UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
55 Great Republic Drive
Gloucester, MA 01930-2276

JUL 2 2 2010

Joshua A. Bundick
National Aeronautics and Space Administration
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, Virginia 23337-5099

Dear Mr. Bundick,

Enclosed is the biological opinion (Opinion), issued under Section 7(a)(2) of the Endangered Species Act (ESA), for the National Aeronautics and Space Administration's (NASA) proposal for shoreline restoration and sediment management at the Goddard Space Flight Center's Wallops Flight Facility on Wallops Island, Virginia. NASA is working with the US Army Corps of Engineers (ACOE) and the Minerals Management Service (MMS) to obtain the appropriate permits for this activity. NASA has been designated as the lead Federal agency for this project. This Opinion is based in part upon NOAA's National Marine Fisheries Service's (NMFS) independent evaluation of the following: the 2010 Biological Assessment (BA) and the Programmatic Environmental Impact Statement (PEIS) for NASA's Wallops Flight Facility Shoreline Restoration Project, correspondence with NASA, and other sources of information. The Opinion concludes that the proposed project may adversely affect but is not likely to jeopardize the continued existence of loggerhead and Kemp's ridley sea turtles and is not likely to adversely affect leatherback or green sea turtles or right, humpback or fin whales. NMFS has also concluded that the action will not affect hawksbill turtles as these species are unlikely to occur in the action area. NMFS has assessed the project's impacts on listed species over the project's proposed 50 year lifetime.

Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2) of the ESA, 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. The Incidental Take Statement (ITS) accompanying this Biological Opinion, pursuant to Section 7 (b)(4) of the ESA, exempts the incidental taking of no more than 1 sea turtle for approximately every 1.5 million cy of material removed from the borrow areas. NMFS has estimated that at least 90% of these turtles will be loggerheads. As such, over the course of the project life, NMFS expects that a total of 9 sea turtles will be killed, with no more than 1 being Kemp's ridleys and the remainder being loggerheads. No take of any other species of sea turtle is exempted.

NMFS anticipates that the dredging may collect an additional unquantifiable number of previously dead sea turtles or sea turtle parts. Provided that NMFS concurs with NASA's determination regarding the state of decomposition, condition of the specimen, and likely cause of mortality, the collection of previously dead sea turtle parts will not be attributed to the incidental take level for this action.

The ITS specifies six reasonable and prudent measures (RPMs) and sixteen Terms and Conditions necessary to minimize and monitor take of listed species. The RPMs outlined in the ITS are non-discretionary, and must be undertaken so that they become binding conditions for the exemption in section 7(o)(2) to apply. Failure to implement the terms and conditions through enforceable measures may result in a lapse of the protective coverage of section 7(o)(2). Monitoring that is required by the ITS will continue to supply information on the level of take resulting from the proposed action.

This Opinion concludes consultation for the proposed shoreline restoration and sediment management project at the Goddard Space Flight Center's Wallops Flight Facility on Wallops Island, Virginia. Reinitiation of this consultation is required if: (1) the amount of taking specified in the ITS is exceeded; (2) new information reveals effects of these actions that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) project activities are subsequently modified in a manner that causes an effect to the listed species that was not considered in this biological opinion; or (4) a new species is listed or critical habitat designated that may be affected by the identified actions.

We look forward to continuing to work cooperatively with your office to minimize the effect of dredging projects on listed species. For further information regarding any consultation requirements, please contact Danielle Palmer at (978) 282-8468 or by e-mail (Danielle.Palmer@noaa.gov). Thank you for working cooperatively with my staff throughout this consultation process.

Sincerely,

Patricia A. Kurkul
Regional Administrator

EC: Bundick, NASA
Silbert, NASA
Cole, ACOE Norfolk
Palmer - F/NER3
Herkhof, MMS
O'Brien, F/NER4

File Code: Section 7 NASA Wallops Island SRIPP
PCTS: F/NER12010/00534

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

Agency: National Aeronautics and Space Administration, Corps of Engineers Norfolk District, and Minerals Management Service

Activity: Wallops Island Shoreline Restoration and Infrastructure Protection Program (F/NER/2010/00534)

Conducted by: National Marine Fisheries Service
Northeast Regional Office

Date Issued: July 22, 2010

Approved by: [signature]

This constitutes the biological opinion (Opinion) of NOAA's National Marine Fisheries Service (NMFS) on the effects of the National Aeronautics and Space Administration's (NASA) proposed Wallops Island Shoreline Restoration and Infrastructure Protection Program (SRIPP) 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.). This Opinion is based on information provided in the Biological Assessment (BA) and the Programmatic Environmental Impact Statement (PEIS) for NASA's Wallops Flight Facility Shoreline Restoration Project, correspondence with NASA, 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 February 18, 2010.

CONSULTATION HISTORY

In October 2006, NASA informed NMFS that it was preparing National Environmental Policy Act (NEPA) documentation for the proposed Wallops Island SRIPP (the project). On a November 13, 2006 conference call, NASA provided an explanation of the proposed project and informed NMFS that while multiple Federal agencies would be involved in the project, NASA would be the lead federal agency for the proposed project[1]. Also during this call, the need for formal consultation pursuant to Section 7 of the ESA was discussed. Representatives from NASA and the Norfolk district of the Army Corps of Engineers (USACE) agreed that consultation was necessary and that NASA would be the lead agency for conducting the consultation with NMFS.

In February 2007, NMFS received a draft BA from NASA and NMFS provided comments on the draft BA. In a letter dated May 9, 2007, NASA requested formal consultation on the effects of the proposed project on listed species and submitted the final BA. A Biological Opinion (Opinion) was

1 The US Army Corps of Engineers Norfolk District will be issuing a permit, pursuant to Section 10 of the Rivers and Harbors Act, to authorize the proposed dredging and placement of sand on the beach.

issued by NMFS to NASA and the USACE on September 25, 2007. In this Opinion, NMFS concluded that the proposed action was likely to adversely affect but was not likely to jeopardize the continued existence of loggerhead and Kemp's ridley sea turtles and was not likely to adversely affect leatherback or green sea turtles or right, humpback, and fin whales. NMFS also concluded that the action would not affect hawksbill turtles as this species is unlikely to occur in the action area. The Opinion included an Incidental Take Statement (ITS) exempting the incidental taking of no more than 1 sea turtle for approximately every 2,000,000 cy of material removed from the borrow areas, which over the life of the project exempted the take of 28 sea turtles, with no more than 3 being Kemp's ridleys and the remainder being loggerheads. The action considered in the September 25, 2007 Opinion was never initiated by NASA, and NASA has now redesigned the Wallop's Island SRIPP.

Reinitiation of consultation is required and shall be requested by the Federal agency or by NMFS, where discretionary Federal involvement or control over the action has been retained or is authorized by law and: (a) if the amount or extent of incidental take is exceeded; (b) a new species is listed or critical habitat designated that may be affected by the identified action; (c) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the consultation; or (d) 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.

In October 2009, NMFS received a draft BA from NASA. NMFS provided comments on the draft BA and on February 12, 2010, NMFS received a letter from NASA reinitiating consultation due to the actions previously considered in the September 25, 2007 Opinion being modified in manner that will cause effects to listed species or critical habitat that were not considered in the 2007 Opinion. These modifications included the construction/extension of the existing seawall; the relocation of the borrow site to offshore sites located in Federal waters; and the reduction of the amount of material removed during the initial dredge cycle and subsequent renourishment cycles throughout the 50 year life of the SRIPP. In addition to the February 12, 2010 letter, NASA supplied additional information in the form of a BA and PEIS for the proposed SRIPP. NASA has made the preliminary determination that the proposed action may adversely affect listed species. On February 18, 2010, NMFS initiated formal consultation. As NASA is funding and carrying out the proposed action, NASA will serve as the lead Federal agency for purposes of this consultation. Other Federal agencies involved in authorizing, funding or carrying out the proposed action include the US Army Corps of Engineers (USACE) and the Minerals Management Service (MMS). The USACE will be issuing a permit to NASA pursuant to Section 10 of the Rivers and Harbors Act. The MMS will be issuing a non-competitive lease to NASA pursuant to the Outer Continental Shelf Lands Act. These actions will be considered in this consultation.

DESCRIPTION OF THE PROPOSED ACTION

NASA's Wallops Flight Facility (WFF) is located in the northeastern portion of Accomack County, Virginia on the Delmarva Peninsula. NASA has occupied the WFF since the 1940s and is currently used by NASA, the US Coast Guard (USGS), the US Navy, NOAA, and the Mid-Atlantic Regional Spaceport (MARS). Wallops Island is bounded by Chincoteague Inlet to the north and Assawoman Inlet to the south. Chincoteague Inlet is dredged annually to a depth of 12 feet. The predominant direction of longshore sediment movement is from north to south. This longshore movement of sediment has caused sand pits to grow. The consequence of the sand traps is that Wallops Island and the barrier islands to the south have been deprived of sediment and their shorelines have eroded.

From 1857 to 1994, the southern part of Wallops Island has retreated approximately 400 meters (1300 feet), with an average rate of retreat of 12 feet per year. This encroachment of the ocean has threatened the existence of launch pads, infrastructure, and test and training facilities belonging to NASA, the Navy, and to MARS. In the 1960s and 1970s, NASA installed wooden groins to attempt to prevent shoreline retreat and keep sand on the beach. By the mid-1980s, the groins were almost completely gone as a result of the lack of replenishing sand. In 1992, a stone seawall, approximately 15,900 feet long, was constructed along the center of the island; however, the seawall has failed to provide adequate protection against the loss of sand as the current seawall is porous and has allowed sediment to flow out of the area without allowing replenishment. The integrity of the seawall is also at risk due to the lack of protective beach sand. Currently, beach only exists seaward of the northern portion of the seawall. There is no beach along approximately 14,000 feet of the seawall. In 2007, NASA installed geotextile tubes along the shoreline south of the existing seawall as an emergency measure to slow down the transport of sand off the beach and help protect onshore assets from wave action. Despite these efforts, the ocean has continued to encroach toward the infrastructure on Wallops Island. These conditions have lead to the currently proposed SRIPP by NASA. Under the SRIPP, NASA is proposing to construct and extend the existing seawall, as well as rebuild the beach along the Goddard Space Flight Center's Wallops Flight Facility (WFF), thereby moving the zone of wave break away from launch pads, infrastructure, and testing and training facilities. This will require dredging of offshore borrow sites and/or an area on the northern end of Wallops Island over the life of the SRIPP (50 years) in order to obtain sand to renourish and maintain the newly formed beach. Within the first 3 years of the 50-year life of the SRIPP, seawall construction and initial beach nourishment will be completed.

Year One: Seawall Extension

Prior to beach nourishment, the seawall extension will be constructed on the beach parallel to the shoreline in the approximate location of the existing geotextile tubes. The new seawall will be constructed landward of the shoreline and will extend 4600 feet south of the existing seawall and will consist of 5-7 ton rocks placed on the beach. The top of the seawall will be approximately 14 feet above the normal high tide level.

Year 2-3: Dredging and Beach Fill

Description of Borrow areas

Initial site work conducted in May 2007 identified 3 potential offshore shoals (Blackfish Bank Shoal, Unnamed Shoal A and Unnamed Shoal B) (Appendix A) located in Federal waters where beach compatible sand could be removed for the purposes of beach nourishment along the shoreline of the Wallops Flight Facility. In addition, an area located on the northern end of Wallops Island has also been identified as a borrow area for renourishment purposes only. Blackfish Bank Shoal was removed from consideration as a borrow area due to adverse impacts on the Assateague Island shoreline and due to the public perception that dredging within this shoal would negatively impact commercial and recreational fishing communities. As result, NASA identified Unnamed Shoal A as the source of sand for initial beach nourishment along the shoreline of Wallops Flight Facility, and

Unnamed Shoal B and the beach area located on the northern portion of Wallops Island (North Wallops Island beach borrow site) as potential sites to obtain sand during subsequent cycles of beach renourishment.

The southwest end of Unnamed Shoal A is located approximately 7 miles east of Assateague Island and approximately 11 miles northeast of Wallops Island. The total predicted volume of sand at Unnamed Shoal A is approximately 31 million m^3 (40 million yd^3) and covers an area of approximately 1,800 acres. Depths at Unnamed Shoal A range from 25-40 feet. The sediments within Unnamed Shoal A consist of well sorted medium sand with a median composite grain size of 0.24-0.78mm (USACE 2010a). The borrow area has never been dredged.

Unnamed Shoal B is located approximately 10 miles east of Assateague Island. The southwest end of Unnamed Shoal B is located approximately 12 miles east of Assateague Island and approximately 13 miles northeast of Wallops Island. The total predicted volume of Unnamed Shoal B is approximately 57 million m^3 (70 million yd^3) and covers an area of approximately 3,900 acres. Depths within Unnamed Shoal B range from 29-50 feet. The sediments within Unnamed Shoal B consist of well sorted, medium sand with a median composite grain size of 0.17-0.0.47mm (USACE 2010a). The borrow area has never been dredged.

The North Wallops Island beach borrow site is being considered by NASA as an additional area for obtaining sand for renourishment cycles. The sediments in this area general consist of poorly graded fine to medium sand with trace shell fragments and silt (USACE 2009b). The median grain sizes of all samples were between 0.18-0.27mm. Although not an optimal grain size for use as beach fill material, the northern end of Wallops Island would offer potential renourishment material without the mobilization and operational costs associated with offshore dredging. Based on current vegetation and wildlife habitat constraints, the total potential area for sand removal is approximately 150 acres. This area of Wallops Island has never been excavated.

Offshore Dredging
In year 2 (2011) and 3 (2012) of the SRIPP, approximately 3,998,750 yd^3 of sand are expected to be removed from Unnamed Shoal A and placed as beach nourishment along the shoreline of the Wallops Flight Facility, which will aid in restoring the underwater area in front of the seawall to its equilibrium condition (USACE 2010a). Renourishment cycles are expected to occur every 5 years, with 1,007,500 yd^3 of material removed during each cycle from either of two offshore borrow sites (Unnamed Shoal A and Unnamed Shoal B) and/or the north end of Wallop's Island. Approximately 9 renourishment cycles are proposed to occur over the 50 year life of the SRIPP, with a total of approximately 13,066,250 cubic yards of material removed during this period.

A trailer suction hopper dredge will be used to dredge the offshore borrow sites throughout the 50 year life of the SRIPP. These dredges are self propelled and hydraulically operated and are equipped with two dragheads and a hopper. High speed centrifugal pumps are employed to excavate the sediment and dispose of it into a storage hopper. The intake end of the suction pipe is fitted with a draghead, the function of which is to strip off a layer of sediment (approximately 0.3 m (1 foot) in depth) from the seabed and entrain those sediments into the suction pipe. Material dislodged from the ocean floor by the suction is suspended in water in the form of a slurry and then passed through the centrifugal pump to the storage hopper. Once the dredge hopper is filled, the dredge will transport the material to a pump-out buoy or station that will be placed at a water depth of approximately 30 feet, which is located approximately 2 miles offshore of the placement area. The pathway from Unnamed Shoal A and B to the pump-out buoy is not a straight line, but instead is a dogleg shape with a turning point so as to avoid Chincoteague Shoal and Blackfish Bank. The distance from the turning point to the pump-out buoy is approximately 8 miles. The one-way distance from Unnamed Shoal A to the proposed pump-out buoy is approximately 14 miles and the corresponding transit distance from Unnamed Shoal B to the proposed pump-out buoy is approximately 19 miles. Booster pumps may be needed to aid the offloading of sand from the pump-out buoy to the shoreline. Two dredges will be operating at the same time, with one dredge operating at the offshore site and while the other is transiting to the pump out-station. This pattern would alternate within a 24-hour period, with dredges spending approximately 3-4 hours on site at the shoal and the remainder of time traveling and unloading sand. In general, about three round trips per day will be accomplished with the dredge operating at speeds of 3 knots while dredging and 10 knots when transiting to and from the borrow areas.

On-Shore Excavation

The north Wallops Island borrow site will be excavated with a pan excavator. The pan excavator will stockpile the sand, which will be loaded onto dump trucks that will transport the fill material up and down the beach. Bulldozers will then be used to spread the fill material once it is placed on the beach. All heavy equipment will access the beach from existing roads and established access points. No new temporary or permanent roads will be constructed to access the beach or to transport the fill material to renourishment areas. No in water work will be required for this portion of the project.

Beach Fill

Initial beach fill placement is expected in 2011. The beach fill will start approximately 1,500 feet north of the Wallops Island-Assawoman Island property boundary and extend north for 3.7 miles. The initial fill will be placed so that there will be a 6-foot-high berm extending a minimum 70 feet seaward of the existing seawall. The remainder of the fill will slope underwater for an additional distance seaward; the amount of that distance will vary along the length of the beach fill, but will extend for a maximum of about 170 feet so that the total distance of the fill profile from the seawall will be approximately 240 feet. The beach fill profile will also include a 14-foot-high dune at the seawall. The front sloping face of the dune will rest against the seawall. As noted above, in year 2 of the SRIPP, placement activities will be initiated to restore the underwater area in front of the seawall and the remainder of the initial fill volume will be placed in year 3. Sand for initial nourishment will be dredged, as noted above, from Unnamed Shoal A and placed on the beach as described above. For renourishment fill volumes, up to one half of the fill volume may be excavated from the north Wallops Island borrow site, with the remainder of the sand obtained from either Unnamed Shoal A or Unnamed Shoal B.

Implementation Schedule

The initial components of the SRIPP (seawall extension, beach nourishment) will be staged and completed over a three-year timespan. As noted above, year 1 will involve the construction and completion of the seawall; year 2, partial initial beach fill and dredging; year 3, completion of initial beach fill and dredging.

Using the total volume of fill placed over years 2 and 3 of the SRIPP (3,199,000 yd^3), initial beach fill will require approximately 1,000 to 1,100 dredge trips from the offshore borrow sites to the Wallops Island shoreline. Based on previous offshore dredging operations along the east coast, it is assumed that dredgers with a hopper capacity of approximately 4,000 cubic yards will be used; however, because this volume is a slurry and not all sand, the actual volume of sand that each dredge will transport during each trip will be approximately 3,000 cubic yards. Following the completion of the initial beach fill (i.e., after 3 years) each renourishment cycle will require approximately 240 to 270 dredge trips or approximately 50 days to remove 1,007,500 cubic yards of sand to be placed as renourishment along the Wallops Island shoreline. As noted above, two dredges will be used at the same time and will accomplish about three round trips per day. Assuming 10% downtime for the dredges due to weather, equipment failure, etc., the 1.2 million yd^3 volume of fill placed in Year 2 will result in approximately 410 dredge trips and will take approximately 81 days, or about 3 months. The remaining volume to be placed in Year 3, approximately 2 million yd^3, will result in approximately 690 dredge trips and will take approximately 135 days, or about 4 and one-half months. As noted above, subsequent renourishment activities (assuming all fill is taken from one of the proposed offshore shoals), which are proposed to occur approximately once every five years, will take approximately 50 days, or about 2 months. When in operations, dredging is expected to occur at any time of the year, with the dredging window based upon contractor availability.

Mitigation Measures
Throughout the proposed action, NASA will implement measures to minimize any potential effects of dredging to listed species of sea turtles and whales throughout the proposed project. Mitigation measures specific to sea turtles were incorporated within the BA and PEIS NMFS received on February 18, 2010. After further analysis of the potential effects of dredging on listed species of whales, specifically in regards to dredge noise, NASA and NMFS devised additional mitigation measures to be put in place throughout the proposed action. These additional mitigation measures were received by NMFS on June 28, 2010 and will be incorporated into the final BA and EIS. The following are the mitigation measures NASA will implement as part of the proposed action:

1. NASA will ensure that during April 1-November 30, hopper dredges are outfitted with state-of-the-art sea turtle deflectors on the drag head and operated in a manner that will reduce the risk of interactions with sea turtles that may be present in the action area.

2. A NMFS-approved observer will be present on board the vessel for any dredging occurring from April 1-Novemeber 30.

3. NASA will ensure that dredges are equipped and operated in a manner that provides endangered/threatened species observers with a reasonable opportunity for detecting interactions with listed species and that provides for handling, collection, and resuscitation of turtles injured during project activity.

4. NASA will ensure that all measures are taken to protect any turtles that survive

entrainment in the dredge.

5. As the NMFS approved observer will only be on board the dredge from April 1-November 30, a lookout/bridge watch will be present on the dredge at all times from December1-March 31 to alert the captain when a listed whale is spotted within 1 kilometer (km) (0.62 miles) of the dredge. The lookout will be knowledgeable in listed species identification. From April 1-November 30, the NMFS approved observer will assume this responsibility.

6. If a NMFS approved observer or the lookout/bridgewatch observes a whale within 1 km (0.62 miles) of the dredge, all pumps will be turned off (i.e., dredging will stop) until the whale leaves the area (i.e., is farther than 1 km (0.62 miles) from the dredge).

7. All dredge operators will monitor the right whale (*Eubalaena glacialis*) sighting reports (i.e., sighting advisory system (SAS), dynamic management areas (DMA's), seasonal management areas (SMA's)) to remain informed on the whereabouts of right whales within the vicinity of the action area.

8. All dredge operators will conform to the regulations prohibiting the approach of right whales closer than 500 yards (50 CFR 224.103 (c)). Any vessel finding itself within the 500 yard buffer zone created by a surfacing whale must depart the area immediately at a safe, slow speed.

9. For dredging operations at night, the work area will be lit well enough to ensure that the observer/lookout can perform his/her work safely and effectively and that the measures mentioned above can be performed to the extent practicable.

10. NMFS will be contacted before dredging commences and again upon completion of the dredging activity.

11. All whale sightings will be reported to NMFS' Protected Resources Division Section 7 Coordinator.

Action Area

The action area is defined in 50 CFR 402.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The action area for this consultation includes the Wallops Island offshore borrow sites, the waters between and immediately adjacent to these areas where project vessels will travel and dredged material will be transported (see Appendix A for an illustration of the action area) as well as an area extending 4000 feet in all directions from the area to be dredged to account for the sediment plume generated during dredging activities. The action area also includes the northern portion of Wallops Island and the portion of Wallops Island shoreline and nearshore waters that will be affected by the extended seawall and beach fill (i.e., 3.7 miles of shoreline) (see Appendix A for an illustration of the action area).
As dredging operations will also produce underwater noise levels that range between 120-160 dB the action area will also include the area around the dredge where effects of increased underwater

noise levels will be experienced. Based on the analysis of dredge noise and transmission loss calculations, effects of dredge noise will be experienced within 794 meters from the dredge during loading and pumping.

LISTED SPECIES IN THE ACTION AREA

Several species listed under NMFS' jurisdiction occur in the action area. Four species of listed sea turtles occur in the action area during the warmer months (approximately April 1 – November 30). Three species of listed whales may also occur seasonally in the action area. No critical habitat has been designated within the action area; as such, no critical habitat will be affected by this action.

STATUS OF AFFECTED SPECIES

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

Sea Turtles	
Loggerhead sea turtle (*Caretta caretta*)	Threatened
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered
Kemp's ridley sea turtle (*Lepidochelys kempi*)	Endangered
Green sea turtle (*Chelonia mydas*)	Endangered/Threatened[2]
Cetaceans	
Right whale (*Eubalaena glacialis*)	Endangered
Humpback whale (*Megaptera novaeangliae*)	Endangered
Fin whale (*Balaenoptera physalus*)	Endangered

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.

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)).[3]

---

[2] 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.

3 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.

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 1998), Kemp's ridley sea turtle (USFWS and NMFS 1992), and green sea turtle (NMFS and USFWS 1991b).

Loggerhead sea turtle

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

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

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

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

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

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

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

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

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

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

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

In the southeastern U.S., loggerheads mate from late March to early June, and eggs are laid throughout the summer, with a mean clutch size of 100-126 eggs (Dodd 1988). Individual females nest multiple times during a nesting season, with a mean of 4.1 nests per individual (Murphy and Hopkins 1984). Nesting migrations for an individual female loggerhead are usually on an interval of 2 to 3 years, but can vary from 1 to 7 years (Dodd 1988; NMFS and USFWS 2008). Age at sexual maturity for loggerheads has been estimated at 32 to 35 years (NMFS and USFWS 2008).

For the past decade or so, the scientific literature has recognized five distinct nesting groups, or subpopulations, of loggerhead sea turtles in the Northwest Atlantic, divided geographically as follows: (1) a northern group of nesting females that nest from North Carolina to northeast Florida at about 29°N latitude; (2) a south Florida group of nesting females that nest from 29°N latitude on the east coast to Sarasota on the west coast; (3) a Florida Panhandle group of nesting females that nest around Eglin Air Force Base and the beaches near Panama City, Florida; (4) a Yucatán group of nesting females that nest on beaches of the eastern Yucatán Peninsula, Mexico (Márquez 1990; TEWG 2000); and (5) a Dry Tortugas group that nests on beaches of the islands of the Dry Tortugas, near Key West, Florida (NMFS SEFSC 2001). Genetic analyses of mitochondrial DNA, which a sea turtle inherits from its mother, indicate that there are genetic differences between loggerheads that nest at and originate from the beaches used by each of the five identified nesting groups of females (TEWG 2000). However, analyses of microsatellite loci from nuclear DNA, which represents the genetic contribution from both parents, indicates little to no genetic differences between loggerheads originating from nesting beaches of the five Northwest Atlantic nesting groups (Pearce and Bowen 2001; Bowen 2003; Bowen *et al.* 2005; Shamblin 2007). These results suggest that female loggerheads have site fidelity to nesting beaches within a particular area, while males provide an avenue of gene flow between nesting groups by mating with females that originate from different nesting groups (Bowen 2003; Bowen *et al.* 2005). The extent of such gene flow, however, is unclear (Shamblin 2007).

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

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

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

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

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

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

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

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

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

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

Loggerheads are affected by a completely different set of anthropogenic threats in the marine environment. These include 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; fishery interactions; oil and gas exploration, coastal development, and transportation; and marine pollution. For instance, on April 20, 2010 the Deepwater Horizon oil spill occurred in the Gulf of Mexico off the coast of Louisiana. As loggerhead sea turtles are known to migrate through, and nest and forage along the coastal waters of the Gulf of Mexico, the oil spill is likely to affect the loggerhead population; however, because all the information on sea turtle stranding, deaths, and recoveries has not yet been documented, the effects of the oil spill on the loggerhead population cannot be determined at this time.

A 1990 National Research Council (NRC) report concluded that for juveniles, subadults, and breeders in coastal waters, the most important source of human caused mortality in U.S. Atlantic waters was fishery interactions. Of the many fisheries known to adversely affect loggerheads, the U.S. south Atlantic and Gulf of Mexico shrimp fisheries were considered to pose the greatest threat of mortality to neritic juvenile and adult age classes of loggerheads, accounting for an estimated 5,000 to 50,000 loggerhead deaths each year (National Resource Council (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 on shrimp trawling in the southeastern U.S. was reinitiated in 2002, in part, to consider the effect of a new rulemaking that would require increasing the size of TED escape openings to allow larger loggerheads (as well as green and leatherback sea turtles) to escape from shrimp trawl gear. The resulting Opinion was completed in December 2002 and concluded that, as a result of the new rule, annual loggerhead mortality from capture in shrimp trawls would decline from an estimated 62,294 to 3,948 turtles assuming that all TEDs were installed properly and that compliance was 100% (Epperly *et al.* 2002; NMFS 2002). The total annual level of take for loggerhead sea turtles as a result of the U.S. south Atlantic and Gulf of Mexico shrimp fisheries was estimated to be 163,160 loggerhead interactions (the total number of turtles that enter a shrimp trawl, which may then escape through the TED or fail to escape and be captured) with 3,948 of those takes being lethal (NMFS 2002). On February 21, 2003, NMFS issued the final rule in the *Federal Register* to require the use of the larger opening TEDs (68 FR 8456). The rule also provided the measures to disallow several previously approved TED designs that did not function properly under normal fishing conditions, and to require modifications to the trynet and bait shrimp exemptions to the TED requirements to decrease mortality of sea turtles.

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

Loggerhead sea turtles are also known to interact with non-shrimp trawl, gillnet, longline, dredge, pound net, pot/trap, and hook and line fisheries. The NRC (1990) report stated that other U.S. Atlantic fisheries collectively accounted for 500 to 5,000 loggerhead deaths each year, but recognized that there was considerable uncertainty in the estimate. The first estimate of loggerhead sea turtle bycatch in U.S. Mid-Atlantic bottom otter trawl gear was completed in September 2006 and later updated in November 2008 (Murray 2006, 2008). Observers reported 66 loggerhead sea turtle interactions with bottom otter trawl gear from 1994-2004 of which 38 were reported as alive and uninjured and 28 were reported as dead, injured, resuscitated, or of unknown condition (Murray 2006, 2008). Seventy-seven percent of observed sea turtle interactions occurred on vessels fishing for summer flounder (50%) and Atlantic croaker (27%). The remaining 23% of observed interactions occurred on vessels targeting weakfish (11%), long-finned squid (8%), groundfish (3%), and short-finned squid (1%). 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 per year for the period 1996-2004 (Murray 2006, 2008).

The 2008 update also reported loggerhead bycatch from 2000-2004 by main species (fish or invertebrate) group caught, which is a proxy for FMP group (which is not well reported in the observer data). The average annual bycatch estimate of loggerhead sea turtles from 2000-2004 (based on the rate from 1994-2004) over FMP groups identified by NERO was 411 turtles, with an additional 77 estimated bycatch events unassigned. An estimated 192 (47%) of assigned takes occurred annually in the summer flounder/scup/black sea bass group, 62 (15%) in the Atlantic mackerel/squid/butterfish group, 43 (10%) in the Northeast multispecies group, and 41 (10%) in the Atlantic croaker group. A total of 20 loggerheads (4.8%) were estimated as having been taken annually in bottom otter trawl gear catching sea scallops, which is in addition to the estimated 81-191 loggerheads reported by Murray (2007) as being caught annually in trawl gear designed specifically to harvest scallops based on data from 2004-2005 (Murray 2008).

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

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

Summary of Status for Loggerhead Sea Turtles

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

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

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

Currently, there are no population estimates for loggerhead sea turtles in any of the ocean basins in which they occur. However, a recent loggerhead assessment prepared by NMFS states that the loggerhead adult female population in the western North Atlantic ranges from 20,000 to 40,000 or more, with a large range of uncertainty in total population size (NMFS SEFSC 2009).

In 2007, based on their 5-year status review of the species, NMFS and FWS determined that loggerhead sea turtles should not be delisted or reclassified as endangered. However, it was also determined that an analysis and review of the species should be conducted in the future to determine whether DPSs should be identified for the loggerhead (NMFS and USFWS 2007a). In 2008, NMFS and FWS established a Loggerhead Biological Review Team (BRT) to assess the global loggerhead population structure to determine whether DPSs exist and, if so, the status of each DPS. The BRT report was recently completed in August 2009 (Conant *et al.* 2009). In this report, the BRT identified the following nine loggerhead DPSs distributed globally: (1) North Pacific Ocean, (2) South Pacific Ocean, (3) North Indian Ocean, (4) Southeast Indo-Pacific Ocean, (5) Southwest Indian Ocean, (6) Northwest Atlantic Ocean, (7) Northeast Atlantic Ocean, (8) Mediterranean Sea, and (9) South Atlantic Ocean. According to an analysis using expert opinion in a matrix model framework used in the BRT report, all loggerhead DPSs have the potential to decline in the future. Although some DPSs are indicating increasing trends at nesting beaches (Southwest Indian Ocean and South Atlantic Ocean), available information about anthropogenic threats to juveniles and adults in neritic and oceanic environments indicate possible unsustainable additional mortalities. According to the threat matrix analysis in the BRT report, the potential for future decline is greatest for the North Indian Ocean, Northwest Atlantic Ocean, Northeast Atlantic Ocean, Mediterranean Sea, and South Atlantic Ocean DPSs (Conant *et al.* 2009).

On March 16, 2010, NMFS and USFWS published a proposed rule in the Federal Register to divide the worldwide population of loggerhead sea turtles into nine DPSs, as described in the 2009 Status Review. Two of the DPSs are proposed to be listed as threatened and seven of the DPSs, including the Northwest Atlantic Ocean DPS, are proposed to be listed as endangered (75 FR 12597, March 16, 2010). NMFS and the USFWS are accepting comments on the proposed rule through September 13, 2010 (75 FR 30769, June 2, 2010). Loggerhead sea turtles in the action area for this consultation would be in the Northwest Atlantic Ocean DPS described in the proposed rule.

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 northwestern Atlantic Ocean (USFWS and NMFS 1992).

The majority of Kemp's ridleys nest along a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963; USFWS and NMFS 1992; NMFS and USFWS 2007b). There is a limited amount of scattered nesting to the north and south of the primary nesting beach (NMFS and USFWS 2007b). The number of nesting adult females reached an estimated low of fewer than 250 in 1985 (USFWS and NMFS 1992; TEWG 2000; NMFS and USFWS 2007b). 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 the State of Tamaulipas over a 3-day period in May 2007 and over 4,000 of those nested at Rancho Nuevo (NMFS and USFWS 2007b). There is limited nesting in the U.S., most of which is located in south Texas. In 2006, approximately 100 nests were laid in Texas (NMFS and USFWS 2007b).

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

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

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

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

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

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

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

Summary of Status for Kemp's ridley Sea Turtles

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

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 (e.g., oil spills), and habitat destruction account for an unknown level of other mortality. For instance, on April 20, 2010 the Deepwater Horizon oil spill occurred in the Gulf of Mexico off the coast of Louisiana. As Kemp's ridley sea turtles are known to migrate through, and nest and forage along the coastal waters of the Gulf of Mexico, the oil spill is likely to affect the Kemp's ridley population; however, because all the information on sea turtle stranding, deaths, and recoveries has not yet been documented, the effects of the oil spill on the Kemp's ridley population cannot be determined at this time.

Based on their 5-year status review of the species, NMFS and USFWS (2007b) determined that Kemp's ridley sea turtles should not be reclassified as threatened under the ESA.

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

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

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

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

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

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

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

Indian Ocean. Leatherbacks nest in several areas around the Indian Ocean. These sites include Tongaland, South Africa (Pritchard 2002) and the Andaman and Nicobar Islands (Andrews *et al.* 2002). Intensive survey and tagging work in 2001 provided new information on the level of nesting in the Andaman and Nicobar Islands (Andrews *et al.* 2002). Based on the survey and tagging work, it was estimated that 400-500 female leatherbacks nest annually on Great Nicobar Island (Andrews *et al.* 2002). The number of nesting females using the Andaman and Nicobar Islands combined was estimated around 1,000 (Andrews and Shanker 2002). Some nesting also occurs along the coast of Sri Lanka, although in much smaller numbers than in the past (Pritchard 2002). Spotila *et al.* (2000) indicated that leatherback sea turtles have been virtually extinct in Sri Lanka since 1994 and disappeared from India before 1930.

