

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

**Agency:** Minerals Management Service, US Department of the Interior

**Activity:** Cape Wind Energy Project  
F/NER/2008/03508

**Conducted by:** National Marine Fisheries Service  
Northeast Regional Office

**Date Issued:**

11/13/08

**Approved by:**

*Patricia Kerbel*

This constitutes the biological opinion (Opinion) of NOAA's National Marine Fisheries Service (NMFS) on the effects of the Minerals Management Service's (MMS) proposed approval of an application by Cape Wind Associates, LLC for a lease, easement or right-of-way to construct, operate and decommission a wind energy project 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.). The MMS'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). This Opinion is based on information provided in MMS's Cape Wind Energy Project Nantucket Sound Biological Assessment (BA), the Draft Environmental Impact Statement for the project (DEIS), correspondence with the MMS, 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 initiated on May 22, 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) MMS 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 MMS. MMS then determined that a new DEIS was required given its different federal approval processes and requirements.

MMS and NMFS began discussing consultation requirements in January 2006. Throughout 2006 and 2007 NMFS provided technical assistance to MMS as they drafted a new DEIS and draft BA. The MMS published a DEIS on January 18, 2008. MMS provide NMFS with a final BA and request for formal consultation in a letter dated May 19, 2008. The date that the May 19 letter was received (May 22, 2008) serves as the date consultation was initiated.

## **DESCRIPTION OF THE PROPOSED ACTION**

The proposed action entails the construction of a wind energy facility (wind park) consisting of 130 wind turbine generators (WTG) 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 would occupy a total of 0.67 acres of submerged land. Scour protection for the WTGs would cover an additional 2.5 - 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.

A one-time high resolution geophysical survey may be conducted to assess seafloor and/or shallow subsurface conditions. A survey vessel would be used to run rectilinear geophysical tracklines. If conducted, the survey is expected to take approximately 36 hours to complete. The applicant will use an airgun, boomer, sparker or chirper to obtain the necessary geophysical data. The survey equipment would be towed behind the survey vessel and the survey vessel will travel approximately 3-3.5 knots during the survey. As required by MMS, 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 along the proposed submarine cable route with approximately 2 vibracores per mile and along the inner array cable route with 1 vibracore approximately every 3.5 miles. The vibracores would be advanced from a small (less than 45 feet) gasoline powered vessel. Approximately 50 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, approximately 20 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 casing 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 purposes. The vessel will be likely loaded at Quonset, Rhode Island with the necessary components to erect two to four WTGs. Approximately 43 trips will be needed to deliver the material to the work site. 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.

During construction, Quonset Point, Rhode Island will likely serve as the primary staging area. Vessels will transit between Quonset Point and the wind park 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. Approximately 43 trips are anticipated to move the monopiles to the work site.

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 65 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.

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 fourth quarter of 2008, is as follows: (1) during the winter of 2009-2010 the onshore ductbanks, landfall transition and the temporary cofferdam will be installed; (2) during the third and fourth quarter of 2009 and first quarter of 2010 the ESP, the submarine 115 kV cables, and the onshore 115 kV cables will be installed; and (3) beginning the first quarter of 2010, 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 MMS. MMS 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 MMS 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 is largely consistent with the area identified as Nantucket Sound.

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***

Right whale ( <i>Eubalaena glacialis</i> )	Endangered
Humpback whale ( <i>Megaptera novaeangliae</i> )	Endangered
Fin whale ( <i>Balaenoptera physalus</i> )	Endangered

***Sea Turtles***

Loggerhead sea turtle ( <i>Caretta caretta</i> )	Threatened
Leatherback sea turtle ( <i>Dermochelys coriacea</i> )	Endangered
Kemp's ridley sea turtle ( <i>Lepidochelys kempii</i> )	Endangered
Green sea turtle ( <i>Chelonia mydas</i> <sup>1</sup> )	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 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).

**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

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<sup>1</sup> 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.

1970. The species is also designated as depleted under the Marine Mammal Protection Act (MMPA).

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

The International Whaling Commission (IWC) recognizes two right whale populations in the North Atlantic: a western and eastern population (IWC, 1986). It is thought that the eastern population migrated along the coast from northern Europe to northwest Africa. The current distribution and migration patterns of the eastern North Atlantic right whale population, if extant, are unknown. Sighting surveys from the eastern Atlantic Ocean suggest that right whales present in this region are rare (Best *et al.*, 2001) and it is unclear whether a viable population in the eastern North Atlantic still exists (Brown 1986, NMFS 1991b). Photo-identification work has shown that some of the whales observed in the eastern Atlantic were previously identified as western Atlantic right whales (Kenney 2002). This Opinion will focus on the western North Atlantic subpopulation of right whales which occurs in the action area.

#### *Habitat and Distribution*

Western North Atlantic right whales generally occur from the southeast U.S. to Canada (*e.g.*, Bay of Fundy and Scotian Shelf) (Kenney 2002; Waring *et al.* 2007). Like other right whale species, they follow an annual pattern of migration between low latitude winter calving grounds and high latitude summer foraging grounds (Perry *et al.* 1999; Kenney 2002). Right whale movements and habitat have been described as follows:

The distribution of right whales seems linked to the distribution of their principal zooplankton prey, calanoid copepods (Winn *et al.* 1986; NMFS 2005; Baumgartner and Mate 2005; Waring *et al.* 2007). Right whales are most abundant in Cape Cod Bay between February and April (Hamilton and Mayo 1990; Schevill *et al.* 1986; Watkins and Schevill 1982) and in the Great South Channel in May and June (Kenney *et al.* 1986; Payne *et al.* 1990; Kenney *et al.* 1995; Kenney 2001) where they have been observed feeding predominantly on copepods of the genera *Calanus* and *Pseudocalanus* (Baumgartner and Mate 2005; Waring *et al.* 2007). Right whales also frequent Stellwagen Bank and Jeffrey's Ledge, as well as Canadian waters including the Bay of Fundy and Browns and Baccaro Banks in the summer through fall (Mitchell *et al.* 1986; Winn *et al.* 1986; Stone *et al.* 1990). Calving occurs in the winter months in coastal waters off of Georgia and Florida (Kraus *et al.* 1988). In the North Atlantic it appears that not all reproductively active females return to the calving grounds each year (Kraus *et al.*, 1986; Payne, 1986). The location of the majority of the population during the winter months remains unknown (NMFS 2005).

While right whales are known to congregate in the aforementioned areas, much is still not understood and movements within and between these areas may be more extensive than thought (Waring *et al.* 2007). In the winter, only a portion of the known right whale population is seen on the calving grounds. The winter distribution of the remaining right whales remains uncertain (NMFS 2005, Waring *et al.* 2007). Results from winter surveys and passive acoustic studies suggest that animals may be dispersed in several areas including Cape Cod Bay (Brown *et al.* 2002) and offshore waters of the southeastern U.S. (Waring *et al.* 2007). Telemetry data have shown lengthy and somewhat distant excursions into deep water off of the continental shelf (Mate *et al.* 1997) as well as extensive movements over the continental shelf during the summer foraging period (Mate and Niekirk 1992; Mate *et al.* 1997; Bowman 2003; Baumgartner and Mate 2005). Knowlton *et al.* (1992) reported several long-distance movements as far north as Newfoundland, the Labrador Basin, and southeast of Greenland; in addition, resightings of photographically identified individuals have been made off Iceland, arctic Norway, and in the old Cape Farewell whaling ground east of Greenland. The Norwegian sighting (September 1999) represents one of only two sightings this century of a right whale in Norwegian waters, and the first since 1926. Together, these long-range matches indicate an extended range for at least some individuals and perhaps the existence of important habitat areas not presently well described. Similarly, records from the Gulf of Mexico (Moore and Clark, 1963; Schmidly *et al.*, 1972) represent either geographic anomalies or a more extensive historic range beyond the sole known calving and wintering ground in the waters of the southeastern United States. The frequency with which right whales occur in offshore waters in the southeastern U.S. remains unclear (Waring *et al.*, 2007).

In 1994, critical habitat was designated for the North Atlantic right whales in accordance with the ESA. NMFS designated three critical habitat areas for right whales: (1) portions of Cape Cod Bay and Stellwagen Bank, (2) the Great South Channel, and (3) coastal waters off of Georgia and Florida's east coast (NMFS 1994). Right whale critical habitat in Northeast waters were designated for their importance as right whale foraging sites while the southeast critical habitat area was identified for its importance as a calving and nursery area (NMFS 1994). In 2002, NMFS received a petition to revise designated critical habitat for right whales by combining and expanding the existing Cape Cod Bay and Great South Channel critical habitats in the Northeast and by expanding the existing critical habitat in the Southeast (NMFS 2003). In response to the petition, NMFS (2003) recognized that there was new information on right whale distribution in areas outside of the designated critical habitat. However, the ESA requires that critical habitat be designated based on identification of specific habitat features essential to the conservation of the species rather than just known distribution (NMFS 2003). NMFS, therefore, concluded that more analyses of the sightings data and their environmental correlates are necessary to define and designate these areas as critical habitat (NMFS 2003).

#### *Abundance estimates and trends*

Although an estimate of the pre-exploitation population size for the North Atlantic right whale is not available, it is well known and documented that there are relatively few right whales remaining in the western North Atlantic. As is the case with most wild animals, an exact count cannot be obtained. However, abundance can be reasonably estimated as a result of the extensive study of this subpopulation. IWC participants from a 1999 workshop agreed to a

minimum direct-count estimate of 263 right whales alive in 1996 and noted that the true population was unlikely to be greater than this estimate (Best *et al.* 2001). Based on a census of individual whales using photo-identification techniques and an assumption of mortality for those whales not seen in seven years, a total 299 right whales was estimated in 1998 (Kraus *et al.* 2001), and a review of the photo-ID recapture database on June 15, 2006, indicated that 313 individually recognized whales were known to be alive during 2001 (Waring *et al.* 2007). Because this 2006 review was a nearly complete census, it is assumed this estimate represents a minimum population size. Results from a review of the photo-ID recapture database on May 30, 2007, are still preliminary (matching photos from 2006 and 2007 is not complete), but indicate that 325 individual recognized whales in the catalog were known to be alive in 2003 (Waring *et al.* 2008).

A total of 156 right whale calves have been born from 2001-2007 (P. Hamilton, pers. comm.). The mean calf production for the 15-year period from 1993-2006 is estimated to be 11.2/year (Waring *et al.* 2007). Calving numbers have been sporadic, with large differences among years, including a record calving season in 2000/2001 with 31 right whale births (Waring *et al.* 2007). The three calving years (97/98; 98/99; 99/00) prior to this record year provided low recruitment levels with only 10 calves born. The last six calving seasons (2000-2006) have been remarkably better with 31, 21, 19, 16, 28 and 19 births, respectively (Waring *et al.* 2007). The calf count of 22 animals for the latest calving season (2006/2007) is still preliminary and additional calves may be observed (Waring *et al.* 2008). The subpopulation has also continued to experience losses of calves, juveniles and adults. As of August 1, 2008, there were 528 individually identified right whales in the photo-identification catalog of which 25 were known to be dead, 135 were presumed to be dead as they had not been sighted in the past six years and 368 were presumed to be alive (Hamilton *et al.* 2008). Although the population has seen some growth over the past 8 years, the level of growth is significantly lower than healthy populations of large whales (Pace *et al.* 2008).

As is the case with other mammalian species, there is an interest in monitoring the number of females in this right whale subpopulation since their numbers will affect the subpopulation trend (whether declining, increasing or stable). The sex ratio of the photo-identified and catalogued population of North Atlantic right whales appears to be slightly skewed toward males (196M:187F) (Waring *et al.* 2007). As of 2005, 92 reproductively-active females had been identified (Kraus *et al.* 2007). From 1983-2005, the number of new mothers recruited to the population (with an estimated age of 10 for the age of first calving), varied from 0-11 each year with no significant increase or decline over the period (Kraus *et al.* 2007). By 2005, 16 right whales had produced at least 6 calves each, and 4 cows had at least seven calves. Two of these cows were at an age which indicated a reproductive life span of at least 31 years (Kraus *et al.* 2007). As described above, the 2000/2001 - 2006/2007 calving seasons have had relatively high calf production (31, 21, 19, 16, 28, 19, and at least 22 respectively) and have included additional first time mothers (*e.g.*, eight new mothers in 2000/2001). These potential “gains” have been offset, however, by continued losses to the subpopulation including the death of mature females as a result of anthropogenic mortality (like that described in Glass *et al.* 2008, below). The period of November 2004 through May 2005 was particularly devastating with five right whale mortalities. One of the females, nicknamed “Stumpy” (so named because of an old wound on

her left fluke), was killed in February 2004 of an apparent ship strike (NMFS 2006). One of the largest right whales on record, she was first sighted in 1975 and known to be a prolific breeder, successfully rearing calves in 1980, 1987, 1990, 1993, and 1996 (Moore *et al.* 2007). At the time of her death, she was estimated to be 30 years of age and carrying her sixth calf; the near-term fetus also died (NMFS 2006).

Of the recent mortalities, including those in the first half of 2005, 6 were adult females, three of which were carrying near-term fetuses and 4 of which were just starting to bear calves. Since the average lifetime calf production is 5.25 calves (Fujiwara and Caswell 2001), the deaths of these females represent a loss of reproductive potential of as many as 21 animals (Waring *et al.* 2007). However, it is important to note though that not all right whale mothers are equal with regards to calf production (i.e. #1158 who had 1 calf over a 25-year period) (Kraus *et al.* 2007).

Abundance estimates are an important part of assessing the status of the species. However, for Section 7 purposes, the population trend (*i.e.*, whether increasing or declining) provides better information for assessing the effects of a proposed action on the species. As described in previous Opinions, data collected in the 1990s suggested that right whales were experiencing a slow but steady recovery (Knowlton *et al.* 1994). However, Caswell *et al.* (1999) used photo-identification data and modeling to estimate survival and concluded that right whale survival decreased from 1980 to 1994. Modified versions of the Caswell *et al.* (1999) model as well as several other models were reviewed at the 1999 IWC workshop (Best *et al.* 2001). Despite differences in approach, all of the models indicated a decline in right whale survival in the 1990s relative to the 1980s with female survival, in particular, apparently affected (Best *et al.* 2001, Waring *et al.* 2007). In 2002, NMFS' NEFSC hosted a workshop to review right whale population models to examine: (1) potential bias in the models and (2) changes in the subpopulation trend based on new information collected in the late 1990s (Clapham *et al.* 2002). Three different models were used to explore right whale survivability and to address potential sources of bias. Although biases were identified that could negatively affect the results, all three modeling techniques resulted in the same conclusion; survival has continued to decline and seems to be focused on females (Clapham *et al.* 2002). Mortalities, including those in the first half of 2005, suggest an increase in the annual mortality rate (Kraus *et al.* 2005). Calculations indicate that this increased mortality rate would reduce population growth by approximately 10% per year (Kraus *et al.* 2005).

