measured (see requirements below for *Field Verification of Zone*) and a new exclusion zone will be established based on the results of these field-verified measurements. This new exclusion zone will be based on the field inputs calculating the actual distance from the pile driving source where underwater sound levels are anticipated to equal or exceed 180 dB re 1 microPa rms (impulse). Based on the outcome of the field-verified sound levels and the calculated or measured distances as noted above, the applicant can either: (1) retain the 750 m zone or (2) establish a new zone based on field-verified measurements demonstrating the distance from the pile driving source where underwater SPLs are anticipated to equal or exceed the received the 180 dB re 1 microPa rms (impulse). Any new exclusion zone radius must be based on the most conservative measurement (i.e., the largest safety zone configuration), include an additional 'buffer' area extending out of the 180 dB zone and be approved by MMS and NMFS before implementing. Once approved, this zone will be used for all subsequent pile driving and will be periodically re-evaluated based on the regular sound monitoring described in the *Field Verification of Exclusion Zone* section described below.

- Field Verification of Exclusion Zone: Field verification of the exclusion zone will take during pile driving of the first three piles. The results of the measurements from the first three piles can then be used to establish a new exclusion zone which is greater than or less than the 750 m depending on the results of the field tests.

Acoustic measurements will take place during the driving of the last half (deepest pile segment) for any given open-water pile. One reference location will be established at a distance of 100 m (328 ft) from the pile driving. Sound measurements will be taken

[4] Underwater sound pressure levels measured during impact pile driving to install the monopiles for the Utgrunden Wind Park in Sweden were used to derive the pile driving root mean square (RMS) sound level for the Cape Wind Project because the size of the monopiles and the installation techniques are similar. The RMS sound pressure level at 500 meters is 177.8 dB re 1 μPa for Utgrunden. The monopile diameters for the Cape Wind project, 5.1 to 5.5 meters, are slightly larger than monopiles for Utgrunden, and the cross-sectional area is 60 percent larger. Assuming pile driver blow energy (E) scales by the cross-sectional area and impulse noise is proportional to $10*\log(E_2/E_1)$ when blow energy increases from E_1 to E_2, the RMS sound pressure level for Cape Wind scales up to 179.8 dB re 1 μPa at 500 meters averaged over a 125-millisecond pulse duration. The SEL for Cape Wind also scales up in the same manner to 173 dB re 1 μPa at 500 meters. A recent COWRIE report suggests underwater SEL values of 171-173 dB re 1 μPa at 500 meters for piles with diameters equal to those proposed for Cape Wind (Nehls et al., 2007). Thus, the sound source data for Cape Wind are validated by recent COWRIE data at other wind farms. In order to apply an initial exclusion zone size that conservatively allows for an area that will avoid potential Level A harassment of marine mammals, MMS has established a preliminary 750-m zone. However, the applicant has the option to conduct field verification of this zone, as noted above, and change the size of the zone based on these measurements.

at the reference location at two depths (a depth near the mid-water column and a depth near the bottom of the water column but at least 1 m (3 ft) above the bottom) during the driving of the last half (deepest pile segment) for any given pile. Two additional in-water spot measurements will be conducted at appropriate depths (near mid water column), generally 500 m (1,640 ft) and 750 m (2,461 ft) in two directions either west, east, south or north of the pile driving site. These will be conducted at the same two depths as the reference location measurements. In cases where such measurements cannot be obtained due to obstruction by land mass, structures or navigational hazards, measurements will be conducted at alternate spot measurement locations. Measurements will be made at other locations either nearer or farther as necessary to establish the approximate distance for the zones. Each measuring system shall consist of a hydrophone with an appropriate signal conditioning connected to a sound level meter and an instrument grade digital audiotape recorder (DAT). Overall SPLs shall be measured and reported in the field in dB re 1 micro-Pa rms (impulse). An infrared range finder will be used to determine distance from the monitoring location to the pile. The recorded data will be analyzed to determine the amplitude, time history and frequency content of the impulse.