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

Dutton, NMFS, unpublished data).

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

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

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

As described above, 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 2007d) compiled the most recent information on mean number of leatherback nests per year for each of the seven leatherback populations or groups of populations that were identified by the Leatherback TEWG as occurring within the Atlantic. These are: Florida, North Caribbean, Western Caribbean, Southern Caribbean, West Africa, South Africa, and Brazil (TEWG 2007). In the U.S., the Florida Statewide Nesting Beach Survey program has documented an increase in leatherback nesting numbers from 98 nests in 1988 to between 800 and 900 nests in the early 2000s (NMFS and USFWS 2007d). An analysis of Florida's index nesting beach sites from 1989-2006 shows a substantial increase in leatherback nesting in Florida during this time, with an annual growth rate of approximately 1.17 (TEWG 2007). The TEWG reports an increasing or stable 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 and Garner 2007). In addition, the leatherback rookery along the northern coast of South America in French Guiana and Suriname supports the majority of leatherback nesting in the western Atlantic (TEWG 2007), and represents more than half of total nesting by leatherback sea turtles worldwide (Hilterman and Goverse 2004). Nest numbers in Suriname have shown an increase and the long-term trend for the Suriname and French Guiana nesting group seems to show an increase (Hilterman and Goverse 2004). In 2001, the number of nests for Suriname and French Guiana combined was 60,000, one of the highest numbers observed for this region in 35 years (Hilterman and Goverse 2004). The TEWG (2007) report indicates that using nest numbers from 1967-2005, a positive population growth rate was found over the 39-year period for French Guinea and Suriname, with a 95% probability that the population was growing. Nevertheless, given the magnitude of leatherback nesting in this area compared to other nest sites, impacts to this area that negatively affect leatherback sea turtles could have profound impacts on the species, overall.

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

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

Leatherbacks have been documented interacting with longline, trap/pot, trawl, and gillnet fishing gear. For instance, according to observer records, an estimated 6,363 leatherback sea turtles were caught by the U.S. Atlantic tuna and swordfish longline fisheries between 1992-1999, of which 88 were released dead (NMFS SEFSC 2001). Currently, the U.S. tuna and swordfish longline fisheries managed under the HMS FMP are estimated to capture 1,764 leatherbacks (no more than 252 mortalities) for each 3-year period starting in 2007 (NMFS 2004). In 2008, there were 90 observed interactions between leatherback sea turtles and longline gear used in the HMS fishery. Four of the leatherbacks were dead upon release and one was in unknown condition. The vast majority of leatherbacks that were released alive had injuries due to external hooking (Garrison *et al.* 2009). Based on the observed take, an estimated 381.3 (95% CI: 288.7-503.7) leatherback sea turtles are estimated to have been taken in the longline fisheries managed under the HMS FMP in 2008 (Garrison *et al.* 2009). The 2008 estimate is consistent with the annual numbers since 2005 and remains well below the average prior to implementation of gear regulations (Garrison *et al.* 2009). Since the U.S. fleet accounts for only 5%-8% of the longline hooks fished in the Atlantic Ocean, adding up the under-represented observed takes of the other 23 countries actively fishing in the area would likely result in annual take estimates of thousands of leatherbacks over different life stages (NMFS SEFSC 2001). Lewison *et al.* (2004) estimated that 30,000-60,000 leatherbacks were taken in all Atlantic longline fisheries in 2000 (including the U.S. Atlantic tuna and swordfish longline fisheries as well as others).

Leatherbacks are susceptible to entanglement in the lines associated with trap/pot gear used in several fisheries. From 1990-2000, 92 entangled leatherbacks were reported from New York through Maine (Dwyer *et al.* 2002). Additional leatherbacks stranded wrapped in line of unknown origin or with evidence of a past entanglement (Dwyer *et al.* 2002). More recently, from 2002 to 2007, NMFS received 144 reports of entangled sea turtles in vertical lines from Maine to Virginia, with 96 events confirmed (verified by photo documentation or response by a trained responder; NMFS 2008b). Of the 96 confirmed events during this period, 87 events involved leatherbacks. NMFS identified the gear type and fishery for 42 of the 96 confirmed events, which included lobster, whelk, sea bass, crab, and research pot gear. A review of leatherback mortality documented by the STSSN in Massachusetts suggests that vessel strikes and entanglement in fixed gear (primarily lobster pots and whelk pots) are the principal sources of this mortality (Dwyer *et al.* 2002). Fixed gear fisheries in the Mid-Atlantic have also contributed to leatherback entanglements. For example, in North Carolina, two leatherback sea turtles were reported entangled in a crab pot buoy line inside Hatteras Inlet (NMFS SEFSC 2001). A third leatherback was reported entangled in a crab pot buoy line in Pamlico Sound off of Ocracoke. This turtle was disentangled and released alive; however, lacerations on the front flippers from the lines were evident (NMFS SEFSC 2001). In the southeast U.S., leatherbacks are vulnerable to entanglement in Florida's lobster pot and stone crab fisheries as documented on stranding forms. In the U.S. Virgin Islands, where one 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 2002b). Leatherbacks are likely to encounter shrimp trawls working in the coastal waters off the U.S. Atlantic coast (from Cape Canaveral, Florida through North Carolina) as they make their annual spring migration north. For many years, TEDs that were required for use in the U.S. south Atlantic and Gulf of Mexico shrimp fisheries were less effective for leatherbacks as compared to the smaller, hard-shelled turtle species, because the TED openings were too small to allow leatherbacks to escape. To address this problem, NMFS issued a final rule on February 21, 2003 to amend the TED regulations (68 FR 8456). Modifications to the design of TEDs are now required in order to exclude leatherbacks as well as large benthic immature and sexually mature loggerhead and green sea turtles (see section 3.1.1 above for further information on the shrimp trawl fishery).

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

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

Fishing gear interactions 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 sea turtles in the waters of coastal Nicaragua also incidentally catch leatherback sea turtles (Lagueux 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-M. 2000). An estimated 1,000 mature female leatherback sea turtles are caught annually in fishing nets off of Trinidad and Tobago with mortality estimated to be between 50%-95% (Eckert and Lien 1999). However, many of the sea turtles do not die as a result of drowning, but rather because the fishermen cut them out of their nets (NMFS SEFSC 2001).

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

Summary of Status for Leatherback Sea Turtles

In the Pacific Ocean, the abundance of leatherback sea turtles on nesting beaches has declined dramatically over the past 10 to 20 years. Nesting groups throughout the eastern and western Pacific Ocean have been reduced to a fraction of their former abundance by the combined effects of human activities that have reduced the number of nesting females and reduced the reproductive success of females that manage to nest (for example, egg poaching) (NMFS and USFWS 2007d). 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 2007d).

Nest counts in many areas of the Atlantic Ocean show increasing trends, including for beaches in Suriname and French Guiana which support the majority of leatherback nesting (NMFS and USFWS 2007d). The species as a whole continues to face numerous threats at nesting and marine habitats. As with the other sea turtle species, fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like pollution (e.g., oils spills) and habitat destruction account for an unknown level of other mortality. For instance, on April 20, 2010 the Deepwater Horizon oil spill occurred in the Gulf of Mexico off the coast of Louisiana. As leatherback sea turtles are known to migrate through and along the coastal waters of the Gulf of Mexico, the oil spill is likely to affect the leatherback population; however, because all the information on sea turtle stranding, deaths, and recoveries has not yet been documented, the effects of the oil spill on the leatherback population cannot be determined at this time. 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 2007d).

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

Green sea turtle

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

Pacific Ocean. Green sea turtles occur in the western, central, and eastern Pacific. Foraging areas are also found throughout the Pacific and along the southwestern U.S. coast (NMFS and USFWS 1991b). In the western Pacific, major nesting rookeries at four sites including Heron Island (Australia), Raine Island (Australia), Guam, and Japan were evaluated and determined to be increasing in abundance, with the exception of Guam which appears stable (NMFS and USFWS 2007c). In the central Pacific, nesting occurs on French Frigate Shoals, Hawaii, which has also been reported as increasing with a mean of 400 nesting females from 2002-2006 (NMFS and USFWS 2007c). 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 2007c). The number of nesting females per year exceeds 1,000 females at each site (NMFS and USFWS 2007c). However, historically, greater than 20,000 females per year are believed to have nested in Michoacan alone (Cliffton *et al.* 1982; NMFS and USFWS 2007c). Thus the current number of nesting females is still far below what has historically occurred. Again, the Pacific Mexico green turtle nesting population (also called the black turtle) is considered endangered.

Historically, green sea turtles were used in many areas of the Pacific for food. They were also commercially exploited and this, coupled with habitat degradation, led to their decline in the Pacific (NMFS and USFWS 1991b). Green sea turtles in the Pacific continue to be affected by poaching, habitat loss or degradation, fishing gear interactions, and fibropapilloma (NMFS and USFWS 1991b; NMFS 2004).

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 sea turtle nesting were evident for many of the Indian Ocean Index Sites. While several of these had not demonstrated further declines in the more recent past, only the Comoros Island Index Site in the Western Indian Ocean showed evidence of increased nesting (Seminoff 2004).

Mediterranean Sea. There are four nesting concentrations of green sea turtles in the Mediterranean from which data are available, including those in Turkey, Cyprus, Israel, and Syria. Currently, approximately 300-400 females nest each year—about two-thirds of which nest in Turkey and one-third in Cyprus. Although this population is depleted from historic levels (Kasparek *et al.* 2001), nesting data gathered since the early 1990s in Turkey, Cyprus, and Israel show no apparent trend in any direction. However, a declining trend is apparent along the coast of Palestine/Israel, where 300-350 nests were deposited each year in the 1950s (Sella 1982) compared to a mean of 6 nests per year from 1993-2004 (Kuller 1999; Y. Levy, Israeli Sea Turtle Rescue Center, unpublished data). A recent discovery of green sea turtle nesting in Syria adds roughly 100 nests per year to green sea turtle nesting activity in the Mediterranean (Rees *et al.* 2005). That such a major nesting concentration could have gone unnoticed until recently (the Syria coast was surveyed in 1991, but nesting activity was attributed to loggerheads) bodes well for the ongoing speculation that the unsurveyed coast of Libya may also host substantial nesting.

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

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

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

Age at maturity for green sea turtles is estimated to be 20-50 years (Balazs 1982; Frazer and Ehrhart 1985; Seminoff 2004). As is the case with the other sea turtle species described above, adult females may nest multiple times in a season (average 3 nests/season with approximately 100 eggs/nest) and typically do not nest in successive years (NMFS and USFWS 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 threatened green sea turtle nesting in the Atlantic/Caribbean, and reviewed the trend in nest count data for each (NMFS and USFWS 2007c). 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 2007c). Nesting at all of these sites was considered to be stable or increasing with the exception of Bioko Island, which may be declining, and the Bijagos Archipelago, which may be stable; however, the lack of sufficient data precluded a meaningful trend assessment for either site (NMFS and USFWS 2007c).

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

By far, the most important nesting concentration for green sea turtles in the western Atlantic is in Tortuguero, Costa Rica (NMFS and USFWS 2007c). Nesting in the area has increased considerably since the 1970s and nest count data from 1999-2003 suggest nesting by 17,402-37,290 females per year (NMFS and USFWS 2007c). 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 2007c).

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

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

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

As with the other sea turtle species, incidental fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches. Sea sampling coverage in the pelagic driftnet, pelagic longline, southeast shrimp trawl, and summer flounder bottom trawl fisheries has recorded takes of green sea turtles. Other activities like dredging, pollution (e.g., oil spills), and habitat destruction account for an unknown level of other mortality (i.e., stranding reports indicate that between 200-400 green sea turtles strand annually along the eastern U.S. coast from a variety of causes most of which are unknown (STSSN database)). For instance, on April 20, 2010 the Deepwater Horizon oil spill occurred in the Gulf of Mexico off the coast of Louisiana. As green sea turtles are known to migrate through, and nest and forage along the coastal waters of the Gulf of Mexico, the oil spill is likely to affect the green sea turtle population; however, because all the information on sea turtle stranding, deaths, and recoveries has not yet been documented, the effects of the oil spill on the green sea turtle population cannot be determined at this time.

Summary of Status of Green Sea Turtles

A review of 32 Index Sites[4] distributed globally revealed a 48%-67% decline in the number of mature females nesting annually over the last three generations[5] (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 2007c). Of the 23 threatened nesting groups assessed in that report for which nesting abundance trends could be determined, 10 were considered to be increasing, 9 were considered stable, and 4 were considered to be decreasing (NMFS and USFWS 2007c). Nesting groups were considered to be doing relatively well (the number of sites with increasing nesting were greater than the number of sites with decreasing nesting) in the Pacific, western Atlantic, and central Atlantic (NMFS and USFWS 2007c). However, nesting populations were determined to be doing relatively poorly in Southeast Asia, Eastern Indian Ocean, and perhaps the Mediterranean. Overall, based on mean annual reproductive effort, the report estimated that 108,761 to 150,521 females nest each year among the 46 threatened and endangered nesting sites included in the evaluation (NMFS and USFWS 2007c). 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 2007c).

There is cautious optimism that green sea turtle abundance is increasing in the Atlantic Ocean. Seminoff (2004) and NMFS and USFWS (2007c) 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 1970s (Seminoff 2004; NMFS and USFWS 2007c). 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 2007c). The endangered breeding population in Florida appears to be increasing based upon index nesting data from 1989-2006 (NMFS and USFWS 2007c).

---

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

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

As with the other sea turtle species, fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like dredging, pollution, and habitat destruction account for an unknown level of other mortality.

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

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).

Right whales have been listed as endangered under the Endangered Species Act (ESA) since 1973. They were originally listed as the "northern right whale" as endangered under the Endangered Species Conservation Act, the precursor to the ESA in June 1970. NMFS interpreted this listing to have included two species: *Eubalaena glacialis* and *Eubalaena australis.* 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 right whales in the northern hemisphere 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 are extensive (Waring *et al.* 2009). In the winter, only a portion of the known right whale population is seen on the calving grounds. The winter distribution of the remaining right whales remains uncertain (NMFS 2005, Waring *et al.* 2007). Results from winter surveys and passive acoustic studies suggest that animals may be dispersed in several areas including Cape Cod Bay (Brown *et al.* 2002) and offshore waters of the southeastern U.S. (Waring *et al.* 2007). Telemetry data have shown lengthy and somewhat distant excursions into deep water off of the continental shelf (Mate *et al.* 1997) as well as extensive movements over the continental shelf during the summer foraging period (Mate *et al.* 1992; Mate *et al.* 1997; Bowman 2003; Baumgartner and Mate 2005). Knowlton *et al.* (1992) reported several long-distance movements as far north as Newfoundland, the Labrador Basin, and southeast of Greenland; in addition, resightings of photographically identified individuals have been made off Iceland, arctic Norway, and in the old Cape Farewell whaling ground east of Greenland. The Norwegian sighting (September 1999) represents one of only two sightings this century of a right whale in Norwegian waters, and the first since 1926. Together, these long-range matches indicate an extended range for at least some individuals and perhaps the existence of important habitat areas not presently well described. Similarly, records from the Gulf of Mexico (Moore and Clark, 1963; Schmidly *et al.*, 1972) represent either geographic anomalies or a more extensive historic range beyond the sole known calving and wintering ground in the waters of the southeastern United States. The frequency with which right whales occur in offshore waters in the southeastern U.S. remains unclear (Waring *et al.*, 2009a).

Abundance estimates and trends

Although an estimate of the pre-exploitation population size for the North Atlantic right whale is not available, it is well known and documented that there are relatively few right whales remaining in the western North Atlantic. As is the case with most wild animals, an exact count cannot be obtained. However, abundance can be reasonably estimated as a result of the extensive study of this subpopulation. IWC participants from a 1999 workshop agreed to a minimum direct-count estimate of 263 right whales alive in 1996 and noted that the true population was unlikely to be greater than this estimate (Best *et al.* 2001). Based on a census of individual whales using photo-identification techniques and an assumption of mortality for those whales not seen in seven years, a total 299 right whales was estimated in 1998 (Kraus *et al.* 2001), and a review of the photo-ID recapture database on October 10, 2008, indicated that 345 individually recognized whales were known to be alive during 2005 (Waring *et al.* 2009). Because this 2008 review was a nearly complete census, it is assumed this estimate represents a minimum population size. The minimum number alive population index for the years 1990-2004 suggests a positive trend in numbers. These data reveal a significant increase in the number of catalogued whales alive during this period, but with significant variation due to apparent losses exceeding gains during 1998-1999. Mean growth rate for the period was 1.8% (Waring *et al.* 2009).

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

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

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

Reproductive Fitness

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

Factors that have been suggested as affecting the right whale reproductive rate include reduced genetic diversity (and/or inbreeding), contaminants, biotoxins, disease, nutritional stress, and loss of habitat (e.g., breeding and foraging grounds). 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 2001a). 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. finamarchicus* abundance levels also decreased significantly. Right whale calving rates since the early 1980's seem to follow a similar pattern, where stable calving rates were noted from 1982-1992, but then two major, multi-year declines occurred from 1993-2001, consistent with the drops in copepod abundance. It has been hypothesized that right whale calving rates are thus a function of food availability as well as the number of females available to reproduce (Greene *et al.* 2003, Greene and Pershing 2004). Such findings suggest that future climate change may emerge as a significant factor influencing the recovery of right whales. Some believe the effects of increased climate variability on right whale calving rates should be incorporated into future modeling studies so that it may be possible to determine how sensitive right whale population numbers are to variable climate forcing (Greene and Pershing 2004).

Anthropogenic Mortality

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

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

Although disentanglement is either unsuccessful or not possible for the majority of cases, during the period of 2003-2007, there were at least 4 documented cases of entanglements for which the intervention of disentanglement teams averted a likely serious injury determination (Waring *et al.* 2009). Even when entanglement or vessel collision does not cause direct mortality, it may weaken or otherwise affect individuals so that further injury or death is likely (Waring *et. al* 2007). Some right whales that have been entangled were subsequently involved in ship strikes (Hamilton *et al.*

1998) suggesting that the animal may have become debilitated by the entanglement to such an extent that it was less able to avoid a ship. Similarly, skeletal fractures and/or broken jaws sustained during a vessel collision may heal, but then compromise a whale's ability to efficiently filter feed (Moore *et al.* 2007). A necropsy of right whale #2143 ("Lucky) found dead in January 2005 suggested the animal (and her near-term fetus) died after healed propeller wounds from a previous ship strike re-opened and became infected as a result of pregnancy (Moore *et al.* 2007, Glass *et al.* 2008). Sometimes, even with a successful disentanglement, an animal may die of injuries sustained by fishing gear (e.g. RW #3107) (Waring *et al.* 2009).

Entanglement records from 1990-2007 maintained by NMFS include 46 confirmed right whale entanglement events (Waring *et al.* 2009). Because whales often free themselves of gear following an entanglement event, scarification analysis of living animals may provide better indications of fisheries interactions rather than entanglement records (Waring et al. 2009). Data presented in Knowlton *et al.* 2008 indicate the annual rate of entanglement interaction remains at high levels. Four hundred and ninety-three individual, catalogued right whales were reviewed and 625 separate entanglement interactions were documented between 1980 and 2004. Approximately 358 out of 493 animals (72.6% of the population) were entangled at least once; 185 animals bore scars from a single entanglement, however one animal showed scars from 6 different entanglement events. The number of male and female right whales bearing entanglement scars was nearly equivalent (142/202 females, 71.8%; 182/224 males, 81.3%), indicating that right whales of both sexes are equally vulnerable to entanglement. However, juveniles appear to become entangled at a higher rate than expected if all age groups were equally vulnerable. For all years but one (1998), the proportion of juvenile, entangled right whales exceeded their proportion within the population. Based on photographs of catalogued animals from 1935 through 1995, Hamilton *et al.* (1998) estimated that 6.4 percent of the North Atlantic right whale population exhibit signs of injury from vessel strikes. Reports received from 2003-2007 indicate that right whales had the greatest number of ship strike mortalities (n=9) and serious injuries (n=2) (Glass *et al.* 2009). In 2006 alone, four reported mortalities and one serious injury resulted from right whale ship strikes (Glass *et al.* 2009).

Summary of Right Whale Status

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

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

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

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

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

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

Gulf of Maine (North Atlantic)
Humpback whales from most Atlantic feeding areas calve and mate in the West Indies and migrate to feeding areas in the northwestern Atlantic during the summer months. Most of the humpbacks that forage in the Gulf of Maine visit Stellwagen Bank and the waters of Massachusetts and Cape Cod Bays. Previously, the North Atlantic humpback whale population was treated as a single stock for management purposes, however due to the strong fidelity to the region displayed by many whales, the Gulf of Maine stock was reclassified as a separate feeding stock (Waring *et al.* 2009). Sightings are most frequent from mid-March through November between 41□N and 43□N, from the Great South Channel north along the outside of Cape Cod to Stellwagen Bank and Jeffrey's Ledge (CeTAP 1982) and peak in May and August. Small numbers of individuals may be present in this area year-round, including the waters of Stellwagen Bank. They feed on a number of species of small schooling fishes, particularly sand lance and Atlantic herring, targeting fish schools and filtering large amounts of water for their associated prey. It is hypothesized humpback whales may also feed on euphausiids (krill) as well as capelin (Waring *et al.* 2009, Stevick *et al.* 2006).

In winter, whales from waters off New England, Canada, Greenland, Iceland, and Norway, migrate to mate and calve primarily in the West Indies where spatial and genetic mixing among these groups does occur (Waring *et al.* 2009). Various papers (Clapham and Mayo 1990; Clapham 1992; Barlow and Clapham 1997; Clapham *et al.* 1999) summarize information gathered from a catalogue of photographs of 643 individuals from the western North Atlantic population of humpback whales. These photographs identified reproductively mature western North Atlantic humpbacks wintering in tropical breeding grounds in the Antilles, primarily on Silver and Navidad Banks, north of the Dominican Republic. The primary winter range also includes the Virgin Islands and Puerto Rico (NMFS 1991a).

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

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

As is the case with other large whales, the major known sources of anthropogenic mortality and injury of humpback whales occur from fishing gear entanglements and ship strikes. For the period 2003 through 2007, the minimum annual rate of human-caused mortality and serious injury to the Gulf of Maine humpback whale stock averaged 4.4 animals per year (U.S. waters, 4.0; Canadian waters, 0.4) (Glass *et al.* 2009, Waring *et al.* 2009). Between 2003 and 2007 humpback whales were involved in 76 confirmed entanglement events and 11 confirmed ship strike events (Glass *et al.* 2009). Over the five-year period, humpback whales were the most commonly observed entangled whale species; entanglements accounted for 4 mortalities and 10 serious injuries (Glass *et al.* 2009). Although ship strikes were relatively uncommon, 8 of the 11 confirmed events were fatal (Glass *et al.* 2009). 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 May 2009, all of the available information indicated that the events described here involved animals from the Gulf of Maine stock (Glass *et al.* 2009). There were also many carcasses that washed ashore or were spotted floating at sea for which the cause of death could not be determined. Given the number of decomposed and incompletely or unexamined animals in the records, there needs to be greater emphasis on the timely recovery of carcasses and complete necropsies; decomposed and/or unexamined animals (e.g., carcasses reported but not retrieved or no necropsy performed) represent 'lost data' some of which may relate to human impacts (Glass *et al.* 2009, Waring *et al.* 2009).

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

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

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

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.* 2009). Anthropogenic mortality associated with fishing gear entanglements and ship strikes remains significant. In the winter, mating and calving occurs in areas located outside of the United States where the species is afforded less protection. Despite all of these factors, current data suggest that the Gulf of Maine humpback stock is steadily increasing in size (Waring *et al.* 2009). Population modeling, using data obtained from photographic mark-recapture studies, estimates the growth rate of the Gulf of Maine stock to be at 6.5% for the period 1979-1991 (Barlow and Clapham 1997). More recent analysis for the period 1992-2000 revealed lower growth rates ranging from 0% to 4.0%, depending on calf survival rate (Clapham *et al.* 2003 in Waring *et al.* 2009). However, it is unclear whether the decline is an artifact resulting from a shift in distribution documented for the period 1992-1995, or whether it is a real decline related to high mortality of young-of-the-year whales in US mid-Atlantic waters (Waring *et al.* 2009). Regardless, calf survival appears to have increased since 1996, presumably accompanied by an increase in population growth (Waring *et al.* 2009). Stevick *et al.* (2003) calculated an average population growth rate of 3.1% in the North Atlantic population overall for the period 1979-1993 (Waring *et al.* 2009). With respect to the species overall, there are also indications of increasing abundance for the eastern and central North Pacific stocks. Trend and abundance data is lacking for the western North Pacific stock, the Southern Hemisphere humpback whales, and the Southern Indian Ocean humpbacks. However, changes in status of the North Atlantic humpback population are likely to affect the overall survival and recovery of the species. Therefore, given the best available information, for the purposes of this biological opinion, NMFS believes the humpback whale population is increasing.

Fin Whale

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

Pacific Ocean

Within US waters of the Pacific, fin whales are found seasonally off of the coast of North America and Hawaii and in the Bering Sea during the summer (Angliss and Allen 2009). Although stock structure in the Pacific is not fully understood, NMFS recognizes three fin whale stocks in the US Pacific waters for the purposes of managing this species under the MMPA. These are: Alaska (Northeast Pacific), California/Washington/Oregon, and Hawaii (Carretta *et al.* 2009). Reliable estimates of current abundance for the entire Northeast Pacific fin whale stock are not available

(Angliss and Allen 2009). A provisional population estimate of 5,700 was calculated for the Alaska stock west of the Kenai Peninsula by adding estimates from multiple surveys (Angliss and Allen 2009). This can be considered a minimum estimate for the entire stock because it was estimated from surveys that covered only a portion of the range of the species (Angliss and Allen 2009). An annual population increase of 4.8% between 1987-2003 was estimated for fin whales in coastal waters south of the Alaska Peninsula (Angliss and Allen 2009). This is the first estimate of population trend for North Pacific fin whales; however, it must be interpreted cautiously due to the uncertainty in the initial population estimate and the population structure (Angliss and Allen 2009). The best available estimate for the California/Washington/Oregon stock is 2,636, which is likely an underestimate (Carretta *et al.* 2009). The best available estimate for the Hawaii stock is 174, based on a 2002 line-transect survey (Carretta *et al.* 2009).

Stock structure for fin whales in the southern hemisphere is unknown. Prior to commercial exploitation, the abundance of southern hemisphere fin whales is estimated to have been at 400,000 (IWC 1979, Perry *et al.* 1999). There are no current estimates of abundance for southern hemisphere fin whales. Since these fin whales do not occur in US waters, there is no recovery plan or stock assessment report for the southern hemisphere fin whales.

North Atlantic

NMFS has designated one population of fin whale in US waters of the North Atlantic (Waring *et al.* 2008). This species is commonly found from Cape Hatteras northward. A number of researchers have suggested the existence of fin whale subpopulations in the North Atlantic based on local depletions resulting from commercial overharvesting (Mizroch and York 1984) or genetics data (Bérubé *et al.* 1998). Photoidentification studies in western North Atlantic feeding areas, particularly in Massachusetts Bay, have shown a high rate of annual return by fin whales, both within years and between years (Seipt *et al.* 1990) suggesting some level of site fidelity. In 1976, the IWC's Scientific Committee proposed seven stocks (or populations) for North Atlantic fin whales. These are: (1) North Norway, (2) West Norway-Faroe Islands, (3) British Isles-Spain and Portugal, (4) East Greenland-Iceland, (5) West Greenland, (6) Newfoundland-Labrador, and (7) Nova Scotia (Perry *et al.* 1999). However, it is uncertain whether these boundaries define biologically isolated units (Waring *et al.* 2008).

During 1978-1982 aerial surveys, fin whales accounted for 24% of all cetaceans and 46% of all large cetaceans sighted over the continental shelf between Cape Hatteras and Nova Scotia (Waring *et al.*2009). Underwater listening systems have also demonstrated that the fin whale is the most acoustically common whale species heard in the North Atlantic (Clark 1995). The single most important area for this species appeared to be from the Great South Channel, along the 50m isobath past Cape Cod, over Stellwagen Bank, and past Cape Ann to Jeffrey's Ledge (Hain *et al.*1992).

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

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

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

Threats to fin whale recovery

The major known sources of anthropogenic mortality and injury of fin whales include entanglement in commercial fishing gear and ship strikes. The mean annual rate of confirmed human-caused serious injury and mortality to North Atlantic fin whales from 2003-2007 was 2.8 (Glass *et al.* 2009). During this five year period, there were 13 confirmed entanglements (3 fatal; 3 serious injuries) and 11 ship strikes (8 fatal) (Glass *et al.* 2009). Fin whales are believed to be the cetacean most commonly struck by large vessels (Laist *et al.* 2001). In addition, hunting of fin whales continued well into the 20th century. Fin whales were given total protection in the North Atlantic in 1987 with the exception of a subsistence whaling hunt for Greenland (Gambell 1993, Caulfield 1993). However, Iceland reported a catch of 136 whales in the 1988/89 and 1989/90 seasons, and has since ceased reporting fin whale kills to the IWC (Perry *et al.* 1999). In total, there have been 239 reported kills of fin whales from the North Atlantic from 1988 to 1995. Fin whales may also be adversely affected by habitat degradation, habitat exclusion, acoustic trauma, harassment, or reduction in prey resources due to trophic effects resulting from a variety of activities.

Population Trends and Status

Various estimates have been provided to describe the current status of fin whales in western North Atlantic waters. One method used the catch history and trends in Catch Per Unit Effort to obtain an estimate of 3,590 to 6,300 fin whales for the entire western North Atlantic (Perry *et al.* 1999). Hain *et al.* (1992) estimated that about 5,000 fin whales inhabit the Northeastern US continental shelf waters. The Draft 2009 Stock Assessment Report (SAR) gives a best estimate of abundance for fin whales of 2,269 (CV = 0.37). However, this estimate must be considered extremely conservative in view of the incomplete coverage of the known habitat of the stock and the uncertainties regarding population structure and whale movements between surveyed and unsurveyed areas (Waring *et al.* 2009). The minimum population estimate for the western North Atlantic fin whale is 1,678 (Waring *et al.* 2009). However, there are insufficient data at this time to determine population trends for the fin whale (Waring *et al.* 2009).

Summary of Fin Whale Status

Information on the abundance and population structure of fin whales worldwide is limited. NMFS recognizes three fin whale stocks in the Pacific for the purposes of managing this species under the MMPA. Reliable estimates of current abundance for the entire Northeast Pacific fin whale stock are not available (Angliss *et al.* 2001). Stock structure for fin whales in the southern hemisphere is unknown and there are no current estimates of abundance for southern hemisphere fin whales. As noted above, the best population estimate for the western North Atlantic fin whale is 2,269 which is believed to be an underestimate. The minimum population estimate for the western North Atlantic fin whale is 1,678. The Draft 2009 SAR indicates that there are insufficient data at this time to determine population trends for the fin whale. Fishing gear appears to pose less of a threat to fin whales in the North Atlantic Ocean than to North Atlantic right or humpback whales. However, fin whales continue to be struck by large vessels and some level of whaling for fin whales in the North Atlantic may still occur. As this species continues to be subject to natural and anthropogenic mortality, for the purposes of this Opinion, NMFS considers this population to be at best stable and at worst declining.

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 Opinion includes the effects of several activities that may affect the survival and recovery of the listed species in the action area. The activities that shape the environmental baseline in the action area of this consultation generally include: dredging operations, vessel and fishery operations, water quality/pollution, and recovery activities associated with reducing those impacts.

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. Additionally, NMFS has consulted on dredging and construction projects authorized by the USACE. Formal consultations completed in the action area are summarized below.

Assateague Island Short Term Restoration (STRP) Project and Assateague Island Long Term Sand Management (LTSMP) Project, Maryland-Dredging

In 1998, a consultation was completed between the USACE and NMFS on the effects of the USACE's authorization and completion of several beach restoration and renourishment projects in Maryland. The projects under consideration were the STRP, the LTSMP, and the Atlantic Coast of Maryland Shoreline Protection Project (see below). The Opinion considered the effects of the STRP, which was a one-time remedial action that involved the dredging of an offshore borrow site, Great Gull Bank, for the purposes of short term restoration of the northern end of Assateague Island, and the renourishment cycles to occur annually (or biannually) over the 25 year life of the LTSMP on sea turtles. Both the STRP and LTSMP involved the use of a self propelled hopper dredge. In the 1998 Opinion, NMFS concluded that both the STRP and the LTSMP were likely to adversely affect, but were not likely to jeopardize the continued existence of the loggerhead, Kemp's ridley, and green sea turtles, and were not likely to adversely affect leatherback sea turtles and listed species of marine mammals. The Incidental Take Statement (ITS) issued with 1998 Opinion exempted the lethal take (due to entrainment in the hopper dredge) of one Kemp's ridley, one green sea turtle, and five loggerhead sea turtles for the STRP, while the ITS for the LTSMP exempted the lethal take of one Kemp's ridley, two green sea turtles, and ten loggerhead sea turtles for the 25-year life of the proposed action. To date no takes have been recorded.

Atlantic Coast of Maryland Shoreline Protection Project (ACMSPP) -Dredging
In 2006 the ACMSPP consultation was reinitiated as a result of proposed modifications to the proposed action (i.e., revised borrow area locations). In a November 30, 2006 Opinion NMFS concluded that the proposed action may adversely affect, but is not likely to jeopardize the continued existence of the loggerhead and Kemp's ridley sea turtles and is not likely to adversely affect leatherback or green sea turtles or right, humpback, and fin whales. The ITS exempted the incidental taking of sea turtles as follows:

- For dredge cycles involving the removal of up to and including 500,000 cy of material, the take of 1 sea turtle is exempted;
- For dredge cycles involving the removal of more than 500,000 cy up to and including 1 million cy of material, the take of 2 sea turtles is exempted;
- For dredge cycles involving the removal of more than 1 million up to and including 1.5 million cy of material, the take of 3 sea turtles is exempted; and,
- For dredge cycles involving the removal of more than 1.5 million cy up to 1.6 million cy of material, the take of 4 sea turtles in exempted.