### *Reproductive Fitness*

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

Factors that have been suggested as affecting the right whale reproductive rate include reduced genetic diversity (and/or inbreeding), contaminants, biotoxins, disease, nutritional stress, and

loss of critical habitat. Although it is believed that a combination of these factors is likely causing an effect on right whales (Kraus *et al.* 2007), there is currently no evidence available to determine their potential effect, if any. The dramatic reduction in the North Atlantic right whale population believed to have occurred due to commercial whaling may have resulted in a loss of genetic diversity which could affect the ability of the current population to successfully reproduce (*i.e.*, decreased conceptions, increased abortions, and increased neonate mortality). The current hypothesis is that the low level of genetic variability in this species produces a high rate of mate incompatibility and unsuccessful pregnancies (Frasier *et al.* 2007). Analyses are currently under way to assess this relationship further as well as the influence of genetic characteristics on the potential for species recovery (Frasier *et al.* 2007). Studies by Schaeff *et al.* (1997) and Malik *et al.* (2000) indicate that western North Atlantic right whales are less genetically diverse than southern right whales. However, several apparently healthy populations of cetaceans, such as sperm whales and pilot whales, have even lower genetic diversity than observed for western North Atlantic right whales (IWC 2001). Similarly, while contaminant studies have confirmed that right whales are exposed to and accumulate contaminants, researchers could not conclude that these contaminant loads were negatively affecting right whale reproductive success since concentrations were lower than those found in marine mammals proven to be affected by PCBs and DDT (Weisbrod *et al.* 2000). Another suite of contaminants (*i.e.* antifouling agents and flame retardants) that have been proven to disrupt reproductive patterns and have been found in other marine animals, have raised new concerns (Kraus *et al.* 2007). Recent data also support a hypothesis that chromium, an industrial pollutant, may be a concern for the health of the North Atlantic right whales and that inhalation may be an important exposure route (Wise *et al.* 2008). A number of diseases could be also affecting reproduction, however tools for assessing disease factors in free-swimming large whales currently do not exist (Kraus *et al.* 2007). Once developed, such methods may allow for the evaluation of disease effects on right whales. Impacts of biotoxins on marine mammals are also poorly understood, yet data is showing that marine algal toxins may play significant roles in mass mortalities of these animals (Rolland *et al.* 2007). Although there are no published data concerning the effects of biotoxins on right whales, researchers are now certain that right whales are being exposed to measurable quantities of paralytic shellfish poisoning (PSP) toxins and domoic acid via trophic transfer through the copepods upon which they feed (Durbin *et al.* 2002, Rolland *et al.* 2007).

Data indicating right whales are food-limited are difficult to evaluate (Kraus *et al.* 2007). Although North Atlantic right whales seem to have thinner blubber than right whales from the South Atlantic (Kenney 2000), there is no evidence at present to demonstrate that the decline in birth rate and increase in calving interval is related to a food shortage. Nevertheless, a connection among right whale reproduction and environmental factors may yet be found. Modeling work by Caswell *et al.* (1999) and Fujiwara and Caswell (2001) suggests that the North Atlantic Oscillation (NAO), a naturally occurring climatic event, does affect the survival of mothers and the reproductive rate of mature females, and it also seems to affect calf survival (Clapham *et al.* 2002). Greene *et al.* (2003) described the potential oceanographic processes linking climate variability to the reproduction of North Atlantic right whales. Climate-driven changes in ocean circulation have had a significant impact on the plankton ecology of the Gulf of Maine, including effects on *Calanus finmarchicus*, a primary prey resource for right whales.

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

#### *Anthropogenic Mortality*

There is general agreement that right whale recovery is negatively affected by anthropogenic mortality. From 2002-2006, right whales had the highest proportion of entanglement and ship strike events relative to the number of reports for a species (Glass *et al.* 2008). 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.* 2007). For the period 2002-2006, the annual mortality and serious injury rate for the North Atlantic right whale averaged to be 3.8 per year (2.4 in U.S. waters; 1.4 in Canadian waters) (Glass *et al.* 2008, Waring *et al.* 2008). Twenty-one confirmed right whale mortalities were reported along the U.S. east coast and adjacent Canadian Maritimes from 2002-2006 (Glass *et al.* 2008). 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.* 2008)). Moreover, carcasses floating at sea often cannot be examined sufficiently and may generate false negatives if they are not towed to shore for further necropsy (Glass *et al.* 2008). Decomposed and/or unexamined animals represent lost data, some of which may relate to human impacts (Waring *et al.* 2007).

Considerable effort has been made to examine right whale carcasses for the cause of death (Moore *et al.* 2004). Because they live in an ocean environment, examining right whale carcasses is often very difficult. Some carcasses are discovered floating at sea and cannot be retrieved. Others are in such an advanced stage of decomposition when discovered that a complete examination is not possible. Wave action and post-mortem predation by sharks can also damage carcasses, and preclude a thorough examination of all body parts. It should also be noted that mortality and serious injury event judgments are based upon the best available data and additional information may result in revisions (Cole *et al.* 2005). Of the 21 total, confirmed right whale mortalities (2002-2006) described in Glass *et al.* (2008), 3 were confirmed to be entanglement mortalities (1 yearling female, 1 adult female, 1 calf [sex not listed]) and 10 were confirmed to be ship strike mortalities (1 yearling female, 1 yearling male, 6 adult females, 1 male calf, and 1 female of unknown age). Serious injury involving right whales was documented for 4 entanglement events (1 calf [sex not indicated], 2 adult females, and 1 individual whose sex



and age were unknown) and 2 ship strike events (1 individual whose sex and age were unknown and 1 yearling male).

Although disentanglement is either unsuccessful or not possible for the majority of cases, during the period of 2001-2005, there were at least 5 documented cases of entanglements for which the intervention of disentanglement teams averted a likely serious injury determination (for 2002-2006, there were 4 documented cases of such disentanglement efforts) (Waring *et al.* 2007, Waring *et al.* 2008). Entanglement or vessel collisions may not cause direct mortalities, but may weaken or otherwise affect individuals so that further injury or death is likely (Waring *et al.* 2007). Some right whales that have been entangled were subsequently involved in ship strikes (Hamilton *et al.* 1998) suggesting that the animal may have become debilitated by the entanglement to such an extent that it was less able to avoid a ship. In the same, 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.* 2008).

Entanglement records from 1990-2006 maintained by NMFS include 45 confirmed right whale entanglement events (Waring *et al.* 2008). 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.* 2008). Data presented in Knowlton *et al.* 2008 indicate the annual rate of entanglement interaction remains at high levels. Four hundred and ninety-three individual, catalogued right whales were reviewed and 625 separate entanglement interactions were documented between 1980 and 2004. Approximately 358 out of 493 animals (72.6% of the population) were entangled at least once; 185 animals bore scars from a single entanglement, however one animal showed scars from 6 different entanglement events. The number of male and female right whales bearing entanglement scars was nearly equivalent (142/202 females, 71.8%; 182/224 males, 81.3%), indicating that right whales of both sexes are equally vulnerable to entanglement. However, juveniles appear to become entangled at a higher rate than expected if all age groups were equally vulnerable. For all years but one (1998), the proportion of juvenile, entangled right whales exceeded their proportion within the population. Based on photographs of catalogued animals from 1935 through 1995, Hamilton *et al.* (1998) estimated that 6.4 percent of the North Atlantic right whale population exhibit signs of injury from vessel strikes. Preliminary data indicate 6 reported right whale ship strikes in 2006, 2 reported right whale strikes in 2007, and as of March 20, 2008, no reported right whale vessel strikes in 2008 (note: these numbers may include cases where whales were observed with indications of ship strike, however it could not be confirmed if the interaction was pre-mortem) (NMFS 2008 DRAFT).

#### *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.

In the Atlantic, there are an estimated 300 right whales (+/- 10%) (Best *et al.* 2001). The 2000/2001 - 2006/2007 calving seasons have had relatively high calf production (31, 21, 19, 16, 28, 19 and at least 22 calves, respectively) and have included additional first time mothers (*e.g.*, eight new mothers in 2000/2001) (Waring *et al.* 2008 DRAFT). These potential “gains” have been offset, however, by continued losses to the subpopulation including the death of mature females as a result of anthropogenic mortality (Glass *et al.* 2008). Of the recent mortalities, including those in the first half of 2005, 6 were adult females, three of which were carrying near-term fetuses and 4 of which were just starting to bear calves. 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 anthropogenic mortality.

Over the five-year period (2002-2006), right whales had the highest proportion of entanglements and ship strikes relative to the number of reports for a species: of 54 reports involving right whales, 25 were confirmed entanglements and 16 were confirmed ship strikes. There were 21 verified right whale mortalities, three due to entanglements, and ten due to ship strikes (Glass *et al.* 2008). 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 number of different modeling exercises using the extensive data collected on this subpopulation have come to the same conclusion; right whale survival continues to decline (Clapham *et al.* 2002). Based on the information currently available, for the purposes of this Opinion, NMFS believes that the western North Atlantic right whale subpopulation numbers 300 (+/- 10%) and is declining.

### **Humpback Whales**

Humpback whales inhabit all major ocean basins from the equator to subpolar latitudes. They generally follow a predictable migratory pattern in both hemispheres, feeding during the summer in the higher near-polar latitudes and migrating to lower latitudes in the winter where calving and breeding takes place (Perry *et al.* 1999). Humpbacks are listed under the ESA at the species level. Therefore, information is presented below regarding the status of humpback whales throughout their range.

*North Pacific, Northern Indian Ocean and Southern Hemisphere*

Humpback whales range widely across the North Pacific during the summer months; from Port Conception, CA, to the Bering Sea (Johnson and Wolman 1984, Perry *et al.* 1999). Although the IWC 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). 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, the central North Pacific stock and the western North Pacific stock (Anglis and Outlaw 2007, Carretta *et al.* 2007). Winter/spring populations of humpback whales also occur in Mexico's offshore islands, however the migratory destinations of these whales is currently not well known (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 (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 6-8% growth per year (Carretta *et al.* 2007). The central North Pacific stock appears to also have increased in abundance between the 1980's -1990's (Anglis and Outlaw 2007). 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 (Anglis and Outlaw 2007).

Little or no research has been conducted on humpbacks in the Northern Indian Ocean so information on their current abundance does not exist (Perry *et al.* 1999). Since these humpback whales do not occur in U.S. waters, there is no recovery plan or stock assessment report for the northern Indian Ocean humpback whales. Likewise, there is no recovery plan or stock assessment report for southern hemisphere humpback whales, and there is also no current estimate of abundance for humpback whales in the southern hemisphere although there are estimates for some of the six southern hemisphere humpback whale stocks recognized by the IWC (Perry *et al.* 1999). Like other whales, southern hemisphere humpback whales were heavily exploited for commercial whaling. Although they were given protection by the IWC in 1963, Soviet whaling data made available in the 1990's revealed that 48,477 southern hemisphere humpback whales were taken from 1947-1980, contrary to the original reports to the IWC which accounted for the take of only 2,710 humpbacks (Zemsky *et al.* 1995, IWC 1995, Perry *et al.* 1999).

#### *Gulf of Maine (North Atlantic)*

Humpback whales from most Atlantic feeding areas calve and mate in the West Indies and migrate to feeding areas in the northwestern Atlantic during the summer months. Most of the humpbacks that forage in the Gulf of Maine visit Stellwagen Bank and the waters of Massachusetts and Cape Cod Bays. Previously, the North Atlantic humpback whale population was treated as a single stock for management purposes, however due to the strong fidelity to the region displayed by many whales, the Gulf of Maine stock was reclassified as a separate feeding stock (Waring *et al.* 2007). Sightings are most frequent from mid-March through November between 41°N and 43°N, from the Great South Channel north along the outside of Cape Cod to Stellwagen Bank and Jeffrey's Ledge (CeTAP 1982) and peak in May and August. Small

numbers of individuals may be present in this area year-round, including the waters of Stellwagen Bank. They feed on a number of species of small schooling fishes, particularly sand lance and Atlantic herring, targeting fish schools and filtering large amounts of water for their associated prey. It is hypothesized humpback whales may also feed on euphausiids (krill) as well as capelin (Waring *et al.* 2007, 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.* 2007). Various papers (Clapham and Mayo 1990; Clapham 1992; Barlow and Clapham 1997; Clapham *et al.* 1999) summarize information gathered from a catalogue of photographs of 643 individuals from the western North Atlantic population of humpback whales. These photographs identified reproductively mature western North Atlantic humpbacks wintering in tropical breeding grounds in the Antilles, primarily on Silver and Navidad Banks, north of the Dominican Republic. The primary winter range also includes the Virgin Islands and Puerto Rico (NMFS 1991a).

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

Photographic mark-recapture analyses from the Years of the North Atlantic Humpback (YONAH) project gave an ocean-basin-wide estimate of 11,570 animals during 1992/1993 and an additional genotype-based analysis yielded a similar but less precise estimate of 10,400 whales (95% c.i. = 8,000 - 13,600) (Waring *et al.* 2007). For management purposes under the MMPA, the estimate of 11,500 individuals is regarded as the best available estimate for the North Atlantic population (Waring *et al.* 2007). Assessing abundance for the Gulf of Maine stock of humpback whales has proved problematic, however, the best, recent estimate for the Gulf of Maine stock is 847 whales, derived from the 2006 aerial survey (Waring *et al.* 2007).

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 2002 through 2006, 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.* 2008, Waring *et al.* 2008). Between 2002 and

2006 humpback whales were involved in 77 confirmed entanglement events and 9 confirmed ship strike events (Glass *et al.* 2008). Over the five-year period, humpback whales were the most commonly observed entangled whale species; entanglements accounted for 6 mortalities and nine serious injuries (Glass *et al.* 2008). Although ship strikes were relatively uncommon, 7 of the 9 confirmed events were fatal (Glass *et al.* 2008). It was assumed that all of these events involved members of the Gulf of Maine stock of humpback whales unless a whale was confirmed to be from another stock; in reports prior to 2007, only events involving whales confirmed to be members of the Gulf of Maine stock were included. As of February 2008, there was no available information to indicate that the events described here do *not* include a Gulf of Maine animal. There were also many carcasses that washed ashore or were spotted floating at sea for which the cause of death could not be determined. Given the number of decomposed and incompletely or unexamined animals in the records, there needs to be greater emphasis on the timely recovery of carcasses and complete necropsies; decomposed and/or unexamined animals (e.g., carcasses reported but not retrieved or no necropsy performed) represent 'lost data' some of which may relate to human impacts (Glass *et al.* 2008, Waring *et al.* 2008).