- Visual Monitoring of Exclusion Zone: Visual monitoring of the exclusion zone will be conducted during driving of all piles. Monitoring of the zones will be conducted by one qualified NMFS approved observer[5]. Multiple monitors will be required if pile driving is occurring at multiple locations at the same time.

  Observer(s) will begin monitoring at least 30 minutes prior to soft start of the pile driving. Pile driving will not begin until the zone is clear of all listed whales and sea turtles for at least 30 minutes. Monitoring will continue through the pile driving period and end approximately 30 minutes after pile driving is completed.

  Visual observations will be made using binoculars or other suitable equipment during daylight hours. Data on all observations will be recorded based on standard marine mammal observer collection data. This will include: dates and locations of construction operations; time of observation, location and weather; details of marine mammal sightings (e.g., species, numbers, behavior); and details of any observed taking (behavioral disturbances or injury/mortality). Any significant observations concerning impacts on listed whales or sea turtles will be transmitted to NMFS and MMS within 48 hours. Any observed takes of listed whales or sea turtles resulting in injury or mortality will be immediately reported to NMFS and MMS.

[5] Observer qualifications will include direct field experience on a marine mammal/sea turtle observation vessel and/or aerial surveys in the Atlantic Ocean/Gulf of Mexico. All observers will receive NMFS-approved marine mammal observer training and be approved in advance by NMFS after a review of their qualifications.

- Required Mitigation Should Listed Whales or Sea Turtles Enter the Exclusion Zone: The exclusion zone around the pile driving activity must be monitored for the presence of listed whales or sea turtles before, during and after any pile driving activity. The exclusion zone will be monitored for 30 minutes prior to the soft start of pile driving. If the safety radius is obscured by fog or poor lighting conditions, pile driving will not be initiated until the entire safety radius is visible for the 30 minute period. If listed whales or sea turtles are observed within the zone during the 30 minute period and before the soft start begins, pile driving of the segment will be delayed until they move out of the area and until at least an additional 30 minutes have passed without a listed whale or sea turtle sighting. Monitoring of the zone will continue for 30 minutes following completion of the pile driving activity.

  MMS recognizes that once the pile driving of a segment begins it cannot be stopped until that segment has reached its predetermined depth due to the nature of the sediments underlying the Sound. If pile driving stops and then resumes, it would potentially have to occur for a longer time and at increased energy levels. In sum, this would simply amplify impacts to listed whales and sea turtles, as they would endure potentially higher SPLs for longer periods of time. Pile segment lengths and wall thickness have been specially designed so that when work is stopped between segments (but not during a single segment), the pile tip is never resting in highly resistant sediment layers. Therefore, because of this operational situation, if listed whales or sea turtles enter the zone after pile driving of a segment has begun, pile driving will continue and observers will monitor and record listed whale and sea turtle numbers and behavior. However, if pile driving of a segment ceases for 30 minutes or more and a listed whale or sea turtle is sighted within the designated zone prior to commencement of pile driving, the observer(s) must notify the Resident Engineer (or other authorized individual) that an additional 30 minute visual and acoustic observation period will be completed, as described above, before restarting pile driving activities.

  In addition, pile driving may not be started during night hours or when the safety radius can not be adequately monitored (i.e., obscured by fog, inclement weather, poor lighting conditions) unless the applicant implements an alternative monitoring method that is agreed to by MMS and NMFS. However, if a soft start has been initiated before dark or the onset of inclement weather, the pile driving of that segment may continue through these periods. Once that pile has been driven, the pile driving of the next segment cannot begin until the exclusion zone can be visually or otherwise monitored.

- Implementation of Soft Start: A "soft start" will be required at the beginning of each pile installation in order to provide additional protection to listed whales and sea turtles near the project area by allowing them to vacate the area prior to the commencement of pile driving activities. The soft start requires an initial set of 3 strikes from the impact hammer at 40 percent energy with a one minute waiting period between subsequent 3-strike sets. If listed whales or sea turtles are sighted within the exclusion zone prior to pile-driving, or during the soft start, the Resident Engineer (or other authorized individual) will delay pile-driving until the animal has moved outside the exclusion zone.