All exempted take was lethal take due to entrainment in a hopper dredge. Over the life of the project (i.e., through 2044), NMFS anticipated that up to 24 sea turtles were likely to be entrained and killed, with up to two of these being Kemp's ridleys and the remainder being loggerheads. To date no dredging associated with this action has been undertaken.

Assateague Island Emergency Response Action (ERA), Maryland-Dredging
During the fall of 1998, the USACE constructed the ERA, which repaired a storm damaged area on North Assateague Island with sand borrowed from Great Gull Bank. NMFS issued a Biological Opinion on the ERA in August 1998, which concluded that the ERA would adversely affect, but was not likely to jeopardize the continued existence of protected sea turtles. The ITS issued with the 1998 Opinion exempted the lethal take (due to entrainment in the hopper dredge) of one Kemp's ridley, one green sea turtle, and five loggerhead sea turtles. The action was completed and no takes were recorded.

Assateague State Park Beach Nourishment Project (ASPBN), Maryland
On December 20, 2000 NMFS issued an Opinion that considered the effects of the USACE's proposed one time borrowing of material from Great Gull bank, via a self propelled hopper dredge, for the purposes of beach nourishment along the Assateague State Park's oceanfront shoreline. NMFS concluded that the ASPBN may adversely affect, but would not likely jeopardize the continued existence of listed species of sea turtles. The 2000 Opinion included an ITS which exempted the lethal take (due to entrainment in the hopper dredge) of one Kemp's ridley, one green sea turtle, and two loggerhead sea turtles during the one time conduction of this project.

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 USACE. NMFS has conducted formal consultations with the USCG, the USN, EPA and NOAA on their vessel operations. In addition to operation of USACE vessels, NMFS has consulted with the USACE 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 details on the scope of vessel operations for these agencies and conservation measures being implemented as standard operating procedures.

Federal Fishery Operations

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

Formal ESA section 7 consultation has been conducted on the following fisheries which occur in the action area: Multispecies, Monkfish, Summer Flounder/Scup/Black Sea Bass, Atlantic Bluefish, Highly Migratory Species, Tilefish, Skate, and Spiny Dogfish fisheries. These consultations are summarized below. These fisheries overlap with the action area in the ocean to varying degrees.

The ***Multispecies sink gillnet fishery*** occurs in the action area and is known to entangle whales and sea turtles. This fishery has historically occurred along the northern portion of the Northeast Shelf Ecosystem from the periphery of the Gulf of Maine to Rhode Island in water depths to 60 fathoms. In recent years, more of the effort in this fishery has occurred in offshore waters and into the Mid-Atlantic. The fishery operates throughout the year with peaks in the spring and from October through February. Formal consultation on the multispecies fishery has been on-going since June 12, 1986. The most recent consultation was completed on June 14, 2001 and concluded that the continued operation of the multispecies fishery, including measures previously implemented as part of the Atlantic Large Whale Take Reduction Plan (ALWTRP), was likely to jeopardize the continued existence of right whales. The Seasonal Area Management (SAM) program and the Dynamic Area Management (DAM) program components of the RPA were implemented as part of the revised ALWTRP. The June 14, 2001 Opinion also concluded that continued operation of the fishery may adversely affect ESA-listed sea turtles. An Incidental Take Statement (ITS) was provided in the Opinion that exempted the lethal or non-lethal take of one loggerhead, and one green, leatherback, or Kemp's ridley sea turtle annually.

In 2006, the Northeast Fisheries Science Center (NEFSC) reported on the annual estimated taking of loggerhead sea turtles in bottom-otter trawl gear fished in Mid-Atlantic waters during the period of 1996-2004 (Murray 2006). The bycatch rate identified in Murray 2006 was used to estimate the take of loggerhead sea turtles in all fisheries (by FMP group) using bottom otter trawl gear fished in Mid-Atlantic waters during the period of 2000-2004 (Murray 2008). Based on the approach described in Murray (2008), the average annual take of loggerhead sea turtles in bottom otter trawl gear for the period of 2000-2004 was estimated to be 43 for trawl gear used in the Northeast multispecies fishery. In addition, on October 5, 2007, NMFS published a final rule in the *Federal Register* (72 FR 57104; October 5, 2007) that made many changes to the ALWTRP, including elimination of the DAM program as of April 7, 2008, and elimination of the SAM program as of October 6, 2008[6]. The newly estimated levels of take for loggerhead sea turtles and the changes to the ALWTRP (72 FR 57104; October 5, 2007) resulted in NMFS reinitiating formal consultation on the multispecies fishery on April 2, 2008 to reconsider the effects of the continued operation of the multispecies fishery on ESA-listed cetaceans and sea turtles. Consultation is currently ongoing and to date, a revised Opinion has not yet been issued.

The ***Atlantic Bluefish fishery*** may pose a risk to protected marine mammals, but is most likely to interact with sea turtles (primarily Kemp's ridleys and loggerheads) given the time and locations where the fishery occurs. Gillnets are the primary gear used to commercially land bluefish. Whales and turtles can become entangled in the buoy lines of the gillnets or in the net panels. Formal consultation on this fishery was completed on July 2, 1999, with NMFS concluding that operation of the fishery under the FMP and Amendment 1 was not likely to jeopardize the continued existence of listed species. The ITS exempted the annual take 6 loggerheads (no more than 3 lethal), 6 Kemp's ridleys (lethal or non-lethal) and 1 shortnose sturgeon (lethal or non-lethal). However, as a result of new information on large whale interactions with, and sea turtle bycatch in net gear used to target Atlantic bluefish (*Pomatomus saltatrix*), NMFS reinitiated section 7 consultation on this FMP in December 2007 to consider the effects of the fisheries on ESA-listed whales and sea turtles that were previously considered in the 1999 Opinion. Consultation is currently ongoing and to date, a revised Opinion has not yet been issued.

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 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 ALWTRP measures, and the ability of the reasonable and prudent alternatives (RPAs) 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

[6] Effective October 5, 2008, NMFS reinstituted the DAM program under the ALWTRP pursuant to a preliminary injunction issued in the case The Humane Society of the United States, et al. v. Gutierrez, et al. (Civil Action No. 08-cv-1593 (ESH)). The DAM program was effective through 2400 hrs April 4, 2009, and expired at this time when the broad-based sinking groundline requirement for Atlantic trap/pot fisheries became effective on April 5, 2009.

right whale. A new RPA was provided that was expected to remove the threat of jeopardy to right whales. In addition, a new ITS was provided for the take of sea turtles in the fishery.

On February 12, 2003, consultation was reinitiated on the Monkfish FMP to consider the effects of Framework Adjustment 2 on ESA-listed species. This consultation was completed on April 14, 2003 and concluded that the proposed action may adversely affect, but was not likely to jeopardize the continued existence of any ESA-listed species under NMFS jurisdiction. The ITS issued under the 2003 Opinion anticipated the take of 3 loggerheads and 1 non-loggerhead species (green, leatherback, or Kemp's ridley) in monkfish gillnet gear, and 1 sea turtle (loggerhead, green, leatherback, or Kemp's ridley) in monkfish trawl gear. Due to changes in the ALWTRP (72 FR 57104; October 5, 2007), as well as new information on the effects of the monkfish fishery on sea turtle takes (i.e., the average annual take of loggerhead sea turtles in bottom otter trawl gear for the period of 2000-2004 was estimated to be 2 for trawl gear used in the monkfish fishery (Murray 2006, 2008)), formal consultation was reinitiated on April 2, 2008 to reconsider the effects of the continued operation of the monkfish fishery on ESA-listed cetaceans and sea turtles. Consultation is currently ongoing and to date, a revised Opinion has not yet been issued.

The ***Skate fishery***, which ranges from Maine to Cape Hatteras, North Carolina, is primarily a bottom trawl (i.e., otter trawls) fishery with 65%-85% of skate landings attributed to this gear type. Gillnet gear is the next most common gear type, accounting for 30% of skate landings. The Northeast skate complex is comprised of seven skate species which are distributed along the coast of the northeast US from the tide line to depths exceeding 700m (383 fathoms). Section 7 consultation on the new Skate FMP was completed July 24, 2003, and concluded that implementation of the Skate FMP may adversely affect ESA-listed sea turtles as a result of interactions with (capture in) gillnet and trawl gear. The ITS anticipated the take of one sea turtle annually of any species of sea turtle.

In August 2007, NMFS received an estimate of loggerhead sea turtle bycatch in bottom otter trawl gear used in the skate fishery (Memo from K. Murray, Northeast Fisheries Science Center [NEFSC] to L. Lankshear, NERO, Protected Resources Division [PRD]). This information has since been published in a 2008 NEFSC Reference Document (Murray 2008). Using Vessel Trip Report (VTR) data from 2000-2004, and the average annual bycatch of sea 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 per year (Memo from K. Murray, NEFSC to L. Lankshear, NERO, PRD; Murray 2008). NMFS also received an estimate of loggerhead sea turtle bycatch in gillnet gear used in the skate fishery from the NEFSC in November 2009 (Murray 2009a). In that report, the average annual bycatch of loggerhead sea turtles in gillnet gear used in the skate fishery, based on VTR data from 2002-2006, was estimated to be 9 per year (Murray 2009a). Both of these bycatch estimates represent new information on the effects of the skate fishery on sea turtles and as such, formal consultation was reinitiated on April 2, 2008 to reconsider the effects of the skate fishery on ESA-listed sea turtles, including loggerhead, leatherback, Kemp's ridley, and green 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. After the entanglement and death of a Northern right whale in spiny dogfish gillnet gear in 1999 and the exceedance of the 1999 Opinion's incidental take level of sea turtles in 2000, NMFS 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, 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 right whales as a result of the gillnet sector of the spiny dogfish fishery. In addition, the ITS anticipated the annual take 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). Due to changes in the ALWTRP (72 FR 57104; October 5, 2007), as well as new information on the effects of the fishery on sea turtle takes (Murray 2006, 2008), formal consultation was reinitiated on April 2, 2008 to reconsider the effects of the continued operation of the spiny dogfish fishery on ESA-listed cetaceans and sea turtles. Consultation is currently ongoing and to date, a revised Opinion has not yet been issued.

The ***Summer Flounder, Scup and Black Sea Bass fisheries*** are known to interact with sea turtles. Significant measures have been developed to reduce the injury and mortality associated with takes of sea turtles in the summer flounder trawls, and trawls that meet the definition of a summer flounder trawl, by requiring the use of turtle excluder devices (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. Takes 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 (up to 5 lethal) and 2 green turtle takes (lethal or non-lethal) 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 ***Squid/Mackerel/Butterfish (MSB) fishery*** is known to take sea turtles and may occasionally interact with whales and shortnose sturgeon. Several types of gillnet gear may be used in this fishery. Other gear types that may be used in this fishery include midwater and bottom trawl gear, pelagic longline/hook-and-line/handline, pot/trap, dredge, poundnet, and bandit gear. Entanglements or entrapments of whales, sea turtles, and sturgeon have been recorded in one or more of these gear types. An Opinion issued on April 28, 1999 anticipates the take of 6 loggerheads (up to 3 lethal), 2 Kemp's ridleys (lethal or non-lethal), 2 green (lethal or non-lethal), 1 leatherback (lethal or non-lethal) and 3 shortnose sturgeon (1 lethal).

In August 2007, NMFS received an estimate of loggerhead sea turtle bycatch in bottom otter trawl gear used in the MSB fishery (Memo from K. Murray, Northeast Fisheries Science Center [NEFSC] to L. Lankshear, NERO, Protected Resources Division [PRD]). This information has since been published in a 2008 NEFSC Reference Document (Murray 2008). Using Vessel Trip Report (VTR) data from 2000-2004 and the average annual bycatch of sea turtles as described in Murray (2006), the average annual bycatch of loggerhead sea turtles in bottom otter trawl gear used in the MSB fishery was estimated to be 62 loggerhead sea turtles per year. Given that information on a listed species (Loggerhead sea turtle) may be affected in a manner or to an extent not previously considered NMFS reinitiated formal consultation on March 6, 2008. Consultation is currently ongoing and to date, a revised Opinion has not yet been issued.

Fishing Vessel Operations
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. Generally speaking, listed species or critical habitat may also be affected by fuel oil spills resulting from fishing vessel accidents. No collisions between commercial fishing vessels and listed species or adverse effects resulting from disturbance have been documented within the action area. Fishing vessels operate at relatively slow speeds, particularly when towing or hauling gear. Thus, large cetaceans and sea turtles in the path of a fishing vessel would be more likely to have time to move away before being struck. Although entanglement in fishing vessel anchor lines has been documented historically, no information is available on the prevalence of such events. Fuel oil spills could affect animals directly or indirectly through the food chain. Fuel spills involving fishing vessels are common events. However, these spills typically involve small amounts of material that are unlikely to adversely affect listed species. Larger spills may result from accidents, although these events would be rare and involve small areas. No direct adverse effects on listed species or critical habitat resulting from fishing vessel fuel spills have been documented within the action area. There is no critical habitat in the action area for this consultation. Given the current lack of information on prevalence or impacts of vessel related interactions with listed species in the action area, the effects of such activities on the environmental baseline are unknown at this time.

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; however, 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.

An unknown number of private recreational boaters frequent coastal waters; some of these are engaged in whale watching or sport fishing activities. These activities have the potential to result in lethal (through entanglement or boat strike) or non-lethal (through harassment) takes of listed species. Effects of harassment or disturbance which may be caused by such vessel activities are currently unknown; however, no conclusive detrimental effects have been demonstrated. Recent federal efforts regarding mitigating impacts of the whale watch and shipping industries on endangered whales are discussed below.

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. Impacts on sea turtles from state fisheries may be greater than those from federal activities in certain areas due to the distribution of these species. 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 (e.g., in 1998, 3 entanglements of humpback whales in state-water fisheries were documented).

Global Climate Change

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

Sea Turtles

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

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

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

Several studies have also investigated the effects of changes in sea surface temperature and air temperatures on turtle reproductive behavior. For loggerhead sea turtles, warmer sea surface temperatures in the spring have been correlated to an earlier onset of nesting (Weishampel *et al.* 2004; Hawkes *et al.* 2007), shorter internesting intervals (Hays *et al.* 2002), and a decrease in the length of the nesting season (Pike *et al.* 2006). Green sea turtles also exhibited shorter internesting intervals in response to warming water temperatures (Hays *et al.* 2002).

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

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

Whales

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

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

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

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

There are many direct and indirect effects that global climate change may have on marine mammal prey species. For example, Greene *et al.* (2003) described the potential oceanographic processes linking climate variability to the reproduction of North Atlantic right whales. Climate-driven changes in ocean circulation have had a significant impact on the plankton ecology of the Gulf of Maine, including effects on *Calanus finmarchicus*, a primary prey resource for right whales. More information is needed in order to determine the potential impacts global climate change will have on the timing and extent of population movements, abundance, recruitment, distribution and species composition of prey (Learmonth *et al.* 2006). Changes in climate patterns, ocean currents, storm frequency, rainfall, salinity, melting ice, and an increase in river inputs/runoff (nutrients and pollutants) will all directly affect the distribution, abundance and migration of prey species (Waluda *et al.* 2001; Tynan & DeMaster 1997; Learmonth *et al.* 2006). These changes will likely have several indirect effects on marine mammals, which may include changes in distribution including displacement from ideal habitats, decline in fitness of individuals, population size due to the potential loss of foraging opportunities, abundance, migration, community structure, susceptibility to disease and contaminants, and reproductive success (Macleod 2009). Global climate change may also result in changes to the range and abundance of competitors and predators which will also indirectly affect marine mammals (Learmonth *et al.* 2006). A decline in the reproductive fitness as a result of global climate change could have profound effects on the abundance and distribution of large whales in the Atlantic. However, fully understanding the effects of climate change on listed species of marine mammals will require development of conceptual and predictive models of the effects of climate change on marine mammals, which to date are still being developed and will depend greatly on the continued aquistion and maintenance of long-term data sets on marine mammal life history and responses to environmental changes. Until such time, the type and extent of effects to marine mammals as a result of global climate change are will continue to be speculative and as such, the effects of these changes on marine mammals cannot, for the most part, be accurately predicted at this time.

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 affected listed species in the action area of this consultation. These potential sources of impacts include previous dredging projects, pollution, water quality/pollution. However, the impacts from these activities are difficult to measure. Where possible, conservation actions are being implemented to monitor or study impacts from these sources.

Pollution and Water Quality

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

Marine debris (*e.g.*, discarded fishing line or lines from boats) can entangle turtles and whales causing serious injuries or mortalities to these species. Turtles commonly ingest plastic or mistake debris for food (Magnuson et al. 1990). Sources of contamination in the action area include atmospheric loading of pollutants, stormwater runoff from coastal development, groundwater discharges, industrial development, and debris and materials from launch activities occurring at WFF (i.e., spent rockets, payloads, and rocket-boosted projectiles, as well as non-hazardous expended material such as steel, aluminum, rubber, vinyl, glass, and plastics). Chemical contaminants may also have an effect on sea turtle reproduction and survival and 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. Excessive turbidity due to coastal development and/or construction sites could influence sea turtle and whale foraging ability; however, as mentioned previously, turtles and whales are not very easily affected by changes in water quality or increased suspended sediments, but if these alterations make habitat less suitable for prey species of turtles and/or whales, foraging capabilities may be hindered resulting in whales and/or sea turtles eventually leaving or avoiding these less desirable areas (Ruben and Morreale 1999). Noise pollution has primarily been raised 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 and whales (e.g., affecting when female sea turtles lay eggs and the sex ratios of sea turtle offspring; affecting whale distribution as well abundance of foraging items). 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.

As noted above, private and commercial vessels operate within the action area. Listed species may 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 also occur as a result of accidents. A prime example of this is the Deepwater Horizon oil spill that occurred on April 20, 2010. As the effects of this disaster are still ongoing, and information on the number of strandings, deaths, and recoveries of listed species are still being recorded, the effects of the oil spill on listed species will remain unknown at this time.

Conservation and Recovery Actions Reducing Threats to Listed Species

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

Reducing threats of vessel collision on listed whales

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

Northeast Implementation Team (NEIT)

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

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

The Ship Strike Committee (SSC) of the former NEIT undertook multiple projects to reduce ship collisions with North Atlantic right whales. These included production of a video entitled: *Right Whales and the Prudent Mariner* and most recently, a CD entitled: *A Prudent Mariner's Guide to Right Whale Protection*, both of which provide information to mariners on the plight of right whales and on distribution and behavior of right whales in relation to vessel traffic. Additionally, SSC has also developed a merchant mariner education module that can be used by instructors in mariner certification or licensing safety courses to educate ship's captains about the potential for ship strikes of right whales. 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 North Atlantic Right Whale identified anthropogenic disturbance as one of many factors which had some potential to impede right whale recovery (NMFS 2005a). 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 yards. 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 yards, 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 U.S., 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 U.S., 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 program is the implementation of speed restrictions for vessels transiting the US Atlantic in areas and seasons where right whales predictably occur in high concentrations. 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; June 1, 2004), and subsequently published a proposed rule on June 26, 2006 (71 FR 36299; June 26, 2006). NMFS published regulations on October 10, 2008 to implement a 10-knot speed restriction for all vessels 65 feet or longer in Seasonal Management Areas (SMAs) along the East coast of the U.S. Atlantic seaboard at certain times of the year (73 FR 60173; October 10, 2008). In view of uncertainties these restrictions will have on large whales and the burdens imposed on vessel operators, the rule will expire five years from the date of effectiveness. During the five-years the rule is in effect, NOAA will analyze data on ship-whale interactions and review the economic consequences to determine further steps regarding the rule.

Right Whale Sighting Advisory System

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

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

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

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," and more recently, the CD "A Prudent Mariner's Guide to Right Whale Protection," a placard on the MSR system, extracts from the US Coast Pilots about whale avoidance measures and seasonal right whale distribution, and a placard on applicable right whale protective regulations and recommended vessel operating measures.

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

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

Miscellaneous Activities
Through deliberations of the NEIT and its Ship Strike Committee, NMFS and the National Ocean Service (NOS) revised the whale watch guidelines for the Northeast in 1999, including the Studds-Stellwagen Bank National Marine Sanctuary (SBNMS). The whale watch guidelines provide operating measures to reduce repeated harassment of whales from close approaches of whale watch vessels. These measures include vessel speed guidelines at specific approach distances, and are therefore expected to reduce the risk of ship strike as well as harassment.

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

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

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

Reducing the Threat of Entanglement on Whales
Atlantic Large Whale Take Reduction Plan
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 that reduce the risk of serious injury to and/or mortality of large whales due to incidental entanglement in U.S. commercial fishing gear. The ALWTRP focuses on the critically endangered North Atlantic right whale, but is also intended to reduce entanglement of endangered humpback and fin whales and to benefit non-endangered minke whales. The plan is required by the Marine Mammal Protection Act (MMPA) and has been developed by NOAA's National Marine Fisheries Service (NMFS). The ALWTRP covers the U.S. Atlantic Exclusive Economic Zone (EEZ) from Maine through Florida (26°46.5'N lat.). The requirements are year-round in the Northeast, and seasonal in the Mid and South Atlantic.

The plan has been developing in collaboration with the Atlantic Large Whale Take Reduction Team (ALWTRT), which consists of fishing industry representatives, environmentalists, state and federal officials, and other interested parties. The ALWTRP is an evolving plan that changes as NMFS and the ALWTRT learn more about why whales become entangled and how fishing practices might be modified to reduce the risk of entanglement. 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 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. The first ALWTRP went into effect in 1997.

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. Despite these measures, entanglements, some of which resulted in serious injuries or mortalities, continued to occur. The ALWTRP is an evolving plan, and revisions are made to the regulations as new information and technology becomes available. Because serious injury and mortality of right, humpback and fin whales have continued to occur due to gear entanglements, new and revised regulatory measures have been issued since the original plan was developed. 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.

Gear Research and Development
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 while still allowing fishing, 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. The ALWTRT has now moved into the next phase with the focus and priority being research to reduce risk associated with vertical lines. This aspect of the ALWTRP is important, in that it incorporates the knowledge and encourages the participation of industry in the development and testing of modified and experimental gear. Currently, NMFS is developing a co-occurrence risk model that will allow us to examine the density of whale and density of vertical lines in time and space to identify those areas and times that appear to pose the greatest vertical line risk and prioritize those areas for management. The current schedule would result in a proposed rule for additional vertical line risk reduction to be published in 2013.

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

Large Whale Disentanglement Program

Entanglement of marine mammals in fishing gear and/or marine debris is a significant problem throughout the world's oceans. NMFS created and manages a 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. Along the eastern seaboard of the United States, large whale entanglement reports have been received of humpback whales and North Atlantic right whales and to a lesser extent minke whales, fin whales, sei whales and blue whales. In 1984 the Provincetown Center for Coastal Studies (PCCS), in partnership with NMFS, developed a technique for disentangling free-swimming large whales from life threatening entanglements. Over the next decade PCCS and NMFS continued working on the development of the technique to safely disentangle both anchored and free swimming large whales. In 1995 NOAA Fisheries Service issued a contract to disentangle large whales with PCCS. Based on successful disentanglement efforts by many researchers and partners NOAA Fisheries Service and Provincetown Center for Coastal Studies established the large whale disentanglement program, also referred to as the Atlantic Large Whale Disentanglement Network (ALWDN).

Memorandums of Agreement were also issued between NMFS and other Federal Government agencies to increase the resources available to respond to reports of entangled large whales anywhere along the eastern seaboard of the United States. For instance, a Memorandum of Understandings developed with the USCG ensured their participation and assistance in the disentanglement effort. Hundreds of Coast Guard and Marine Patrol workers have received training to assist in disentanglements. In addition, NMFS has also established agreements with many coastal states to collaboratively monitor and respond to entangled whales. As a result of the success of the disentanglement network, NMFS believes whales that may otherwise have succumbed to complications from entangling gear have been freed and survived. Over the past several years the disentanglement network has been involved in many successes and has assisted many whales shed gear or freed them by disentangling gear from 42 humpback and 18 right whales (PCCS 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.

Educational 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 related to protected species and to educate them regarding handling and release guidelines. NMFS intends to continue these outreach efforts in an attempt to increase the survival of protected species through education on proper release techniques.

Reducing Threats to Listed Sea Turtles
Strategy for Sea Turtle Conservation and Recovery in Relation to Atlantic Ocean and Gulf of Mexico Fisheries
The Strategy for Sea Turtle Conservation and Recovery in Relation to Atlantic and Gulf of Mexico Fisheries (Sea Turtle Strategy) is a program to reduce sea turtle bycatch by evaluating and addressing priority gear types on a comprehensive per-gear basis throughout the Atlantic and Gulf of Mexico, rather than fishery by fishery. Certain types of gear are more prone to the incidental capture of sea turtles than others, depending on the design of the gear, the way the gear is fished, and the time and area in which the gear is fished. The Strategy will address sea turtle bycatch across jurisdictional boundaries and fisheries for gear types that have the greatest impact on sea turtle populations. The major components of the strategy are: characterizing fisheries in state and federal waters of the Atlantic and the Gulf of Mexico; developing a geographical information system that depicts sea turtle distribution, bycatch, fisheries effort, regulated areas, and oceanographic information; soliciting constituent input on the Strategy framework, prioritization of gears, and management alternatives; and, developing and implementing management measures, where necessary, to reduce sea turtle bycatch.

NMFS has announced that it is considering, through the Sea Turtle Strategy, amendments to the regulatory requirements in trawl fisheries to help conserve and recover sea turtles (72 FR 7382; 15 February 2007). On May 8, 2009, NMFS announced its intent to prepare an Environmental Impact Statement to assess potential impacts resulting from the proposed implementation of new sea turtle regulations in the Atlantic and Gulf of Mexico trawl fisheries (74 FR 21627).

Turtle Excluder Devices (TEDs)
TEDs are devices comprised of a grid of bars with an escape opening, usually covered by a webbing flap that allows sea turtles to escape from trawl nets. As TEDs have proven an effective method to minimize adverse effects related to sea turtle bycatch in the shrimp fishery, and where applicable, the summer flounder fishery, NMFS sea turtle conservation regulations (50 CFR 223.206(d)) require most shrimp and summer flounder trawlers operating in the Southeast United States (Atlantic area and Gulf area) to have a NMFS approved TED installed in each net that is rigged for fishing.

As noted on page 54, the summer flounder fishery influences the environmental baseline of this Opinion. Since 1992, all vessels using bottom trawls to fish for summer flounder within an area off Virginia and North Carolina have been required to use NMFS approved TEDs in their nets (57 FR 57358, December 4, 1992; 50 CFR 223.206(d)(2)(iii)). This area is considered the Summer Flounder Fishery-Sea Turtle Protection Area and is bounded on the north by a line extending off from Cape Charles, Virginia, on the south by a line extending from the South Carolina-North Carolina boundary, and seaward of the Exclusive Economic Zone boundary. Vessels are exempted from the TED requirement north of Oregon Inlet, North Carolina, from January 15-March 15 when take of sea turtles by the fishery is not expected.

Recently, based on documented takes of sea turtles from 1994-2004 in the summer flounder and other Mid-Atlantic bottom otter trawl fisheries in areas and times when TEDS are not required (Murray 2006), NMFS is considering moving the northern boundary of the Summer Flounder Fishery-Sea Turtle Protection Area farther north to reduce sea turtle bycatch. Additionally, NMFS is considering expanding the TED requirements to other trawl fisheries in the Mid-Atlantic which currently do not have any TED requirements within this geographic area.

NMFS is also considering an option to modify TED regulations in the summer flounder trawl fishery to require a larger escape opening. Currently, the escape opening requirements for the summer flounder TEDs are ≤35 inches (≤89 cm) in width and ≤12 inches (≤30 cm) in height (50 CFR 223.207(b)(1)). The proposed larger openings would have a 142-inch circumference with a corresponding 71-inch straight line stretched measurement. This larger escape opening is expected to decrease escape times for all turtles and allow for the release of leatherback and all large loggerhead and green sea turtles. The larger opening would be consistent with sea turtle conservation measures currently in place in the shrimp trawl fishery (69 FR 8456, February 2003).

Large-Mesh Gillnet Restrictions

In December 2002, NMFS issued regulations for the use of gillnets with larger than 8 inch stretched mesh in federal waters off of North Carolina and Virginia (67 FR 71895, Dec. 3, 2002). Gillnets with larger than 8 inch stretched mesh were not allowed in federal waters (3-200 nautical miles) north of the North Carolina/South Carolina border at the coast to Oregon Inlet at all times; north of Oregon Inlet to Currituck Beach Light, NC from March 16 through January 14; north of Currituck Beach Light, NC to Wachapreague Inlet, VA from April 1 through January 14; and, north of Wachapreague Inlet, VA to Chincoteague, VA from April 16 through January 14. On April 26, 2006, NMFS published a final rule (71 FR 24776) that included modifications to the large-mesh gillnet restrictions. Specifically, the new final rule revises the gillnet restrictions to apply to stretched mesh that is 7 inches or greater and extends the prohibition on the use of such gear to North Carolina and Virginia state waters. Federal and state waters north of Chincoteague, VA remain unaffected by the large-mesh gillnet restrictions. These measures are in addition to the Harbor Porpoise Take Reduction Plan measures that prohibit the use of large-mesh gillnets in southern mid-Atlantic waters (territorial and federal waters from Delaware through North Carolina out to 72° 30'W longitude) from February 15 – March 15, annually.

Pelagic Longline Restrictions

In July 2004, NMFS issued new sea turtle bycatch and bycatch mortality mitigation measures for all Atlantic vessels that have pelagic longline gear onboard and that have been issued, or are required to have, Federal HMS limited access permits, consistent with the requirements of the ESA, the MSFCMA, and other domestic laws. These measures include mandatory circle hook and bait requirements, and mandatory possession and use of sea turtle release equipment to reduce bycatch mortality. This final rule also allows vessels with pelagic longline gear onboard that have been issued, or are required to have, Federal HMS limited access permits to fish in the Northeast Distant Closed Area, if they possess and/or use certain circle hooks and baits, sea turtle release equipment, and comply with specified sea turtle handling and release protocols (69 FR 40733, July 6, 2004).

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

Sea Turtle Disentanglement Network
NMFS Northeast Region established the Northeast Atlantic Coast Sea Turtle Disentanglement Network (STDN) in 2002. This program was established in response to the high number of leatherback sea turtles found entangled in vertical lines or fixed 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.

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

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

Education and Outreach Activities

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

Summary and synthesis of the Status of Species and Environmental Baseline

The Status of the Species and Environmental Baseline taken together, along with the Cumlative Effects, establish a "baseline" to which the effects of the proposed action are added in order to determine whether the action-NASA's proposed seawall extension, dredging of offshore borrow sites for the purposes of beach renourishment along the Wallops Island Shoreline, and renourishment cycles over the 50 year life of the SRIPP-is likely to jeopardize the continued existence of listed species. This section synthesizes the Status of the Species and the Environmental Baseline sections as best as possible given that some information on sea turtles and whales is quantified, yet much remains qualitative or unknown.

North Atlantic right whales, humpback whales, fin whales, 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 numbers to be increasing for North Atlantic right whales and humpback whales. 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 and Environmental Baseline Sections taken together and are, for the purposes of this Opinion, assumed to continue throughout the 50-year life of the proposed project. Additional information is provided below.

North Atlantic Right Whales. North Atlantic right whales are listed as a single species classified as endangered under the ESA. The International Whaling Commission (IWC) recognizes two right whale populations in the North Atlantic: a western and eastern population (IWC 1986). However, sighting surveys from the eastern Atlantic Ocean suggest that right whales present in this region are rare (Best *et al.* 2001) and it is unclear whether a viable population in the eastern North Atlantic still exists (Brown 1986; NMFS 2005a). In the western Atlantic, North Atlantic right whales generally occur from the Southeast U.S. (waters off of Georgia, Florida) to Canada (*e.g.*, Bay of Fundy and Scotian Shelf) (Kenney 2002; Waring *et al.* 2009). Research results suggest the existence of six major habitats or congregation areas for western North Atlantic right whales. Results from telemetry studies and photo-id studies have shown extensive right whale movements: (a) over the continental shelf during the summer foraging period (Mate *et al.*1992; Mate *et al.* 1997; Baumgartner and Mate 2005), (b) between calving/nursery areas and foraging areas in the winter (Brown and Marx 2000; Waring *et al.* 2009), and (c) into deep water off of the continental shelf (Mate *et al.* 1997).

As of August 1, 2008, there were 368 individually identified right whales in the photo-identification catalog that were presumed to be alive (Hamilton *et al.* 2008). An additional 135 were presumed to be dead as they had not been sighted in the past six years (Hamilton *et al.* 2008). Examination of the minimum number of right whales alive as calculated from the sightings database indicate a significant increase in the number of catalogued whales (Waring *et al.* 2009). Based on counts of animals alive from the sightings database as of 10 October 2008, for the years 1990-2004, the mean growth rate for the period was 1.9% (Waring *et al.* 2009). However, there was significant variation in the annual growth rate due to apparent losses exceeding gains during 1998-1999 and the number of photo-identified and catalogued female North Atlantic right whales numbers less than 200 whales (Waring *et al.* 2007). The current estimate of breeding females is 97 (Schick *et al.* 2009).

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

In light of the above, for purposes of this Opinion, NMFS considers the numbers for North Atlantic right whales to be increasing at a low rate. Although the right whale population is believed to be increasing, caution is exercised in considering the overall effect to the species given the many on-going negative impacts to the species across all areas of its range and to all age classes, and information to support that there are fewer than 200 female right whales total (of all age classes) in the population. New measures recently implemented into the ALWTRP and ship strike reduction program are expected to reduce the risk of anthropogenic serious injury and mortality to right whales. The programs are evolving plans and will continue to undergo changes based on available information to reduce the serious injury and mortality risk to large whales. For the purposes of this Opinion, the increase of North Atlantic right whales will be assumed to continue throughout the 50-year life of the action.

Humpback Whales. Humpback whales are listed as a single species classified as "endangered" under the ESA. Humpback whales range widely across the North Pacific during the summer months (Johnson and Wolman 1984; Perry *et al.* 1999). Although the IWC only considered one stock (Donovan 1991) there is evidence to indicate multiple populations migrating between their respective summer/fall feeding areas to winter/spring calving and mating areas within the North Pacific Basin (Anglis and Outlaw 2007; Carretta *et al.* 2007). Recent research efforts via the Structure of Populations, Levels of Abundance, and Status of Humpback Whales (SPLASH) Project estimate the abundance of humpback whales to be just under 20,000 whales for the entire North Pacific, a number which doubles previous population predictions obtained for 1991-1993 in a previous study (Calambokidis *et al.* 2008). There are indications that some stocks of North Pacific humpback whales increased in abundance between the 1980's -1990's (Anglis and Outlaw 2007; Carretta *et al.* 2009). 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). Likewise, 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). Although they were given protection by the IWC in 1963, Soviet whaling data made available in the 1990's revealed that southern hemisphere humpbacks continued to be hunted through 1980 (Zemsky *et al.* 1995; IWC 1995; Perry *et al.* 1999).