Based on photographs taken between 2000-2002 of the caudal peduncle and fluke of humpback whales, Robbins and Mattila (2004) estimated that at least half (48-57%) of the sample (187 individuals) was coded as having a high likelihood of prior entanglement. Evidence suggests that entanglements have occurred at minimum rate of 8-10% per year. Scars acquired by Gulf of Maine stock humpback whales between 2000 and 2002 suggest a minimum of 49 interactions with gear took place. Based on composite scar patterns, it was believed that male humpback whales were more vulnerable to entanglement than females. Males may be subject to other sources of injury that could affect scar pattern interpretation. Images were obtained from a humpback whale breeding ground; 24% exhibited raw injuries, presumably 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. In October 2006, NMFS declared an unusual mortality event (UME) for humpback whales in the Northeast United States. At least 17 dead humpback whales have been discovered since March 2006. There has also been a documented bloom of *Alexandrium* sp., a toxic dinoflagellate that causes red tide from Maine to Massachusetts. Prior to the most recent UME, there had been only three other known cases of a mass mortality involving large whale species along the east coast: 1987–1988, 2003, and 2005. Geraci *et al.* (1989) provide strong evidence that, in the former case, these deaths of humpback whales 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).

Changes in humpback distribution in the Gulf of Maine have been found to be associated with changes in herring, mackerel, and sand lance abundance associated with local fishing pressures (Stevick *et al.* 2006, Waring *et al.* 2007). Shifts in relative finfish species abundance correspond to changes in observed humpback whale movements (Stevick *et al.* 2006). However, there is no evidence that humpback whales were adversely affected by these trophic changes.

#### *Summary of Humpback Whales Status*

The best available population estimate for humpback whales in the North Atlantic Ocean is estimated as 11,570 animals, and the best, recent estimate for the Gulf of Maine stock is 847 whales (Waring *et al.* 2007). Anthropogenic mortality associated with fishing gear entanglements and ship strikes remains significant. 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, 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% (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.* 2007). With respect to the species overall, there are also indications of increasing abundance for the eastern and central North Pacific stocks. However, trend and abundance data is lacking for the western North Pacific stock, the Southern Hemisphere humpback whales, and the Southern Indian Ocean humpbacks. Given the best available information, changes in status of the North Atlantic humpback population are, therefore, likely to affect the overall survival and recovery of the species.

#### **Fin Whale**

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

Within US waters of the Pacific, fin whales are found seasonally off of the coast of North America and Hawaii and in the Bering Sea during the summer (Angliss *et al.* 2001). NMFS recognizes three fin whale stocks in the Pacific for the purposes of managing this species under the MMPA. These are: Alaska (Northeast Pacific), California/Washington/Oregon, and Hawaii (Angliss *et al.* 2001). Reliable estimates of current abundance for the entire Northeast Pacific fin whale stock are not available (Angliss *et al.* 2001). Stock structure for fin whales in the southern hemisphere is unknown. Prior to commercial exploitation, the abundance of southern hemisphere fin whales is estimated to have been at 400,000 (IWC 1979, Perry *et al.* 1999).

There are no current estimates of abundance for southern hemisphere fin whales. Since these fin whales do not occur in US waters, there is no recovery plan or stock assessment report for the southern hemisphere fin whales.

NMFS has designated one population of fin whale in US waters of the North Atlantic (Waring *et al.* 1998). This species is commonly found from Cape Hatteras northward. A number of researchers have suggested the existence of fin whale subpopulations in the North Atlantic based on local depletions resulting from commercial overharvesting (Mizroch and York 1984) or genetics data (Bérubé *et al.* 1998). Photoidentification studies in western North Atlantic feeding areas, particularly in Massachusetts Bay, have shown a high rate of annual return by fin whales, both within years and between years (Seipt *et al.* 1990) suggesting some level of site fidelity. In 1976, the IWC's Scientific Committee proposed seven stocks (or populations) for North Atlantic fin whales. These are: (1) North Norway, (2) West Norway-Faroe Islands, (3) British Isles-Spain and Portugal, (4) East Greenland-Iceland, (5) West Greenland, (6) Newfoundland-Labrador, and (7) Nova Scotia (Perry *et al.* 1999). However, it is uncertain whether these boundaries define biologically isolated units (Waring *et al.* 2005).

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.* 1998). Underwater listening systems have also demonstrated that the fin whale is the most acoustically common whale species heard in the North Atlantic (Clark 1995). The single most important area for this species appeared to be from the Great South Channel, along the 50m isobath past Cape Cod, over Stellwagen Bank, and past Cape Ann to Jeffrey's Ledge (Hain *et al.* 1992).

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

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

The predominant prey of fin whales varies greatly in different geographical areas depending on what is locally available (IWC 1992). In the western North Atlantic, fin whales feed on a variety of small schooling fish (*i.e.*, herring, capelin, sand lance) as well as squid and planktonic crustaceans (Wynne and Schwartz 1999). Fin whales feed by filtering large volumes of water for their prey through their baleen plates.

#### *Threats to fin whale recovery*

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

#### *Summary of Fin Whale Status*

As noted above, the minimum population estimate for the western North Atlantic fin whale is 2,362 which is believed to be an underestimate. Fishing gear appears to pose less of a threat to fin whales in the North Atlantic Ocean than North Atlantic right or humpback whales. However, more fin whales are struck by large vessels than right or humpback whales (Laist *et al.* 2001). Some level of whaling for fin whales in the North Atlantic may still occur.

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.

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 2001 Stock Assessment Report (SAR) gives a best estimate of abundance for fin whales of 2,814 (CV = 0.21). The minimum population estimate for the western North Atlantic fin whale is 2,362 (Waring *et al.* 2001). However, this is considered an underestimate since the estimate was derived from surveys over a limited portion of the western North Atlantic. The 2005 SAR indicates that there are insufficient data at this time to determine population trends for the fin whale.

#### **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))<sup>2</sup>. 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 NMFS 1992), and green sea turtle (NMFS and USFWS 1991b; NMFS and USFWS 1998b).

### *Loggerhead sea turtle*

Loggerhead sea turtles are a cosmopolitan species, found in temperate and subtropical waters. Loggerhead sea turtles are the most abundant species of sea turtle in U.S. waters.

*Pacific Ocean.* In the Pacific Ocean, major loggerhead nesting grounds are generally located in temperate and subtropical regions with scattered nesting in the tropics. The abundance of loggerhead turtles on nesting colonies throughout the Pacific basin have declined dramatically over the past 10-20 years. Loggerhead sea turtles in the Pacific are represented by a northwestern Pacific nesting group (located in Japan) and a smaller southwestern nesting group that occurs in Australia (Great Barrier Reef and Queensland), New Caledonia, New Zealand, Indonesia, and Papua New Guinea. Data from 1995 estimated the Japanese nesting group at 1,000 female loggerhead turtles (Bolten *et al.* 1996). More recent information suggests that nest numbers have increased somewhat over the period 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 indicates the presence of genetically distinct nesting colonies (Hatase *et al.* 2002).

In Australia, long-term census data has been collected at some rookeries since the late 1960's and early 1970's, and nearly all the data show marked declines in nesting since the mid-1980's

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<sup>2</sup> 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.

(Limpus and Limpus 2003). The nesting group in Queensland, Australia, was as low as 300 females in 1997.

Pacific loggerhead turtles are captured, injured, or killed in numerous Pacific fisheries including gillnet, longline, and trawl fisheries in the western and/or eastern Pacific Ocean (NMFS and USFWS 2007a). In Australia, where turtles are taken in bottom trawl and longline fisheries, efforts have been made to reduce fishery bycatch (NMFS and USFWS 2007a).

*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 turtle meat 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. 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). As has been found in other areas, nesting numbers are disproportionate within the area with the majority of nesting occurring at a single location. This may, however, be the result of fox predation on eggs at other Western Australia nesting sites (Baldwin *et al.* 2003).

*Mediterranean Sea.* Nesting in the Mediterranean is confined almost exclusively to the eastern basin (Margaritoulis *et al.* 2003). The greatest number of nests in the Mediterranean are found in Greece with an average of 3,050 nests per year (Margaritoulis *et al.* 2003; NMFS and USFWS 2007a). Turkey has the second largest number of nests with 2,000 nest per year (NMFS and USFWS 2007a). There is a long history of exploitation for loggerheads in the Mediterranean (Margaritoulis *et al.* 2003). Although much of this is now prohibited, some directed take still occurs (Margaritoulis *et al.* 2003). Loggerheads in the Mediterranean also face the threat of habitat degradation, incidental fishery interactions, vessel strikes, and marine pollution (Margaritoulis *et al.* 2003). 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 habitat of Atlantic loggerheads as well as known foraging areas within the Atlantic. Information is also provided in the 5-year status review (NMFS and USFWS 2007a). 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 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). In both the eastern and western Atlantic, waters as far north as 41°-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). Of these, loggerheads that nest and/or forage in U.S. waters of the western Atlantic have been most extensively studied.

Loggerheads commonly occur throughout the inner continental shelf from Florida through Cape Cod, Massachusetts although their presence varies with the seasons due to changes in water temperature (Shoop and Kenney 1992; Epperly *et al.* 1995a; Epperly *et al.* 1995b; Braun and Epperly 1996; Epperly and Braun-McNeill 2002; Mitchell *et al.* 2003). Aerial surveys of continental shelf waters north of Cape Hatteras indicate that loggerhead sea turtles are most commonly sighted in waters with bottom depths ranging from 22 to 49 meters deep (Shoop and Kenney 1992). However, 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). The presence of loggerhead turtles in an area is also influenced by water temperature. Loggerheads have been observed in waters with surface temperatures of 7-30°C but water temperatures of  $\geq 11^\circ\text{C}$  are favorable to sea turtles (Shoop and Kenney 1992; Epperly *et al.* 1995b).

In the western North Atlantic, loggerhead sea turtles occur year round in offshore waters off of North Carolina where water temperature is influenced by the Gulf Stream. As coastal water temperatures warm in the spring, loggerheads begin to migrate to North Carolina inshore waters (*e.g.*, Pamlico and Core Sounds) and also move up the coast (Epperly *et al.* 1995a; Epperly *et al.* 1995b; Epperly *et al.* 1995c; Braun-McNeill and Epperly 2004), occurring in Virginia foraging areas as early as April 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 may remain in Mid-Atlantic and Northeast areas until late Fall. By December loggerheads have migrated from inshore North Carolina waters and more northern coastal waters to waters offshore of North Carolina, particularly off of Cape Hatteras, and waters further south where the influence of the Gulf Stream provides temperatures favorable to sea turtles (Shoop and Kenney 1992; Epperly *et al.* 1995b; Epperly and Braun-McNeill 2002).

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

The scientific literature for loggerhead sea turtles recognizes five nesting groups in the western North 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 nest on beaches of the islands of the Dry Tortugas, near Key West, Florida (NMFS SEFSC 2001). Genetic analyses of mitochondrial DNA, which a turtle inherits from its mother, indicate that there are genetic differences between turtles 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 turtles originating from nesting beaches of the five western North Atlantic loggerhead 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).

In the western Atlantic, most loggerhead sea turtles nest from North Carolina to Florida and along the Gulf coast of Florida. In 1989, a statewide sea turtle Index Nesting Beach Survey (INBS) program was developed and implemented in Florida. There are currently 33 nesting beaches in the INBS program (letter to NMFS from the Director, Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, October 25, 2006). As of 2006, 27 of the 33 beaches had reached the mandatory minimum of 10-years participation for their nest count data to be included in trend evaluations (letter to NMFS from the Director, Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, October 25, 2006). Nesting recorded by the INBS program on the 27 beaches represented an average of 65% of all annual nesting by loggerheads in the state for the period 2001-2005 (letter to NMFS from the Director, Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, October 25, 2006). Standardized nesting beach survey programs have been implemented in Georgia, South Carolina, and North Carolina as well (Dodd 2003; USFWS and NMFS 2003). A near complete census of the Dry Tortugas nesting beaches were conducted from 1995 – 2004 (excluding 2002). However, no trend in the number of nests laid was detected for the time period and no surveys have been conducted since 2004 (NMFS and USFWS 2007a). Survey effort to counts nests for loggerhead nesting beaches of the Yucatán, Mexico, was consistent from 1987-2001 for seven beaches in Quintana Roo, Mexico (NMFS and USFWS 2007a). However, nesting survey effort overall has been inconsistent among the Yucatán nesting beaches (Zurita *et al.* 2003).

Sea turtle nesting survey data is important in that it provides 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 5-year review for loggerhead sea turtles (NMFS and USFWS 2007a) compiled the most recent information on mean number of loggerhead nests per year, and, where available, the approximated counts of nesting females for each of the five identified western north Atlantic loggerhead nesting groups. These are: (1) For the south Florida nesting group, a mean of 65,460 loggerhead nests per year with approximately 15,966 females nesting per year; (2) for the northern nesting group, a mean of 5,151 nests per year (no estimate of number of females nesting per year provided); (3) for the Florida panhandle nesting group, a mean of 910

nests per year with approximately 222 females nesting per year; (4) for the Dry Tortugas nesting group, a mean of 246 nests per year with approximately 60 females nesting per year; and (5) for the Yucatán nesting group, a range of 903-2,231 nests per year from 1987-2001 (no estimate of number of nesting females provided) (NMFS and USFWS 2007a). As is evident from this information, nests for the south Florida nesting group make up the majority of all loggerhead nests counted along the U.S. Atlantic and Gulf coasts and represents the largest known loggerhead nesting group (in terms of number of nesting females) in the Atlantic (USFWS and NMFS 2003; NMFS and USFWS 2007a). The northern nesting group is the second largest for loggerheads within the United States but smaller than the south Florida nesting group. The remaining three nesting groups (the Dry Tortugas, Florida Panhandle, and Yucatán) are, again, much smaller in terms of the number of nests laid and the estimated number of females laying nests.

In 2006, information was presented at an international sea turtle symposium (Meylan *et al.* 2006) and in a letter to NMFS (letter to NMFS from the Director, Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, October 25, 2006) that a trend analysis of the nesting data collected for Florida's INBS program showed a decrease in nesting of 22.3% in the annual nest density of surveyed shoreline over the 17-year period and a 39.5% decline since 1998 (letter to NMFS from the Director, Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, October 25, 2006). Data collected in Florida for the 2007 loggerhead nesting season reveals that the decline in nest numbers has continued, with even fewer nests counted in 2007 in comparison to any previous year of the period, 1989-2007 (Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission web posting November 2007). Declines in nesting have been noted for some of the other western Atlantic loggerhead nesting groups as well. Standardized ground surveys of 11 North Carolina, South Carolina, and Georgia nesting beaches showed a significant declining trend of 1.9% annually in loggerhead nesting from 1983-2005 (NMFS and USFWS 2007a). Aerial surveys conducted by the South Carolina Department of Natural Resources showed a 3.1% annual decline in nesting since 1980 (Dodd 2003; NMFS and USFWS 2007a). The South Carolina data represents approximately 59% of nesting by the northern nesting group (Dodd 2003). A significant declining trend ( $P=0.04$ ) in loggerhead nesting of 6.8% annually from 1995-2005 has also been detected for the Florida Panhandle nesting group (NMFS and USFWS 2007a). Nesting for the Yucatán nesting group is characterized as having declined since 2001 (NMFS and USFWS 2007a) while no trend is detectable for the Dry Tortugas nesting group (NMFS and USFWS 2007a).