- Compliance with Equipment Noise Standards: All construction equipment will comply as much as possible with applicable equipment noise standards of the U.S. Environmental Protection Agency, and all construction equipment will have noise control devices no less effective than those provided on the original equipment.

- *Reporting for Construction Activities*: The following reports must be submitted during construction:

  - Prior to any re-establishment of the exclusion zone, a report must be provided to MMS and NMFS detailing the field verification measurements and proposal for the new exclusion zone. This includes information, such as: a fuller account of the levels, durations, and spectral characteristics of the impact and vibratory pile driving sounds; and the peak, rms, and energy levels of the sound pulses and their durations as a function of distance, water depth, and tidal cycle. Any new zone may not be implemented until MMS and NMFS have reviewed and approved any changes.

  - Weekly status reports will be provided to MMS and NMFS that include a summary of the previous week's monitoring activities and an estimate of the number of listed whales and sea turtles that may have been taken as a result of pile driving activities. These reports will include information, such as: dates and locations of construction operations, details of listed whale or sea turtle sightings (dates, times, locations, activities, associated construction activities), and estimates of the amount and nature of listed whale or sea turtle takings. NMFS and MMS may reduce or increase the frequency of this reporting throughout the time period of pile driving activities dependent upon the outcome of these initial weekly reports.

  - Any observed injury or mortality to a listed whale or sea turtle must be reported to NMFS and MMS within 24 hours of observation. Any significant observations concerning impacts on listed whales or sea turtles will be transmitted to NMFS and MMS within 48 hours.

  - A final technical report within 120 days after completion of the pile driving and construction activities will be provided to MMS and NMFS that provides full documentation of methods and monitoring protocols, summarizes the data recorded during monitoring, estimates the number of listed whales and sea turtles that may have been taken during construction activities, and provides an interpretation of the results and effectiveness of all monitoring tasks.

- *Requirements for Cable Laying*: The following measures will be implemented during the conduct of cable laying activities:
    - The applicant must contact NMFS and MMS within 24-hours of the commencement of jet plowing activities and again within 24-hours of the completion of the activity.
    - All interactions with listed whales or sea turtles during cable laying activities must be reported to NMFS and MMS within 24 hours.
    - A final report must be submitted to NMFS and MMS within 60 days of completing cable laying activities which summarizes the results and any takes of listed species.

8.1.4 Requirements During Operation/Maintenance

Nedwell *et al.* (In press) measured and assessed the underwater noise and potential impacts to marine life during the construction and operations/maintenance phases of four offshore wind parks located in U.K. waters. For the operations/maintenance phase, they concluded that in general the level of underwater noise from the operation of a wind facility was very low and not above ambient levels even in close proximity to the turbines. Therefore, the underwater noise from the operation of offshore wind farms was unlikely to result in any behavioral response for the marine mammals and fish assessed in this study.

Given these results, the main mitigation required for the operations/maintenance phase of the proposed project, including standard and major repairs, inspections, etc. of the turbines, submarine cable and ESP, will include the vessel and aircraft measures outlined in section 8.1.1 of this BA. Section 2.4 of the DEIS outlines the anticipated vessel activity during the operations/maintenance phase of the proposal.

A yearly status report will also be provided to MMS that includes a summary of the year's operation and maintenance activities. In addition, any observed injury or mortality to a listed whale or sea turtle must be reported to NMFS and MMS within 24 hours of observation. Any significant observations concerning impacts on listed whales or sea turtles will be transmitted to NMFS and MMS within 48 hours.

8.1.5 Requirements During Decommissioning

Section 2.5.3 of the BA and Section 2.5.1 of the DEIS contain detail on the proposed methodology for decommissioning and removal of the wind turbines. Essentially, the decommissioning process is the reverse of the construction process (absent pile driving), and the impacts from decommissioning would likely mirror those of construction. In addition, vessel activity during decommissioning would be essentially the same as that required during construction. Therefore, the vessel and aircraft mitigation measures outlined in section 8.1.1 of this BA will be required.