Photographic mark-recapture analyses from the Years of the North Atlantic Humpback (YONAH) project gave an ocean-basin-wide estimate of 11,570 animals during 1992/1993 and an additional genotype-based analysis yielded a similar but less precise estimate of 10,400 whales (95% c.i. = 8,000 - 13,600) (Waring *et al.* 2009). 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). Previously, the North Atlantic humpback whale population was treated as a single stock for management purposes, however due to the strong fidelity to the region displayed by many whales, the Gulf of Maine stock was reclassified as a separate feeding stock (Waring *et al.* 2009). The best, recent estimate for the Gulf of Maine stock is 847 whales, derived from the 2006 aerial survey (Waring *et al.* 2009). Population modeling estimates the growth rate of the Gulf of Maine stock to be at 6.5% (Barlow and Clapham 1997). Current productivity rates for the North Atlantic population overall are unknown, although Stevick *et al.* (2003) calculated an average population growth rate of 3.1% for the period 1979-1993 (Waring *et al.* 2009).

As is the case with other large whales, the major known sources of anthropogenic mortality and injury of humpback whales occur from fishing gear entanglements and ship strikes. There were 76 confirmed entanglement events and 11 confirmed ship strike events for humpback whales in the Atlantic between 2003-2007, resulting in a total of 12 confirmed mortalities and 10 serious injury determinations (Glass *et al.* 2009). These numbers are expected to be a minimum account of what actually occurred given the range and distribution of humpbacks in the Atlantic. In addition to their potential for being negatively affected by other human related effects such as global climate change and contaminants, humpbacks may be susceptible to consumption of lethal levels of toxic dinoflagellates that can become concentrated in humpback prey such as mackerel. In addition, humpback prey in the Atlantic includes fish species targeted in commercial fishing operations (*i.e.*, herring and mackerel). There is no evidence as yet that current levels of fishing for these fish species has an effect on humpback survival. However, changes in humpback distribution in the Gulf of Maine have been found to be associated with changes in herring, mackerel, and sand lance abundance associated with local fishing pressures (Stevick *et al.* 2003, Waring *et al.* 2009).

In light of the above, for purposes of this Opinion, NMFS considers the numbers for humpback whales as a species to be increasing. However, NMFS also recognizes that there are many on-going negative impacts to the species across all areas of its range and to all age classes. Therefore, caution should also be exercised in considering the overall effect to the species given the available information and its classification as an "endangered" species under the ESA. For the purposes of this Opinion, the increase of humpback whales will be assumed to continue throughout the 50-year life of the action.

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

NMFS recognizes fin whales off the eastern United States, Nova Scotia and the southeastern coast of Newfoundland as a single stock in the Atlantic for the purposes of managing this species under the MMPA (Waring *et al.* 2009). Various estimates have been provided to describe the current status of fin whales in western North Atlantic waters. One method used the catch history and trends in Catch Per Unit Effort to obtain an estimate of 3,590 to 6,300 fin whales for the entire western North Atlantic (Perry *et al.* 1999). Hain *et al.* (1992) estimated that about 5,000 fin whales inhabit the northeastern United States continental shelf waters. Previous abundance estimates of fin whales in the western North Atlantic were 2,200 (Palka 1995), 2,814 (Palka 2000), 2,933 (Palka 2006), and 1,925 (Palka 2006) in 1995, 1999, 2002, and 2004 respectively. The 2009 Stock Assessment Report (SAR) gives a best estimate of abundance for the western North Atlantic stock of fin whales as 2,269 (C.V. = 0.37), derived from an aerial survey in 2006 (Waring *et al.* 2009). This estimate is considered extremely conservative in view of the incomplete coverage of the known habitat of the stock and the uncertainties regarding population structure and whale movements between surveyed and unsurveyed areas (Waring *et al.* 2009). There are insufficient data to determine population trends for this species. Current and maximum net productivity rates are unknown for this stock (Waring *et al.* 2009).

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

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).

---

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

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 above, 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 these 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 2009). Nevertheless, nest count data are a valuable source of information for each loggerhead nesting group and for loggerheads as a species since the number of nests laid 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 is 5,151 nests laid per year (NMFS and USFWS 2007a), which is less than 1/10th 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, 75 FR 12597, March 16, 2010).

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 2007d).

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 2007d).

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 2007d).

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 2007d); however, declines in nesting have been noted for beaches in the western Caribbean (NMFS and USFWS 2007d). The largest leatherback rookery in the western Atlantic remains along the northern coast of South America in French Guiana and Suriname. More than half the present world leatherback population is estimated to be nesting on the beaches in and close to the Marowijne River Estuary in Suriname and French Guiana (Hilterman and Goverse 2004). The long-term trend for the Suriname and French Guiana nesting group seems to show an increase (Hilterman and Goverse 2004). In 2001, the number of nests for Suriname and French Guiana combined was 60,000, one of the highest numbers observed for this region in 35 years (Hilterman and Goverse 2004). Studies by Girondot *et al.* (2007) also suggest that the trend for the Suriname -French Guiana nesting population over the last 36 years is stable or slightly increasing.

Increased nesting by leatherbacks in the Atlantic is not expected to affect leatherback abundance in the Pacific where the abundance of leatherback turtles on nesting beaches has declined dramatically over the past 10 to 20 years (NMFS and USFWS 2007d). 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.

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 2007b). 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 2007b). 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 2007b). 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 2007b). 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 2009). 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 2007b).

The most recent review of the Kemp's ridley as a species suggests that it is in the early stages of recovery (NMFS and USFWS 2007b). 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 numbers for Kemp's ridley sea turtles to be stable. This determination that the numbers 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 2007b), the many on-going negative impacts to the species, and given that the majority of nesting for the species occurs in one area. For the purposes of this Opinion, the number of Kemp's ridleys will be assumed to remain stable throughout the 50-year life of the action.

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 cost 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 1991b; Seminoff 2004; NMFS and USFWS 2007c).

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 2007c). 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 2007c). Historically, however, greater than 20,000 females per year are believed to have nested in Michoacan, alone (Cliffton *et at.* 1982; NMFS and USFWS 2007c). 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 2007c). 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 2007c). The greatest abundance of green sea turtle nesting in the western Atlantic occurs on beaches in Tortuguero, Costa Rica (NMFS and USFWS 2007c). 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 2007c). 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 2007c); however, nesting data for this area has not been published since the 1980's and updated nest numbers are needed (NMFS and USFWS 2007c).

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.

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). This Opinion examines the likely effects (direct and indirect) of the proposed action on whales and sea turtles in the action area and their habitat within the context of the species current status, the environmental baseline and cumulative effects. As explained in the Description of the Action, the proposed action under consideration in this Opinion includes the extension and construction of a seawall during Year One of the SRIPP; the initial dredging cycle needed to renourish the 3.7 mile stretch of shoreline/beach along the Goddard Space Flight Center's WFF, which will be conducted within the second and third year of the SRIPP; the subsequent nine renourishment cycles required to maintain beach nourishment, which are expected to occur every 5 years; and, the transport of material to and from the borrow areas throughout the 50 year life of the SRIPP.

Effects of Seawall Construction and Extension

The construction and extension of the seawall will occur on the beach parallel to the shoreline in the approximate location of the geotextile tubes. The new seawall will be constructed landward of the existing shoreline and will be comprised of 5-7 ton rock that will placed on the beach, with the top of the seawall approximately 14-feet above the normal high tide water level. As this portion of the project will occur on land where listed species under NMFS jurisdiction will not be present, no direct or indirect effects are expected to be incurred on sea turtles or whales during this phase of the SRIPP.

Effects of Dredging Operations

As explained in the Description of the Action section above, over the 50 year life of the SRIPP, a hopper dredge will be used for both initial and renourishment cycles of dredging. Below, the effects of hopper dredging on threatened and endangered species will be considered. Effects of the proposed dredging include (1) entrainment and impingement; (2) alteration of sea turtle prey and foraging behavior due to dredging; (3) suspended sediment associated with dredging operations; (4) underwater noise generated during dredging operations; and (5) the potential for interactions between project vessels and individual whales or sea turtles.

As noted above, sea turtles are likely to occur in the action area from April-November of any year. The primary concern for loggerhead, Kemp's ridley, and green sea turtles is entrainment and the potential for effects to foraging, while the primary concern for leatherbacks is vessel collision. Right whales are likely to be present from November-May; humpbacks from September-April; and fin whales from October-January; however, individual transient right whales could be present in the action area outside of these time frame as this area is used by whales migrating between calving/mating grounds and foraging grounds. The primary concern for listed species of whales is the potential for vessel collisions.

Alteration of foraging habitat

As discussed above, listed species of whales may be present within the action area year round as this area is used by whales migrating between calving/mating grounds and forgaing grounds. Listed species of whales forage upon pelagic prey items (e.g., krill, copepods, sand lance) and as such, dredging and its impacts on the benthic environment will not have any direct or indirect effects on whale prey/foraging items. As such, the remainder of this section will discuss the effects of dredging and the alteration of sea turtle foraging habitat.

As outlined above, sea turtles are likely to occur in the action area from April through November 30 each year with the largest numbers present from June through October of any year (Stetzar 2002). 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. Sea turtles are most likely to occur in the action area between April and November when water temperatures are above 11°C. Sea turtles have been documented in the action area by the CETAP aerial and boat surveys as well as by surveys conducted by NMFS Northeast Science Center and fisheries observers. Additionally, satellite tracked sea turtles have been documented in the action area (seaturtle.org tracking database). The majority of sea turtle observations have been of loggerhead sea turtles, although all four species of sea turtles have been recorded in the area.

As sea turtles are likely to be feeding on or near the bottom of the water column during the warmer months, to some extent, water depth also dictates the number of sea turtles occurring in a particular area. Water depths in and around the borrow sites range from approximately 25-50 feet. 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 feet (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). The areas to be dredged and the depths preferred by sea turtles do overlap, suggesting that if suitable foraging items were present, loggerheads and Kemp's ridleys may be foraging in the offshore shoals where dredging will occur. As there are no SAV beds in any of the borrow areas where dredging will occur, green sea turtles are not likely to use the areas to be dredged for foraging[8].

The offshore borrow sites are not known to be an area where sea turtles concentrate to forage and develop. Instead, the action area is used primarily as a coastal corridor through which sea turtles migrate; however, based on surveys conducted at the borrow sites, potential sea turtle foraging items appear to be present, including jellyfish, comb jellies, crabs (portly spider (*Libinia emarginata*) and Atlantic rock crabs (*Cancer irroratus*)), moon shell, and whelks. Since dredging involves removing the bottom material down to a specific depth, the benthic environment will be impacted by dredging operations as the proposed dredging is likely to entrain and kill some of these forage items. As noted above, no seagrass beds occur in the areas to be dredged.

Of the listed species found in the action area, loggerhead and Kemp's ridley sea turtles are the most

8 According to the 2008 SAV online mapper prepared by the Virginia Institute of Marine Science (VIMS), the nearest mapped SAV bed to the SRIPP project area is in New Virginia Cove, approximately 11 km (7 miles) from the northern most point of the proposed beach fill on Wallops Island shoreline.

likely to utilize these areas for feeding, foraging mainly on benthic species, such as crabs and mollusks (Morreale and Standora 1992; Bjorndal 1997). As no seagrass beds exist at the borrow areas, green sea turtles will not use the borrow sites as foraging areas and as such, dredging activities are not likely to disrupt normal feeding behaviors of green sea turtles. Additionally, jellyfish, the primary foraging item of leatherback sea turtles, are not likely to be affected by dredging activities as jellyfish occur within the upper portions of the water column and away from the sediment surface where dredging will occur. As jellyfish are not likely to be entrained during dredging, there is not likely to be any reduction in available forage for leatherback sea turtles due to the dredging operations. However, as suitable loggerhead and Kemp's ridley sea turtle foraging items occur on the benthos of the borrow areas and depths within the borrow areas are suitable for use by these species of sea turtles, some loggerhead and Kemp's ridley sea turtle foraging likely occurs at these sites and therefore, may be affected by dredging activities within this portion of the action area.

Dredging can cause indirect effects on sea turtles by reducing prey species through the alteration of the existing biotic assemblages. Some of the prey species targeted by turtles, including species of crabs, are mobile; therefore, some individuals are likely to avoid the dredge. While some offshore areas may be more desirable to certain turtles due to prey availability, there is no information to indicate that the borrow areas proposed for dredging have more abundant turtle prey or better foraging habitat than other surrounding areas. The assumption can be made that sea turtles are not likely to be more attracted to the borrow areas than to other foraging areas and should be able to find sufficient prey in alternate areas. Depending on the species, recolonization of a dredged area can begin in as short as a month (Guerra-Garcia and Garcia-Gomez 2006). The dredged area is expected to be completely recolonized by benthic organisms within approximately 12 months. These conclusions are supported by a benthic habitat study which examined an area of Thimble Shoals following dredging, which concluded that recolonization of the dredged area was rapid, with macrobenthic organisms abundant on the first sampling date following cessation of dredging activities (less than a month later). As such, recolonization of the borrow areas should be complete within 3 years after the initial dredge cycle. It also should be noted that only a small percentage of the available sand at each borrow area (e.g., if Unnamed Shoal A is used for the initial dredge cycle and all renourishment cycles, SRIPP will remove approximately 33% of the total volume of available sand on Unnamed Shoal A (40 million yd^3) through 2050) is proposed to be removed and suitable foraging items should continue to be available at each borrow area at all times.

In total, there is nearly 2,560,000 acres of seafloor offshore of Maryland and Virginia. Cumulatively, the reasonably foreseeable, future dredging projects offshore will affect less than 0.4% of the nearshore seafloor in the region (NASA Draft PEIS 2010). NMFS anticipates that while the dredging activities may temporarily disrupt normal feeding behaviors for sea turtles by causing them to move to alternate areas, the action is not likely to remove critical amounts of prey resources from the action area and any disruption to normal foraging is likely to be insignificant. In addition, the dredging activities are not likely to alter the habitat in any way that prevents sea turtles or whales from using the action area as a migratory pathway to other near-by areas that may be more suitable for foraging.

Entrainment

As noted above, sea turtles are likely to be feeding on or near the bottom of the water column during the warmer months, with loggerhead and Kemp's ridley sea turtles being the most common species in these waters. Although not expected to be as numerous as loggerheads and Kemp's ridleys, green and leatherback sea turtles are also likely to occur in the action area; however, leatherbacks are more subject to vessel collisions than dredge entrainment due to their size and behavioral characteristics. Similarly, humpback, fin, and right whales are not vulnerable to entrainment in dredge gear due to their large size. Therefore, this section of the Opinion will only consider the effects of entrainment on loggerhead, Kemp's ridley and green sea turtles.

The National Research Council's Committee on Sea Turtle Conservation (1990) estimated that dredging mortalities, along with boat strikes, were second only to fishery interactions as a source of probable mortality of sea turtles. Experience has shown that injuries sustained by sea turtles entrained in hopper dredge dragheads are usually fatal. Mortality in hopper dredging operations most often occurs when turtles are entrained in the dredge draghead, pumped through the intake pipe and then killed as they cycle through the centrifugal pump and into the hopper. Because entrainment is believed to occur primarily as the dredge is being placed or removed from the bottom, creating suction in the draghead, or when the dredge is operating on an uneven or rocky substrate causing the draghead to rise off the bottom, it is likely that only those species feeding or resting on or near the bottom would be vulnerable to entrainment. Recent information from the USACE suggests that the risk of entrainment is highest when the bottom terrain is uneven or when the dredge is conducting "clean up" operations at the end of a dredge cycle when the bottom is trenched and the dredge is working to level out the bottom. In these instances, it is difficult for the dredge operator to keep the draghead buried in the sand and sea turtles near the bottom may be more vulnerable to entrainment. However, it is possible to operate the dredge in a manner that minimizes potential for such incidents as noted in the Monitoring Specifications for Hopper Dredges (Appendix B).

Sea turtles have been killed in hopper dredge operations along the East and Gulf coasts of the US. Documented turtle mortalities during dredging operations in the USACE South Atlantic Division (SAD; i.e., south of the Virginia/North Carolina border) are more common than in the USACE North Atlantic Division (NAD; Virginia-Maine) probably due to the greater abundance of turtles in these waters and the greater frequency of hopper dredge operations. For example, in the USACE SAD, over 467 sea turtles have been entrained in hopper dredges since 1980 and in the Gulf Region over 186 sea turtles have been killed since 1995. Records of sea turtle entrainment in the USACE NAD began in 1994. Since this time, at least 72 sea turtles deaths (see Table 1) related to hopper dredge activities have been recorded in waters north of the North Carolina/Virginia border (USACE Sea Turtle Database[9]).

9 The USACE Sea Turtle Data Warehouse is maintained by the USACE's Environmental Laboratory and contains information on USACE dredging projects conducted since 1980 with a focus on information on interactions with sea turtles.

Table 1. Sea Turtle Takes in USACE NAD Dredging Operations

Project Location	**Year of Operation**	**Cubic Yardage Removed**	**Observed Takes**
Thimble Shoal Channel	2009	NA	3 Loggerheads
York Spit	2007	608,000	1 Kemp's Ridley
Cape Henry	2006	NA	3 Loggerheads
Thimble Shoal Channel	2006	300,000	1 loggerhead
Delaware Bay	2005	50,000	2 Loggerheads
Thimble Shoal Channel	2003	1,828,312	7 Loggerheads 1 Kemp's ridley 1 unknown
Cape Henry	2002	1,407,814	6 Loggerheads 1 Kemp's ridley 1 green
VA Beach Hurricane Protection Project (Cape Henry)	2002	NA	1 Loggerhead
York Spit Channel	2002	911,406	8 Loggerheads 1 Kemp's ridley
Cape Henry	2001	1,641,140	2 loggerheads 1 Kemp's ridley
VA Beach Hurricane Protection Project (Thimble Shoals)	2001	NA	5 loggerheads 1 unknown
Thimble Shoal Channel	2000	831,761	2 loggerheads 1 unknown
York River Entrance Channel	1998	672,536	6 loggerheads
Atlantic Coast of NJ	1997	1,000,000	1 Loggerhead
Thimble Shoal Channel	1996	529,301	1 loggerhead
Delaware Bay	1995	218,151	1 Loggerhead
Cape Henry	1994	552,671	4 loggerheads 1 unknown
York Spit Channel	1994	61,299	4 loggerheads
Delaware Bay	1994	NA	1 Loggerhead
Cape May NJ	1993	NA	1 Loggerhead
Off Ocean City MD	1992	1,592,262	3 Loggerheads
			TOTAL = 72 Turtles

Official records of sea turtle mortality in dredging activities in the USACE NAD begin in the early 1990s. Before this time, endangered species observers were not required on board hopper dredges and dredge baskets were not inspected for sea turtles or sea turtle parts. The majority of sea turtle takes in the NAD have occurred in the Norfolk district. This is largely a function of the large number of loggerhead and Kemp's ridley sea turtles that occur in the Chesapeake Bay each summer and the intense dredging operations that are conducted to maintain the Chesapeake Bay entrance channels and for beach nourishment projects at Virginia Beach. Since 1992, the take of 10 sea turtles (all loggerheads) has been recorded during hopper dredge operations in the Philadelphia, Baltimore and New York Districts. Hopper dredging is relatively rare in New England waters where sea turtles are known to occur, with most hopper dredge operations being completed by the specialized Government owned dredge Currituck which operates at low suction and has been demonstrated to have a very low likelihood of entraining or impinging sea turtles. To date, no hopper dredge operations (other than the Currituck) have occurred in the New England District in areas or at times when sea turtles are likely to be present.

Of the 10 sea turtle mortalities attributed to hopper dredge operations outside of the Norfolk District, 6 have occurred in the Philadelphia District, 3 in the Baltimore District and 1 in the New York District. As explained in the USACE BA, the Philadelphia District Endangered Species Monitoring Program began in 1992. For four hopper dredging projects conducted in 1992 -1994, observers were present to provide approximately 25% coverage (6 hours on, 6 hours off on a biweekly basis). No sea turtles were observed during the 8/25-10/13/92 dredging at Bethany Bay, DE or the 10/24-11114/92 dredging at Cape May, NJ. The dredge McFarland worked in the Delaware River entrance channel from 6/23 -7/23/93 with no sea turtle observations. The dredge continued at Cape May from 7/24-8/2 and 8/10-8/19/93. Fresh sea turtle parts were observed in the inflow screening on two separate dates three days apart at Cape May. Additionally, three live sea turtles were observed from the bridge during dredging operations. Dredging with the McFarland continued in the Delaware Bay entrance channel from 6/13-8/1 0/94. During this dredging cycle, relocation trawling was conducted in an attempt to capture sea turtles in the area where dredging was occurring and move them away from the dredge. Eight loggerhead sea turtles were captured alive with the trawl and relocated away from the dredging site. One loggerhead was taken by the dredge on June 22, 1994. Since this event in 1994, dredge observer coverage was increased to 50%. On November 3, 1995, one loggerhead was taken by a hopper dredge operating in the entrance channel. In 1999, dredging occurred in July at the entrance channel. Three decomposed loggerheads were observed at Brandywine Shoal and Reedy Island by the dredge observer while the dredge was transiting to the disposal site. There is no evidence to suggest that these turtles were killed during dredging operations. On July 27, 2005 fresh loggerhead parts were observed in two different dredge loads while dredging was being conducted in the Miah Maul Range of the channel in Delaware Bay. It is currently unknown whether these were parts of the same turtle or two different turtles.

In addition to sea turtles observed as entrained, one loggerhead was killed during dredging operations off Sea Girt, New Jersey during an USACE New York District beach renourishment project on August 23, 1997. This turtle was closed up in the hinge between the draghead and the dragarm as the dragarm lifted off the bottom.

Most of the available information on the effects of hopper dredging on sea turtles in the USACE NAD has come from operations in Virginia waters, particularly in the entrance channels to the Chesapeake Bay. Since 1994, 63 sea turtles mortalities have been observed on hopper dredges operating in Virginia waters. In Thimble Shoals Channel, maintenance dredging took several turtles during the warmer months of 1996 (1 loggerhead) and 2000 (2 loggerheads, 1 unknown). A total of 6 turtles (5 loggerhead, 1 unknown) were taken in association with dredging in Thimble Shoal Channel during 2001, and one turtle was taken in May 2002 (1 loggerhead). Nine sea turtle takes were reported during dredging conducted in September and October 2003 (7 loggerhead, 1 Kemp's ridley, 1 unknown) and one sea turtle take (1 loggerhead) was reported in the summer of 2006. Most recently, Thimble Shoals Channel was dredged in the spring of 2009, with 3 loggerheads killed during this operation.

Incidental takes have occurred in the Cape Henry and York Spit Channels as well. In May and June 1994, parts of at least five sea turtles were observed (at least 4 loggerheads and 1 unknown) during dredging at Cape Henry. In September and October 2001, 3 turtle takes were observed (1 Kemp's ridley and 2 loggerheads). Eight turtle takes were observed during dredging at Cape Henry in April, May, June and October 2002 (1 green, 1 Kemp's and 6 loggerhead). Three loggerheads were killed during the dredging of the Cape Henry Channel in the summer of 2006. At York Spit, four loggerheads were taken in dredging operations occurring during one week in June 1994. Nine turtles were taken in dredging operations at York Spit in 2002 (8 loggerheads, 1 Kemp's ridley). York Spit was last dredged in the summer of 2007, with the take of 1 Kemp's ridley reported. In 1998, dredging in the York River Entrance Channel took 5 loggerheads. No turtles had been observed in dredging operations in Rappahannock Shoal Channels or the Sandbridge Shoals borrow area.

It should be noted that the observed takes may not be representative of all the turtles killed during dredge operations. Typically, endangered species observers are required to observe a total of 50% of the dredge activity (i.e., 6 hours on watch, 6 hours off watch). As such, if the observer was off watch or the cage was emptied and not inspected or the dredge company either did not report or was unable to identify the turtle incident, there is the possibility that a turtle could be taken by the dredge and go unnoticed. Additionally, in older Opinions (i.e., prior to 1995), NMFS frequently only required 25% observer coverage and monitoring of the overflows which has since been determined to not be as effective as monitoring of the intakes. These conditions may have led to sea turtle takes going undetected.

NMFS raised this issue to the USACE during the 2002 season, after several turtles were taken in the Cape Henry and York Spit Channels, and expressed the need for 100% observer coverage. On September 30, 2002, the USACE informed the dredge contractor that when the observer was not present, the cage should not be opened unless it is clogged. This modification was to ensure that any sea turtles that were taken and on the intake screen (or in the cage area) would remain there until the observer evaluated the load. The USACE's letter further stated "Crew members will only go into the cage and remove wood, rocks, and man-made debris; any aquatic biological material is left in the cage for the observer to document and clear out when they return on duty. In addition, the observer is the only one allowed to clean off the overflow screen. This practice provides us with

100% observation coverage and shall continue." Theoretically, all sea turtle parts were observed under this scheme, but the frequency of clogging in the cage is unknown at this time. Obviously, the most effective way to ensure that 100% observer coverage is attained is to have a NMFS-approved endangered species observer monitoring all loads at all times. This level of observer coverage would document all turtle interactions and better quantify the impact of dredging on turtle populations. More recently issued Opinions have required 100% observer coverage which increases the likelihood of takes being detected and reported.

Sea turtles have been found resting in deeper waters, which could increase the likelihood of interactions from dredging activities. In 1981, observers documented the take of 71 loggerheads by a hopper dredge at the Port Canaveral Ship Channel, Florida (Slay and Richardson 1988). This channel is a deep, low productivity environment in the Southeast Atlantic where sea turtles are known to rest on the bottom, making them extremely vulnerable to entrainment. The large number of turtle mortalities at the Port Canaveral Ship Channel in the early 1980s resulted in part from turtles being buried in the soft bottom mud, a behavior known as brumation. Since 1981, 77 loggerhead sea turtles have been taken by hopper dredge operations in the Port Canaveral Ship Channel, Florida. 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. While sea turtle brumation has not been documented in mid-Atlantic or New England waters, it is possible that this phenomenon occurs in these waters.

It is likely that not all sea turtles killed by dredges are observed onboard the hopper dredge. Several sea turtles stranded on Virginia shores with crushing type injuries from May 25 to October 15, 2002. The Virginia Marine Science Museum (VMSM) found 10 loggerheads, 2 Kemp's ridleys, and 1 leatherback exhibiting injuries and structural damage consistent with what they have seen in animals that were known dredge takes. While it cannot be conclusively determined that these strandings were the result of dredge interactions, the link is possible given the location of the strandings (e.g., in the southern Chesapeake Bay near ongoing dredging activity), the time of the documented strandings in relation to dredge operations, the lack of other ongoing activities which may have caused such damage, and the nature of the injuries (e.g., crushed or shattered carapaces and/or flipper bones, black mud in mouth). Additionally, in 1992, three dead sea turtles were found on an Ocean City, Maryland beach while dredging operations were ongoing at a borrow area located 3 miles offshore. Necropsy results indicate that the deaths of all three turtles were dredge related. It is unknown if turtles observed on the beach with these types of injuries were crushed by the dredge and subsequently stranded on shore or whether they were entrained in the dredge, entered the hopper and then were discharged onto the beach with the dredge spoils.

A dredge could crush an animal as it was setting the draghead on the bottom, or if the draghead was lifting on and off the bottom due to uneven terrain, but the actual cause of these crushing injuries cannot be determined at this time. Further analyses need to be conducted to better understand the link between crushed strandings and dredging activities, and if those strandings need to be factored into an incidental take level. More research also needs to be conducted to determine if sea turtles are in fact undergoing brumation in mid-Atlantic or New England waters. Regardless, it is possible that dredges are taking animals that are not observed on the dredge which may result in strandings on nearby beaches.

Due to the nature of interactions between listed species and dredge operations, it is difficult to predict the number of interactions that are likely to occur from a particular dredging operation. Projects that occur in an identical location with the same equipment year after year may result in interactions in some years and none in other years as noted in the examples of sea turtle takes above. Dredging operations may go on for months, with sea turtle takes occurring intermittently throughout the duration of the action. For example, dredging occurred at Cape Henry over 160 days in 2002 with 8 sea turtle takes occurring over 3 separate weeks while dredging at York Spit in 1994 resulted in 4 sea turtle takes in one week. In Delaware Bay, dredge cycles have been conducted during the May-November period with no observed entrainment and as many as two sea turtles have been entrained in as little as three weeks. Even in locations where thousands of sea turtles are known to be present (e.g., Chesapeake Bay) and where dredges are operating in areas with preferred sea turtle depths and forage items (as evidenced by entrainment of these species in the dredge), the numbers of sea turtles entrained is an extremely small percentage of the likely number of sea turtles in the action area. This is likely due to the distribution of individuals throughout the action area, the relatively small area which is affected at any given moment and the ability of some sea turtles to avoid the dredge even if they are in the immediate area.

The number of interactions between dredge equipment and sea turtles seems to be best associated with the volume of material removed, which is closely correlated to the length of time dredging takes, with a greater number of interactions associated with a greater volume of material removed and a longer duration of dredging. The number of interactions is also heavily influenced by the time of year dredging occurs (with more interactions correlated to times of year when more sea turtles are present in the action area) and the type of dredge plant used (sea turtles are apparently capable of avoiding pipeline and mechanical dredges as no takes of sea turtles have been reported with these types of dredges). The number of interactions may also be influenced by the terrain in the area being dredged, with interactions more likely when the draghead is moving up and off the bottom frequently. Interactions are also more likely at times and in areas when sea turtle forage items are concentrated in the area being dredged, as sea turtles are more likely to be spending time on the bottom while foraging.

Few interactions with listed sea turtles have been recorded during dredging at offshore borrow areas. This is likely due to the transitory nature of most sea turtles occurring in offshore borrow areas as well as the widely distributed nature of sea turtles in offshore waters. This lack of information is also largely due to the infrequency of dredging in offshore borrow areas in the USACE NAD, which makes it even more difficult to predict the likely number of interactions between this action and listed sea turtles. However, as sea turtles have been documented in the action area and suitable habitat and forage items are present, it is likely that sea turtles will be present in the action area when dredging takes place. As sea turtles are likely to be less concentrated in the action area than they are while foraging in Virginia waters such as the entrance channels to the Chesapeake Bay, the level of interactions during this project are likely to be fewer than those recorded during dredging in the Chesapeake Bay area (i.e., the Thimble Shoals and Cape Henry projects noted above).

In the USACE Sea Turtle Database, records for 34 projects occurring during "sea turtle season" (i.e., April 1 – November 30) are available that report the cubic yardage removed during a project (see Table 2). As noted above, the most complete information is available for the Norfolk district.

Records for 19 projects occurring in the April – November time frame that report cubic yards removed are available for channels in the Chesapeake Bay (see Table 3). NMFS has made calculations from that data which indicate that, in the Norfolk District, an average of 1 sea turtle is killed for approximately every 290,000 cubic yards (cy) removed. This calculation has been based on a number of assumptions including the following: that sea turtles are evenly distributed throughout all channels and borrow areas for which takes have occurred, that all dredges will take an identical number of sea turtles, and that sea turtles are equally likely to be encountered throughout the April to November time frame.

Table 2. Dredging projects in USACE NAD with recorded cubic yardage

Project Location	**Year of Operation**	**Cubic Yards Removed**	**Observed Takes**
York Spit Channel	2009	372,533	0
Dewey and Bethany Beach (DE)	2009	397,956	0
York Spit	2007	608,000	1 Kemp's Ridley
Atlantic Ocean Channel	2006	1,118,749	0
Thimble Shoal Channel	2006	300,000	1 loggerhead
Dewey Beach/Cape Henlopen (DE Bay)	2005	1,134,329	0
Delaware Bay	2005	50,000	2 Loggerheads
Cape May	2004	2,425,268	0
Thimble Shoal Channel	2004	139,200	0
Thimble Shoal Channel	2003	1,828,312	7 Loggerheads 1 Kemp's ridley 1 unknown
York River Entrance Channel	2003	343,092	0
Off Ocean City MD	2002	744,827	0
Cape Henry	2002	1,407,814	6 Loggerheads 1 Kemp's ridley 1 green
York Spit Channel	2002	911,406	8 Loggerheads 1 Kemp's ridley
Chincoteague Inlet	2002	84,479	0
Cape Henry	2001	1,641,140	2 loggerheads 1 Kemp's ridley
Cape Henry	2001	1,641,140	0
Thimble Shoal Channel	2000	831,761	2 loggerheads 1 unknown
Cape Henry	2000	759,986	0
York River Entrance Channel	1998	672,536	6 loggerheads
Off Ocean City MD	1998	1,289,817	0
York Spit Channel	1998	296,140	0
Atlantic Coast of NJ	1997	1,000,000	1 Loggerhead
Thimble Shoal Channel	1996	529,301	1 loggerhead
Delaware Bay	1995	218,151	1 Loggerhead
Cape Henry Channel	1995	485,885	0
Bethany Beach (DE Bay)	1994	184,451	0
York Spit Channel	1994	61,299	4 loggerheads
Cape Henry	1994	552,671	4 loggerheads 1 unknown
Dewey Beach (DE Bay)	1994	907,740	0
Off Ocean City MD	1994	1,245,125	0
Off Ocean City MD	1992	1,592,262	3 Loggerheads
Off Ocean City MD	1991	1,622,776	0
Off Ocean City MD	1990	2,198,987	0
	TOTAL	***29,597,133 cy***	***57 Turtles***

Table 3. Projects in USACE NAD with recorded cubic yardage – Chesapeake Bay Only

Project Location	**Year of Operation**	**Cubic Yards Removed**	**Observed Takes**
York Spit Channel	2009	372,533	0
York Spit	2007	608,000	1 Kemp's Ridley
Atlantic Ocean Channel	2006	1,118,749	0
Thimble Shoal Channel	2006	300,000	1 loggerhead
Thimble Shoal Channel	2004	139,200	0
Thimble Shoal Channel	2003	1,828,312	7 Loggerheads 1 Kemp's ridley 1 unknown
York River Entrance Channel	2003	343,092	0
Cape Henry	2002	1,407,814	6 Loggerheads 1 Kemp's ridley 1 green
York Spit Channel	2002	911,406	8 Loggerheads 1 Kemp's ridley
Cape Henry	2001	1,641,140	2 loggerheads 1 Kemp's ridley
Cape Henry	2001	1,641,140	0
Thimble Shoal Channel	2000	831,761	2 loggerheads 1 unknown
Cape Henry	2000	759,986	0
York River Entrance Channel	1998	672,536	6 loggerheads
York Spit Channel	1998	296,140	0
Thimble Shoal Channel	1996	529,301	1 loggerhead
Cape Henry Channel	1995	485,885	0
York Spit Channel	1994	61,299	4 loggerheads
Cape Henry	1994	552,671	4 loggerheads 1 unknown
	TOTAL	***14,500,965 cy***	***50 turtles***

As noted above, sea turtles are likely to be less concentrated in the action area for this consultation than they are in the Chesapeake Bay area. Based on this information, NMFS believes that hopper dredges operating in the offshore borrow areas are less likely to interact with sea turtles than hopper dredges operating in the Chesapeake Bay area. Based on habitat characteristics and geographic area, the level of interactions during this project may be more comparable to the level of interactions recorded for dredging projects in Delaware Bay or offshore New York and New Jersey (i.e., Cape May, Sea Girt, lower Delaware Bay).