Unlike nesting beach data, 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 western 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.* 2004; Mansfield 2006; Ehrhart *et al.* 2007; Epperly *et al.* 2007). Maier *et al.* (2004) used fishery-independent trawl data to establish a regional index of loggerhead abundance for the southeast coast of the United States (Winyah Bay, South Carolina to St. Augustine, FL) 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 southeastern United States appear to be larger, possibly an

order of magnitude higher than they were 25 years ago (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 similarly 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). In contrast to these studies, Morreale *et al.* (2004) observed a decline in the incidental catch of loggerhead sea turtles in pound net gear fished around Long Island, NY, during the period 2002-2004 in comparison to the period 1987-1992, with only two loggerhead sea turtles observed captured in pound net gear during the period 2002-2004. No additional loggerheads were reported captured in pound net gear through 2007, although 2 loggerhead sea turtles were found cold-stunned on Long Island bay beaches in the fall of 2007 (Memo to the File, L. Lankshear, December 2007). 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 1980's. Significantly fewer turtles ( $p < 0.05$ ) were observed in both the spring (May-June) and the summer (July-August) of 2001-2004 compared to aerial surveys in the 1980's (Mansfield 2006). A comparison of median densities from the 1980's to the 2000's 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 diversity of a sea turtle's life history leaves them susceptible to many natural and human impacts, including impacts while they are on land, in the benthic environment, and in the pelagic environment. Recent studies have established that the loggerheads 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 females post-nesting and found a difference in habitat use was related to body size with larger turtles staying in coastal waters and smaller turtles 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 while others moved off into oceanic waters (McClellan and Read 2007). However, unlike the Hawkes *et al.* study (2006), 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 not only supports the need to revise the life history model for loggerheads but also 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 of loggerhead sea turtles recently completed by NMFS and the USFWS provides a summary of natural as well as anthropogenic threats to loggerhead sea turtles (NMFS and USFWS 2007a). Amongst those of natural origin, hurricanes are known to be destructive to sea turtle nests. Sand accretion and rainfall that result from these storms as well as wave action can appreciably reduce hatchling success. Other sources of natural mortality include cold

stunning and biotoxin exposure.

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

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

A 1990 National Research Council report concluded that for juvenile, subadults, and breeders in coastal waters, the most important source of human caused mortality in U.S. Atlantic waters was fishery interactions. Of these, the U.S. south Atlantic and Gulf of Mexico shrimp fisheries were considered to pose the greatest cause of mortality to neritic juvenile and adult age classes of loggerheads accounting for an estimated 5,000 – 50,000 loggerheads 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 2002; Lewison *et al.* 2003). Section 7 consultation was reinitiated in 2002 to, in part, consider the effect of a new rulemaking that would require increasing the size of TED escape openings to allow larger loggerheads (and green 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 3,947 turtles assuming that all TEDs were installed properly and that compliance was 100% (Epperly *et al.* 2002; NMFS 2002). The total level of take (capture) 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 loggerheads per year (NMFS 2002) with up to 3,948 mortalities. On February 21, 2003, NMFS issued the final rule to require the use of the larger opening TED (68 FR 8456). 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.

The NRC report (1990) also stated that other U.S. Atlantic fisheries collectively accounted for 500-5,000 loggerhead deaths each year, but recognized that there was considerable uncertainty in the estimate. Subsequent studies suggest that these numbers were underestimated. For example, the first estimate of loggerhead sea turtle bycatch in U.S. Mid-Atlantic bottom otter trawl gear was completed in September 2006 (Murray 2006). Observers reported 66 loggerhead turtle interactions with bottom otter trawl gear during the period of which 38 were reported as alive and uninjured and 28 were reported as dead, injured, resuscitated, or of unknown condition (Murray 2006). Seventy-seven percent of observed turtle interactions occurred on vessels fishing for summer flounder (50%) and croaker (27%). The remaining 23% of observed takes occurred on vessels targeting weakfish (11%), long-finned squid (8%), groundfish (3%) and short-finned squid (1%) (Murray 2006). Based on observed interactions and fishing effort as reported on VTRs, the average annual loggerhead bycatch in these bottom-otter trawl fisheries combined was estimated to be 616 sea turtles for each year of the period 1996-2004 (Murray 2006).

The U.S. tuna and swordfish longline fisheries that are managed under the Highly Migratory Species Fishery Management Plan (HMS FMP), were estimated to capture 1,905 loggerheads (no more than 339 mortalities) for each 3-year period (NMFS 2004c). NMFS has mandated gear changes for the HMS fishery to reduce turtle bycatch and the likelihood of death from those takes that would still occur (Fairfield-Walsh and Garrison 2007). In 2006, there were 46 observed interactions between loggerhead sea turtles and longline gear used in the HMS fishery. Nearly all of the loggerheads (42 of 46) were released alive but with injuries (Fairfield-Walsh and Garrison 2007). The majority of the injured had been hooked internally (Fairfield-Walsh and Garrison 2007). Based on the observed take, an estimated 561 (range = 318-981) loggerhead sea turtles are estimated to have been taken (hooked and released live, with injuries) in the longline fisheries managed under the HMS FMP in 2006 (Fairfield-Walsh and Garrison 2007). This number is an increase from 2005 when 274 loggerheads were estimated to have been taken in the fisheries but is still lower than some previous years in the period of 1992-2006 (Fairfield-Walsh and Garrison 2007). This fishery represents just one of several longline fisheries operating in the Atlantic. Lewison *et al.* (2004) estimated that 150,000-200,000 loggerheads were taken (capture) in the Atlantic longline fisheries in 2000 (includes 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; 20-38 years (NMFS SEFSC 2001). Loggerhead sea turtles are injured and killed by numerous human activities (NRC 1990; NMFS and USFWS 2007a). There are no population estimates for loggerhead sea turtles in any of the ocean basins in which they occur.

Genetic differences exist between 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). Based on the most recent information, a decline in the annual nest counts has been measured or suggested for four of five western Atlantic loggerhead nesting groups. These include the south Florida nesting group which is the largest (in terms of number of nests laid) in the Atlantic.

NMFS has also convened a new loggerhead TEWG to review all available information on Atlantic loggerheads in order to determine what can be said about the status of this species in the Atlantic. A final report from the Loggerhead TEWG is not yet available. An interim update was provided by the Loggerhead TEWG to NMFS in December 2007. In summary, the memo stated that nest counts, fishery dependent data, and stranding data do not provide the necessary insight into loggerhead turtle population dynamics to properly assess species status (Loggerhead TEWG 2007). As has been stated in the literature (Meylan 1982; Ross 1996; Zurita *et al.* 2003; Hawkes *et al.* 2005), the TEWG remarked that nest counts alone provide no insight into the trend/abundance of sexually mature males or of other age classes of either sex (Loggerhead TEWG 2007). In addition, the TEWG stated that interpreting the meaning of a decline in nest counts in terms of the status/trend of the number of nesting females in the population is difficult since converting nest counts to the number of nesting females is confounded by several issues such as variability in the number of nests per female per year; variability in remigration interval; and, as the ability to nest is resource dependent, the effect of habitat changes and the availability of food resources (Loggerhead TEWG 2007). The TEWG is continuing to explore several hypotheses for why nest counts have been declining. These hypotheses will be more fully discussed in the final report (Loggerhead TEWG 2007).

#### *Leatherback sea turtle*

Leatherback sea turtles are widely distributed throughout the oceans of the world, and are found in waters of the Atlantic and Pacific Oceans, the Caribbean Sea, and the Gulf of Mexico (Ernst and Barbour 1972). Leatherback sea turtles are the largest living turtles and range farther than any other sea turtles species; their large size and tolerance of relatively low temperatures allows them to occur in northern waters such as off Labrador and in the Barents Sea (NMFS and USFWS 1995).

In 1980, the 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). However, the most recent population size estimate for the North Atlantic alone is a range of 34,000-94,000 adult leatherbacks (Leatherback TEWG 2007). Thus, there is 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; NMFS and USFWS 1998a; Sarti *et al.* 2000; Spotila *et al.* 2000). Leatherback turtles disappeared from India before 1930, have been virtually extinct in Sri Lanka since 1994, and appear to be approaching extinction in Malaysia (Spotila *et al.* 2000). For example, the nesting group on Terengganu (Malaysia) - which was one of the most significant nesting sites in the western Pacific Ocean - has declined severely from an estimated

3,103 females in 1968 to 2 nesting females in 1994 (Chan and Liew 1996). Nesting groups of leatherback 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 (East Papua), leatherback turtles have only been known to nest in low densities and scattered colonies.

Only an Indonesian nesting group has remained relatively abundant in the Pacific basin. The largest, extant leatherback nesting group in the Indo-Pacific lies on the north Vogelkop coast of Irian Jaya (West Papua), Indonesia, with over 1,000 nesting females during the 1996 season (Suarez *et al.* 2000). During the early-to-mid 1980s, the number of female leatherback turtles nesting on the two primary beaches of Irian Jaya appeared to be stable. However, in 1999, for example, local Indonesian villagers started reporting dramatic declines in sea turtles near their villages (Suarez 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.*, Suarez 1999).

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

In the eastern Pacific Ocean, leatherback nesting is declining along the Pacific coast of Mexico and Costa Rica. According to reports from the late 1970s and early 1980s, three beaches located on the Pacific coast of Mexico support as many as half of all leatherback turtle nests. Since the early 1980s, the eastern Pacific Mexican population of adult female leatherback turtles has declined to slightly more than 200 during 1998-99 and 1999-2000 (Sarti *et al.* 2000). Spotila *et al.* (2000) reported the decline of the leatherback nesting at Playa Grande, Costa Rica, which had been the fourth largest nesting group in the world. Between 1988 and 1999, the nesting group declined from 1,367 to 117 female leatherback 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 the past 15 years of monitoring (1989-2004) with approximately 1,504 females nesting in 1988-89 to an average of 188 females nesting in 2000-2001 and 2003-2004 (NMFS and USFWS 2007b). A similar dramatic decline has been seen on nesting beaches in Pacific Mexico, where tens of thousands of leatherback nests were laid on the beaches in the 1980s but where a total of only 120 nests on the four primary index beaches (combined) were counted in the 2003-2004 season.

Commercial and artisanal swordfish fisheries off Chile, Columbia, Ecuador, and Peru, purse seine fisheries for tuna in the eastern tropical Pacific Ocean, and California/Oregon drift gillnet fisheries are known to capture, injure or kill leatherback turtles in the eastern Pacific Ocean. 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; Spotila *et al.* 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 1000 (Andrews and Shanker 2002). Some nesting also occurs along the coast of Sri Lanka although in much smaller numbers than in the past (Pritchard 2002).

*Atlantic Ocean.* Evidence from tag returns and strandings in the western Atlantic suggests that adult leatherback sea turtles engage in routine migrations between boreal, temperate and tropical waters (NMFS and USFWS 1992). Leatherbacks are frequently thought of as a pelagic species that feed on jellyfish (*i.e.*, *Stomolophus*, *Chryaora*, and *Aurelia* (Rebel 1974)), and tunicates (salps, pyrosomas) in oceanic habitat. However, leatherbacks are also known to use coastal waters of the U.S. continental shelf (James *et al.* 2005b; Eckert *et al.* 2006; Murphy *et al.* 2006) as well as the European continental shelf on a seasonal basis (Witt *et al.* 2007).

A 1979 aerial survey of the outer Continental Shelf from Cape Hatteras, North Carolina to Cape Sable, Nova Scotia showed leatherbacks to be present throughout the area with the most numerous sightings made from the Gulf of Maine south to Long Island. Leatherbacks were sighted in water depths ranging from 1-4151m 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 as compared to loggerheads (Shoop and Kenney 1992). This aerial survey estimated the leatherback population for the northeastern U.S. at approximately 300-600 animals (from near Nova Scotia, Canada to Cape Hatteras, North Carolina). However, the estimate was based on turtles visible at the surface and does not include those that were below the surface out of view. Therefore, it likely underestimates the leatherback population for the northeastern U.S. Estimates of leatherback abundance of 1,052 turtles (C.V.= 0.38) and 1,174 turtles (C.V.= 0.52) were obtained from surveys conducted from Virginia to the Gulf of St. Lawrence in 1995 and 1998, respectively (Palka 2000). However, since these estimates were also based on sightings of leatherbacks at the surface, the author considered the estimates to be negatively biased and the true abundance of leatherbacks may be 4.27 times the estimates (Palka 2000). Studies of satellite tagged leatherbacks suggest that they spend a 10% - 41% of their time at the surface, depending on the phase of their migratory cycle (James *et al.* 2005a). The greatest amount of surface time (up to 41%) was recorded when leatherbacks occurred in continental shelf and slope waters north of 38° N (James *et al.* 2005a).

Leatherbacks are a long lived species (> 30 years). They mature at a younger age than loggerhead turtles, with an 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). 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 this seasonal estimate. As is the case with other sea turtle species, leatherback hatchlings enter the water soon after hatching. Based on a review of all sightings of leatherback sea turtles of <145 cm (56.55 in) curved carapace length (CCL), Eckert (1999) found that leatherback juveniles remain in waters warmer than 26° C until they exceed 100 cm (39 in) 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. 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 Survey 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 (Leatherback TEWG 2007). The TEWG reports an increasing or stable trend for all of the seven populations or groups of populations with the exception of the Western Caribbean and West Africa. However, caution is also warranted even for those that were identified as stable or increasing. In St. Croix, for example, researchers have noted a declining presence of neophytes (first-time nesters) since 2002 (Garner *et al.* 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 (Leatherback TEWG 2007), and represents more than half of total nesting by leatherback sea turtles world-wide (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 most recent Leatherback TEWG report (2007) 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 impact leatherback sea turtles could have profound impacts on the species, overall.

Tag return data demonstrate that leatherbacks that nest in South America also use U.S. waters. A nesting female tagged May 29, 1990, in French Guiana was later recovered and released alive from the York River, VA. Another nester tagged in French Guiana was later found dead in Palm

Beach, Florida (STSSN database). Many other examples also exist. For example, leatherbacks tagged at nesting beaches in Costa Rica have been found in Texas, Florida, South Carolina, Delaware, and New York (STSSN database). Leatherback turtles tagged in Puerto Rico, Trinidad, and the Virgin Islands have also been subsequently found on U.S. beaches of southern, Mid-Atlantic and northern states (STSSN database).