Records for 15 projects occurring during "sea turtle season" (i.e., April 1 – November 30) in the

Baltimore, Philadelphia and New York District (all offshore) are available that report the cubic yardage removed during a project; however an important caveat is that observer coverage at these projects has ranged from 0 to 50% (see Table 4).

As explained above, for projects prior to 1995, observers were only present on the dredge for every other week of dredging. For projects in 1995 to the present, observers were present on board the dredge full time and worked a 6-hour on, 6-hour off shift. The only time that cages (where sea turtle parts are typically observed) were cleaned by anyone other than the observer was when there was a clog. If a turtle or turtle part was observed in such an instance, crew were instructed to inform the observer, even if off-duty. As such, it is reasonable to expect that even though there was only 50% observer coverage, an extremely small amount of biological material went unobserved. To make the data from the 1993 and 1994 dredge events when observers were only on board every other week, comparable to the 1995-2006 data when observers were on board full time, NMFS has assumed that an equal number of turtles were entrained when observers were not present. This calculation is reflected in Table 4 as "adjusted entrainment number."

Table 4. Projects in USACE NAD with recorded cubic yardage (with Chesapeake Bay projects removed)

Project Location	Year of Operation	Cubic Yards Removed	Observed Entrainment	Adjusted Entrainment Number
Dewey and Bethany Beach (DE)	2009	397,956	0	0
Dewey Beach/Cape Henlopen (DE Bay)	2005	1,134,329	0	0
Delaware Bay	2005	50,000	2 Loggerhead	2 Loggerhead
Cape May	2004	2,425,268	0	0
Off Ocean City MD	2002	744,827	0	0
Chincoteague Inlet	2002	84,479	0	0
Offshore New Jersey	1997	1,000,000	1 Loggerhead	1 Loggerhead
Off Ocean City MD	1998	1,289,817	0	0
Delaware Bay	1995	218,151	1 Loggerhead	1 Loggerhead
Bethany Beach (DE Bay)	1994	184,451	0	0
Dewey Beach (DE Bay)	1994	907,740	0	0
Off Ocean City MD	1994	1,245,125	0	0
Off Ocean City MD	1992	1,592,262	3 Loggerheads	6 Loggerheads
Off Ocean City MD	1991	1,622,776	0	0
Off Ocean City MD	1990	2,198,987	0	0
	TOTAL	***15,096,168***	***7 Loggerheads***	***10 Loggerheads***

As information available (number of days dredged, cubic yards removed) on projects outside of the Norfolk District is incomplete and observer coverage has been relatively low, it is difficult to estimate the number of sea turtles likely to be taken in these areas. The most reasonable approach is to calculate the number of sea turtles taken during projects where cubic yardage is available, not just for projects where take has occurred (which would overestimate the likelihood of interactions). Using this method, and based on the adjusted entrainment number in Table 4, an estimate of 1 sea turtle per 1.5 million cubic yards is calculated. As noted above, it is likely that including the Norfolk District data would overestimate the number of interactions in offshore borrow areas likely due to the concentration of sea turtles in the Chesapeake Bay and differences in habitat between the Norfolk District's Chesapeake Bay entrance channels and the offshore locations dredged in the other districts. Therefore, the best available information indicates that for dredging in offshore borrow areas outside of the Chesapeake Bay, 1 sea turtle is likely to be entrained for every 1.5 million cubic yards of material removed by a hopper dredge. This calculation has been based on a number of assumptions including the following: that sea turtles are evenly distributed throughout all borrow areas, that all dredges will take an identical number of sea turtles, and that sea turtles are equally likely to be encountered throughout the April to November time frame.

With the exception of one green turtle in a Virginia dredge, all other sea turtles entrained in dredges operating in the USACE NAD have been loggerheads and Kemp's ridley. Of these 72 sea turtles, 62 have been loggerhead, 5 have been Kemp's ridleys, 1 green and 4 unknown. Overall, of those identified to species, approximately 90% of the sea turtles taken in dredges operating in the USACE North Atlantic Division have been loggerheads. No Kemp's ridleys or greens have been taken in dredge operations outside of the Chesapeake Bay area. The high percentage of loggerheads is likely due to several factors including their tendency to forage on the bottom where the dredge is operating and the fact that this species is the most numerous of the sea turtle species in Northeast and Mid-Atlantic waters. It is likely that the documentation of only one green sea turtle take in Virginia dredging operations is a reflection of the low numbers of green sea turtles that occur in waters north of North Carolina. The low number of green sea turtles in the action area makes an interaction with a green sea turtle extremely unlikely to occur.

Based on the above information, NMFS believes that it is reasonable to expect that 1 sea turtle is likely to be injured or killed for approximately every 1.5 million cy of material removed from the proposed borrow area and that at least 90% will be loggerheads. Based on the information outlined above, NMFS anticipates that no more than 3 sea turtles are likely to be entrained in the initial dredge cycle when 3,998,750 cy of material is removed. Maintenance dredging operations are expected to remove up to 1,007,500 cy of sand every 5 years. Over the 50 year life of the SRIPP 9 maintenance cycles will occur removing approximately 9,067,500 cubic yards of material from the shoals, preferably Shoal A, resulting in the death of no more than 6 sea turtles are likely to be killed. Due to the nature of the injuries expected to result from entrainment, all of the turtles are expected to die.

NMFS expects that nearly all of the sea turtles will be loggerheads and that the entrainment of a Kemp's ridley during a particular dredge cycle will be rare; however, as Kemp's ridleys have been documented in the action area and have been entrained in hopper dredges, it is likely that this species will interact with the dredge over the course of the project life. As explained above, approximately 90% of the sea turtles taken in dredges operating in the USACE North Atlantic Division have been loggerheads. Based on that ratio, NMFS anticipates that over the life of the project, for every 10 sea turtle interactions only 1 of them is likely to be with a Kemp's ridley. As noted above, no interactions with green sea turtles are likely. The USACE has indicated that over the life of the project, approximately 13,066,250 cy of material will be removed from the borrow area. As such, over the life of the project (i.e., through 2061), NMFS anticipates that up to 9 sea turtles could be killed, with no more than 1 being a Kemp's ridley.

As explained in the Status of the Species section, loggerheads in the action area are most likely to come from the northern nesting subpopulation and the south Florida nesting subpopulation with a smaller portion from the Yucatan subpopulation. Based on the best available information on sea turtles in the action area, NMFS anticipates that a loggerhead entrained at the Wallops Island borrow site is likely to be either a benthic immature or sexually mature turtle. There is no information to suggest that either sex is disproportionately taken in hopper dredges. Therefore, either a male or female loggerhead may be entrained in the dredge.

Interactions with the Sediment Plume

Dredging operations cause sediment to be suspended in the water column. This results in a sediment plume in the water, typically present from the dredge site and decreasing in concentration as sediment falls out of the water column as distance increases from the dredge site. The nature, degree, and extent of sediment suspension around a dredging operation are controlled by many factors including: the particle size distribution, solids concentration, and composition of the dredged material; the dredge type and size, discharge/cutter configuration, discharge rate, and solids concentration of the slurry; operational procedures used; and the characteristics of the hydraulic regime in the vicinity of the operation, including water composition, temperature and hydrodynamic forces (i.e., waves, currents, etc.) causing vertical and horizontal mixing (USACE 1983).

Resuspension of fine-grained dredged material during hopper dredging operations is caused by the dragheads as they are pulled through the sediment, turbulence generated by the vessel and its prop wash, and overflow of turbid water during hopper filling operations. During the filling operation, dredged material slurry is often pumped into the hoppers after they have been filled with slurry in order to maximize the amount of solid material in the hopper. The lower density turbid water at the surface of the filled hoppers overflows and is usually discharged through ports located near the waterline of the dredge. In the vicinity of hopper dredge operations, a near-bottom turbidity plume of resuspended bottom material may extend 2,300 to 2,400 ft down current from the dredge. In the immediate vicinity of the dredge, a well-defined upper plume is generated by the overflow process. Approximately 1,000 ft behind the dredge, the two plumes merge into a single plume. Suspended solid concentrations may be as high as several tens of parts per thousand (ppt; grams per liter) near the discharge port and as high as a few parts per thousand near the draghead. In a study done by Anchor Environmental (2003), nearfield concentrations ranged from 80.0-475.0 mg/l. Turbidity levels in the near-surface plume appear to decrease exponentially with increasing distance from the dredge due to settling and dispersion, quickly reaching concentrations less than 1 ppt. By a distance of 4000 feet from the dredge, plume concentrations are expected to return to background levels. Studies also indicate that in almost all cases, the vast majority of resuspended sediments resettle close to the dredge within one hour, and only a small fraction takes longer to resettle (Anchor Environmental 2003).

No information is available on the effects of total suspended solids (TSS) on juvenile and adult sea turtles or whales. Studies of the effects of turbid waters on fish suggest that concentrations of suspended solids can reach thousands of milligrams per liter before an acute toxic reaction is expected (Burton 1993). TSS is most likely to affect sea turtles or whales if a plume causes a barrier to normal behaviors or if sediment settles on the bottom affecting sea turtle prey. As sea turtles and whales are highly mobile they are likely to be able to avoid any sediment plume and any effect on sea turtle or whale movements is likely to be insignificant. Additionally, the TSS levels expected are below those shown to have an adverse effect on fish (580.0 mg/L for the most sensitive species, with 1,000.0 mg/L more typical (Breitburg 1988 in Burton 1993; Summerfelt and Moiser 1976 and Combs 1979 in Burton 1993)) and benthic communities (390.0 mg/L (EPA 1986)).

While the increase in suspended sediments may cause sea turtles or whales to alter their normal movements, any change in behavior is likely to be insignificant as it will only involve movement to alter course out of the sediment plume. Based on this information, any increase in suspended sediment is not likely to affect the movement of sea turtles or whales between foraging areas or while migrating or otherwise negatively affect listed species in the action area. Based on this information, it is likely that the effect of the suspension of sediment resulting from dredging operations will be insignificant.

Collisions with dredges

There have not been any reports of dredge vessels colliding with listed species, but contact injuries resulting from dredge movements could occur at or near the water surface and could therefore involve any of the listed species present in the action area. Because the dredge is unlikely to be moving at speeds greater than three knots during dredging operations, blunt trauma injuries resulting from contact with the hull are unlikely during dredging operations. It is more likely that contact injuries during actual dredging would involve the propeller of the vessel and are more likely to occur when the dredge is moving from the dredging area to port or between dredge locations. While the distance between these areas is relatively short, the dredge in transit would be moving at faster speeds (i.e., 10 knots) than during dredging operations (i.e., 3 knots), particularly when empty and returning to the borrow area. The speed of the dredge while empty is not expected to exceed 10 knots.

The dredge vessel may collide with marine mammals and sea turtles when they are at the surface. These species have been documented with injuries consistent with vessel interactions and it is reasonable to believe that the dredge vessels considered in this Opinion could inflict such injuries on marine mammals and sea turtles, should they collide. As mentioned, sea turtles are found distributed throughout the action area in the warmer months, generally from April through November, while right whales are likely to be present from November-May; humpbacks from September-April; and fin whales from October-January; however, individual transient right whales could be present in the action area outside of these time frame as the this area serves as a migration corridor for whales migrating between calving/mating grounds and foraging grounds.

Effects of Vessel Collisions on Sea Turtles

Interactions between vessels and sea turtles occur and can take many forms, from the most severe (death or bisection of an animal or penetration to the viscera), to severed limbs or cracks to the carapace which can also lead to mortality directly or indirectly. Sea turtle stranding data for the U.S. Gulf of Mexico and Atlantic coasts, Puerto Rico, and the U.S. Virgin Islands show that between 1986 and 1993, about 9% of living and dead stranded sea turtles had propeller or other boat strike injuries (Lutcavage *et al.* 1997). According to STSSN stranding data from 2001-2008, at least 520 sea turtles (loggerhead, green, Kemp's ridley and leatherbacks) that stranded on beaches within the NMFS Northeast Region (Maine through Virginia) showed evidence of propeller wounds and were, therefore, probable vessel strikes. In the vast majority of cases, it is unknown whether these injuries occurred pre or post mortem; however, in 18 cases there was evidence that the turtle was alive at the time of the strike.

Information is lacking on the type or speed of vessels involved in 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). Although little is known about a sea turtle's reaction to vessel traffic, it is generally assumed that turtles are more likely to avoid injury from slower-moving vessels since the turtle has more time to maneuver and avoid the vessel. The speed of the dredge is not expected to exceed 3 knots while dredging or transiting to the pump site with a full load and is expected to operate at a maximum speed of 10 knots while empty. As such, the 10 knot or less speed of the dredge vessel is likely to reduce the chances of collision with a sea turtle. In addition, the risk of ship strike will be influenced by the amount of time the animal remains near the surface of the water. For the proposed action, the greatest risk of vessel collision will occur during transit between shore and the offshore Wallops Island borrow sites to be dredged. Sea turtles present in these shallow nearshore waters are most likely to be foraging along the bottom. The presence of an experienced endangered species observer who can advise the vessel operator to slow the vessel or maneuver safely when sea turtles are spotted will further reduce to a discountable level the potential for interaction with vessels.

Effects of Vessel Collisions on Whales
Large whales, particularly right whales, are vulnerable to injury and mortality from ship strikes. Ship strike injuries to whales take two forms: (1) propeller wounds characterized by external gashes or severed tail stocks; and (2) blunt trauma injuries indicated by fractured skulls, jaws, and vertebrae, and massive bruises that sometimes lack external expression (Laist *et al.* 2001). Collisions with smaller vessels may result in propeller wounds or no apparent injury, depending on the severity of the incident. Laist et al. (2001) reports that of 41 ship strike accounts that reported vessel speed, no lethal or severe injuries occurred at speeds below ten knots, and no collisions have been reported for vessels traveling less than six knots. A majority of whale ship strikes seem to occur over or near the continental shelf, probably reflecting the concentration of vessel traffic and whales in these areas (Laist *et al.* 2001). As discussed in the Status of the Species section, all whales are potentially subject to collisions with ships. However, due to their critical population status, slow speed, and behavioral characteristics that cause them to remain at the surface, vessel collisions pose the greatest threat to right whales. From 2003-2007, NMFS confirmed that 7 female right whales have been killed by ship collisions, one of which was carrying a near-term fetus. Because females are more critical to a population's ability to replace its numbers and grow, the premature loss of even one reproductively mature female could hinder the species' likelihood of recovering.

On October 10, 2008 a final rule for the Ship Strike Reduction Strategy was issued (50 CFR 224.105). The final rule mandates all vessels, 65 feet or greater, to travel at speeds of 10 knots or less within seasonal management units (designated for right whales) located along the East Coast of the United States. These measures outlined in the NMFS Ship Strike Reduction Strategy are the best available means of reducing ship strikes of right whales. Most ship strikes have occurred at vessel speeds of 13-15 knots or greater (Jensen and Silber 2003; Laist et al. 2001). An analysis by Vanderlaan and Taggart (2006) showed that at speeds greater than 15 knots, the probability of a ship strike resulting in death increases asymptotically to 100%. At speeds below 11.8 knots, the probability decreases to less than 50%, and at ten knots or less, the probability is further reduced to approximately 30%. Although these measures have been developed specifically with right whales in mind, the speed reduction is likely to provide protection for other large whales as well, as these species are generally faster swimmers and are more likely to be able to avoid oncoming vessels. As noted above, under the proposed action, the speed of the dredge is not expected to exceed 3 knots while dredging or while transiting to the pump out site with a full load, and it is expected to operate at a maximum speed of 10 knots while empty. As such, compliance with 50 CFR 224.105 is expected throughout the life of the SRIPP. In addition, all vessels operators and observers will receive training on prudent vessel operating procedures to avoid vessel strikes with all protected species, which will further reduce to a discountable level the potential for interaction with vessels.

Synthesis of the Effects of Vessel Collisions on Listed Species
Although the threat of vessel collision exists anywhere listed species and vessel activity overlap, ship strike is more likely to occur in areas where high vessel traffic coincides with high species density. In addition, ship strikes are more likely to occur and more likely to result in serious injury or mortality when vessels are traveling at speeds greater than ten knots. As noted above, compliance with 50 CFR 224.105 is expected throughout the life of the SRIPP. As such, with dredge vessels moving at speeds of 10 knots or less, dredge vessels in the action area are not likely to pose a vessel strike risk to listed species of whales and sea turtles. In addition, the onboard observer will be able to watch for whales and sea turtles while the vessel is in transit and provide information to both dredges operating in the action area about the location of sea turtles and whales nearby, thereby allowing vessels to reduce their speeds further and/or alter their course accordingly. Based on the best available information on sea turtle and whale interactions with vessels, and the fact that vessel strike avoidance measures will be in place, NMFS concludes that the likelihood of dredge related vessel traffic resulting in the collision with a whale or sea turtle is discountable.

Dredge Noise
When anthropogenic disturbances elicit responses from sea turtles and marine mammals, it is not always clear whether they are responding to visual stimuli, the physical presence of humans or manmade structures, acoustic stimuli, or any combination of these. 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 dredging operations provides a reasonable and conservative estimate of the magnitude of disturbance caused by the general presence of a hopper dredge 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 taxa, particularly marine mammals. Effects of noise exposure on these taxa can be characterized by the following range of behavioral and physical 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. TTS may occur within specified frequency range or across all frequency ranges.
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. PTS may occur within a specified frequency range or across

all frequency ranges.

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).

Under the proposed action, dredging will produce sound that may affect listed species of sea turtles and whales. NMFS is in the process of developing a comprehensive acoustic policy that will provide guidance on assessing the impacts of anthropogenically produced sound on marine mammals. In the interim, NMFS' current thresholds for determining impacts to marine mammals typically center around root-mean-square (RMS) received levels of 180 dB re 1μPa for potential injury, 160 dB re 1μPa for behavioral disturbance/harassment from an impulsive noise source (e.g., seismic survey), and 120 dB re 1μPa for behavioral disturbance/harassment from a continuous noise source (e.g., dredging). These thresholds are based on a limited number of experimental studies on captive odontocetes and pinnipeds, a limited number of controlled field studies on wild marine mammals, observations of marine mammal behavior in the wild, and inferences from studies of hearing in terrestrial mammals. In addition, marine mammal responses to sound can be highly variable, depending on the individual hearing sensitivity of the animal, the behavioral or motivational state at the time of exposure, past exposure to the noise which may have caused habituation or sensitization, demographic factors, habitat characteristics, environmental factors that affect sound transmission, and non-acoustic characteristics of the sound source, such as whether it is stationary or moving (NRC 2003). Nonetheless, the threshold levels referred to above are considered conservative and are based on the best available scientific information and will be used as guidance in the analysis of effects for this BO.

Noise generated by dredges are considered continuous and low in frequency (i.e., no rapid rise times and below 1000 Hertz (Hz)) (MALSF 2009; 74FR 46090, September 8, 2009) and as such, are within the audible range of listed species of whales and sea turtles likely to occur in the action area (e.g., auditory bandwidth for right, humpback, and fin whales are 7 Hz-22kHz (Southall *et al.* 2007); hearing thresholds for sea turtles are 100-1000 Hz (Ketten and Bartol 2005)). Low frequency noise tends to carry long distances in water, but due to spreading loss, is attenuated as the distance from the source increases. Under the proposed action, underwater noise will be generated through the use of a hopper dredge. The primary noise produced from a hopper dredge is associated with the suction pipes and pumps used to remove the fill from the seabed; however, these noise levels fluctuate with the operational status of the dredge, with the highest levels occurring during loading operations (i.e., during the removal of the substrate) (Greene 1985a, 1987). Greene (1987) measured hopper dredge noise during the removal of gravel in the Beaufort Sea and reported received levels of 142 dB re 1μPa at 0.93 kilometers (km) (0.58 miles) for loading operations at a depth of 20 meters, 127 dB re 1μPa at 2.4 km (1.5 miles) while underway, and 117 dB re 1μPa at 13.3 km (8.3 miles) while pumping at a depth of 13 meters. Based on this information, NASA calculated a worst case estimate of underwater noise levels to the 120dB threshold (i.e., the threshold for continuous noise sources); however, based on the review of the paper by Greene (1987) and a document by the USACE (Clarke *et al.* 2003), which dealt with the removal of sand substrate via a hopper dredge, NMFS has determined that the most appropriate document to use in the analysis of dredge noise, for the purposes of this proposed action, is the information presented by Clarke *et al.* (2003), as it deals with the removal of similar substrate and the recorded levels of underwater noise are in accordance with thresholds established by NMFS (i.e., RMS values) for marine mammals. Additionally, in the analysis of dredge noise and propagation undertaken by NMFS, a transmission loss of 15 log R was used over 10 log R as the latter is more appropriate to use for dredging operations occurring in extremely shallow waters (e.g., less than 25 feet). Based on this information, NMFS has calculated that within 794 meters from the dredge, noise levels could reach 120 dB_{RMS} re 1μPa, with source levels of 164 dB_{RMS} re 1μPa being produced approximately 1 meter from the dredge. It should be noted that to date, equations that take into account other factors affecting perceived underwater noise levels and the propagation of noise (e.g., water depth, frequency, absorptive bottom substrate, ambient noise levels, level of activity in the area, etc.) have not been developed and as such, the estimated distances by NASA and NMFS are most likely overestimates of where increased underwater noise levels will be experienced. Based on the best available information, listed species of whales and sea turtles may be exposed to increased underwater noise levels within the action area; however, the audibility and behavioral response of listed species of whales and sea turtles is dependent on many factors, such as the physical environment (e.g., depth), existing ambient noise, acoustic characteristics of the sound (e.g., frequency), hearing ability of the animal, as well as behavioral context of the animal (e.g., feeding, migrating, resting) (Southall *et al.* 2007).

Exposure Analysis: Right, Humpback, and Fin Whale Hearing

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

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

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

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

Exposure Analysis: 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 dredge noise, and are therefore likely to be exposed to construction-related noise.

Exposure to Injurious Levels of Sound

As described above, NMFS considers 180 dB to be the onset of potential for injury for cetaceans; however, based on the scientific literature, injury likely occurs at some level well above this level. Therefore, this level is considered conservative. Regardless, hopper dredging under the proposed action will not generate source levels in excess of 180 dB re 1μPa and thus is not likely to cause injury to whales or sea turtles. The predominant noise source associated with hopper dredging is caused by the noise generated by suction pipes and pumps. Although source levels of some dredging operations have been reported to reach source levels of 180 dB re 1μPa within 10 meters or less of the dredge, it is extremely unlikely that whales or sea turtles would be exposed to such injurious sound levels as the dredges are moving at very slow speeds (i.e., 10 knots or less), minimizing the likelihood that a sea turtle or whale would be unable to move away from an approaching vessel before the received level reaches a potentially injurious threshold. Based on this information, and the fact that the source levels of dredge noise under the proposed action will not exceed 164 dB_{RMS}, sea turtles and whales are not likely to be exposed to levels of dredge related noise that will result injury.

Exposure to Disturbing Levels of Sound

Injury from dredging noise is not expected; however, there is potential for whales to be exposed to behaviorally disturbing levels of sound produced by these activities. Potentially disturbing levels of construction-related noise (120-160 dB) are expected to propagate over distances ranging from 1.0-794 meters from the source. As dredging operations are proposed to occur year round and humpbacks are likely to occur in the action area from September-April; right whales from November-May; and Fin whales from October-January; and, individual transient whales could be present in the action area outside of these time frame as the this area is used by whales migrating between calving/mating grounds and foraging grounds, there is a potential for listed species to be exposed to increased underwater noise levels at anytime throughout the year.

There is very little information about sea turtle behavioral reactions to levels of sound below the thresholds suspected to cause injury or TTS. However, some studies have demonstrated that sea turtles have fairly limited capacity to detect sound, although all results are based on a limited number of individuals and must be interpreted cautiously. Ridgway et al. (1969) found that one green turtle with a region of best sensitivity around 400 Hz had a hearing threshold of about 126 dB in water. Streeter (in press) found similar results in a captive green sea turtle, which demonstrated a hearing threshold of approximately 125 dB at 400 Hz, but better sensitivity at 200 Hz (110-115 dB threshold). McCauley (2000) noted that dB levels of 166 dB re 1μPa were required before any behavioral reaction was observed. As underwater noise levels produced by dredging operations throughout the 50 year life of the SRIPP will not exceed 166 dB re 1μPa (i.e., maximum underwater noise levels will be 164 dB_{RMS} re 1μPa within 1 meter of the dredge) under water noise levels are not likely to reach levels that will disturb sea turtles. As such, NMFS concludes that dredge noise is not likely to adversely affect sea turtles, and the remainder of the acoustics portion of the analysis will focus on the effects of dredge noise on listed species of whales.

Effects of Dredge Noise

Characterizing the effects of noise on whales and sea turtles involves assessing the species' sensitivity to the particular frequency range of the sound; the intensity, duration, and frequency of the exposure; the potential physiological effects caused by the animals response to the increase in underwater noise; and, the potential behavioral responses that could lead to impairment of feeding, breeding, nursing, breathing, sheltering, migration, or other biologically important functions. To date, few studies have been done that analyze and assess the effects of dredge noise and operations on marine mammals. Much of any analysis involving the effects of anthropogenic sounds on listed species relates to how an animal may change behavior upon exposure to vessel noise and operations (e.g., drillships and seismic vessels) and as such, will be used as the best available information in referencing potential effects of dredge noise on listed species of whales.

The most commonly observed marine mammal behavioral responses to vessel noise and activities include increased swim speed (Watkins 1981), horizontal and vertical (diving) avoidance (Baker et al 1983; Richardson *et al.* 1985), changes in respiration or dive rate (Baker *et al.* 1982; Bauer and Herman 1985; Richardson *et al.* 1985; Baker and Herman 1989; Jahoda *et al.* 2003), and interruptions or changes in feeding or social behaviors (Richardson *et al.* 1985; Baker *et al.* 1982; Jahoda *et al.* 2003). However, Watkins *et al.* (1981) noted that the passage of a tanker within 800 m did not disrupt feeding humpback whales and Brewer *et al.* (1993) and Hall *et al.* (1994) reported numerous sightings of marine mammals, including bowhead whales, in the vicinity of offshore drilling operations in the Beaufort Sea, with one whale sighted 400 m of the drilling vessel. Additionally, based on the review of a number of papers describing the response of marine mammals to non-pulsed sound, Southall *et al.* (2007) reported that in general, behavioral responses of marine mammals did not occur until sounds were higher than 120 dB and that many animals had no observable response at all when exposed to anthropogenic sound at levels of 120 dB or even higher.

Although the above studies demonstrate that a high degree of variability exists in the intensity of responses of marine mammals to vessel noise and activities, it is still unclear whether these responses are due solely to the increase in underwater noise levels, the physical presence of a nearby vessel, or a combination of both. Often, specific acoustic features of the sound and contextual variables (i.e., proximity, durations, or recurrence of the sound or the current behavior that the marine mammal is engaged in or its prior experience), as well as entirely separate factors such as the physical presence of a nearby vessel, may be more relevant to the animal's response than the received level alone (75 FR Register 20482, April 19, 2010). For instance, Baker *et al.* (1982) found that abrupt changes in engine speed and aggressive maneuvers such as circling the whale or crossing directly behind or in front of the whale or its projected path elicited much stronger responses than unobtrusive maneuvering (tracking in parallel to the whale and changing vessel speed only when necessary to maintain a safe distance from the whale). Reactions were even less intense during a simple straight line passby, which most closely represents the type of vessel transit that will take place as a result of the construction activities (i.e., not targeted toward viewing whales).

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

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

One playback experiment on right whales recorded behavioral reactions on summer foraging grounds to different stimuli, including an alert signal, vessel noise, other whale social sounds, and a silent control (Nowacek *et al.* 2004). No significant response was observed in any case except the alert signal broadcast ranging from 500-4500 Hz. In response to the alert signal, which had measured received levels between 130 and 150 dB, whales abandoned current foraging dives, began a high power ascent, remained at or near the surface for the duration of the exposure, and spent more time at subsurface depths (1–10 m) (Nowacek *et al.* 2004). The only whale that did not respond to this signal was the sixth and final whale tested, which had potentially already been exposed to the sound five times. The lack of response to a vessel noise stimulus from a container ship and from passing vessels indicated that whales are unlikely to respond to the sounds of approaching vessels even when they can hear them (Nowacek *et al.* 2004). This non-avoidance behavior could be an indication that right whales have become habituated to the vessel noise in the ocean and therefore do not feel the need to respond to the noise or may not perceive it as a threat. In another study, scientists played a recording of a tanker using an underwater sound source and observed no response from a tagged whale 600 meters away (Johnson and Tyack 2003). These studies may suggest that if right whales are startled or disturbed by novel construction sounds, they may temporarily abandon feeding activities, but may habituate to those sounds over time, particularly if the sounds are not associated with any aversive conditions.

The evidence presented above indicates that animals do respond and modify behavioral patterns in the presence of vessel noise and activity, although adequate data does not yet exist to quantitatively assess or predict the significance of minor alterations in behavior to the health and viability of marine mammal and sea turtle populations. Based on this information it is reasonable to assume that the potential exists that dredge noise and operations under the proposed action may similarly cause behavioral changes to listed species of whales in the action area. However, in previous studies the areas of research were known to be sites where whales concentrated and as such had a higher probability of being exposed to elevated underwater noise levels that resulted in behavioral alterations. The action area is not known as an area where listed species of whales congregate for the purposes of foraging, resting, or reproduction. Instead, the action area is primarily used for migration to and from foraging and calving grounds throughout the year. As such, the behavioral responses observed in previous studies due to vessel noise and operations are extremely unlikely to occur under the proposed action as it is extremely unlikely that whales will be found in high concentrations in the action area, resulting in an extremely low probability that a whale will be within 794 meters of the dredge at any one time and therefore, exposed to levels of underwater noise levels that could adversely affect and/or cause behavioral changes to the animal in a manner that disrupts essential behaviors (e.g., feeding, resting, migrating, reproducing). In addition, in the unlikely event that a whale approaches the area where the dredge is in operation, the mitigation measures NASA has established as part of the proposed action (e.g., NMFS approved sea turtle/marine mammal observer on board all dredge vessels from April-November and a designated lookout/bridge watch on board all dredge vessels from December 1- March 31; shut down of dredge pumps when a whale is observed within 1 km of the dredge; 500 yard restriction on vessel approach to right whales; compliance with SAS operations), will ensure that whales will not be exposed to underwater noise levels greater than or equal to 120 dB. Based on the best available information, NMFS concludes that the effects of dredge noise on listed species of whales will be insignificant and discountable.

In addition, it should be noted that when assessing the potential effects of anthropogenic noise on marine mammals, it is important to consider that there are "zones of audibility" and "zones of responsiveness" that will affect marine mammal responses to anthropogenic noise. The most extensive zone is the zone of audibility, the area within which the mammal might hear noise (Richardson *et al.* 1995). The zone of responsiveness is the region within which the animal reacts behaviorally (i.e., stop feeding) or physiologically (i.e., increase in respiratory rates) (Richardson *et al.* 1995). Marine mammals usually do not respond overtly to audible, but weak man made sounds and therefore, the zone of responsiveness is usually much smaller than the zone of audibility (Richardson *et al.* 1995). It has believed that marine mammals will not remain in areas where received levels of continuous underwater noise are 140 + dB at frequencies to which the animals are most sensitive (Richardson *et al.* 1995). As such, although underwater noise levels of 120 dB may be audible to listed species of whales within 794 meters of the dredge, the behavioral response to elevated noise levels most likely will occur within 40 meters or less from the dredge where underwater noise levels will be greater than or equal to 140 dB. As noted above, it is extremely unlikely for whales to be within 1 km of the dredge and therefore, extremely unlikely for a whale to be within 40 meters or less of the dredge where responses to underwater noise levels are believed to occur. In addition, with the mitigation measures in place, listed species of whales will not be exposed to levels greater than or equal 120 dB as all pumps will be turned off upon a whale observed within 1 km of the dredge. As such, based on the best available information, NMFS concludes that the effects of dredge noise on listed species of whales is discountable.

Fuel Oil Spills

Fuel oil spills could occur from the dredge plant or tender vessel. A fuel 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 fuel oil released it is difficult to predict the likely effects on listed species. No accidental spills of diesel fuel are expected during dredging operations; however, if such an incident does occur, implementation of the USCG-approved safety response plans or procedures outlined in the WFF Integrated Contingency Plan (ICP) to prevent and minimize any impacts associated with a spill will be implemented by all personnel to ensure a rapid response to any spill. As the effects of a possible 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 United States Environmental Protection Agency or the USCG, there would be an opportunity for NMFS to conduct a consultation with the lead Federal agency on the oil spill response.

Effects of Sand Placement/Beach Renourishment
As noted in the Description of the Action, 3.7 miles of the Wallops Island shoreline will receive beach fill and renourishment over the 50 year life of the SRIPP. Initial nourishment will require the placement of 3.2 million cy of sand along the shoreline, with 806,000 cy of fill placed every 5 years for renourishment. The initial fill will be placed so that there will be a 6-foot high berm extending a minimum of 70-feet seaward of the existing seawall. The remainder of the fill will slope underwater for an additional distance seaward. The amount will vary along the length of the beach fill, but will extend a maximum of about 170-feet so that the total distance of the fill profile from the seawall will be up to approximately 240-feet. The primary effects under consideration are: (1) reduction in sea turtle prey and alteration of foraging behavior; and (2) suspended sediment associated with beach fill operations.

Interactions with the Sediment Plume
The placement of sand along the 3.7 mile area along the Wallops Island shoreline will cause an increase in localized turbidity associated with the beach nourishment operations in the nearshore environment and from the anchoring of the dredge and pump-out stations. Nearshore turbidity impacts from fill placement are directly related to the quantity of fines (silt and clay) in the nourishment material. As the material from the offshore borrow sites is comprised of medium sized grains of sand, and consists of beach quality sand of similar grain size and composition as indigenous beach sands, short suspension time and containment of sediment during and after placement activities is expected. As such, turbidity impacts are expected to be short-term (i.e., within several hours of the cessation of operations (Greene 2002)) and spatially limited to the vicinity of the dredge outfall pipe, the pump-out station, and dredge anchor points.

The Atlantic States Marine Fisheries Commission (Greene 2002) review of the biological and physical impacts of beach nourishment cites several studies that report that the turbidity plume and elevated total suspended sediment (TSS) levels drop off rapidly seaward of the sand placement operations. Wilber *et al.* (2006) reported that turbidity approximately 100 meters directly offshore from an active fill site was similar to turbidity along other areas of a beach in New Jersey, while other studies have reported that the turbidity plume and elevated TSS levels produced from beach nourishment operations are limited to a narrow area of the swash zone (defined as the area of the nearshore that is intermittently covered and uncovered by waves) up to 500 meters down current from the discharge pipe (Schubel *et al.* 1978; Burlas *et al.* 2001; Wilber *et al.* 2006). Previous studies have estimated maximum turbidity levels of several hundred Nephelometric Turbidity Units (NTUs) within the swash zone of an active sand placement site, below 100 NTUs (approximately 13 mg/l) in the surf zone, and below 50 NTUs (approximately 6.5 mg/l) in the nearshore area offshore of the placement site (Greene 2002; Wilber *et al.* 2006). As such, based on the best available information, turbidity levels created by the beach fill operations along Wallops Island shoreline are expected to be between 6.5-13 mg/l; limited to an area approximately 500 meters down current from the discharge pipe, with dissipation occurring within several hundred meters along the shore; and, are expected to be short term, only lasting several hours.

As noted above, no information is available on the effects of total suspended solids (TSS) on juvenile and adult sea turtles. Studies of the effects of turbid waters on fish suggest that concentrations of suspended solids can reach thousands of milligrams per liter before an acute toxic reaction is expected (Burton 1993). TSS 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 are below those shown to have an adverse effect on fish (580.0 mg/L for the most sensitive species, with 1,000.0 mg/L more typical (Breitburg 1988 in Burton 1993; Summerfelt and Moiser 1976 and Combs 1979 in Burton 1993)) and benthic communities (390.0 mg/L (EPA 1986)).

While the increase in suspended sediments may cause sea turtles to alter their normal movements, any change in behavior is likely to be insignificant as it will only involve movements to alter course out of the sediment plume. Based on this information, any increase in suspended sediment is not likely to affect the movement of sea turtles between foraging areas or while migrating. Based on this information, it is likely that the effect of the suspension of sediment resulting from beach fill operations will be insignificant.

Alteration of foraging habitat
Of the listed species found in the action area, loggerhead and Kemp's ridley sea turtles are the most likely to utilize the nearshore area for feeding, foraging mainly on benthic species, namely crabs and mollusks (Morreale and Standora 1992, Bjorndal 1997). As no seagrass beds exist along the nearshore area of Wallops Island, green sea turtles will not use the nearshore area as foraging areas and as such, sand placement and beach nourishment are not likely to disrupt normal feeding behaviors of green sea turtles. Additionally, leatherback sea turtles are primarily pelagic, feeding on jellyfish and may come into shallow water if there is an abundance of jellyfish nearshore. However, as the nearshore area along Wallops Island is not known to be an area where jellyfish concentrate, leatherback sea turtles are unlikely to be found foraging in the nearshore area where disposal activities will occur. As such, beach nourishment activities are not likely to disrupt leatherback foraging behavior. However, as suitable loggerhead and Kemps ridley foraging items occur on the benthos of the nearshore area and depths within this portion of the action area are suitable for use by sea turtles, some loggerhead and Kemp ridley sea turtle foraging likely occurs at these sites.

Beach nourishment can affect sea turtles by reducing prey species through the alteration of the existing biotic assemblages. The placement of dredged sand along the Wallops shoreline will bury existing subtidal benthic organisms (i.e., crabs, clams, mussels) along the 14,000 feet of seawall as well as the area extending seaward, approximately 250-feet from the seawall. In total, approximately 1.2 acres of hard bottom, intertidal habitat will be permanently buried. In addition, approximately 225 acres of the sub-tidal benthic community along the existing seawall will be buried during initial fill placement.

Some of the prey species targeted by turtles, including species of crabs, are mobile; therefore, some individuals are likely to avoid the disturbance by migrating out of the area where sand placement is occurring. While some nearshore areas may be more desirable to certain turtles due to prey availability, there is no information to indicate that the nearshore areas proposed for beach nourishment have more abundant turtle prey or better foraging habitat than other surrounding areas. The assumption can be made that sea turtles are not likely to be more attracted to the nearshore waters along the Wallops Island shoreline than to other foraging areas and should be able to find sufficient prey in alternate areas. Depending on the species, recolonization of a newly renourished beach are can begin in as short as 2-6 months (Burlas *et al.* 2001) when there is a good match between the fill material and the natural beach sediment. As the sand being placed along the Wallops shoreline is similar in grain size as the indigenous beach sand, it is expected that recolonization of the nearshore benthos will occur within 2-6 months after initial beach fill or renourishment cycles are complete. As such, no long term impacts on the numbers of species or community composition of the beach infauna is expected (USACE 1994; Burlas *et al.* 2001)

NMFS anticipates that while the beach nourishment activities may temporarily disrupt normal feeding behaviors for sea turtles by causing them to move to alternate areas, the beach nourishment activities are not likely to alter the habitat in any way that prevents sea turtles from using the action area as a migratory pathway to other near-by areas that may be more suitable for foraging. In addition, the placement of sand seaward of the existing seawall, where previously no beach area existed, will have beneficial effects on benthic organisms by restoring and creating new beach habitat and therefore, providing additional sources of prey along the Wallops Island shoreline that previously were not present. As such, based on the best available information, the placement of sand is not likely to remove critical amounts of prey resources from the action area and any disruption to normal foraging is likely to be insignificant.

Fuel Oil Spills
Throughout the proposed project, construction vehicles will be present on the existing roads and also during the use of heavy machinery on the beach or at the north end of Wallops Island throughout different phases of the SRIPP. The nearshore marine environment may be affected if a spill or leak from construction vehicles or heavy machinery occurs. Construction-related impacts are expected to be temporary and will not likely be adverse because any accidental release of contaminants or liquid fuels will be addressed in accordance with the existing WFF ICP emergency response and clean-up measures. Additionally, implementation of Best Management Practices (BMPs) for equipment and vehicle fueling and maintenance and spill prevention and control measure will reduce the potential impacts on surface water during construction. As the effects of a possible 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 United States Environmental Protection Agency or the USCG, there would be an opportunity for NMFS to conduct a consultation with the lead Federal agency on the oil spill response.

CUMULATIVE EFFECTS

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

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

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

Natural mortality of listed species, including disease (parasites) and predation, occurs in Mid-Atlantic waters. In addition to dredging activities, sources of anthropogenic mortality, injury, and/or harassment of listed species in the action area include incidental takes in state-regulated fishing activities, private vessel interactions, marine debris and/or contaminants.

As noted in the Environmental Baseline section, private vessel activities in the action area may adversely affect listed species in a number of ways, including entanglement, boat strike, or harassment. It is not possible to predict whether additional impacts from these private activities will occur in the future, but it appears likely that they will continue, especially if actions are not taken to minimize these impacts.

Excessive turbidity due to coastal development and/or construction sites could also 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).

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

Sources of contamination in the action area include atmospheric loading of pollutants, stormwater runoff from coastal development, groundwater discharges, and industrial development. Chemical contamination may have an effect on listed species reproduction and survival. While the effects of contaminants on sea turtles are relatively unclear, pollution may also make sea turtles more susceptible to disease by weakening their immune systems. While dependent upon environmental stewardship and clean up efforts, impacts from marine pollution, excessive turbidity, and chemical contamination on marine resources and the Virginia coastal ecosystem are expected to continue in the future.

Increasing vessel traffic (e.g., commercial fishing operations) in the action area is possible and raises concerns about the potential effects of noise pollution on marine mammals and sea turtles. The effects of increased noise levels are not yet completely understood, although they 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.

INTEGRATION AND SYNTHESIS OF EFFECTS

In the effects analysis outlined above, NMFS considered potential effects from the following sources: (1) dredging, via hopper dredges, of offshore shoals; (2) placement of dredge material along the shoreline of Wallops Island for beach nourishment; (3) physical alteration of the action area including disruption of benthic communities and changes in turbidity levels in the action area; (4) dredge noise and resultant increases in underwater noise levels. In addition to these categories of effects, NMFS considered the potential for collisions between listed species and project vessels in the action area.

Green and Leatherback Sea Turtles

As noted in sections above, the dredging operations, beach nourishment, and associated physical disturbance of sediments is not likely to affect the foraging behavior of green or leatherback sea turtles as suitable foraging habitat (i.e., SAV) for green sea turtles is not known to occur at the borrow sites or along the nearshore area of Wallops Island and jellyfish, the primary food source of leatherbacks, are not known to be concentrated within the borrow sites or the nearshore area of the action area and are not known to be affected by dredging operations or increases in turbidity. Additionally, dredging operations and beach nourishment/fill operations within the action area are not likely to alter the habitat in any way that prevents leatherback or green sea turtles from using the action area as a migratory pathway to other areas that may be more suitable for foraging or resting. Also, as explained above, no green or leatherback sea turtles are likely to be entrained in any dredge operating within the offshore shoals and, while vessel strikes area possible, neither of these species is likely to be involved in any collision with a project vessel as all vessels will be traveling at low speeds (i.e., 10 knots or less). As all effects to green and leatherback sea turtles from the proposed project are likely to be insignificant or discountable, this action is not likely to adversely affect these species.

Kemp's ridley and Loggerhead Sea Turtles

In the "Effects of the Action" section above, NMFS determined that Kemp's ridleys and loggerhead sea turtles could be entrained in hopper dredge operations occurring over the 50 year life of the SRIPP. Based on a calculated entrainment rate of sea turtles for projects using hopper dredges in the action area, NMFS estimates that 1 sea turtle is likely to be entrained for every 1.5 million cy of material removed with a hopper dredge. Also, based on the ratio of loggerhead and Kemp's ridleys entrained in other hopper dredge operations in the USACE NAD, NMFS estimates that no more than 10% of the sea turtles entrained during project operations are likely to be Kemp's ridleys with the remainder being loggerheads. Based on this information, NMFS has determined that of the 9 sea turtles likely to be entrained during the 50 year life of the SRIPP, no more than 1 is likely to be a Kemp's ridley, with the remainder being loggerheads.

Kemp's ridley sea turtles
The lethal removal of up to one Kemp's ridley sea turtle over the 50 year time period, whether a male or female, immature or mature animal, would reduce the number of Kemp's ridley sea turtles as compared to the number of Kemp's ridleys that would have been present in the absence of the proposed action assuming all other variables remained the same; the loss of one Kemp's ridley over a 50 year time period represents a very small percentage of the species' population as a whole (less than 0.01%). The loss of up to 1 female Kemp's ridley sea turtle, over the 50 year life of the permit, would be expected to reduce the reproduction of Kemp's ridley sea turtles as compared to the reproductive output of Kemp's ridley sea turtles in the absence of the proposed action. As described in the "Status of the Species" section above, NMFS considers the trend for Kemp's ridley sea turtles to be stable. Nevertheless, the death of up to one Kemp's ridley sea turtles as a result of the proposed SRIPP will not appreciably reduce the likelihood of survival for the species for the following reasons. From 1985 to 1999, the number of Kemp's ridley nests observed at Rancho Nuevo and nearby beaches increased at a mean rate of 11.3 % per year. An estimated 4,047 females nested in 2006 and an estimated 5,500 females nested in Tamaulipas (the primary but not sole nesting site) over a 3-day period in May 2007 (NMFS and USFWS 2007b). 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 ridleys in 2006 (NMFS and USFWS 2007b). The observed increase in nesting of Kemp's ridley sea turtles suggests that the combined impact to Kemp's ridley sea turtles from on-going activities as described in the *Environmental Baseline, Cumulative Effects,* and the *Status of the Species* (for those activities that occur outside of the action area of this Opinion) are less than what has occurred in the past. The result of which is that more female Kemp's ridley sea turtles are maturing and subsequently nesting, and/or are surviving to an older age and producing more nests across their lifetime, suggesting that in the future the population of Kemp's ridley sea turtles may increase.

As described in the *Status of the Species* and *Environmental Baseline,* action has been taken to reduce anthropogenic effects to Kemp's ridley sea turtles. These include regulatory measures implemented in 2002 to reduce the number and severity of Kemp's ridley sea turtle interactions in the U.S. South Atlantic and Gulf of Mexico shrimp fisheries --a leading known cause of Kemp's ridley sea turtle mortality. Since these regulatory measures are relatively recent, it is unlikely that current nesting trends reflect the benefit of these measures to Kemp's ridley sea turtles. Therefore, the current nesting trends for Kemp's ridley sea turtles are likely to improve as a result of regulatory action taken for the U.S. south Atlantic and Gulf of Mexico shrimp fisheries.

While generally speaking, the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction and distribution of the species this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range, or the species has extremely low levels of genetic diversity. This situation is not likely the case of Kemp's ridleys because: the species is widely distributed geographically, it is not known to have low levels of genetic diversity, there are several thousand individuals in the population, and the number of Kemp's ridleys is likely to be increasing and at worst is stable. This action is also not likely to reduce the distribution of Kemp's ridleys because the action will not impede Kemp's ridleys from accessing other suitable foraging grounds or disrupt other migratory behaviors.

Based on the information provided above, the death of up to one Kemp's ridley sea turtle over a 50 year time period as a result of the proposed SRIPP will not appreciably reduce the likelihood of survival (i.e., it will not increase the risk of extinction faced by this species) for Kemp's ridley sea turtles given that: (1) the species' nesting trend is increasing; (2) the death of one Kemp's ridley represents an extremely small percentage of the species as a whole (less than 0.01%); (3) the loss of one Kemp's ridley will not change the status or trends of the species as a whole; (4) the loss of one Kemp's ridley is likely to have an undetectable effect on reproductive output of the species as a whole; (5) the action will have no effect on the distribution of Kemp's ridleys in the action area or throughout its range; and, (6) measures have been implemented to reduce the number of Kemp's ridley sea turtles injured and killed (which should result in increases to the numbers of Kemp's ridley sea turtles that would not have occurred in the absence of those regulatory measures).

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. As explained above, the proposed action will not appreciably reduce the likelihood of survival of this species. Also, it is not expected to modify, curtail or destroy the range of the species since: (1) it will result in an extremely small reduction in the number of Kemp's ridley sea turtles in any geographic area and (2) it will not affect the overall distribution of Kemp's ridley sea turtles other than to cause minor temporary adjustments in movements in the action area. The proposed action will not utilize Kemp's ridley 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 cause the mortality of no more than one Kemp ridley, which represents an extremely small percentage of the total population of Kemp's ridleys and this mortality is not expected to result in the reduction of overall reproductive fitness for the species as a whole. Therefore, the proposed action will not appreciably reduce the likelihood that Kemp's ridley sea turtles can be brought to the point at which they are no longer listed as endangered or threatened. Based on the analysis presented herein, the proposed action, resulting in the mortality of no more than one Kemp's ridley over a 50 year time period, is not likely to appreciably reduce the survival and recovery of this species.

Loggerhead sea turtles

Loggerheads are threatened throughout their entire range. As noted above, currently, there are no population estimates for loggerhead sea turtles in any of the ocean basins in which they occur. However, a recent loggerhead assessment prepared by NMFS states that the loggerhead adult female population in the western North Atlantic ranges from 20,000 to 40,000 or more, with a large range of uncertainty in total population size (NMFS SEFSC 2009).

This species exists as five subpopulations in the western Atlantic, which were recognized as recovery units in the 2008 Recovery Plan for this species and showed limited evidence of interbreeding. Based on information provided in this Opinion, NMFS anticipates the entrainment and mortality of no more than 9 sea turtles over a period of 50 years, with no more than one being a Kemp's ridley. The lethal removal of potentially 9 loggerhead sea turtles from the action area would be expected to reduce the number of loggerhead sea turtles from the recovery unit of which they originated as compared to the number of loggerheads that would have been present in the absence of the proposed actions (assuming all other variables remained the same). However, this does not necessarily mean that these recovery units will experience reductions in reproduction, numbers, or distribution in response to these effects to the extent that survival and recovery would be appreciably reduced. The final revised recovery plan compiled the most recent information on mean number of loggerhead nests and the approximated counts of nesting females per year for four of the five identified recovery units (i.e., nesting groups). They are: (1) for the NRU, a mean of 5,215 loggerhead nests per year with approximately 1,272 females nesting per year; (2) for the PFRU, a mean of 64,513 nests per year with approximately 15,735 females nesting per year; (3) for the DTRU, a mean of 246 nests per year with approximately 60 females nesting per year; and (4) for the NGMRU, a mean of 906 nests per year with approximately 221 females nesting per year. For the GCRU, the only estimate available for the number of loggerhead nests per year is from Quintana Roo, Yucatan, Mexico, where a range of 903-2,331 nests per year was estimated from 1987-2001 (NMFS and USFWS 2007a). There are no annual nest estimates available for the Yucatan since 2001 or for any other regions in the GCRU, nor are there any estimates of the number of nesting females per year for any nesting assemblage in this recovery unit.

It is likely that the sea turtles entrained in hopper dredges operating in the waters off Virginia originate from several of the recovery units. Limited information is available on the genetic makeup of sea turtles in the mid-Atlantic. Cohorts from each of the five western Atlantic subpopulations are expected to occur in the action area. Genetic analysis of samples collected from immature loggerhead sea turtles captured in pound nets in the Pamlico-Albemarle Estuarine Complex in North Carolina from September-December of 1995-1997 indicated that cohorts from all five western Atlantic subpopulations were present (Bass *et al.* 2004). In a separate study, genetic analysis of samples collected from loggerhead sea turtles from Massachusetts to Florida found that all five western Atlantic loggerhead subpopulations were represented (Bowen *et al.* 2004). Bass et al. (2004) found that 80 percent of the juveniles and sub-adults utilizing the foraging habitat originated from the south Florida nesting population, 12 percent from the northern subpopulation, 6 percent from the Yucatan subpopulation, and 2 percent from other rookeries. The previously defined loggerhead subpopulations do not share the exact delineations of the recovery units identified in the 2008 recovery plan. However, the PFRU encompasses both the south Florida and Florida panhandle subpopulations, the NRU is roughly equivalent to the northern nesting group, the Dry Tortugas subpopulation is equivalent to the DTRU, and the Yucatan subpopulation is included in the GCRU.

Based on the genetic analysis presented in Bass *et al.* (2004), and the small number of loggerheads likely to occur in the action area from the DTRU or the NGMRU, it is extremely unlikely that any of the up to 9 loggerheads that are likely to be entrained during dredging operations are likely to have originated from either of these recovery units. The majority, at least 80% of the loggerheads entrained, are likely to have originated from the PFRU, with the remainder from the NRU and GCRU. As such, 7 of the sea turtles are expected to be from the PFRU and 2 from the NRU or the GCRU.

As noted above, the most recent population estimates indicate that there are approximately 15,735 females nesting annually in the PFRU and approximately 1,272 females nesting per year in the NRU. For the GCRU, the only estimate available for the number of loggerhead nests per year is from Quintana Roo, Yucatan, Mexico, where a range of 903-2,331 nests per year was estimated from 1987-2001 (NMFS and USFWS 2007a). There are no annual nest estimates available for the Yucatan since 2001 or for any other regions in the GCRU, nor are there any estimates of the number of nesting females per year for any nesting assemblage in this recovery unit; however, the 2008 recovery plan indicates that the Yucatan nesting aggregation has at least 1,000 nesting females annually. As the numbers outlined here are only for nesting females, the total number of loggerhead sea turtles in each recovery unit is likely significantly higher. The loss of 7 loggerheads over a 50 year time period represents an extremely small percentage of the number of sea turtles in the PFRU. Even if the total population was limited to 15,735 loggerheads, the loss of 7 individuals would represent approximately 0.04% of the population. Similarly, the loss of two loggerheads over a 50 year period from the NRU or GCRU represents an extremely small percentage from either recovery unit. Even if the total NRU population was limited to 1,272 loggerheads, the loss of two individuals would represent approximately 0.16% of the NRU population, while the loss of two loggerheads over a 50 year time period from the GCRU, which is expected to support at least 1,000 nesting females, represents less than 0.2 % of the population. The loss of such a small percentage of individuals from any of these recovery units represents an even smaller percentage of the species as a whole. As such, it is unlikely that the death of these individuals will have a detectable effect on the numbers and population trends of loggerheads in these recovery units or the number of loggerheads in the population as a whole. Additionally, this action is not likely to reduce the distribution of loggerheads as the action will not impede loggerheads from accessing suitable foraging grounds or disrupt other migratory behaviors.

In general, while the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction and distribution of the species, this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of loggerhead sea turtles because: the species is widely distributed geographically, it is not known to have low levels of genetic diversity, and there are several thousand individuals in the population.

Based on the information provided above, the death of up to 9 loggerhead sea turtles over a 50 year time period as a result of the proposed deepening project will not appreciably reduce the likelihood of survival (i.e., it will not increase the risk of extinction faced by this species) for loggerhead sea turtles given that: (1) the death of up to 9 loggerheads represents an extremely small percentage of the species as a whole; (2) the loss of these loggerheads will not change the status or trends of any nesting aggregation, recovery unit or the species as a whole; (3) the loss of these loggerheads is likely to have an undetectable effect on reproductive output of any nesting aggregation or the species as a whole; and, (4) the action will have no effect on the distribution of loggerheads in the action area or throughout its range.

Section 4(a)(l) 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. As explained above, the proposed action will not appreciably reduce the likelihood of survival of the loggerhead sea turtle species. Also, it is not expected to modify, curtail or destroy the range of the species since it will result in an extremely small reduction in the number of loggerheads in any geographic area and since it will not affect the overall distribution of loggerheads other than to cause minor temporary adjustments in movements in the action area. The proposed action will not utilize loggerheads 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 cause the mortality of only an extremely small percentage of the loggerheads in any nesting aggregation, recovery unit or the species as whole and these mortalities are not expected to result in the reduction of overall reproductive fitness for the species as a whole. Therefore, the proposed action will not appreciably reduce the likelihood that loggerhead sea turtles can be brought to the point at which they are no longer listed as endangered or threatened. Based on the analysis presented herein, the proposed action, resulting in the mortality of no more than 9 loggerheads over a 50 year time period, is not likely to appreciably reduce the survival and recovery of this species.

Right, Humpback and Fin Whales

Right, humpback, and fin whales may be affected by increased levels of underwater noise produced during dredging operations and by vessels transiting the action area during project operations or. Although there is potential for collisions with these large whales to occur within the action area, these collisions are considered unlikely as all vessels will be operating at speeds of 10 knots or less in accordance with 50 CFR 224.105 and the use of a bridge watch will further aid in reducing the possibility of these interactions as well. Additionally, although increased levels of underwater noise (i.e., 120-160 dB) will be produced during dredging operations, these elevated levels of underwater noise will be experienced within a 794 meter radius of the dredge (i.e., beyond 794 meters underwater noise levels will be less than 120 dB). As the action area is not known as an area where listed species of whales congregate for the purposes of foraging, resting, or reproduction, but instead is used primarily for migration, it is extremely unlikely that whales will be found in high concentrations in the action area, resulting in an extremely low probability that a whale will be within 794 meters of the dredge at any one time and therefore, exposed to levels of underwater noise levels that could adversely affect and/or cause behavioral changes to the animal in a manner that disrupts essential behaviors (e.g., feeding, resting, migrating, reproducing). In addition, in the unlikely event that a whale approaches the area where the dredge is in operation, the mitigation measures NASA has established (e.g., NMFS observer/designated bridge watch; shut down of dredge pumps if whale within 1 km of dredge) will ensure that whales will not be exposed to underwater noise levels greater than or equal to 120 dB. As all effects of the proposed action on right, humpback, and fin whales will be insignificant or discountable, the proposed action is not likely to adversely affect these 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 and Kemp's ridley sea turtle and is not likely to adversely affect leatherback or green sea turtles or right, humpback or fin whales. Because no critical habitat is designated in the action area, none will be affected by the proposed action.

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

As described in this Opinion, the proposed action is anticipated to result in the death of no more than 9 loggerhead sea turtles over a 50 year time period. In this Opinion, NMFS concludes that this level of take is not likely to reduce appreciably the likelihood of both the survival and recovery of the species in the wild by reducing the reproduction, numbers, or distribution of that species and that, therefore, the action is not likely to jeopardize the continued existence of loggerhead sea turtles.

As explained in the Opinion, the majority, at least 80% of the loggerheads entrained, are likely to have originated from the Peninsular Florida Recovery Unit (PFRU: Florida/Georgia border through Pinellas County, Florida), with the remainder from the Northern Recovery Unit (NRU: Florida/Georgia border through southern Virginia), and the Greater Caribbean Recovery Unit (GCRU: Mexico through French Guiana, The Bahamas, Lesser Antilles, and Greater Antilles). All of these recovery units fall within the Northwest Atlantic DPS, one of the seven DPSs proposed to be listed as endangered in the March 16, 2010 proposed rule. In this Opinion, NMFS determined that the loss of these individuals would not be detectable at the recovery unit level or at the species as whole (i.e., range-wide) and that the death of up to 9 loggerhead sea turtles over a 50 year time period as a result of the proposed SRIPP project will not appreciably reduce the likelihood of survival (i.e., it will not increase the risk of extinction faced by this species) or recovery for loggerhead sea turtles. As explained in the Opinion, the individuals likely to be killed represent

0.04% (PFRU), 0.16 % (NRU), and 0.2 % (GCRU) of the individuals in each recovery unit. The proposed Northwest Atlantic DPS consists of these three recovery units as well as two others; the individuals likely to be killed represent no more than 0.1% of the sea turtles in the proposed Northwest Atlantic DPS. In this Opinion NMFS determines that the loss of these individuals from each of the three recovery units was likely to be undetectable; as such, and given that the proposed DPS is comprised of these three recovery units as well as two others, it is reasonable to expect that the conclusions reached for the current range-wide listing would be the same as for the proposed Northwest Atlantic DPS. Conference is only required when an action is likely to jeopardize the continued existence of any proposed species, and, based on the above information, it is unlikely that the effects of the proposed action would result in jeopardy for the proposed Northwest Atlantic DPS. Thus, conference is not required for this proposed action. Additionally, as ITS included with this Opinion contains all terms and conditions and reasonable and prudent measures necessary and appropriate to minimize and monitor take of loggerhead sea turtles, it is unlikely that a conference would identify or resolve additional conflicts or provide additional means to minimize or monitor take of loggerhead sea turtles.

INCIDENTAL TAKE STATEMENT

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

The measures described below are non-discretionary, and must be undertaken so that they become binding conditions for the exemption in section 7(o)(2) to apply. Failure to implement the terms and conditions through enforceable measures may result in a lapse of the protective coverage of section 7(o)(2).

Amount or Extent of Take

The proposed dredging project has the potential to directly affect loggerhead and Kemp's ridley sea turtles by entraining these species in the dredge. These interactions are likely to cause injury and/or mortality to the affected sea turtles. Based on the distribution of sea turtles in the action area and information available on historic interactions between sea turtles and dredging and relocation trawling operations, NMFS believes that it is reasonable to expect that no more than 1 sea turtle is likely to be injured or killed for approximately every 1.5 million cy of material removed from the borrow areas. NMFS has estimated that at least 90% of these turtles will be loggerheads. As such, over the course of the project life, NMFS expects that a total of 9 sea turtles will be killed, with no more than 1 being a Kemp's ridley and the remainder being loggerheads. Due to the nature of the injuries expected by entrainment, any entrained sea turtle is expected to die.

NMFS also expects that the maintenance dredging may collect an additional unquantifiable number of parts from previously dead sea turtles. While collecting decomposed animals or parts there of in federal operations is considered to be a take, based on the definition of "take" in Section 3 of the ESA and "wildlife" at 50CFR§222.102, NMFS recognizes that decomposed sea turtles may be taken in dredging operations that may not necessarily be related to the dredging activity itself. Theoretically, if dredging operations are conducted properly, no takes of sea turtles should occur as the turtle draghead defector should push the turtles to the side and the suction pumps should be turned off whenever the dredge draghead is away from the substrate. However, due to certain environmental conditions (e.g., rocky bottom, uneven substrate), the dredge draghead may periodically lift off the bottom and entrain previously dead sea turtle parts (as well as live turtles) that may be on the bottom through the high level of suction.

Thus, the aforementioned anticipated level of take refers to those turtles which NMFS confirms as freshly dead. While this definition is subject to some interpretation by the observer, a fresh dead animal may exhibit the following characteristics: little to no odor; fresh blood present; fresh (not necrotic, pink/healthy color) tissue, muscle, or skin; no bloating; color consistent with live animal; and live barnacles. A previously (non-fresh) dead animal may exhibit the following characteristics: foul odor; necrotic, dark or decaying tissues; sloughing of scutes; pooling of old blood; atypical coloration; and opaque eyes. NMFS recognizes that decomposed sea turtles may be taken in dredging operations that may not necessarily be related to the dredging activity itself. NMFS expects that the proposed dredging may take an additional unquantifiable number of previously dead sea turtle parts.

NMFS believes this level of incidental take is reasonable given the seasonal distribution and abundance of these species in the action area and the level of take historically during other dredging operations in the USACE NAD. In the accompanying Opinion, NMFS determined that this level of anticipated take is not likely to result in jeopardy to loggerhead or Kemp's ridley sea turtles.

Measures have been undertaken by the USACE to reduce the takes of sea turtles in dredging activities. Measures that have been successful in minimizing take in other dredging operations have included reevaluating all dredging procedures to assure that the operation of the dragheads and turtle deflectors were in accordance with the project specifications; modifying dredging operations per the recommendation of Mr. Glynn Banks of the USACE Engineering Research and Development Center; training the dredge crew and all inspectors in proper operation of the dragpipe and turtle deflector systems; and, initiating sea turtle relocation trawling. Proper use of draghead deflectors prevent an unquantifiable yet substantial number of sea turtles from being entrained and killed in dredging operations. Tests conducted by the USACE's Jacksonville District using fake turtles and draghead deflectors showed convincingly that the sea turtle deflecting draghead is useful in reducing entrainments. As the use of draghead deflectors and other modifications to hopper dredge operations have been demonstrated to be effective at minimizing the number of sea turtles taken in dredging operations, NMFS has determined that the use of draghead deflectors and certain operating guidelines (as outlined below) are necessary and appropriate to minimize the take of sea turtles during the dredging of the two borrow areas.

In order to effectively monitor the effects of this action, it is necessary to examine the sea turtles entrained in the dredge. Monitoring provides information on the characteristics of the turtles encountered and may provide data which will help develop more effective measures to avoid future interactions with listed species. For example, measurement data may reveal that draghead deflectors or trawl gear is most effective for a particular size class of turtle. In addition, data from genetic sampling of dead sea turtles can definitively identify the species of turtle as well as the subpopulation from which it came (in the case of loggerheads). Reasonable and prudent measures and implementing terms and conditions requiring this monitoring are outlined below.

Reasonable and Prudent Measures

NMFS has determined that the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of sea turtles. It should be noted that this Opinion results from the reintiation of consultation that lead to the September 25, 2007 Opinion. The action agencies have incorporated the reasonable and prudent measures from the 2007 Opinion as well as all associated specifications and requirements for monitoring hopper dredge operations (Appendix B); sea turtle handling and resuscitation (Appendix C); protocols for collecting tissue from sea turtles for genetic analysis (Appendix D, E, F); endangered species observer forms (Appendix G); and incident report forms for sea turtle takes (Appendix H) as part of this consultations proposed action's mitigation measures (see pages 6-7).

1. NMFS must be contacted within 3 days prior to commencement of dredging and again within 3 days following completion of the dredging activity. Upon contacting NMFS, NASA shall report to NMFS whether:
    a. during April 1-November 30, when sea turtles are known to be present in the action area, hopper dredges are outfitted with state-of-the-art sea turtle deflectors on the draghead and operated in a manner that will reduce the risk of interactions with sea turtles which may be present in the action area;
    b. NMFS-approved observer is present on board the vessel for any dredging occurring in the April 1 – November 30 time frame;
    c. all dredges are equipped and operated in a manner that provides endangered/threatened species observers with a reasonable opportunity for detecting interactions with listed species and that provides for handling, collection, and resuscitation of turtles injured during project activity. Full cooperation with the endangered/threatened species observer program is essential for compliance with the ITS; and,
    d. measures are taken to protect any turtles that survive entrainment in the dredge.
2. All interactions with listed species must be properly documented and promptly reported to NMFS.

Terms and conditions

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

1. To implement RPM #1(a-d), the NASA must contact NMFS (section 7 coordinator: by phone (978)-281-9328 or mail: Protected Resources Division, 55 Great Republic Drive, Gloucester, MA 01930)). This correspondence will serve both to alert NMFS of the commencement and cessation of dredging activities, to give NMFS an opportunity to provide NASA with any updated contact information or reporting forms, and to provide NMFS with information of any incidences with listed species.

2. To implement RPM #2, if a sea turtle or their parts are taken in dredging operations, the take must be documented on the form included as Appendix H and submitted to NMFS along with the final report.

3. To implement RPM #2, NASA must contact NMFS within 24 hours of any interactions with sea turtles, including non-lethal and lethal takes. NMFS will provide contact information annually when alerted of the start of dredging activity. Until alerted otherwise, the USACE should contact the Section 7 Coordinator by phone (978)281-9328 or fax 978-281-9394).

4. To implement RPM #2, NASA must ensure that any sea turtles observed during project operations are measured and photographed (including sea turtles or body parts observed at the disposed location or on board the dredge, hopper or scow and the corresponding form (Appendix H) must be completed and submitted to NMFS **within 24 hours** by fax (978-281-9394).