Of the Atlantic turtle species, leatherbacks seem to be the most vulnerable to entanglement in fishing gear. 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. They are also susceptible to entanglement in gillnets (used in various fisheries) and capture in trawl gear (*e.g.*, shrimp trawls, bottom otter trawls). Sea turtles entangled in fishing gear generally have a reduced ability to feed, dive, surface to breathe or perform any other behavior essential to survival (Balazs 1985). 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 are exposed to pelagic longline fisheries in many areas of their range. According to observer records, an estimated 6,363 leatherback sea turtles were caught by the U.S. Atlantic tuna and swordfish longline fisheries between 1992-1999, of which 88 were released dead (NMFS SEFSC 2001). Since the U.S. fleet accounts for only 5-8% of the hooks fished in the Atlantic Ocean, adding up the under-represented observed takes of the other 23 countries actively fishing in the area would likely result in annual take estimates of thousands of leatherbacks over different life stages (NMFS SEFSC 2001).

Leatherbacks are susceptible to entanglement in the lines associated with trap/pot gear used in several fisheries. From 1990-2000, 92 entangled leatherbacks were reported from New York through Maine (Dwyer *et al.* 2002). Additional leatherbacks stranded wrapped in line of unknown origin or with evidence of a past entanglement (Dwyer *et al.* 2002). A review of leatherback mortality documented by the STSSN in Massachusetts suggests that vessel strikes and entanglement in fixed gear (primarily lobster pots and whelk pots) are the principal sources of this mortality (Dwyer *et al.* 2002). Fixed gear fisheries in the Mid-Atlantic have also contributed to leatherback entanglements. For example, in North Carolina, two leatherback sea turtles were reported entangled in a crab pot buoy inside Hatteras Inlet (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, leatherbacks are vulnerable to entanglement in Florida's lobster pot and stone crab fisheries as documented on stranding forms. In the U.S. Virgin Islands, where one of five leatherback strandings from 1982 to 1997 were due to entanglement (Boulon 2000), leatherbacks have been observed with their flippers wrapped in the line of West Indian fish traps (R. Boulon, pers. comm. to Joanne Braun-McNeill, NMFS SEFSC 2001).

Leatherback interactions with the U.S. south Atlantic and Gulf of Mexico shrimp fisheries, are also known to occur (NMFS 2002). Leatherbacks are likely to encounter shrimp trawls working

in the coastal waters off the Atlantic coast (from Cape Canaveral, Florida through North Carolina) as they make their annual spring migration north. For many years, TEDs that were required for use in the 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, on February 21, 2003, NMFS issued a final rule to amend the TED regulations. Modifications to the design of TEDs are now required in order to exclude leatherbacks as well as large benthic immature and sexually mature loggerhead and green turtles.

Other trawl fisheries are also known to interact with leatherback sea turtles although on a much smaller scale. In October 2001, for example, a fisheries observer documented the take of a leatherback in a bottom otter trawl fishing for *Loligo* squid off of Delaware. TEDs are not required in this fishery. 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 nearshore 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 through 1998 (excluding 1997) indicate that a total of 37 leatherbacks were incidentally captured (16 lethally) in drift gillnets set in offshore waters from Maine to Florida during this period. Observer coverage for this period ranged from 54% to 92%. In North Carolina, a leatherback was reported captured in a gillnet set in Pamlico Sound in the spring of 1990 (D. Fletcher, pers.comm. to Sheryan Epperly, NMFS SEFSC 2001). Five other leatherbacks were released alive from nets set in North Carolina during the spring months: one was from a net (unknown gear) set in the nearshore waters near the North Carolina/Virginia border (1985); two others had been caught in gillnets set off of Beaufort Inlet (1990); a fourth was caught in a gillnet set off of Hatteras Island (1993), and a fifth was caught in a sink net set in New River Inlet (1993). In addition to these, in September 1995, two dead leatherbacks were removed from a 11-inch (28.2 cm) monofilament shark gillnet set in the nearshore waters off of Cape Hatteras, North Carolina (STSSN unpublished data reported in NMFS SEFSC 2001).

Fishing gear interactions and poaching are problems for leatherbacks throughout their range. Entanglements are common in Canadian waters where Goff and Lien (1988) reported that 14 of 20 leatherbacks encountered off the coast of Newfoundland/Labrador were entangled in fishing gear including salmon net, herring net, gillnet, trawl line and crab pot line. Leatherbacks are known to drown in fish nets set in coastal waters of Sao Tome, West Africa (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 turtles in the waters of coastal Nicaragua also incidentally catch leatherback turtles (Lagueux *et al.* 1998). Observers on shrimp trawlers operating in the northeastern region of Venezuela documented the capture of six leatherbacks from 13,600 trawls (Marcano and Alio 2000). An estimated 1,000 mature female leatherback sea turtles are caught annually in fishing nets off of Trinidad and Tobago with mortality estimated to be between 50-95% (Eckert and Lien 1999). However, many of the turtles do not die as a result of drowning, but rather because the fishermen butcher them in order to get them out of their nets (NMFS SEFSC 2001).

Leatherback sea turtles may be more susceptible to marine debris ingestion than other species due to the tendency of floating debris to concentrate in convergence zones that adults and juveniles 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 and plastic debris (Mrosovsky 1981). Balazs (1985) speculated that the object may resemble a food item by its shape, color, size or even movement as it drifts about, and induce a feeding response in leatherbacks.

#### *Summary of Status for Leatherback Sea Turtles*

In the Pacific Ocean, the abundance of leatherback 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 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 at nesting and marine habitats. 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 the USFWS (2007b) determined that endangered leatherback sea turtles should not be delisted or reclassified as threatened. However, it was also determined that an analysis and review of the species should be conducted in the future to determine whether DPS's should be identified for the leatherback, and what the status of any DPSs should be (NMFS and USFWS 2007b).

#### *Kemp's ridley sea turtle*

The Kemp's ridley is one of the least abundant of the world's sea turtle species. In contrast to loggerhead, leatherback and green sea turtles which are found in multiple oceans of the world, Kemp's ridleys typically occur only in the Gulf of Mexico and the northern half of the 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

300 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% C.I. slope = 0.096-0.130) per year (TEWG 2000). An estimated 5,500 females nested in Tamaulipas over a 3-day period in May 2007 (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 beach, neonates presumably enter the Gulf of Mexico where they feed on available sargassum and associated infauna or other epipelagic species (USFWS and NMFS 1992). The presence of juvenile turtles along both the Atlantic and Gulf of Mexico coasts of the U.S., where they are recruited to the coastal benthic environment, indicates that post-hatchlings are distributed in both the Gulf of Mexico and Atlantic Ocean (TEWG 2000).

The location and size classes of dead turtles recovered by the STSSN suggests that benthic immature developmental areas occur in many areas along the U.S. coast and that these areas may change given resource quality and quantity (TEWG 2000). Foraging areas documented along the Atlantic coast include Pamlico Sound (NC), Chesapeake Bay, Long Island Sound, Charleston Harbor (SC) and Delaware Bay. 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 50m (NMFS and USFWS 2007c). The suitability of these habitats depends on resource availability, with optimal environments providing rich sources of crabs and other invertebrates. A wide variety of substrates have been documented to provide good foraging habitats, including seagrass beds, oyster reefs, sandy and mud bottoms and rock outcroppings (NMFS and USFWS 2007c). Adults are primarily found in near-shore waters of 37m or less that are rich in crabs and have a sandy or muddy bottom (NMFS and USFWS 2007c).

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

Kemp's ridleys face many of the same natural threats as loggerheads, including destruction of



nesting habitat from storm events, natural predators at sea, and oceanic events such as cold-stunning. Although cold-stunning can occur throughout the range of the species, it may be a greater risk for sea turtles that utilize the more northern habitats of Cape Cod Bay and Long Island Sound. For example, 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 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 waters in a given year, oceanographic conditions and the occurrence of storm events in the late fall. Although many cold-stun turtles can survive if found early enough, cold-stunning events can represent a significant cause of natural mortality.

Like other turtle species, the severe decline in the Kemp's ridley population appears to have been heavily influenced by a combination of exploitation of eggs and impacts from fishery interactions. From the 1940s through the early 1960s, nests from Rancho Nuevo were heavily exploited (USFWS and NMFS 1992), but beach protection in 1966 helped to curtail this activity (USFWS and NMFS 1992). Following World War II, there was a substantial increase in the number of trawl vessels, particularly shrimp trawlers, in the Gulf of Mexico where the adult Kemp's ridley turtles occur. Information from fishers helped to demonstrate the high number of turtles taken in these shrimp trawls (USFWS and NMFS 1992). Subsequently, NMFS has worked with the industry to reduce turtle takes in shrimp trawls and other trawl fisheries, including the development and use of TEDs. 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 2002; Lewison *et al.* 2003). The Biological Opinion 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 2002).

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

#### *Summary of Status for Kemp's ridley Sea Turtles*

The 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 1990's (NMFS and USFWS 2007c). Based on the number of nests laid in 2006 and the remigration interval for Kemp's ridley sea turtles, 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 ridleys suggest that the population is female biased (NMFS and USFWS 2007c). Based on its 5-year status review of the species, NMFS and the USFWS (2007c) determined that Kemp's ridley sea turtles should not be reclassified as threatened under the ESA.

#### *Green sea turtle*

Green turtles are distributed circumglobally, and can be found in the Pacific, Indian and Atlantic Oceans as well as the Mediterranean Sea (NMFS and USFWS 1991b; 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 turtles occur in the eastern, central, and western Pacific. Foraging areas are also found throughout the Pacific and along the southwestern U.S. coast (NMFS and USFWS 1998b). Nesting is known to occur in the Hawaiian archipelago, American Samoa, Guam, and various other sites in the Pacific but none of these are considered large breeding sites (with 2,000 or more nesting females per year)(NMFS and USFWS 1998b). 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 exceed 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 (Cliffon *et al.* 1982; NMFS and USFWS 2007d). Thus the current number of nesting females is still far below what has historically occurred.

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

*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.* 2003). Based on a review of the 32 Index Sites used to monitor green sea turtle nesting worldwide, Seminoff (2004) concluded that declines in green turtle nesting were evident for many of the Indian Ocean Index Sites. While several of these had not demonstrated further declines in the more recent past, only the Comoros Island Index Site in the Western Indian Ocean showed evidence of increased nesting (Seminoff 2004).

*Atlantic Ocean.* As has occurred in other oceans of its range, green turtles were once the target of directed fisheries in the United States and throughout the Caribbean. In 1890, over one million pounds of green turtles were taken in the Gulf of Mexico green sea turtle fishery

(Doughty 1984). However, declines in the turtle fishery throughout the Gulf of Mexico were evident by 1902 (Doughty 1984).

In the western Atlantic, green sea turtles range from Massachusetts to Argentina, including the Gulf of Mexico and Caribbean (Wynne and Schwartz 1999). Green turtles occur seasonally in Mid-Atlantic and Northeast waters such as Long Island Sound (Musick and Limpus 1997; Morreale and Standora 1998; Morreale *et al.* 2004), presumably for foraging.

Some of the principal feeding pastures in the western Atlantic Ocean include the upper west coast of Florida and the northwestern coast of the Yucatan 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).

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 turtle species described above, adult females may nest multiple times in a season and typically do not nest in successive years (NMFS and USFWS 1991b; 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 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 Archipelago (Guinea-Bissau) (NMFS and USFWS 2007d). Nesting at all of these sites was considered to be stable or increasing with the exception of Bioko Island and the Bijagos Archipelago where the lack of sufficient data precluded a meaningful trend assessment for either site (NMFS and USFWS 2007d). Seminoff (2004) likewise reviewed green sea turtle nesting data for eight sites in the western, eastern, and central Atlantic, including all of the above 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. 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 turtles in the western Atlantic is in Tortuguero, Costa Rica (NMFS and USFWS 2007d). Nesting in the area has increased considerably since the 1970's 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). In the U.S., certain Florida nesting beaches have been designated index beaches. Index beaches were established to standardize data collection methods and effort on key nesting beaches. The pattern of green turtle nesting shows biennial peaks in abundance, with a generally positive trend during the ten years of regular monitoring since establishment of the index beaches in 1989, perhaps due to increased protective legislation throughout the Caribbean (Meylan *et al.* 1995).

An average of 5,039 green turtle nests were laid annually in Florida between 2001 and 2006 with a low of 581 in 2001 and a high of 9,644 in 2005 (NMFS and USFWS 2007d). Occasional nesting has been documented along the Gulf coast of Florida, at southwest Florida beaches, as well as the beaches on the Florida Panhandle (Meylan *et al.* 1995). More recently, green turtle nesting occurred on Bald Head Island, North Carolina just east of the mouth of the Cape Fear River, on Onslow Island, and on Cape Hatteras National Seashore. Increased nesting has also been observed along the Atlantic Coast of Florida, on beaches where only loggerhead nesting was observed in the past (Pritchard 1997).

Green turtles face many of the same natural threats as loggerhead and Kemp's ridley sea turtles. In addition, green turtles appear to be susceptible to fibropapillomatosis, an epizootic disease producing lobe-shaped tumors on the soft portion of a turtle's body. Juveniles are most commonly affected. The occurrence of fibropapilloma tumors may result in impaired foraging, breathing, or swimming ability, leading potentially to death.

As with the other sea turtle species, incidental 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. Stranding reports indicate that between 200-400 green turtles strand annually along the Eastern U.S. coast from a variety of causes most of which are unknown (STSSN database). Sea sampling coverage in the pelagic driftnet, pelagic longline, southeast shrimp trawl, and summer flounder bottom trawl fisheries has recorded takes of green turtles.

#### *Summary of Status of Green Sea Turtles*

A review of 32 Index Sites<sup>3</sup> distributed globally revealed a 48% to 67% decline in the number of mature females nesting annually over the last 3-generations<sup>4</sup> (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 nesting groups assessed in that report, 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

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<sup>3</sup> 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.

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

nesting) in the Pacific, western Atlantic, and central Atlantic (NMFS and USFWS 2007d). The report also estimates that 108,761 to 150,521 females nest each year among the 46 sites (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).

There is cautious optimism that the green sea turtle abundance is increasing in the Atlantic. Seminoff (2004) and NMFS and USFWS (2007d) made comparable conclusions with regard to nesting for four nesting sites in the western Atlantic. 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 1970's (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). 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.

#### **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.

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. 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. While some of the bycatch is likely returned to the water dead or injured to the extent that the organisms will shortly die, they 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). Several of the aforementioned fisheries (e.g., Atlantic mackerel, squid) use bottom-otter trawl gear. 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. Fixed gear such as pot/trap and sink gillnet gear is expected to have less of an effect on bottom habitat than mobile gear. Given this, the use of trawl gear and fixed gear in the aforementioned fisheries will have an insignificant effect on the bottom habitat utilized by sea turtles.

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.

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 July 24, 2003, and concluded that authorization of the skate fishery may adversely affect ESA-listed sea turtles, including loggerheads, as a result of interactions with (capture in) gillnet and trawl gear. In August 2007, NMFS received an estimate of loggerhead sea turtle takes in bottom otter trawl gear used in the skate fishery (Memo from K. Murray, NEFSC to L. Lankshear, NERO, PRD). Using VTR data from 2000-2004 and the average annual bycatch of turtles as described in Murray 2006, the average annual bycatch of loggerhead sea turtles in bottom otter trawl gear used in the skate fishery was estimated to be 24 loggerhead sea turtles a year (Memo from K. Murray, NEFSC to L. Lankshear, NERO, PRD). This information represents new information on the capture of loggerhead sea turtles in skate fishery. NMFS has, therefore, reinitiated section 7 consultation on the continued authorization of the directed skate fishery under the Northeast skate FMP.