5. To implement RPM #2, in the event of any lethal takes of sea turtles, any dead specimens or body parts must be photographed, measured, and preserved (refrigerate or freeze) until disposal procedures are discussed with NMFS. The form included as Appendix H must be completed and submitted to NMFS as noted above.

6. To implement RPM #2, if a dead sea turtle or sea turtle part is taken in dredging operations, a genetic sample must be taken following the procedure outlined in Appendix D.

7. To implement RPM #2, if a decomposed turtle or turtle part is entrained during dredging operations, an incident report must be completed and the specimen must be photographed. Any turtle parts that are considered 'not fresh' (i.e., they were obviously dead prior to the dredge take and NASA anticipates that they will not be counted towards the ITS) must be frozen and transported to a nearby stranding or rehabilitation facility for review. NASA must submit an incident report for the decomposed turtle part, as well as photographs, to NMFS within 24 hours of the take (see Appendix H) and request concurrence that this take should not be attributed to the Incidental Take Statement. NMFS shall have the final say in determining if the take should count towards the Incidental Take Statement.

8. To implement RPM #2, any time take occurs NASA immediately contacts NMFS at (978) 281-9328 to review the situation. At that time, NASA must provide NMFS with information on the amount of material dredged thus far and the amount remaining to be dredged during that cycle. Also at that time, NASA and the USACE should discuss with

NMFS whether any new management measures could be implemented to prevent the total incidental take level from being exceeded.

9. To implement RPM #2, NASA must submit a final report summarizing the results of dredging and any takes of listed species to NMFS within 30 working days of the completion of each dredging contract (by mail to the attention of the Section 7 Coordinator, NMFS Protected Resources Division, 55 Great Republic Drive, Gloucester, MA 01930). This report must be submitted at the close of each dredging contract.

10. To implement RPM#2, if the take estimate for any contract is exceeded, NASA and the USACE must work with NMFS to determine whether the additional take represents new information revealing effects of the action that may not have been previously considered.

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 keep NMFS informed of when and where dredging activities are taking place and will require USACE to report any take in a reasonable amount of time, as well as implement measures to monitor for entrainment during dredging. The NASA has reviewed the RPMs and Terms and Conditions outlined above and has agreed to implement all of these measures as described herein and in the referenced Appendices. The discussion below explains why each of these RPMs and Terms and Conditions are necessary and appropriate to minimize or monitor the level of incidental take associated with the proposed action and how they represent only a minor change to the action as proposed by the NASA.

RPM #1 and Term and Condition #1 are necessary and appropriate because they will serve to ensure that NMFS is aware of the dates and locations of all dredging activities as well as any incidences of interactions of listed species. This will also allow NMFS to monitor the duration and seasonality of dredging activities as well as give NMFS an opportunity to provide NASA with any updated contact information for NMFS staff. This is only a minor change because it is not expected to result in any delay to the project and will merely involve an occasional telephone call or e-mail between NASA and NMFS staff.

RPM #2 and Terms and Conditions (#2-10) are necessary and appropriate to ensure the proper handling and documentation of any interactions with listed species as well as requiring that these interactions are reported to NMFS in a timely manner with all of the necessary information. This is essential for monitoring the level of incidental take associated with the proposed action. RPM #16 requires that NASA work with NMFS to determine if any takes above those estimated for each contract represent new information on the effects of the project that was not previously considered. In a situation where the estimated level of take for a particular contract is exceeded but the overall level of take exempted by the ITS is not exceeded, compliance with this condition will allow NASA and NMFS to determine if reinitiation of consultation is necessary at the time that the take occurs. These RPMs and Terms and Conditions represent only a minor change as compliance will not result in any increased cost, delay of the project or decrease in the efficiency of the dredging operations.

CONSERVATION RECOMMENDATIONS

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

1. When endangered species observers are required on hopper dredges (April 1 to November 30), 100% overflow screening is recommended. While monitoring 100% of the inflow screening is required as a term and condition of this project's Incidental Take Statement, observing 100% of the overflow screening would ensure that any takes of sea turtles are detected and reported.

2. To facilitate future management decisions on listed species occurring in the action area, NASA should maintain a database mapping system to: a) create a history of use of the geographic areas affected; and, b) document endangered/threatened species presence/interactions with project operations.

3. NASA should support ongoing and/or future research to determine the abundance and distribution of sea turtles in offshore Virginia waters.

4. NASA should work with the USACE to investigate, support, and/or develop additional technological solutions to further reduce the potential for sea turtle takes in hopper dredges. For instance, NMFS recommends that the USACE coordinate with other Southeast Districts, the Association of Dredge Contractors of America, and dredge operators regarding additional reasonable measures they may take to further reduce the likelihood of sea turtle takes. The diamond-shaped pre-deflector, or other potentially promising pre-deflector designs such as tickler chains, water jets, sound generators, etc., should be developed and tested and used where conditions permit as a means of alerting sea turtles and sturgeon of approaching equipment. New technology or operational measures that would minimize the amount of time the dredge is spent off the bottom in conditions of uneven terrain should be explored. Pre-deflector use should be noted on observer daily log sheets, and annual reports to NMFS should note what progress has been made on deflector or pre-deflector technology and the benefits of or problems associated with their usage. NMFS believes that development and use of effective pre-deflectors could reduce the need for sea turtle relocation trawling.

5. New approaches to sampling for turtle parts should be investigated. Project proponents should seek continuous improvements in detecting takes and should determine, through research and development, a better method for monitoring and estimating sea turtle takes by hopper dredges. Observation of overflow and inflow screening appears to be only partially effective and may provide only minimum estimates of total sea turtle mortality. NMFS believes that some listed species taken by hopper dredges may go undetected because body parts are forced through the sampling screens by the water pressure (as seen in 2002 Cape Henry dredging) and are buried in the dredged material, or animals are crushed or killed, but not entrained by the suction and so

the takes may go unnoticed (or may subsequently strand on nearby beaches). The only mortalities that are documented are those where body parts float, are large enough to be caught in the screens, or can be identified to species.

6. NMFS recommends that all sea turtles entrained in hopper dredge dragheads be sampled for genetic analysis by a NMFS laboratory. Any genetic samples from live sea turtles must be taken by trained and permitted personnel. Copies of NMFS genetic sampling protocols for live and dead turtles are attached as Appendix D.

7. NASA and the USACE should consider devising and implementing some method of significant economic incentives to hopper dredge operators such as financial reimbursement based on their satisfactory completion of dredging operations, or a certain number of cubic yards of material removed, or hours of dredging performed, *without taking turtles*. This may encourage dredging companies to research and develop "turtle friendly" dredging methods, more effective deflector dragheads, pre-deflectors, top-located water ports on dragarms, etc.

8. When whales are present in the action area, vessels transiting the area should post a bridge watch, avoid intentional approaches closer than 100 yards (or 500 yards in the case of right whales) when in transit, and reduce speeds to below 4 knots.

REINITIATION OF CONSULTATION

This concludes formal consultation on NASA's proposed Wallops Island Shoreline Restoration and Infrastructure Protection Program. 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, NASA must immediately request reinitiation of formal consultation.

LITERATURE CITED

Ackerman, R.A. 1997. The nest environment and embryonic development of sea turtles. Pages 83 106 in P.L. Lutz and J.A. Musick, eds. The Biology of Sea Turtles. New York: CRC Press.

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

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

Anchor Environmental. 2003. Literature review of effects of resuspended sediments due to dredging. June. 140pp.

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

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

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

Angliss, R.P. and R.B. Outlaw. 2007. Alaska Marine Mammal Stock Assessments, 2006. NOAA Technical Memorandum NOAA-TM-AFSC-168. 244p.

Angliss, R. P., and B.M. Allen. 2009. Alaska Marine Mammal Stock Assessments, 2008. NOAA Technical Memorandum NOAA-TM-AFSC-193. 258 p.

Army Corps of Engineers. 1983. Dredging and Dredged Material Disposal. U.S. Dept. Army. Engineer Manual 1110-2-5025.

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

Avens, L., J.C. Taylor, L.R. Goshe, T.T. Jones, and M. Hastings. 2009. Use of skeletochronological analysis to estimate the age of leatherback sea turtles *Dermochelys coriacea* in the western North Atlantic. Endangered Species Research 8:165-177.

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

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

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

Baker J.D., C.L. Littnan, D.W. Johnston. 2006. Potential effects of sea level rise on the terrestrial habitats of endangered and endemic megafauna in the Northwestern Hawaiian Islands. Endang Species Res 2:21–30.

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

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

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

Baumgartner, M.F., and B.R. Mate. 2005. Summer and fall habitat of North Atlantic right whales (*Eubalaena glacialis*) inferred from satellite telemetry. Can. J. Fish. Aquat. Sci. 62:527-543.

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

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

Bass, A.L., S.P. Epperly, J.Braun-McNeill. 2004. Multi-year analysis of stock composition of a loggerhead sea turtle (*Caretta caretta*) foraging habitat using maximum likelihood and Bayesian methods. Conservation Genetics 5: 784-796.

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

Berube, M., A. Aguilar, D. Dendanto, F. Larsen, G. Notarbatolo di Sciara, R. Sears, J. Sigurjonsson, J. Urban-R, and P. Palsboll. 1998. Population genetic structure of North Atlantic, Mediterranean Sea and Sea of Cortez fin whales: analysis of mitochondrial and nuclear loci. Molecular ecology 7: 585-599.

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

Bjork, M., F. Short, E. McLeod, and S. Beers. 2008. Managing seagrasses for resilience to climate change. IUCN, Gland.

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

Blumenthal, J.M., J.L. Solomon, C.D. Bell, T.J. Austin, G. Ebanks-Petrie, M.S. Coyne, A.C. Broderick, and B.J. Godley. 2006. Satellite tracking highlights the need for international cooperation in marine turtle management. Endangered Species Research 2:51-61.

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

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

Bowen, B.W. 2003. What is a loggerhead turtle? The genetic perspective. Pages 7-27 in A.B. Bolten and B.E. Witherington, (eds). Loggerhead Sea Turtles. Washington, D.C.: Smithsonian Press.

Bowen, B.W. , A. L. Bass, S. Chow, M. Bostrom, K. A.Bjorndal, A. B. Bolten, T. Okuyama, B. M. Bolker, S.Epperley, E. Lacasella, D. Shaver, M. Dodd, S. R. Hopkins-Murphy, J. A. Musick, M. Swingle, K. Rankin-Baransky, W. Teas, W. N. Witzell, and P. H. Dutton. 1992. Natal homing in juvenile loggerhead turtles *(Caretta caretta).* Molecular Ecology (2004) 13: 3797-3808.

Bowen, B.W., A.L. Bass, L. Soares, and R.J. Toonen. 2005. Conservation implications of complex population structure: lessons from the loggerhead turtle (*Caretta caretta*). Molecular Ecology 14:2389-2402.

Bowen, B.W., and S.A. Karl. 2007. Population genetics and phylogeography of sea turtles. Molecular Ecology 16:4886-4907.

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

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

Brewer, K., M. Gallagher, P. Regos, P. Isert, and J. Hall. 1993. Kuvlum #1 Exploration Prospect: Site Specific Monitoring Program, Final Report. Prepared by Coastal Offshore Pacific Corporation, Walnut Creek, CA, for ARCO Alaska, Inc., Anchorage, AK. 80pp.

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

Brown, M. W., and M.K. Marx. 2000. Surveillance, Monitoring and Management of North Atlantic Right Whales, Eubalaena glacialis, in Cape Cod Bay, Massachusetts: January to Mid-May, 2000. Final report.

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

Burlas, M., G. L Ray, & D. Clarke. 2001. The New York District's Biological Monitoring Program for the Atlantic Coast of New Jersey, Asbury Park to Manasquan Section Beach Erosion Control Project. Final Report. U.S. Army Engineer District, New York and U.S. Army Engineer Research and Development Center, Waterways Experiment Station.

Burton, W. 1993. Effects of bucket dredging on water quality in the Delaware River and the potential for effects on fisheries resources. Prepared by Versar, Inc. for the Delaware Basin Fish and Wildlife Management Cooperative, unpublished report. 30 pp.

Caillouet, C., C.T. Fontaine, S.A. Manzella-Tirpak, and T.D. Williams. 1995. Growth of head-started Kemp's ridley sea turtles (*Lepidochelys kempi*) following release. Chelonian Conservation and Biology. 1(3):231-234.

Calambokidis, J., E. A. Falcone, T.J. Quinn., A.M. Burdin, P.J. Clapham, J.K.B. Ford, C.M. Cabriele, R. LeDuc, D. Matilla, L. Rojas-Bracho, J.M. Straley, B.L. Taylor, J. Urban, D. Weller, B.H. Witteveen, M.Yamaguchi, A. Bendlin, D. Camacho, K. Flynn, A. Havron, J. Huggins, and N. Maloney. 2008. SPLASH: Structure of Populations, Levels of Abundance and Status of Humpback Whales in the North Pacific. Final Report for Contract AB133F-03-RP-00078; 57pp.

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

Casale, P., P. Nicolosi, D. Freggi, M. Turchetto, and R. Argano. 2003. Leatherback turtles (*Dermochelys coriacea*) in Italy and in the Mediterranean basin. Herpetological Journal 13: 135-139.

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

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

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

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

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

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

Church, J., J.M. Gregory, P. Huybrechts, M. Kuhn, K. Lambeck, M.T. Nhuan, D. Qin, P.L. Woodworth. 2001. Changes in sea level. In: Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P.J. Vander Linden, X. Dai, K. Maskell, C.A. Johnson CA (eds.) Climate change 2001: the scientific basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, p 639–694

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

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

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

Clapham, P., S. Brault, H. Caswell, M. Fujiwara, S. Kraus, R. Pace and P. Wade. 2002. Report of the Working Group on Survival Estimation for North Atlantic Right Whales.

Clarke, D., C. Dickerson, and K. Reine. 2003. Characterization of underwater sounds produced by dredges. *In* Proceedings of the Third Specialty Conference on Dredging and Dredged Material Disposal, May 5-8, 2002, Orlando, Florida.

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

Cliffton, K., D.O. Cornejo, and R.S. Felger. 1982. Sea turtles of the Pacific coast of Mexico. Pages 199-209 in K.A. Bjorndal, ed. Biology and Conservation of Sea Turtles. Washington, D.C.: Smithsonian Institution Press.

Cole, T.V.N., D.L. Hartly, and R.L. Merrick. 2005. Mortality and serious injury determinations for large whale stocks along the eastern seaboard of the United States, 1999-2003. U. S. Dep. Commer., Northeast Fish. Sci. Cent. Ref. Doc. 05-08. 20 pp.

Conant, T.A., P.H. Dutton, T. Eguchi, S.P. Epperly, C.C. Fahy, M.H. Godfrey, S.L. MacPherson, E.E. Possardt, B.A. Schroeder, J.A. Seminoff, M.L. Snover, C.M. Upite, and B.E. Witherington. 2009. Loggerhead sea turtle (*Caretta caretta*) 2009 status review under the U.S. Endangered Species Act. Report of the Loggerhead Biological Review Team to the National Marine Fisheries Service, August 2009. 222 pp.

Davenport, J., and G.H. Balazs. 1991. 'Fiery bodies' – Are pyrosomas an important component of the diet of leatherback turtles? British Herpetological Society Bulletin 37: 33-38.

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

Dodd, M. 2003. Northern Recovery Unit - Nesting Female Abundance and Population Trends. Presentation to the Atlantic Loggerhead Sea Turtle Recovery Team, April 2003.

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

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

Durbin, E, G. Teegarden, R. Campbell, A. Cembella, M.F. Baumgartner, B.R. Mate. 2002. North Atlantic right whales, *Eubalaena glacialis*, exposed to Paralytic Shellfish Poisoning (PSP) toxins via a zooplankton vector, *Calanus finmarchicus*. Harmful Algae 1: 243-251.

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

Dutton, P.H., C. Hitipeuw, M. Zein, S.R. Benson, G. Petro, J. Pita, V. Rei, L. Ambio, and J. Bakarbessy. 2007. Status and genetic structure of nesting populations of leatherback turtles (*Dermochelys coriacea*) in the Western Pacific. Chelonian Conservation and Biology 6(1): 47-53.

Dwyer, K.L., C.E. Ryder, and R. Prescott. 2002. Anthropogenic mortality of leatherback sea turtles in Massachusetts waters. Poster presentation for the 2002 Northeast Stranding Network Symposium.

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

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

Eckert, S.A., D. Bagley, S. Kubis, L. Ehrhart, C. Johnson, K. Stewart, and D. DeFreese. 2006. Internesting and postnesting movements of foraging habitats of leatherback sea turtles (*Dermochelys coriacea*) nesting in Florida. Chel. Cons. Biol. 5(2): 239-248.

Ehrhart, L.M., D.A. Bagley, and W.E. Redfoot. 2003. Loggerhead turtles in the Atlantic Ocean: geographic distribution, abundance, and population status. Pp. 157-174 In: Bolten, A.B. and B.E. Witherington (eds.). Loggerhead Sea Turtles. Smithsonian Institution Press, Washington D.C.

Elliott, W. and M. Simmonds. 2007. Whales in Hot Water? The impact of a changing climate on whales, dolphins and porpoises: A call for action. WWF-International, Gland Switzerland/WDCS, Chippenham, UK. 14 pp.

Encyclopedia Britannica. 2008. Neritic Zone Defined. Retrieved March 8, 2008, from Encyclopedia Britannica Online: http://www.britannica.com/eb/article-9055318.

Environmental Protection Agency (EPA). 1986. Quality Criteria for Water. EPA 440/5-86-001.

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

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

Epperly, S.P., J. Braun, A.J. Chester, F.A. Cross, J.V. Merriner and P.A. Tester. 1995b. Winter distribution of sea turtles in the vicinity of Cape Hatteras and their interactions with the summer flounder trawl fishery. Bull. of Marine Sci. 56(2): 547-568.

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

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

Epperly, S.P. and J. Braun-McNeill. 2002. The use of AVHRR imagery and the management of sea turtle interactions in the Mid-Atlantic Bight. National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL. 8pp.

Epperly, S.P., J. Braun-McNeill, and P.M. Richards. 2007. Trends in catch rates of sea turtles in North Carolina, USA. Endangered Species Research 3: 283-293.

Ehrhart. L.M., W.E. Redfoot, and D.A. Bagley. 2007. Marine turtles of the central region of the Indian River Lagoon System, Florida. Florida Scientist 70(4): 415-434.

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

Ferreira, M.B., M. Garcia, and A. Al-Kiyumi. 2003. Human and natural threats to the green turtles, *Chelonia mydas*, at Ra's al Hadd turtle reserve, Arabian Sea, Sultanate of Oman. Page 142 in J.A. Seminoff, compiler. Proceedings of the Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-503.

Fish, M.R., I.M. Cote, J.A. Gill, A.P. Jones, S. Renshoff, A.R.Watkinson. 2005. Predicting the impact of sea-level rise on Caribbean sea turtle nesting habitat. Conserv Biol 19: 482–491.

FPL (Florida Power and Light Company) and Quantum Resources. 2005. Florida Power and Light Company, St. Lucie Plant Annual Environmental Operating Report, 2002. 57 pp.

Frasier, T.R., B.A. McLeod, R.M. Gillett, M.W. Brown and B.N. White. 2007. Right Whales Past and Present as Revealed by Their Genes. Pp 200-231. *In*: S.D. Kraus and R.M. Rolland (eds) *The Urban Whale*. Harvard University Press, Cambridge, Massachusetts, London, England. vii-xv + 543pp.

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

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

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

Gagosian, R.B. 2003. Abrupt climate change: should we be worried? Prepared for a panel on abrupt climate change at the World Economic Forum, Davos, Switzerland, January 27, 2003. 9pp.

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

Garner, J.A, and S.A. Garner. 2007. Tagging and nesting research of leatherback sea turtles (*Dermochelys coriacea*) on Sandy Point St. Croix, U.S. Virgin Islands. Annual Report to U.S. Fish and Wildlife Service. WIMARCS Publication.

Garrison, L.P., L. Stokes, and C. Fairfield. 2009. Estimated bycatch of marine mammals and sea turtles in the U.S. Atlantic pelagic longline fleet during 2008. NOAA Technical Memorandum NMFS-SEFSC-591: 1-58.

George, R.H. 1997. Health Problems and Diseases of Sea Turtles. Pages 363-386 in P.L. Lutz and J.A. Musick, eds. The Biology of Sea Turtles. Boca Raton, Florida: CRC Press.

Geraci, Joseph R., Daniel M. Anderson, R.J. Timperi, David J. St. Aubin, Gregory A. Early, John H.Prescott, and Charles A. Mayo. 1989. Humpback Whales (*Megaptera novaeangliae*) Fatally Poisoned by Dinoflagellate Toxin. Can. J. Fish. and Aquat. Sci. 46(11): 1895-1898.

GHD. (2005). Port of Hay Point Apron Areas and Departure Path Capital Dredging: Draft EIS. GHD Pty Ltd.

Girondot, M. and J. Fretey. 1996. Leatherback turtles, *Dermochelys coriacea*, nesting in French Guiana 1978-1995. Chelonian Conserv Biol 2: 204–208.

Girondot, M., M.H. Godfrey, L. Ponge, and P. Rivalan. 2007. Modeling approaches to quantify leatherback nesting trends in French Guiana and Suriname. Chelonian Conservation and Biology 6(1): 37-46.

Glass, A. H., T. V. N. Cole, M. Garron, R. L. Merrick, and R. M. Pace III. 2008. Mortality and Serious Injury Determinations for Baleen Whale Stocks Along the United States Eastern Seaboard and Adjacent Canadian Maritimes, 2002-2006. Northeast Fisheries Science Center Document 08-04; 18 pp.

Glass AH, Cole TVN, Garron M. 2009. Mortality and serious injury determinations for baleen whale stocks along the United States eastern seaboard and adjacent Canadian Maritimes, 2003-2007 (2nd Edition). US Dep Commer, Northeast Fish Sci Cent Ref Doc. 09-04; 19 p.

Glass A, Cole TVN, Garron M. 2010. Mortality and Serious Injury Determinations for Baleen Whale Stocks along the United States and Canadian Eastern Seaboards, 2004-2008. NOAA Technical Memorandum NMFS NE 214 19 p. Available from: National Marine Fisheries Service, 166 Water Street, Woods Hole, MA 02543-1026, or online at http://www.nefsc.noaa.gov/nefsc/publications/

Glen, F., A.C. Broderick, B.J. Godley, and G.C. Hays. 2003. Incubation environment affects phenotype of naturally incubated green turtle hatchlings. Journal of the Marine Biological Association of the United Kingdom 83(5): 1183-1186.

GMFMC (Gulf of Mexico Fishery Management Council). 2007. Amendment 27 to the Reef Fish FMP and Amendment 14 to the Shrimp FMP to end overfishing and rebuild the red snapper stock. Tampa, Florida: Gulf of Mexico Fishery Management Council. 490 pp. with appendices.

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

Goldenberg, S.B., C.W. Landsea, A.M. Mestas-Nunez, W.M. Gray. 2001. The recent increase in Atlantic hurricane activity: causes and implications. Science 293:474–479

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

Greene, C.R. 1985a. Characteristics of waterborne industrial noise, 1980-1984. p. 197-253 In: W.J. Richardson (ed.), Behavior, disturbance responses and distribution of bowhead whales *Balaena mysticetus* in the eastern Beaufort Sea, 1980-1984. OCS Study MMS 85-0034. Rep. from LGL Ecol. Res. Assoc. Inc., Bryan, TX, for U.S. Minerals Management Service, Reston, Virgina. 306 p. NTIS PB87-124376.

Greene, R.J. Jr. 1987. Characteristics of oil industry dredge and drilling sounds in the Beaufort Sea. Journal of Acoustical Society of America 82: 1315-1324.

Greene, K. 2002. Beach Nourishment: A Review of the Biological and Physical Impacts. Atlantic States Marine Fisheries Commission (ASMFC) Habitat Management Series #7. 179 pp.

Greene, C.H., A.J. Pershing, R.D. Kenney, and J.W. Jossi. 2003. Impact of climate variability on the recover of endangered North Atlantic right whales. Oceanography 16: 96-101.

Greene, C.H and A.J. Pershing. 2004. Climate and the conservation biology of North Atlantic right whales: the right whale at the wrong time? Frontiers in Ecology and the Environment 2(1): 29-34.

Guerra-Garcia, J.M. and J. C. Garcia-Gomez. 2006. Recolonization of defaunated sediments: Fine versus gross sand and dredging versus experimental trays. Estuarine Coastal and Shelf Science 68 (1-2): 328-342

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

Hall, J.D., M. Gallagher, K. Brewer, P. Regos, and P. Isert. 1994. 1993 Kuvlum Exploration Area Site Specific Monitoring Program. Prepared for ARCO Alaska, Inc., Anchorage, AK, by Coastal and Offshore Pacific Corporation, Walnut Creek, CA.

Hamann, M., C.J. Limpus, and M.A. Read. 2007. Chapter 15 Vulnerability of marine reptiles in the Great Barrier Reef to climate change. *In:* Johnson JE, Marshall PA (eds) Climate change and the Great Barrier Reef: a vulnerability assessment, Great Barrier Reef Marine Park Authority and Australia Greenhouse Office, Hobart, p 465–496.

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

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

Hamilton, P.K., A. R. Knowlton, and S. D. Kraus. 2008. Maintenance of the North Atlantic right whale catalog: 1 January-31 December 2007. Final report to the Northeast Fisheries Science Center, NMFS, Contract No. EA133F-05-CN-1231. Edgerton Research Laboratory, New England Aquarium: 27pp.

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

Hawkes, L. A. Broderick, M. Godfrey and B. Godley. 2005. Status of nesting loggerhead turtles, *Caretta caretta,* at Bald Head Island (North Carolina, USA) after 24 years of intensive monitoring and conservation. Oryx. 39(1): 65-72.

Hawkes, L.A., A.C. Broderick, M.S. Coyne, M.H. Godfrey, L.-F. Lopez-Jurado, P. Lopez-Suarez, S.E. Merino, N. Varo-Cruz, and B.J. Godley. 2006. Phenotypically linked dichotomy in sea turtle foraging requires multiple conservation approaches. Current Biology 16: 990-995.

Hawkes, L.A., A.C. Broderick, M.H. Godfrey, and B.J. Godley. 2007. Investigating the potential impacts of climate change on a marine turtle population. Global Change Biology 13: 1-10.

Hawkes, L.A., A.C. Broderick, M.H. Godfrey, and B.J. Godley. 2009. Climate change and marine turtles. Endangered Species Research 7: 137-159.

Hays, G.C., A.C. Broderick, F. Glen, B.J. Godley, J.D.R. Houghton, and J.D. Metcalfe. 2002. Water temperature and internesting intervals for loggerhead (*Caretta caretta*) and green (*Chelonia mydas*) sea turtles. Journal of Thermal Biology 27: 429-432.

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

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

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

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

Intergovernmental Panel on Climate Change (IPCC). 2007. Summary for Policymakers. Cambridge University Press, Cambridge.

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

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

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

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

International Whaling Commission [IWC]. 1997. Report of the IWC workshop on climate change and cetaceans. *Report ofthe International Whaling Commission* 47: 293-313.

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

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

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

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

James, M.C., C.A. Ottensmeyer, and R.A. Myers. 2005b. Identification of high-use habitat and threats to leatherback sea turtles in northern waters: new directions for conservation. Ecol. Lett. 8: 195-201.

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

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

Jones A.R., W. Gladstone, N.J. Hacking. 2007. Australian sandy beach ecosystems and climate change: ecology and management. Aust Zool 34:190–202

Kasparek, M., B.J. Godley, and A.C. Broderick. 2001. Nesting of the green turtle, *Chelonia mydas*, in the Mediterranean: a review of status and conservation needs. Zoology in the Middle East 24: 45-74.

Kelle, L., N. Gratiot, I. Nolibos, J. Therese, R. Wongsopawiro, and B. DeThoisy. 2007. Monitoring of nesting leatherback turtles (*Dermochelys coriacea*): contribution of remote-sensing for real time assessment of beach coverage in French Guiana. Chelonian Conserv Biol 6: 142–149.

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

Kenney, R.D. 2001. Anomalous 1992 spring and summer right whale (*Eubalaena glacialis*) distribution in the Gulf of Maine. Journal of Cetacean Research and Management (special Issue) 2: 209-23.

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

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

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

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

Ketten, D.R. and S.M. Bartol. (2005). Functional Measures of Sea Turtle Hearing. ONR Award No: N00014-02-1-0510.

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

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

Kraus, S.D. 1990. Rates and potential causes of mortality in North Atlantic right whales (*Eubaleana glacialis*). Mar. Mamm. Sci. 6(4): 278-291.

Kraus, S.D., J. H. Prescott, and A. R. Knowlton. 1986. Wintering right whales (*Eubalaena glacialis*) along the Southeastern coast of the United, 1984-1986. New England Aquarium: 15pp. Kraus, S.D., M.J. Crone, and A.R. Knowlton. 1988. The North Atlantic right whale. Pages 684-98 *in* W.J. Chandler, ed. Audbon wildlife report 1988/1989. Academic Press, San Diego, CA.

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

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

Kraus S.D., R. M. Pace III and T.R. Frasier. 2007. High Investment, Low Return: The Strange Case of Reproduction in *Eubalaena Glacialis*. Pp 172-199. *In*: S.D. Kraus and R.M. Rolland (eds) *The Urban Whale*. Harvard University Press, Cambridge, Massachusetts, London, England. vii-xv + 543pp.

Kuller, Z. 1999. Current status and conservation of marine turtles on the Mediterranean coast of Israel. Marine Turtle Newsletter 86: 3-5.

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

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

Lalli, C.M. and T.R. Parsons. 1997. Biological oceanography: An introduction – 2nd Edition. Pages 1-13. Butterworth-Heinemann Publications. 335 pp.

Laurent, L., P. Casale, M.N. Bradai, B.J. Godley, G. Gerosa, A.C. Broderick, W. Schroth, B. Schierwater, A.M. Levy, D. Freggi, E.M. Abd El-Mawla, D.A. Hadoud, H.E. Gomati, M. Domingo, M. Hadjichristophorou, L. Kornaraki, F. Demirayak, and C. Gautier. 1998. Molecular resolution of the marine turtle stock composition in fishery bycatch: A case study in the Mediterranean. Molecular Ecology 7: 1529-1542.

Learmonth, J.A., C.D. MacLeod, M.B. Santos, G.J. Pierce, H.Q.P. Crick, and R.A. Robinson. 2006. Potential effects of climate change on marine mammals. Oceanogr Mar Biol Annu Rev 44: 431-464.

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

Lenhardt, M.L., S. Moein, and J. Musick. 1996. A method for determining hearing thresholds in marine turtles. Proceedings of the Fifteenth Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-387, pp 160-162.

Lewison, R.L., L.B. Crowder, and D.J. Shaver. 2003. The impact of turtle excluder devices and fisheries closures on loggerhead and Kemp's ridley strandings in the western Gulf of Mexico. Conservation Biology 17(4): 1089-1097.

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

Limpus, C.J. and D.J. Limpus. 2000. Mangroves in the diet of *Chelonia mydas* in Queensland, Australia. Mar Turtle Newsl 89: 13–15.

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

Lutcavage, M.E. and P.L. Lutz. 1997. Diving Physiology. Pp. 277-296 *in* The Biology of Sea Turtles. P.L. Lutz and J.A. Musick (Eds). CRC Press.

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

MacLeod, C.D. 2009. Globalclimate change, range changes and potential implications for the conservation of marine cetaceans: a review and synthesis. Endang Species Res 7: 125-136.

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

Maier, P. P., A. L. Segars, M. D. Arendt, J. D. Whitaker, B. W. Stender, L. Parker, R. Vendetti, D. W. Owens, J. Quattro, and S. R. Murphy. 2004. Development of an index of sea turtle abundance based on in-water sampling with trawl gear. Final report to the National Marine Fisheries Service. 86 pp.

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

MALSF (Marine Aggregate Levy Sustainability Fund). 2009. A generic investigation into noise profiles of marine dredging in relation to the acoustic sensitivity of the marine fauna in UK waters with particular emphasis on aggregate dredging: Phase I Scoping and Review of key issues. MEPF Ref No.: MEPF 08/21.

Mansfield, K. L. 2006. Sources of mortality, movements, and behavior of sea turtles in Virginia. Chapter 5. Sea turtle population estimates in Virginia. pp.193-240. Ph.D. dissertation. School of Marine Science, College of William and Mary.

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

Marcovaldi, M.A., and M. Chaloupka. 2007. Conservation status of the loggerhead sea turtle in Brazil: an encouraging outlook. Endangered Species Research 3: 133-143.

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

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

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

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

Martin, R.E. 1996. Storm impacts on loggerhead turtle reproductive success. Mar Turtle Newsl 73:10–12.

Mazaris A.D., G. Mastinos, J.D. Pantis. 2009. Evaluating the impacts of coastal squeeze on sea turtle nesting. Ocean Coast Manag 52:139–145.

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

McClellan, C.M., and A.J. Read. 2007. Complexity and variation in loggerhead sea turtle life history. Biology Letters 3: 592-594.

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

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

Meylan, A., B.E. Witherington, B. Brost, R. Rivero, and P.S. Kubilis. 2006. Sea turtle nesting in Florida, USA: Assessments of abundance and trends for regionally significant populations of Caretta, Chelonia, and Dermochelys. pp 306-307. *In*: M. Frick, A. Panagopoulou, A. Rees, and K. Williams (compilers). 26th Annual Symposium on Sea Turtle Biology and Conservation Book of Abstracts.

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

Mitchell, E., V.M. Kozicki, and R.R. Reeves. 1986. Sightings of right whales, *Eubalaena glacialis*, on the Scotian Shelf, 1966-1972. Reports of the International Whaling Commission (Special issue) 10: 83-107.

Mitchell, G.H., R.D. Kenney, A.M. Farak, and R.J. Campbell. 2003. Evaluation of occurrence of endangered and threatened marine species in naval ship trial areas and transit lanes in the Gulf of Maine and offshore of Georges Bank. NUWC-NPT Technical Memo 02-121A. March 2003. 113 pp.

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

Moore, JC and E. Clark. 1963. Discovery of Right Whales in the Gulf of Mexico. Science 141: 269.

Moore M.J., A.R., Knowlton, S.D. Kraus, W.A. McLellan, R.K. Bonde. 2004. Morphometry, gross morphology and available histopathology in North Atlantic right whale (*Eubalaena glacialis*) mortalities (1970–2002). Journal of Cetacean Research and Management 6(3): 199-214.