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 on June 14, 2001, and concluded that continued implementation of the Multispecies FMP may adversely affect loggerhead, Kemp's ridley and green sea turtles and is not likely to jeopardize the

continued existence of the North Atlantic right whale. A new RPA was issued to avoid the likelihood that the operation of the gillnet sector of the multispecies fishery would result in jeopardy to right whales. The ITS exempted the lethal or non-lethal take (i.e., capture that may or may not result in mortality) of one loggerhead sea turtle, and one green, leatherback, or Kemp's ridley turtle annually. The northeast multispecies sink gillnet fishery has historically occurred from the periphery of the Gulf of Maine to Rhode Island in water to 60 fathoms. In recent years, more of the effort in the fishery has occurred in offshore waters and into the Mid-Atlantic. However, participation in this fishery has declined since extensive groundfish conservation measures have been implemented, particularly since implementation of Amendment 13 to the Multispecies FMP in April 2004. Additional management measures (i.e. Framework Adjustment 42) are expected to further reduce and control effort in the multispecies fishery. The exact relationship between multispecies fishing effort and the number of sea turtle interactions with gear used in the fishery is unknown. However, in general, less fishing effort results in less time that gear is in the water and therefore less opportunity for sea turtles to be captured or entangled in multispecies fishing gear. Section 7 consultation is on-going and will consider the information received from the NEFSC as well as information on changes to the fishery since 2004.

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. In 1999, observers documented that turtles were taken in excess of the ITS as a result of entanglements in monkfish gillnet gear. NMFS reinitiated consultation on the Monkfish FMP on May 4, 2000, in part, to reevaluate the affect of the monkfish gillnet fishery on sea turtles. The Opinion also considered new information on the status of the North Atlantic right whale and new Atlantic Large Whale Take Reduction Plan (ALWTRP) measures, and the ability of the RPA to avoid the likelihood of jeopardy to right whales. The Opinion concluded that continued implementation of the Monkfish FMP was likely to jeopardize the existence of the North Atlantic right whale. A new RPA was provided that was expected to remove the threat of jeopardy to North Atlantic right whales. In addition, a new ITS was provided for the take of sea turtles in the fishery. However, consultation was once again reinitiated on the Monkfish FMP as of February 12, 2003, to consider the effects of Framework Adjustment 2 measures on ESA-listed species. This consultation was completed on April 14, 2003, and concluded that the proposed action is not likely to result in jeopardy to any ESA-listed species under NMFS jurisdiction. However, takes of sea turtles are still expected to occur, which was reflected in the ITS. In the Opinion, NMFS anticipated that over a five year period, the action would result in the capture of up to 25 sea turtles with no more than 15 of these being loggerheads captured in monkfish gillnet gear, no more than 5 of any combination of green, Kemp's ridley or leatherback sea turtles caught in monkfish gillnet gear, and no more than 5 being either loggerhead, green, Kemp's ridley or leatherback sea turtles captured in monkfish trawl gear. Of these, no more than 5 loggerheads are expected to die as a result of the capture in monkfish fishing gear. A maximum of 3 of any one of the other three species are expected to die as a result of capture in monkfish fishing gear.

The *Summer Flounder, Scup and Black Sea Bass fisheries* are known to interact with sea turtles. Significant measures have been developed to reduce the capture of sea turtles in summer



flounder trawls and trawls that meet the definition of a summer flounder trawl by requiring the use of TEDs throughout the year for trawl nets fished from the North Carolina/South Carolina border to Oregon Inlet, NC, and seasonally (March 16-January 14) for trawl vessels fishing between Oregon Inlet, NC and Cape Charles, VA. Interactions with sea turtles may still occur with this gear type in other areas however. Based on the occurrence of gillnet entanglements in other fisheries, the gillnet portion of this fishery could entangle endangered whales. The pot gear and staked trap sectors could also entangle whales and sea turtles. The most recent (December 16, 2001) formal consultation on this fishery concluded that the operation of the fishery may adversely affect but is not likely to jeopardize the continued existence of listed species. The ITS anticipated that 19 loggerhead or Kemp's ridley takes (captures, with up to 5 lethal) and 2 green turtle takes (captures that may or may not result in mortality) may occur annually. However, as a result of new information not considered in previous consultations, NMFS has reinitiated section 7 consultation on this FMP to consider the effects of the fisheries on ESA-listed whales and sea turtles. Consultation is currently ongoing and to date, a revised Opinion has not yet been issued.

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. Turtle takes in 2000 included one dead and one live Kemp's ridley. Since the ITS issued with the August 13, 1999, Opinion anticipated the take (capture) of only one Kemp's ridley (that may or may not result in mortality), the incidental take level for the dogfish FMP was exceeded. In addition, a right whale mortality occurred in 1999 as a result of entanglement in gillnet gear that may (but was not determined to be) have originated from the spiny dogfish fishery. NMFS, therefore, reinitiated consultation on the Spiny Dogfish FMP on May 4, 2000, in order to reevaluate the ability of the RPA to avoid the likelihood of jeopardy to right whales, and the effect of the spiny dogfish gillnet fishery on sea turtles. The Opinion also considered new information on the status of the North Atlantic right whale and new ALWTRP measures. The Opinion, signed on June 14, 2001, concluded that continued implementation of the Spiny Dogfish FMP is likely to jeopardize the existence of the North Atlantic right whale. A new RPA was provided that was expected to remove the threat of jeopardy to North Atlantic right whales as a result of the gillnet sector of the spiny dogfish fishery. In addition, the ITS anticipated the annual take (capture) of 3 loggerheads (no more than 2 lethal), 1 green (lethal or non-lethal), 1 leatherback (lethal or non-lethal), and 1 Kemp's ridley (lethal or non-lethal).

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

American lobster occur within U.S. waters from Maine to Virginia. They are most abundant from Maine to New Jersey with abundance declining from north to south (ASMFC 1997). An Interstate Fishery Management Plan (ISFMP) developed through the ASMFC provides management measures for the fishery that are implemented by the states. NMFS has issued regulations for the Federal waters portion of the fishery based on recommendations from the ASMFC. Of the seven lobster management areas (LMAs), only LMA 3 occurs entirely within Federal waters. 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.

## **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](http://www.epa.gov/climatechange/index.html)). Activities in the action area that may have contributed to global warming include the combustion of fossil fuels by vessels.

The effects of global climate change on sea turtles is typically viewed as being detrimental to the species (NMFS and USFWS 2007a; 2007b; 2007c; 2007d). Changes in water temperature would be expected to affect prey distribution and/or abundance, salinity, and water circulation patterns perhaps even to the extent that the Gulf Stream is disrupted (Gagosian 2003; NMFS and USFWS 2007a; 2007b; 2007c; 2007d). The effects of these on sea turtles cannot, for the most part, be accurately predicted at this time. Several studies have, however, 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 (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, 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 resulting in death (Hawkes *et al.* 2007). 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. 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.

For green sea turtles, incubation temperatures also appeared to affect hatchling size with smaller turtles produced at higher incubation temperatures (Glen *et al.* 2003). It is unknown whether this effect is species specific and what impact it has on the survival of the offspring.

While the type and extent of effects to sea turtles as a result of global climate change are still speculative, a disruption of the Gulf Stream such as might occur as a result of global climate change (Gagosian 2003), would be expected to have profound effects on every aspect of sea turtle life history from hatching success, oceanic migrations at all life stages, foraging, and nesting.

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. Additionally, cetaceans may be affected by ocean acidification as more carbon dioxide is absorbed. These changes may effect the distribution of species and the fitness of individuals and populations due to the potential loss of foraging opportunities, displacement from ideal habitats and potential increase in susceptibility to disease (Elliot and Simmonds 2007). 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.

### **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.

### **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 proposed authorization of the Cape Wind project by MMS- 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, the Environmental Baseline, and Cumulative Effects sections as best as possible given that some information on sea turtles is quantified, yet much remains qualitative or unknown.

#### ***Summary of status of species***

Based on recent estimates, NMFS considers the best approximation for the number of *North Atlantic right whales* to be 300 +/- 10%. Losses of adult whales due to ship strikes and

entanglements in fishing gear continue to depress the recovery of this species and the right whale population continues to be declining.

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

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

*Leatherback* 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. For purposes of this Opinion, NMFS considers the trend of the sea turtle species considered in this Opinion to be declining for loggerhead, leatherback, and green sea turtles, and stable for Kemp's ridley sea turtles. These trends are the result of past, present, and likely future human activities and natural events, some effects of which are positive, some negative, and some unknown, as discussed previously in the Status of the Species, Environmental Baseline, and Cumulative Effects Sections taken together. Additional information is provided below.

*Loggerhead Sea Turtles.* Loggerhead sea turtles are listed as a single species classified as "threatened" under the ESA. Loggerhead nesting occurs on beaches of the Pacific, Indian, and Atlantic oceans, and 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).

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 1991a). There are many natural and anthropogenic factors affecting survival of turtles 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. There are no population estimates for loggerhead sea turtles. 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, nest counts cannot be used to estimate the total population size of a nesting group and, similarly, trends in the number of nests laid cannot be used as an indicator of the population trend (whether decreasing, increasing or stable) (Meylan 1982; Ross 1996; Zurita *et al.* 2003; Hawkes *et al.* 2005; Loggerhead TEWG 2007).

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 reflect the reproductive output of the nesting group each year, and also provide 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 occurs along the east coast of the United States where approximately 15,966 females nest per year on south Florida beaches (based on a mean of 65,460 nests laid per year from 1989-2006; NMFS and USFWS 2007a). The world's third largest loggerhead nesting group also occurs in the United States, from approximately northern Florida through North Carolina. However, the mean nest count for this nesting group, the third largest loggerhead nesting group in the world, is 5,151 nests laid per year (NMFS and USFWS 2007a) – less than 1/10<sup>th</sup> the mean number of nests laid by the south Florida nesting group. 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, U.S., 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. These include nesting for the south Florida nesting group – the second largest loggerhead nesting group in the world and the largest of all of the loggerhead nesting groups in the Atlantic (Dodd 2003; Meylan *et al.* 2006; Letter to NMFS from the Director, Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, October 25, 2006; Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission web posting November 2007; NMFS and USFWS 2007a).

In light of the above, for purposes of this Opinion, NMFS considers the trend for loggerheads as a species to be declining. 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. This determination that the trend for loggerheads as a species is declining provides benefit of the doubt to the species given its threatened classification under the ESA, the many on-going negative impacts to the species across all areas of its range and to all age classes, and information to suggest that fewer nests are being laid (potentially reducing the number of offspring that will mature and contribute to the species' continued existence).

*Leatherback turtles.* Leatherback sea turtles are listed as a single species classified 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 (Leatherback 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 be nesting on the beaches in and close to the Marowijne River Estuary in Suriname and French Guiana



(Hilterman and Govere 2004). The long-term trend for the Suriname and French Guiana nesting group seems to show an increase (Hilterman and Govere 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 Govere 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 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 species means that the effects of a proposed action must, ultimately, be considered at the species level for section 7 consultations. In light of the above, for purposes of this Opinion, NMFS considers the trend for leatherbacks, as a species, to be declining. 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 trend in the number of nests laid is not a reflection of the overall trend in any leatherback population given that the proportion of adult males to females, and the age structure of the population(s) is unknown. This determination that the trend for leatherbacks as a species is declining provides benefit of the doubt to the species given its endangered classification under the ESA, the many on-going negative impacts to the species across all areas of its range and to all age classes, the uncertainty in the population estimates, the dramatic decline in leatherback nesting in the Pacific, and the disproportionate nesting of leatherbacks with more than half of the species nesting occurring in one area of the world (thus negative impacts to this area could have very large impacts on reproductive success of the species).

*Kemp's Ridley Sea Turtles.* 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 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 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 be negatively impacting Kemp's ridley sea turtles, Kemp's ridleys continue to be impacted by anthropogenic activities.

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 and, similarly, trends in the number of nests laid cannot be used as an indicator of the population trend (whether decreasing, increasing or stable) (Meylan 1982; Ross 1996; Zurita *et al.* 2003; Hawkes *et al.* 2005; Loggerhead TEWG 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 2007c). The nest count data indicates increased nesting and an increased number of nesting females in the population. In light of this information, for purposes of this Opinion, NMFS considers the trend for Kemp's ridley sea turtles to be stable. This determination that the trend for Kemp's ridleys as a species is stable provides benefit of the doubt to the species given the species classification of "endangered" under the ESA, the caveats associated with using nesting data as indicators of population size and population trends, that the estimated number of nesting females in the current population is still far below historical numbers (Stephens and Alvarado-Bremer 2003; NMFS and USFWS 2007c), the many on-going negative impacts to the species, and given that the majority of nesting for the species occurs in one area.

*Green Sea Turtles.* 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 turtles are considered endangered wherever they occur in U.S. waters. Green 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 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 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 3-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 exceed 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 (Cliffon *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 number 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 1970's 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 1980's 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. In light of the above, for purposes of this Opinion, NMFS considers the trend for green sea turtles, as a species, to be declining. 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. Also, the trend in the number of green sea turtle nests laid is not an indication of the overall population trend given that the proportion of adult males to females, and the age structure of the population(s) is unknown. Finally, 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). This determination that the trend for green sea turtles as a species is declining provides benefit of the doubt to the species given its endangered and threatened classification under the ESA, the many

on-going negative impacts to the species across all areas of its range and to all age classes, the declining or uncertain trend in nesting for the majority of the world's nesting sites for green sea turtles, and the lack of up-to-date nesting information for the largest green sea turtle nesting site in the Indian Ocean and possibly the world.

## **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 (MMS 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 waters from December through July, humpback whales can be found in Massachusetts waters year-round, with peaks between May and August, and fin whales may be in Massachusetts waters year-round, with peaks during the summer months. 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.

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 aerial and shipboard surveys (conducted in the summers of 1998, 1999, 2002, 2004 and 2006) (Waring et al 2008). 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 the action area is rare, with transient individuals likely to overlap only sporadically with the eastern extremes of the action area (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 and, therefore, in the action area.

Similar to humpback whales, there are no documented occurrences of fin whales in Nantucket

Sound (NEFSC unpublished data, and Waring et al. 2008). The nearest observations to the action area 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 the action area is consistent with what is known about their habitat preferences. The best available information indicates that fin whale occurrence in the action area is rare, with transient individuals likely to overlap only sporadically with the eastern extremes of the action 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 no right whales have been documented in Nantucket Sound (NEFSC unpublished data, Waring et al. 2008). Only one source included information on 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). 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 the action area is extremely rare, with transient individuals likely to overlap only sporadically with the eastern extremes of the action area between December and June.

As explained above, only rare, transient whales occur in Nantucket Sound. As such, NMFS has determined that it is extremely unlikely that listed whales would occur within the project footprint. However, as occasional whales have been documented off of Monomoy and Great Point, these species may occasionally occur in the eastern extremes of the action area (i.e., near Monomoy Island and off Great Point). However, any occurrence of whales in the action area is expected to be sporadic and transient. The lack of whales in the action 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.

### **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 edge of the action area but, 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). 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, MMS 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, listed species and their prey are more likely to be displaced from the immediate area by seafloor disturbance, turbidity, and noise than 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 MMS 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. MMS 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 Horseshoe 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 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 MMS'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 predicted 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 MMS' 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.

MMS 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 MMS (30 CFR 250.300) and the USCG (MARPOL Annex V, Public Law 100-220 [Statute 1458]). The discharge of plastics is strictly prohibited. During construction, individual crew members will be responsible for ensuring that debris is not discharged into the marine environment. Additionally, training of construction crews will include a requirement explaining that the discharge of trash and debris overboard is harmful to the environment, and is illegal under the Act to Prevent Pollution from Ships and the Ocean Dumping 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 MMS 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 MMS 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, MMS 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) MMS 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 project vessels will be transiting between the project site and either Quonset, Rhode Island or Falmouth, 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. As no whales are expected to occur along the routes where project vessels will transit or in the project footprint where construction and maintenance vessels will occur, the increase in vessel traffic attributable to the proposed project will not increase the likelihood of a whale being struck by a vessel. As no whales are likely to occur where project vessels will be operating, NMFS has determined that the likelihood of an interaction between a project vessel and a whale is discountable. However, as sea turtles are likely to occur in the area where increased vessel traffic will occur, this section will focus on the effects of an increase in vessel traffic on sea turtles.

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



turtle will strand, every stranded turtle will not be found, and many stranded turtles are too decomposed to determine whether the turtle was struck by a boat. It should be noted, however, that it is not known whether all boat strikes were the cause of death or whether they occurred post-mortem (NMFS SEFSC 2001).

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

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.

### ***Acoustic Effects***

When anthropogenic disturbances elicit responses from sea turtles and marine mammals, it is not always clear whether they are responding to visual stimuli, the physical presence of humans or manmade structures, or acoustic stimuli. However, because sound travels well underwater, it is reasonable to assume that, in many conditions, marine organisms would be able to detect sounds from anthropogenic activities before receiving visual stimuli. As such, exploring the acoustic effects of the proposed 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.

Several components of project construction and operation will produce sound that may affect listed sea turtles and whales. NMFS is in the process of developing a comprehensive acoustic policy that will provide guidance on managing sources of anthropogenic sound based on each species' sensitivity to different frequency ranges and intensities of sound. The available information on the hearing capabilities of cetaceans and the mechanisms they use for receiving and interpreting sounds remains limited due to the difficulties associated with conducting field studies on these animals. However, current thresholds for determining impacts to marine mammals typically center around root-mean-square (RMS) received levels of 180 dB re 1 $\mu$ Pa for potential injury, 160 dB re 1 $\mu$ Pa for behavioral disturbance/harassment from a non-continuous noise source, and 120 dB re 1 $\mu$ Pa 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 Construction 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 construction 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 construction noise, they must be able to perceive the noises produced by the activities. If a species cannot hear a sound, or hears it poorly, then the sound is unlikely to have a significant effect (Ketten 1998). Baleen whale hearing has not been studied directly, and there are no specific data on sensitivity, frequency or intensity discrimination, or localization (Richardson et al. 1995) for these whales. Thus, predictions about probable impact on baleen whales are based on assumptions about their hearing rather than actual studies of their hearing (Richardson et al. 1995; Ketten 1998).

Ketten (1998) summarized that the vocalizations of most animals are tightly linked to their peak hearing sensitivity. Hence, it is generally assumed that baleen whales hear in the same range as their typical vocalizations, even though there are no direct data from hearing tests on any baleen whale. Most baleen whale sounds are concentrated at frequencies less than 1 kHz (Richardson et al. 1995), although humpback whales can produce songs up to 8 kHz (Payne and Payne 1985). Based on indirect evidence, at least some baleen whales are quite sensitive to frequencies below 1 kHz but can hear sounds up to a considerably higher but unknown frequency. Most of the manmade sounds that elicited reactions by baleen whales were at frequencies below 1 kHz (Richardson et al. 1995). Some or all baleen whales may hear infrasounds, sounds at frequencies well below those detectable by humans. Functional models indicate that the functional hearing of baleen whales extends to 20 Hz, with an upper range of 30 Hz. Even if the range of sensitive hearing does not extend below 20-50 Hz, whales may hear strong infrasounds at considerably lower frequencies. Based on work with other marine mammals, if hearing sensitivity is good at 50 Hz, strong infrasounds at 5 Hz might be detected (Richardson et al. 1995). Fin whales are predicted to hear at frequencies as low as 10-15 Hz. The right whale uses tonal signals in the frequency range from roughly 20 to 1000 Hz, with broadband source levels ranging from 137 to 162 dB (RMS) re 1  $\mu$ Pa 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 1 $\mu$ Pa RMS)	References
<b>North Atlantic Right</b>	Moans	< 400	--	--	Watkins and Schevill (1972)
	Tonal Gunshots	20-1000	100-2500 50-2000	137-162 174-192	Parks and Tyack (2005) Parks et al. (2005)
<b>Humpback</b>	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)
<b>Fin</b>	FM moans	14-118	20	160-186	Watkins (1981), Edds (1988), Cummings and Thompson (1994)
	Tonal Songs	34-150 17-25	34-150 17-25	186	Edds (1988) Watkins (1981)

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

### *Sea Turtle Hearing*

The hearing capabilities of sea turtles are poorly known. Few experimental data exist, and since sea turtles do not vocalize, inferences cannot be made from their vocalizations as is the case with baleen whales. Direct hearing measurements have been made in only a few species. An early experiment measured cochlear potential in three Pacific green turtles and suggested a best hearing sensitivity in air of 300–500 Hz and an effective hearing range of 60–1,000 Hz (Ridgway et al. 1969). Sea turtle underwater hearing is believed to be about 10 dB less sensitive than their in-air hearing (Lenhardt 1994). Lenhardt et al. (1996) used a behavioral "acoustic startle response" to measure the underwater hearing sensitivity of a juvenile Kemp's ridley and a juvenile loggerhead turtle to a 430-Hz tone. Their results suggest that those species have a hearing sensitivity at a frequency similar to those of the green turtles studied by Ridgway et al. (1969). Lenhardt (1994) was also able to induce startle responses in loggerhead turtles to low frequency (20–80 Hz) sounds projected into their tank. He suggested that sea turtles have a range of best hearing from 100–800 Hz, an upper limit of about 2,000 Hz, and serviceable hearing abilities below 80 Hz. More recently, the hearing abilities of loggerhead sea turtles were

measured using auditory evoked potentials in 35 juvenile animals caught in tributaries of Chesapeake Bay (Bartol et al. 1999). Those experiments suggest that the effective hearing range of the loggerhead sea turtle is 250–750 Hz and that its most sensitive hearing is at 250 Hz. In general, however, these experiments indicate that sea turtles generally hear best at low frequencies and that the upper frequency limit of their hearing is likely about 1 kHz. As such, sea turtles are capable of hearing in low frequency ranges that overlap with the dominant frequencies of pile driving and vessel noise, and are therefore likely to be exposed to construction-related noise.

### ***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, MMS 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). As no whales will occur within 500 meters of any pile driving, 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 sound levels greater than 180 dB. 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, there is greater potential for 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 MMS 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. As the nearest whale sighting was approximately 18km from the project site, it is extremely unlikely that any whales will be exposed to noise levels greater than 160 dB. Although construction noise may be audible for several kilometers from the source, right, humpback and fin whales are primarily found outside of Nantucket Sound, well beyond the distances over which the 160-180 dB contours are likely to extend. 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 1 $\mu$ Pa were required before any behavioral reaction was observed.

As noted above, modeling results reported by MMS 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<sup>2</sup>.

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<sup>5</sup>) 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 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.,

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<sup>5</sup> 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.

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 will 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 Construction 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  $\mu$ Pa-m at frequencies below 1,000 Hz. A tug pulling a barge generates 164 dB re 1  $\mu$ Pa-m when empty and 170 dB re 1  $\mu$ Pa-m loaded. A tug and barge underway at 18 km/h can generate broadband source levels of 171 dB re 1  $\mu$ Pa-m. A small crew boat produces 156 dB re 1  $\mu$ Pa-m at 90 Hz.

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 1 $\mu$ Pa are required before sea turtles can detect a sound (Ridgway 1969; Streeter, in press). McCauley (2000) noted that dB levels of 166 dB re 1 $\mu$ Pa 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 MMS 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 MMS 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 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 may conduct a high resolution geophysical survey prior to construction. Only the

project footprint on Horseshoe Shoal would be surveyed. The 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. A typical high resolution seismic survey operation consists of a vessel towing an acoustic source (airgun, boomer, sparker, chirper) about 25 m behind the ship and a 600-m streamer cable with a tail buoy. In general, the ships travel at 3-3.5 knots (5.6-6.5 km/hour), and the source is activated every 7-8 seconds (or about every 12.5 m). All involved ships are designed to reduce self-noise, as the higher frequencies used in high-resolution work are easily masked by the vessel noise if special attention is not paid to keeping the ships quiet. If undertaken, this would involve one 36-hour sampling event. 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 sound levels at the source (i.e., the survey vessel) will depend on the type of equipment used for the survey (i.e., airgun, boomer, sparker or chirper). If an airgun is used, noise levels at the source would range from 229-233 dB re 1uPa at 1 meter. A boomer has a sound pressure level of 205 re 1uPa at 1 meter, with an output-sound bandwidth of 0.5-8 kHz, with the main peak at 4.5kHz. A sparker has an SPL of 209 dB re 1uPa at 1 meter at 150-1700 Hz, with a peak amplitude of 900 Hz. A chirper would have an output near 160 dB at the source. MMS has reported that if an airgun is used, at a distance of approximately 500 meters, the noise would be less than 180dB and at 1.5km, the noise would be less than 160 dB. For the other sources, the impact zones would be smaller. Given the likely maximum ranges of the 180 dB and 160 dB isopleths, it is highly unlikely that any whales would be exposed to injurious or disturbing sound levels associated with the survey. However, if the survey occurred between June and November, listed sea turtles could be exposed to effects of the survey. MMS is requiring that the applicant maintain a 500 meter exclusion zone during the survey. As such, no listed sea turtles will be exposed to noise levels greater than 180 dB and therefore, no sea turtles will be exposed to injurious levels of noise. However, sea turtles are likely to be exposed to disturbing levels of noise. Any sea turtles located within one km outside of the exclusion zone (i.e., from 0.5 – 1.5 km from the survey vessel) will be exposed to potentially disturbing levels of noise.

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 would be exposed to disturbing levels of noise during the survey. At any given time during the survey, an approximately 3.14 square kilometer area will have noise levels between 160 and 180 dB.

Sea turtles whose behavior is disrupted would be expected to resume their behavior after the disturbance has stopped. While the total survey will take approximately 36 hours to complete, 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 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 will 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.

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 greatly 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.

### *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 MMS 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, MMS 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. MMS 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.

### **CUMULATIVE EFFECTS**

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

Sources of human-induced mortality, injury, and/or harassment of listed sea turtles in the action area that are reasonably certain to occur in the future include state fisheries, vessel collisions and pollution. While the combination of these activities may affect loggerhead sea turtles, the magnitude of these effects is currently unknown.

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

*Vessel Interactions* – NMFS' STSSN data indicate that vessel interactions are responsible for a number of sea turtles strandings within the action area each year. Vessel use and collisions with sea turtles 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. As a result an estimate of the number of sea turtles that will likely be killed by vessels is not possible.

*Pollution and Contaminants* - Human activities causing pollution are reasonably certain to continue in the future, as are impacts from them on loggerhead sea turtles in the action area. 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. 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. The effects of increased noise levels can range from minor behavioral disturbance to injury and even death. Acoustic impacts can include auditory trauma, temporary or permanent loss of hearing sensitivity, habitat exclusion, habituation, and disruption of other normal behavior patterns such as feeding, migration, and communication. NMFS is working to develop policy guidelines for monitoring and managing acoustic impacts on marine mammals from anthropogenic sound sources in the marine environment. 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 in the action area.

## **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 noted in sections above, whales are extremely unlikely to occur in Nantucket Sound. The analysis contained above demonstrates that all effects of the project will be contained within Nantucket Sound. 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 vessel transit routes or along the cable laying route, no interactions with project vessels or the cable laying are likely. 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.

MMS 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. 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 one km outside of the exclusion zone (i.e., from 0.5 – 1.5 km from the survey vessel) will be exposed to potentially disturbing levels of noise. At any given time during the survey, an approximately 3.14 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 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. 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 will 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 hours a day while pile driving is occurring (as sea turtles will avoid the 34.56 square kilometer impact zone), and during the 36-hour high resolution geophysical survey, 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.

## **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 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 one time 36-hour high resolution geophysical survey, any sea turtles located within one km outside of the exclusion zone (i.e., from 0.5 – 1.5 km from the survey vessel) 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 3.14 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 MMS 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 3.14 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 MMS 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. MMS 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 MMS and reported in the BA.
5. Prior to decommissioning, MMS 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, MMS 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, MMS 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, MMS 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, MMS 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 MMS 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 MMS. 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 MMS 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 MMS 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 MMS 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 MMS 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 MMS 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, MMS 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 on MMS's proposed approval of an application by Cape Wind Associates, LLC for a lease, easement or right-of-way to construct, operate and decommission 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 MMS must immediately request reinitiation of formal consultation.

## 8. Literature Cited

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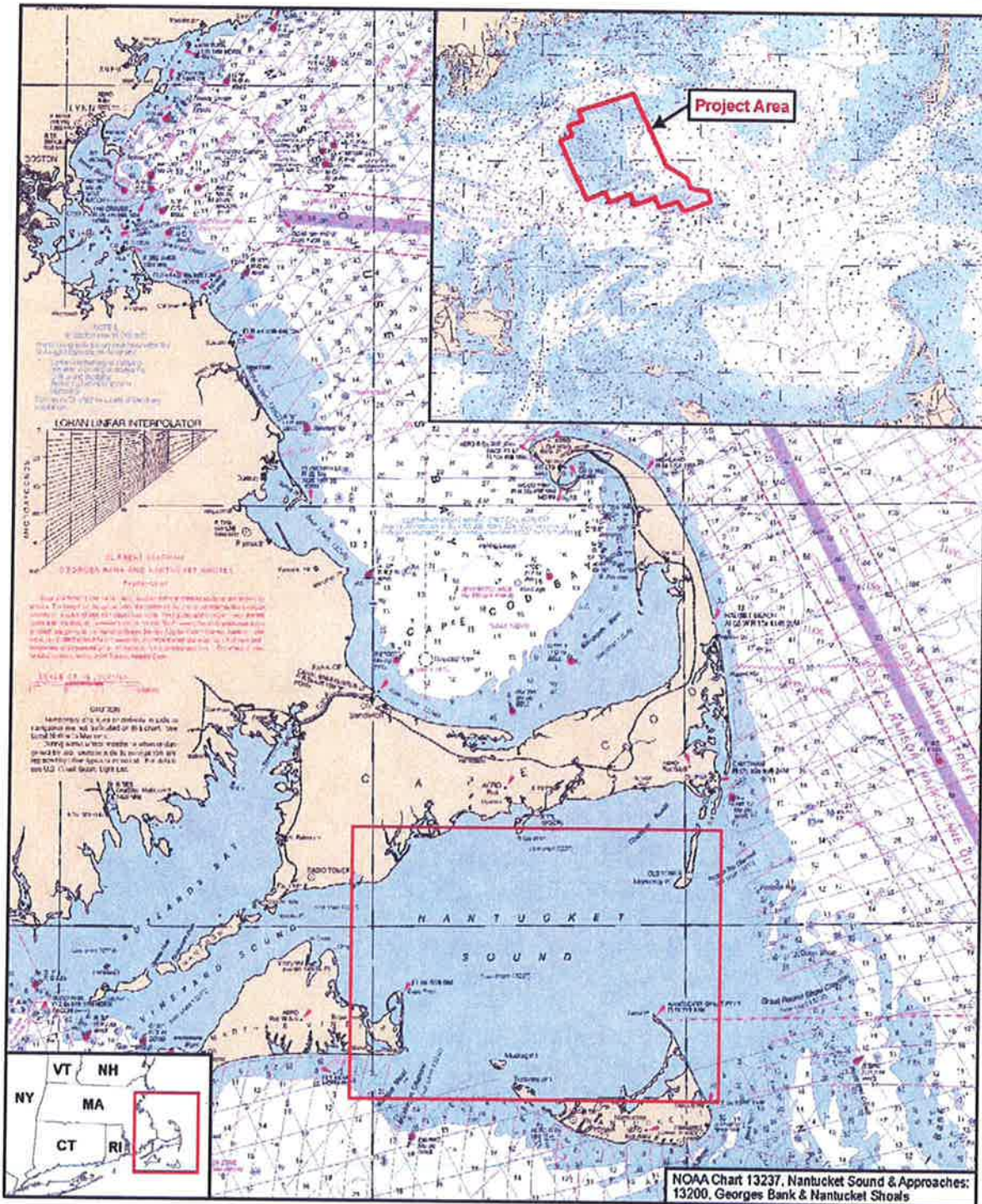
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# Figure 1. Project Area



## CAPE WIND ENERGY PROJECT

Figure BA-1  
Project Locus Map

Figure 2. Action Area

□ = action area

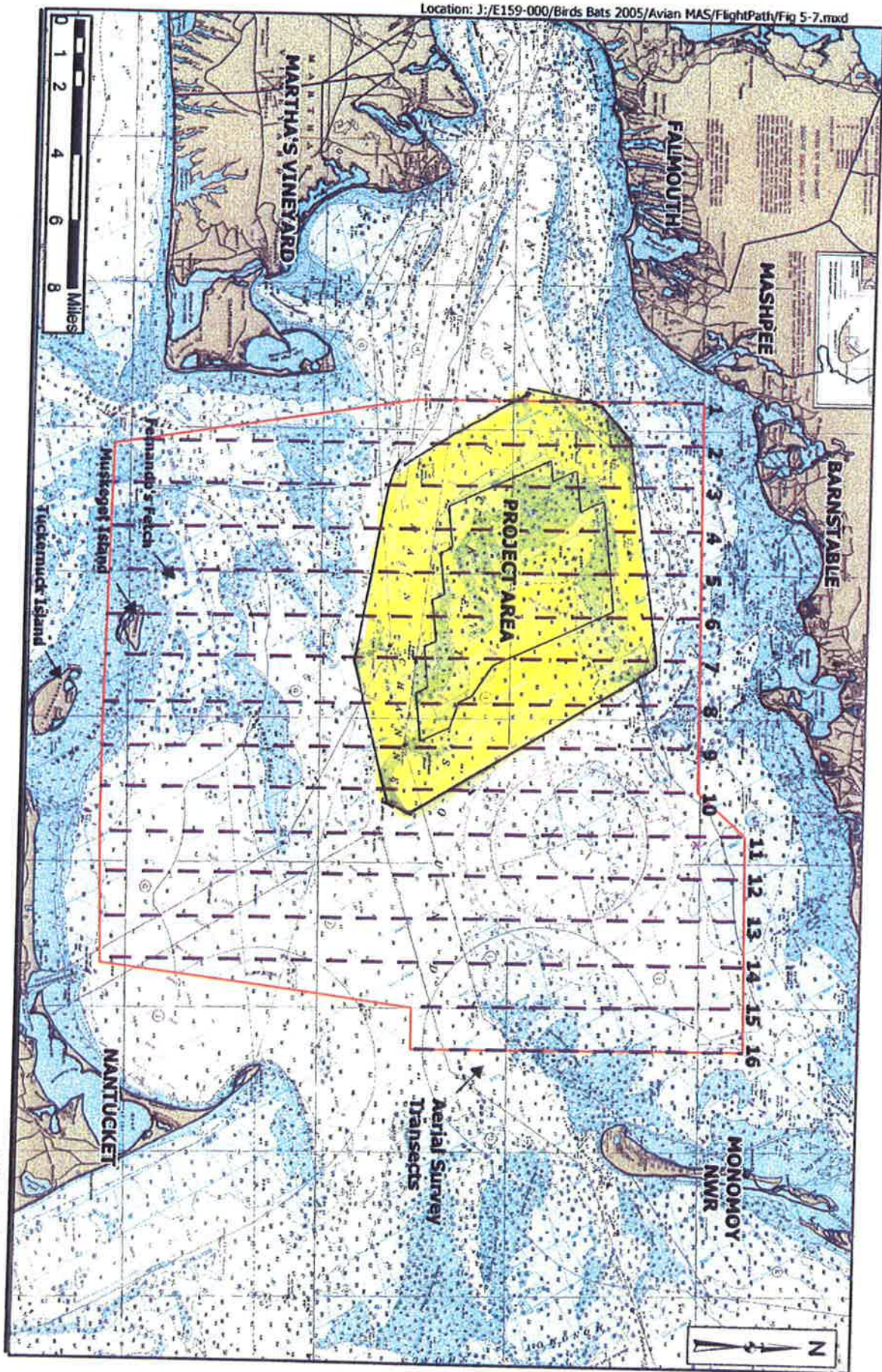




Figure 3  
 Mass Audubon  
 aerial survey area

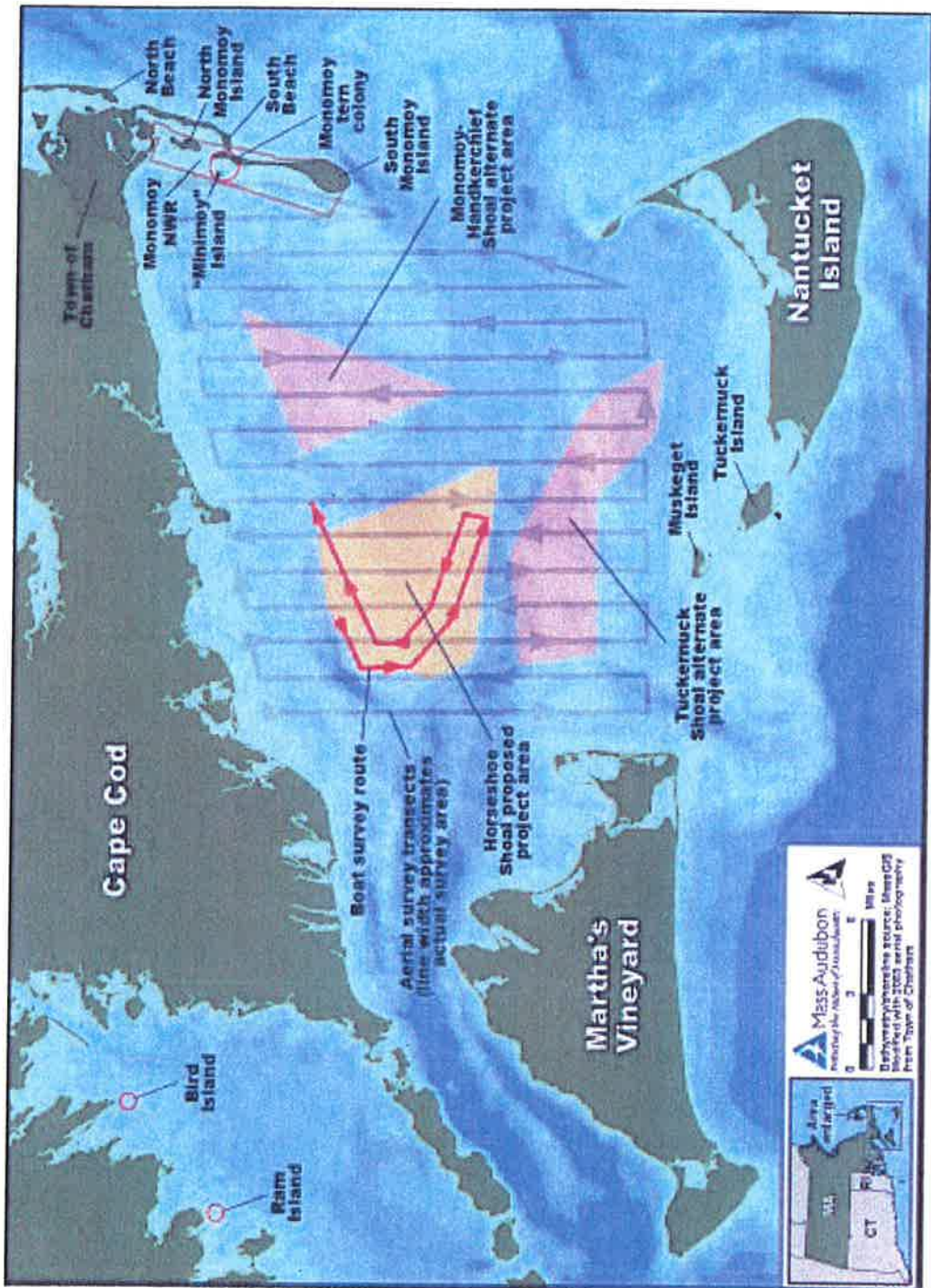
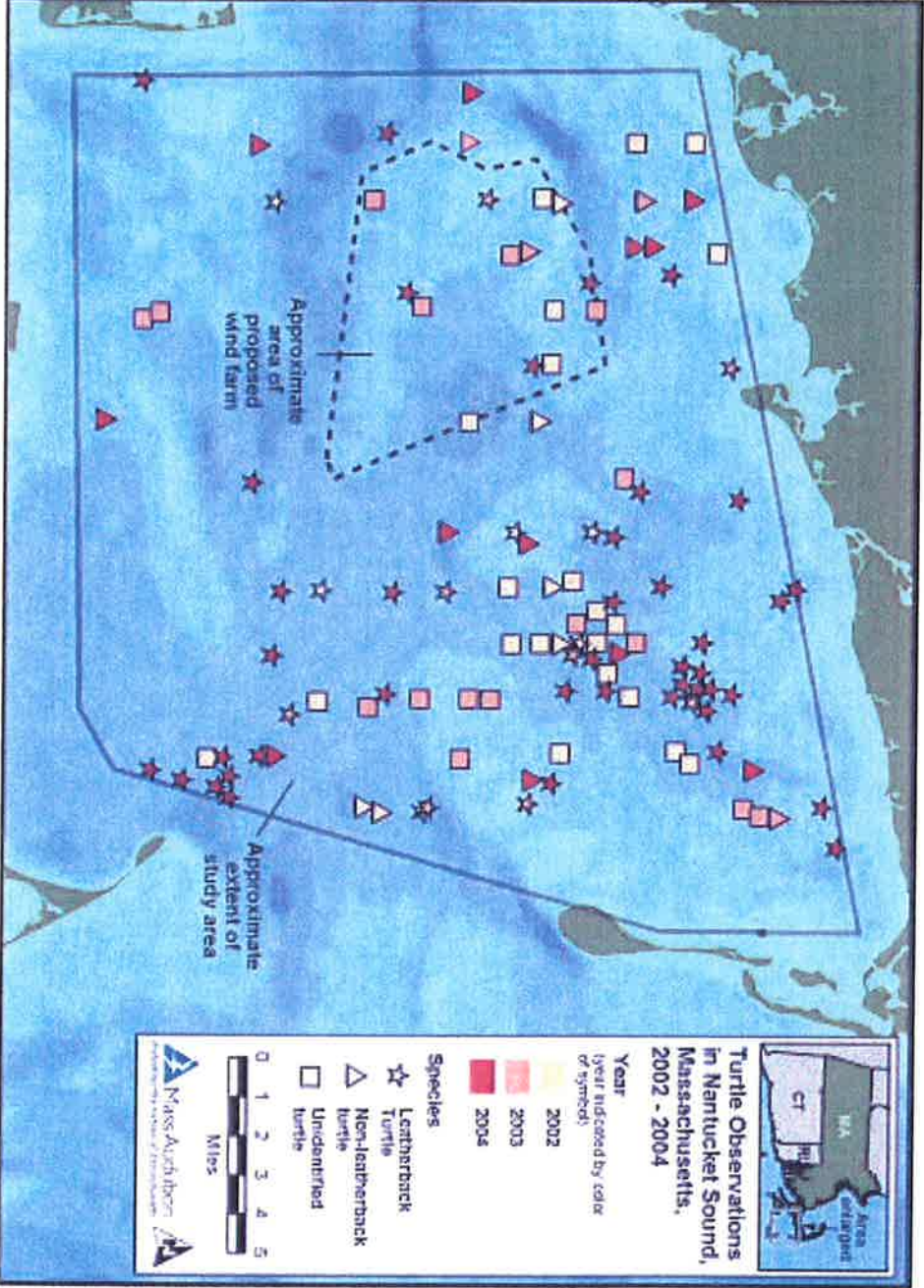


Figure 4  
 Mass Audubon  
 sea turtle sightings



# 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](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<sup>3</sup>. 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.

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<sup>3</sup> 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)<sup>4</sup> 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

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<sup>4</sup> 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  $\mu$ Pa 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  $10 \cdot \log(E_2/E_1)$  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  $\mu$ Pa 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  $\mu$ Pa at 500 meters. A recent COWRIE report suggests underwater SEL values of 171-173 dB re 1  $\mu$ Pa 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<sup>5</sup>. 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.

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<sup>5</sup> 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.