Moore, M.J., W.A. McLellan, P.Daous, R.K. Bonde and A.R. Knowlton. 2007. Right Whale Mortality: A Message from the Dead to the Living. Pp 358-379. *In*: S.D. Kraus and R.M. Rolland (eds) *The Urban Whale*. Harvard University Press, Cambridge, Massachusetts, London, England. vii-xv + 543pp.

Morreale, S.J. and E.A. Standora. 1990. Occurrence, movement, and behavior of the Kemp's ridley and other sea turtles in New York waters. Annual report for the NYSDEC, Return A Gift To Wildlife Program, April 1989 - April 1990.

Morreale, S.J., and E.A. Standora. 1993. Occurrence, movement, and behavior of the Kemp's ridley and other sea turtles in New York waters. Okeanos Ocean Research Foundation Final Report April 1988-March 1993. 70 pp.

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

Morreale, S.J., C.F. Smith, K. Durham, R.A. DiGiovanni, Jr., and A.A. Aguirre. 2005. Assessing health, status, and trends in northeastern sea turtle populations. Interim report - Sept. 2002 - Nov. 2004. Gloucester, Massachusetts: National Marine Fisheries Service.

NMFS Southeast Fisheries Science Center (SEFSC). 2001. Stock assessments of loggerheads and leatherback sea turtles and an assessment of the impact of the pelagic longline fishery on the loggerhead and leatherback sea turtles of the Western North Atlantic. U.S. Department of Commerce, National Marine Fisheries Service, Miami, FL, SEFSC Contribution PRD-00/01-08; Parts I-III and Appendices I-IV. NOAA Tech. Memo NMFS-SEFSC-455, 343 pp.

NMFS SEFSC. 2009. An assessment of loggerhead sea turtles to estimate impacts of mortality reductions on population dynamics. NMFS SEFSC Contribution PRD-08/09-14. 45 pp.

NMFS and U.S. Fish and Wildlife Service (USFWS). 1991a. Recovery plan for U.S. population of loggerhead turtle. National Marine Fisheries Service, Washington, D.C. 64 pp.

NMFS and USFWS. 1991b. Recovery plan for U.S. population of Atlantic green turtle. National Marine Fisheries Service, Washington, D.C. 58 pp.

NMFS and USFWS. 1992. Recovery plan for leatherback turtles in the U.S. Caribbean, Atlantic, and Gulf of Mexico. National Marine Fisheries Service, Washington, D.C. 65 pp.

NMFS and USFWS. 1995. Status reviews for sea turtles listed under the Endangered Species Act of 1973. National Marine Fisheries Service, Silver Spring, Maryland. 139 pp.

NMFS and USFWS. 1998. Recovery Plan for the U.S. Pacific Population of the Leatherback Turtle (*Dermochelys coriacea*). National Marine Fisheries Service, Silver Spring, Maryland.

NMFS and USFWS. 2007a. Loggerhead sea turtle (*Caretta caretta*) 5-year review: Summary and Evaluation. National Marine Fisheries Service, Silver Spring, Maryland. 65pp.

NMFS and FWS. 2007b. Kemp's ridley sea turtle (*Lepidochelys kempii*) 5 year review: summary and evaluation. National Marine Fisheries Service, Silver Spring, Maryland. 50 pp.

NMFS and FWS. 2007c. Green sea turtle (*Chelonia mydas*) 5 year review: summary and evaluation. National Marine Fisheries Service, Silver Spring, Maryland. 102 pp.

NMFS and USFWS. 2007d. Leatherback sea turtle (*Dermochelys coriacea*) 5 year review: summary and evaluation. National Marine Fisheries Service, Silver Spring, Maryland. 79 pp.

NMFS and USFWS. 2008. Recovery plan for the Northwest Atlantic population of the loggerhead turtle (*Caretta caretta*), Second revision. Washington, D.C.: National Marine Fisheries Service. 325 pp.

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

NRC. 2003. Ocean noise and marine mammals. National Academy Press; Washington, D.C.

Nicholls, R.J. 1998. Coastal vulnerability assessment for sea level rise: evaluation and selection of methodologies for implementation. Technical Report R098002, Caribbean Planning for Adaption to Global Climate Change (CPACC) Project. Available at: www.cpacc.org.

Nowacek, D.P., M. P. Johnson and P. L. Tyack. 2004. North Atlantic right whales (*Eubalaena glacialis*) ignore ships but respond to alerting stimuli. Proc. R. Soc. Lond. B **271**: 227–231.

Pace, R.M. III, S.D. Kraus, P.K. Hamilton and A.R. Knowlton. 2008. Life on the edge: examining North Atlantic right whale population viability using updated reproduction data and survival estimates. 17th Biennial Meeting of the Society for Marine Mammalogy. South Africa.

Palka, D. 1995. Abundance estimate of the Gulf of Maine harbor porpoise. Rep. Int. Whal. Comm. (Special Issue) 16: 27-50.

Palka, D.L. 2006. Summer abundance estimates of cetaceans in US North Atlantic Navy Operating Areas. Northeast Fish. Sci. Cent. Ref. Doc. 06-03. 41 pp. http://www.nefsc.noaa.gov/nefsc/publications/crd/crd0603/crd0603.pdf

Palka , D. 2000. Abundance and distribution of sea turtles estimated from data collected during cetacean surveys. *In*: Bjorndal, K.A. and A.B. Bolten. Proceedings of a workshop on assessing abundance and trends for in-water sea turtle populations. U.S. Dep. Commer. NOAA Tech. Mem. NMFS-SEFSC-445, 83pp.

Parks, S.E. and P.L. Tyack. 2005. Sound production by North Atlantic right whales (*Eubalaena glacialis*) in surface active groups. J. Acoust. Soc. Am. 117(5): 3297-3306.

Parvin, S.J., J.R. Nedwell, J. Kynoch, J. Lovell, and A.G. Brooker. (2008). Assessment of underwater noise from dredging operations on the Hastings shingle bank. Report No. Subacoustech 758R0137.

Payne, P.M., J.R. Nicolas, L. O'Brien, and K.D. Powers. 1986. The distribution of the humpback whale on Georges Bank and in the Gulf of Maine in relation to densities of the sand eel (*Ammodytes americanus*). Fishery Bulletin 84 (2): 271-277.

Payne, K. and R.S. Payne. 1985. Large-scale changes over 17 years in songs of humpback whales in Bermuda. Z. Tierpsychol. 68: 89-114.

Payne, P.M., D.N. Wiley, S.B. Young, S. Pittman, P.J. Clapham, and J.W.Jossi. 1990. Recent fluctuations in the abundance of baleen whales in the southern Gulf of Maine in relation to changes in selected prey. Fish. Bull. 88 (4): 687-696.

Pearce, A.F. 2001. Contrasting population structure of the loggerhead turtle (*Caretta caretta*) using mitochondrial and nuclear DNA markers. Master's thesis, University of Florida. 71 pp.

Pearce, A.F. and B.W. Bowen. 2001. Final report: Identification of loggerhead (Caretta caretta) stock structure in the southeastern United States and adjacent regions using nuclear DNA markers. Project number T-99-SEC-04. Submitted to the National Marine Fisheries Service, May 7, 2001. 79 pp.

Perry, S.L., D.P. DeMaster, and G.K. Silber. 1999. The great whales: History and status of six species listed as endangered under the U.S. Endangered Species Act of 1973. Mar. Fish. Rev. Special Edition. 61(1): 59-74.

Pike, D.A., R.L. Antworth, and J.C. Stiner. 2006. Earlier nesting contributes to shorter nesting seasons for the loggerhead sea turtle, *Caretta caretta*. Journal of Herpetology 40(1): 91-94.

Pike, D.A. and J.C. Stiner. 2007. Sea turtle species vary in their susceptibility to tropical cyclones. Oecologia 153: 471–478.

Plaziat, J.C., and P.G.E.F. Augustinius. 2004. Evolution of progradation/ erosion along the French Guiana magrove coast: a comparison of mapped shorelines since the 18th century with Holocene data. Mar Geol 208: 127–143.

Pritchard, P.C.H. 1982. Nesting of the leatherback turtle, *Dermochelys coriacea*, in Pacific, Mexico, with a new estimate of the world population status. Copeia 1982: 741-747.

Pritchard, P.C.H. 2002. Global status of sea turtles: An overview. Document INF-001 prepared for the Inter-American Convention for the Protection and Conservation of Sea Turtles, First Conference of the Parties (COP1IAC), First part August 6-8, 2002.

Prusty, G., S. Dash, and M.P. Singh. 2007. Spatio-temporal analysis of multi-date IRS imageries for turtle habitat dynamics characterisation at Gahirmatha coast, India. Int J Remote Sens 28: 871–883

Rahmstorf, S. 1997. Risk of sea-change in the Atlantic. Nature 388: 825–826.

Rahmstorf, S. 1999. Shifting seas in the greenhouse? Nature 399: 523–524.

Rebel, T.P. 1974. Sea turtles and the turtle industry of the West Indies, Florida and the Gulf of Mexico. Univ. Miami Press, Coral Gables, Florida.

Rees, A.F., A. Saad, and M. Jony. 2005. Marine turtle nesting survey, Syria 2004: discovery of a "major" green turtle nesting area. Page 38 in Book of Abstracts of the Second Mediterranean Conference on Marine Turtles. Antalya, Turkey, 4-7 May 2005.

Richardson, W.J., M.A. Fraker, B. Wursig, and R.S. Wells. 1985. Behavior of bowhead whales *Balaena mysticetus* summering in the Beaufort Sea: Reactions to industrial activities. Biol. Conserv. 32: 195-230.

Richardson, W.J., B. Wuersig, and C.R. Green. 1990. Reactions of bowhead whales, *Balaena mysticetus*, to drilling and dredging noise in the Canadian Beaufort Sea. Marine Environmental Research 29: 135-160.

Richardson, W.J., C.I. Malme, C.R. Green, and D.H. Thomson. 1995. Marine Mammals and noise: Volume 1. Academic Press, San Diego California.

Ridgway, S.H., E.G. Weaver, J.G. McCormick, J. Palin, and J.H. Anderson. 1969. Hearing in the Giant Sea Turtle, *Chelonia mydas*. Proceedings of the National Academy of Sciences 64(3): 884-890.

Rivalan, P., P.H. Dutton, E. Baudry, S.E. Roden, and M. Girondot. 2005. Demographic scenario inferred from genetic data in leatherback turtles nesting in French Guiana and Suriname. Biol Conserv 1: 1–9.

Robbins, J., and D. Mattila. 1999. Monitoring entanglement scars on the caudal peduncle of Gulf of Maine humpback whales. Report to the National Marine Fisheries Service. Order No. 40EANF800288. 15 pp.

Rolland, R.M, K.E. Hunt, G.J. Doucette, L.G. Rickard and S. K. Wasser. 2007. The Inner Whale: Hormones, Biotoxins, and Parasites. Pp 232-272. *In*: S.D. Kraus and R.M. Rolland (eds) *The Urban Whale*. Harvard University Press, Cambridge, Massachusetts, London, England. vii-xv + 543pp.

Ross, J.P. 1996. Caution urged in the interpretation of trends at nesting beaches. Marine Turtle Newsletter 74: 9-10.

Ross. J.P. 2005. Hurricane effects on nesting *Caretta caretta*. Mar Turtle Newsl 108:13–14.

Ruben, H.J, and S.J. Morreale. 1999. Draft Biological Assessment for Sea Turtles in New York and New Jersey Harbor Complex. Unpublished Biological Assessment submitted to National Marine Fisheries Service.

Sarti, L., S.A. Eckert, N. Garcia, and A.R. Barragan. 1996. Decline of the world's largest nesting assemblage of leatherback turtles. Marine Turtle Newsletter 74: 2-5.

Sarti, L., S. Eckert, P. Dutton, A. Barragán, and N. García. 2000. The current situation of the leatherback population on the Pacific coast of Mexico and central America, abundance and distribution of the nestings: an update. Pages 85-87 *In*: H. Kalb and T. Wibbels, compilers. Proceedings of the Nineteenth Annual Symposium on Sea Turtle Conservation and Biology. NOAA Technical Memorandum NMFS-SEFSC-443.

Sarti Martinez, L., A.R. Barragan, D.G. Munoz, N. Garcia, P. Huerta, and F. Vargas. 2007. Conservation and biology of the leatherback turtle in the Mexican Pacific. Chelonian Conservation and Biology 6(1): 70-78.

Schaeff, C.M., Kraus, S.D., Brown, M.W., Perkins, J.S., Payne, R., and White, B.N. 1997. Comparison of genetic variability of North and South Atlantic right whales (*Eubalaena*), using DNA fingerprinting. Can. J. Zool. 75: 1073-1080.

Schevill, WE., WA Watkins, and KE Moore. 1986. Status of *Eubalaena glacialis* off Cape Cod. Report of the International Whaling Commission, Special Issue 10: 79-82.

Schick, Robert S., P.N. Halpin, A.J. Read, C.K. Slay, S.D. Kraus, B.R. Mate, M.F. Baumgartner, J.J. Roberts, B.D. Best, C.P. Good, S.R. Loarie, and J.S. Clark. 2009. Striking the right balance in right whale conservation. NRC Research Press Web site at cjfas.nrc.ca. J21103.

Schmid, J.R., and W.N. Witzell. 1997. Age and growth of wild Kemp's ridley turtles (*Lepidochelys kempi*): cumulative results of tagging studies in Florida. Chelonian Conservation and Biology 2(4): 532-537.

Schmidly, D.J., CO Martin, and GF Collins. 1972. First occurrence of a black right whale (*Balaena glacialis*) along the Texas coast. The Southwestern Naturalist.

Schubel, J.R., H.H. Carter, R.E. Wilson, W.M. Wise, M.G. Heaton, and M.G. Gross. 1978. Field investigations of the nature, degree, and extent of turbidity generated by open-water pipeline disposal operations. Technical Report D-78-30; U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss., 245 pp.

Schultz, J.P. 1975. Sea turtles nesting in Surinam. Zoologische Verhandelingen (Leiden), Number 143: 172 pp.

Seaturtle.org. Sea turtle tracking database. Available at http://www.seaturtle.org. Accessed on August 23, 2007.

Seipt, I., P.J. Clapham, C.A. Mayo, and M.P. Hawvermale. 1990. Population characteristics of individually identified fin whales, *Balaenoptera physalus*, in Massachusetts Bay. Fish. Bull. 88: 271-278.

Sella, I. 1982. Sea turtles in the EasternMediterranean and Northern Red Sea. Pages 417-423 in Bjorndal, K.A. (editor). Biology and Conservation of Sea Turltes. Smithsonian Institution Press, Washington, D.C.

Seminoff, J.A. 2004. Chelonia mydas. In 2007 IUCN Red List of Threatened Species. Accessed 31 July 2009. http://www.iucnredlist.org/search/details.php/4615/summ.

Shamblin, B.M. 2007. Population structure of loggerhead sea turtles (*Caretta caretta*) nesting in the southeastern United States inferred from mitochondrial DNA sequences and microsatellite loci. Master's thesis, University of Georgia. 59 pp.

Shoop, C.R. 1987. The Sea Turtles. Pages 357-358 in R.H. Backus and D.W. Bourne, eds. Georges Bank. Cambridge, Massachusetts: MIT Press.

Shoop, C.R. and R.D. Kenney. 1992. Seasonal distributions and abundances of loggerhead and leatherback sea turtles in waters of the northeastern United States. Herpetological Monographs 6: 43-67.

Short, F.T. and H.A. Neckles. 1999. The effects of global climate change on seagrasses. Aquat Bot 63: 169–196.

Slay, C.K. and J.I. Richardson. 1988. King's Bay, Georgia: Dredging and Turtles. Schroeder, B.A. (compiler). Proceedings of the eighth annual conference on sea turtle biology and conservation. NOAA Technical Memorandum NMFS-SEFC-214, pp. 109-111.

Snover, M.L., A.A. Hohn, L.B. Crowder, and S.S. Heppell. 2007. Age and growth in Kemp's ridley sea turtles: evidence from mark-recapture and skeletochronology. Pages 89-106 in P.T. Plotkin, ed. Biology and Conservation of Ridley Sea Turtles. Baltimore, Maryland: Johns Hopkins University Press.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finnegan, R.L. Gentry, C.R.J. Greene, D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas, and P. Tyack. 2007. Marine mammal noise exposure criteria : initial scientific recommendations. Aquatic Mammals 33: 411-521.

South Carolina Department of Natural Resources. 2007. Examination of Local Movement and Migratory Behavior of Sea Turtles during spring and summer along the Atlantic coast off the southeastern United States. Unpublished report submitted to NMFS as required by ESA Permit 1540. 45 pp.

Spotila, J.R., A.E. Dunham, A.J. Leslie, A.C. Steyermark, P.T. Plotkin, and F. V. Paladino. 1996. Worldwide Population Decline of *Demochelys coriacea*: Are Leatherback Turtles Going Extinct? Chelonian Conservation and Biology 2(2): 209-222.

Spotila, J.R., R.D. Reina, A.C. Steyermark, P.T. Plotkin, F.V. Paladino. 2000. Nature 405: 529-530.

Stephens, S.H., and J. Alvarado-Bremer. 2003. Preliminary information on the effective population size of the Kemp's ridley (*Lepidochelys kempii*) sea turtle. Page 250 *In*: J.A. Seminoff, compiler. Proceedings of the Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-503.

Stetzar, E.J. 2002. Population characterization of sea turtles that seasonally inhabit the Delaware Estuary. Masters thesis, Delaware State University, 146pp.

Stevick P.T., J. Allen, P.J. Clapham, N. Friday, S.K. Katona, F. Larsen, J. Lien, D.K. Matilla, P.J. Palsboll, J. Sigurjonsson, T.D. Smith, N. Oien, P.S. Hammond. 2003. North Atlantic humpback whale abundance and rate of increase four decades after protection from whaling. Marine Ecology Progress Series. 258: 263-273.

Stevick, P. T., J. Allen, P. J. Clapham, S. K. Katona, F. Larsen, J. Lien, D. K. Mattila, P. J. Palsbøll, R. Sears, J. Sigurjonsson, T. D. Smith, G. Vikingsson, N. Øien and P. S. Hammond. 2006. Population spatial structuring on the feeding grounds in North Atlantic humpback whales (*Megaptera novaeangliae*). Journal of Zoology. 270: 244–255

Stocker, T.F. and A. Schmittner. 1997. Influence of CO2 emission rates on the stability of the thermohaline circulation. Nature 388: 862–865.

Stone, G.S., L. Flores-Gonzalez, and S. Cotton. 1990. Whale migration record. Nature 346: 705.

Suárez, A. 1999. Preliminary data on sea turtle harvest in the Kai Archipelago, Indonesia. Abstract appears in the 2nd ASEAN Symposium and Workshop on Sea Turtle Biology and Conservation, held from July 15-17, 1999, in Sabah, Malaysia.

Suárez, A., P.H. Dutton and J. Bakarbessy. 2000. Leatherback (*Dermochelys coriacea*) nesting on the North Vogelkop Coast of Irian Jaya, Indonesia. *In*: Kalb, H.J. and T. Wibbels, compilers. 2000. Proceedings of the Nineteenth Annual Symposium on Sea Turtle Biology and Conservation. U.S. Dept. Commerce. NOAA Tech. Memo. NMFS-SEFSC-443, 291p.

Swingle, W.M., S.G. Barco, T.D. Pitchford, W.A. McLellan, and D.A. Pabst. 1993. Appearance of juvenile humpback whales feeding in the nearshore waters of Virginia. Mar. Mamm. Sci. 9: 309-315.

Turtle Expert Working Group (TEWG). 1998. An assessment of the Kemp's ridley (*Lepidochelys kempii*) and loggerhead (*Caretta caretta*) sea turtle populations in the Western North Atlantic. NOAA Technical Memorandum NOAA Fisheries-SEFSC-409. 96 pp.

TEWG. 2000. Assessment update for the Kemp's ridley and loggerhead sea turtle populations in the western North Atlantic. U.S. Dep. Commer. NOAA Tech. Mem. NMFS-SEFSC-444, 115 pp.

TEWG. 2007. An assessment of the leatherback turtle population in the Atlantic Ocean. NOAA Technical Memorandum NMFS-SEFSC-555, 116 pp.

TEWG. 2009. An assessment of the loggerhead turtle population in the Western North Atlantic Ocean. NOAA Technical Memorandum NMFS-SEFSC-575: 1-131.

Tynan, C.T. and D.P. DeMaster. 1997. Observations and predictions of Arctic climatic change: potential effects on marine mammals. *Arctic* 50: 308-322.

U.S. Army Corps of Engineers (USACE). 1994. Beach Erosion Control and Hurricane Protection Study, Virginia Beach, Virginia- General Reevaluation Report, Main Report, Environmental Assessment , and Appendices. Norfolk District.

USACE. 2009b. North End Sand Borrow Site, NASA Wallops Flight Facility, Wallops Island, Virginia. Report of Subsurface Exploration and Laboratory Testing. Prepared by USACE Norfolk District, GEO Environmental Section, Fort Norfolk, 803 Front Street, Norfolk, Virginia 23510. November.

USACE. 2010a. Storm Damage Reduction Project Design for Wallops Island. USACE, Engineer Research and Development Center. Prepared by King D.B.Jr., D.L. Ward, M.H. Hudgins, and G.G. Williams. ERDC/LAB TR-0X-X. November.

USACE Environmental Laboratory. Sea Turtle Data Warehouse. Available at http://el.erdc.usace.army.mil/seaturtles/index.cfm. Accessed on August 6, 2007.

U.S. Fish and Wildlife Service (USFWS). 1997. Synopsis of the biological data on the green turtle, *Chelonia mydas* (Linnaeus 1758). Biological Report 97(1). U.S. Fish and Wildlife Service, Washington, D.C. 120 pp.

USFWS and NMFS. 1992. Recovery plan for the Kemp's ridley sea turtle (*Lepidochelys kempii*). NMFS, St. Petersburg, Florida.

Van Houton, K.S. and O.L. Bass. 2007. Stormy oceans are associated with declines in sea turtle hatching. Curr Biol 17: R590.

Waluda, C.M., P.G. Rodhouse, G.P. Podesta, P.N. Trathan, and G.J. Pierce. 2001. Surface oceanography of the inferred hatching grounds of *Illex argentinus* (Cephalopoda: Ommastrephidae) and influences on recruitment variability. *Marine Biology* 139: 671-679.

Waring, G.T., E. Josephson, C.P. Fairfield-Walsh, and K. Maze-Foley. 2007. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2006, 2nd edition, US Department of Commerce, NOAA Technical Memorandum NMFS -NE -201.

Waring, G.T., E. Josephson, C.P. Fairfield-Walsh, and K. Maze-Foley. 2008. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2007. NOAA Technical Memorandum NMFS NE 205; 415pp.

Waring GT, Josephson E, Fairfield-Walsh CP, Maze-Foley K, editors. 2009. Final U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2009. Available from: http://www.nmfs.noaa.gov/pr/sars/draft.htm

Watkins, W.A. 1981. Activities and underwater sounds of fin whales. Scientific Reports of the International Whaling Commission 33: 83-117.

Watkins, W.A. 1986. Whale reactions to human activities in Cape Cod waters. Marine Mammal Science 2(4): 251-262.

Watkins, W.A., and W.E. Schevill. 1982. Observations of right whales (*Eubalaena glacialis*) in Cape Cod waters. Fish. Bull. 80(4): 875-880.

Watkins, W.A., K.E. Moore, J. Sigurjonsson, D. Wartzok, and G. Notarbartolo di Sciara. 1984. Fin whale (*Balaenoptera physalus*) tracked by radio in the Irminger Sea. Rit Fiskideildar 8(1): 1-14.

Webster, P.J., G.J. Holland, J.A. Curry, H.R. Chang. 2005. Changes in tropical cyclone number, duration, and intensity in a warming environment. Science 309:1844–1846.

Weisbrod, A.V., D. Shea, M.J. Moore, and J.J. Stegeman. 2000. Organochlorine exposure and bioaccumulation in the endangered Northwest Atlantic right whale (*Eubalaena glacialis*) population. Environmental Toxicology and Chemistry, 19(3): 654-666.

Weishampel, J.F., D.A. Bagley, and L.M. Ehrhart. 2004. Earlier nesting by loggerhead sea turtles following sea surface warming. Global Change Biology 10: 1424-1427.

Wilber, D.H., D.G. Clarke & M.H. Burlas. (2006). Suspended sediment concentrations associated with a beach nourishment project on the northern coast of New Jersey. Journal of Coastal Research 22(5): 1035 – 1042.

Wiley, D.N., R.A. Asmutis, T.D. Pitchford, and D.P. Gannon. 1995. Stranding and mortality of humpback whales, *Megaptera novaengliae*, in the mid-Atlantic and southeast United States, 1985-1992. Fish. Bull. 93: 196-205.

Winn, H.E., C.A. Price, and P.W. Sorensen. 1986. The distributional biology of the right whale (*Eubalaena glacialis*) in the western North Atlantic. Reports of the International Whaling Commission (Special issue) 10: 129-138.

Wise, J.P, S.S. Wise, S. Kraus, R. Shaffley, M. Grau, T.L. Chen, C. Perkins, W.D. Thompson, T. Zhang, Y. Zhang, T. Romano and T. O'Hara. 2008. Hexavalent chromium is cytotoxic and genotoxic to the North Atlantic right whale (*Eubalaena glacialis*) lung and testes fibroblasts. Mutation Research - Genetic Toxicology and Environmental Mutagenesis. 650(1): 30-38.

Witherington, B., P. Kubilis, B. Brost, and A. Meylan. 2009. Decreasing annual nest counts in a globally important loggerhead sea turtle population. Ecological Applications 19: 30-54.

Witt, M.J., A.C. Broderick, D.J. Johns, C. Martin, R. Penrose, M.S. Hoogmoed, and B.J. Godley. 2007. Prey landscapes help identify potential foraging habitats for leatherback turtles in the NE Atlantic. Marine Ecology Progress Series 337: 231-243.

Witt, M.J., A.C. Broderick, M. Coyne, A. Formia and others. 2008. Satellite tracking highlights difficulties in the design of effective protected areas for critically endangered leatherback turtles *Dermochelys coriacea* during the inter-nesting period. Oryx 42: 296–300.

Witzell, W.N. 2002. Immature Atlantic loggerhead turtles (*Caretta caretta*): suggested changes to the life history model. Herpetological Review 33(4): 266-269.

Woodley, T.H., M.W. Brown, S.D. Kraus, and D.E. Gaskin. 1991. Organochlorine levels in North Atlantic right whale *(Eubalaena glacialis)* blubber. Arch. Environ. Contam. Toxicol. 21 (1): 141-145.

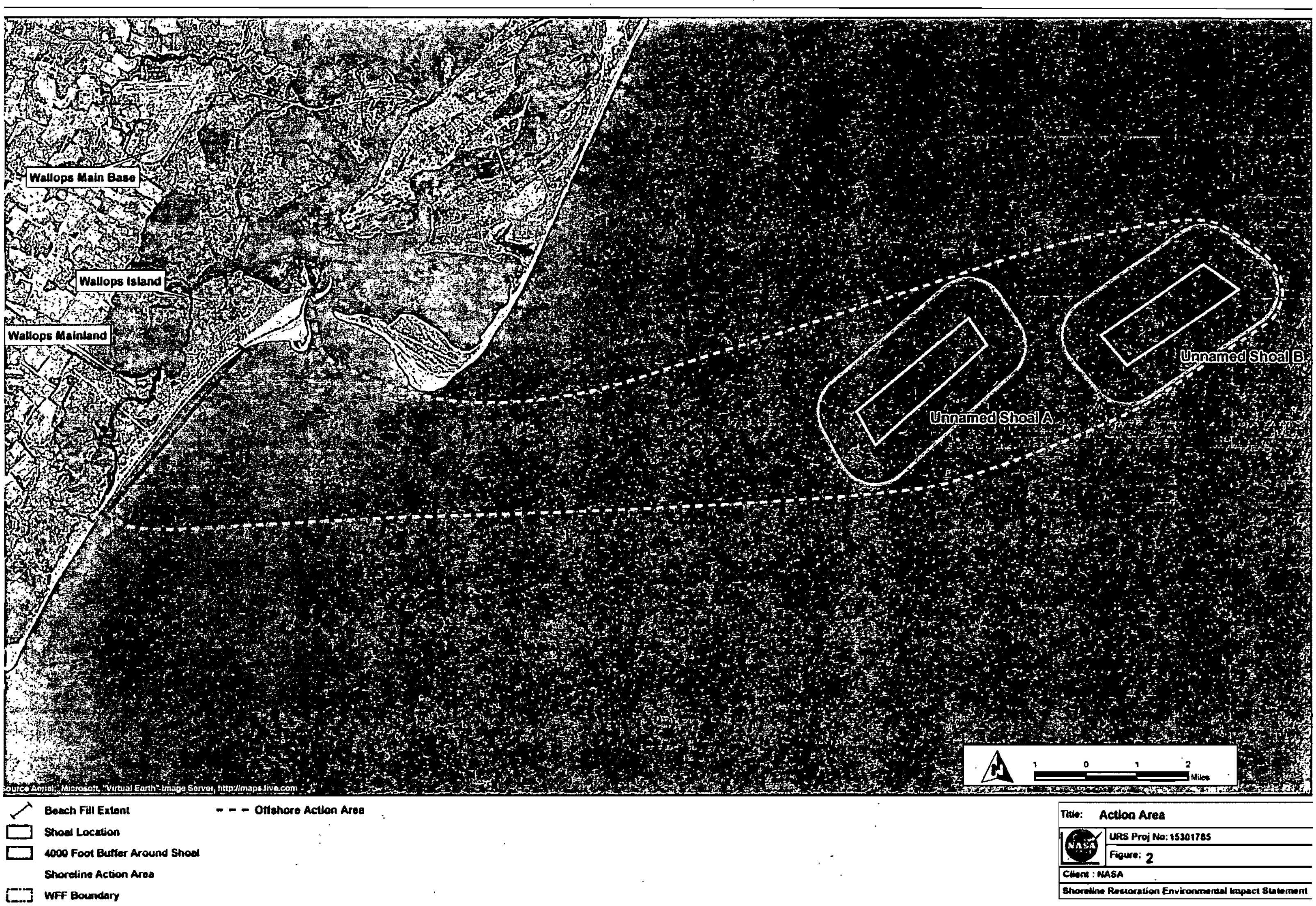
Wynne, K. and M. Schwartz. 1999. Guide to marine mammals and turtles of the U.S. Atlantic and Gulf of Mexico. Rhode Island Sea Grant, Narragansett, Rhode Island. 114 pp.

Zemsky, V., A.A. Berzin, Y.A. Mikhaliev, and D.D. Tormosov. 1995. Soviet Antarctic pelagic whaling after WWII: review of actual catch data. Report of the Sub-committee on Southern Hemisphere baleen whales. Rep. Int. Whal. Comm. 45: 131-135.

Zug, G.R., and J.F. Parham. 1996. Age and growth in leatherback turtles, *Dermochelys coriacea*: a skeletochronological analysis. Chelonian Conservation and Biology 2(2): 244-249.

Zurita, J.C., R. Herrera, A. Arenas, M.E. Torres, C. Calderon, L. Gomez, J.C. Alvarado, and R. Villavicencio. 2003. Nesting loggerhead and green sea turtles in Quintana Roo, Mexico. Pp. 125-127. *In:* J.A. Seminoff (compiler). Proceedings of the Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation. NOAA Tech. Memo. NMFS-SEFSC-503, 308 p.

APPENDIX A
Map of Action Area



APPENDIX B.

MONITORING SPECIFICATIONS FOR HOPPER DREDGES

I. EQUIPMENT SPECIFICATIONS

A. Baskets or screening

Baskets or screening must be installed over the hopper inflows with openings no smaller than 4 inches by 4 inches to provide 100% coverage of all dredged material and shall remain in place during all dredging operations between April and November 30 of any calendar year. Baskets/screening will allow for better monitoring by observers of the dredged material intake for sea turtles and their remains. The baskets or screening must be safely accessible to the observer and designed for efficient cleaning.

B. Draghead

The draghead of the dredge shall remain on the bottom **at all times** during a pumping operation, except when:

1) the dredge is not in a pumping operation, and the suction pumps are turned completely off;
2) the dredge is being re-oriented to the next dredge line during borrow activities; and
3) the vessel's safety is at risk (i.e., the dragarm is trailing too far under the ship's hull).

At initiation of dredging, the draghead shall be placed on the bottom during priming of the suction pump. If the draghead and/or dragarm become clogged during dredging activity, the pump shall be shut down, the dragarms raised, whereby the draghead and/or dragarm can be flushed out by trailing the dragarm along side the ship. If plugging conditions persist, the draghead shall be placed on deck, whereby sufficient numbers of water ports can be opened on the draghead to prevent future plugging.

Upon completion of a dredge track line, the drag tender shall:

1) throttle back on the RPMs of the suction pump engine to an idling speed (e.g., generally less than 100 RPMs) **prior to** raising the draghead off the bottom, so that no flow of material is coming through the pipe into the dredge hopper. Before the draghead is raised, the vacuum gauge on the pipe should read zero, so that no suction exists both in the dragarm and draghead, and no suction force exists that can impinge a turtle on the draghead grate;
2) hold the draghead firmly on the bottom with no flow conditions for approximately 10 to 15 seconds before raising the draghead; then, raise the draghead quickly off the bottom and up to a mid-water column level, to further reduce the potential for any adverse interaction with nearby turtles;
3) re-orient the dredge quickly to the next dredge line; and
4) re-position the draghead firmly on the bottom prior to bringing the dredge pump to normal pumping speed, and re-starting dredging activity.

C. Floodlights

Floodlights must be installed to allow the NMFS-approved observer to safely observe and monitor the baskets or screens.

D. Intervals between dredging

Sufficient time must be allotted between each dredging cycle for the NMFS-approved observer to inspect and thoroughly clean the baskets and screens for sea turtles and/or turtle parts and document the findings. Between each dredging cycle, the NMFS-approved observer should also examine and clean the dragheads and document the findings.

II. OBSERVER PROTOCOL

A. Basic Requirement

A NMFS-approved observer with demonstrated ability to identify sea turtle species must be placed aboard the dredge(s) being used, starting immediately upon project commencement to monitor for the presence of listed species and/or parts being entrained or present in the vicinity of dredge operations.

B. Duty Cycle

Beginning April 1, NMFS-approved observers are to be onboard for every week of the dredging project until project completion or November 30, whichever comes first. While onboard, observers shall provide the required inspection coverage on a rotating basis so that combined monitoring periods represent 100% of total dredging through the project period.

C. Inspection of Dredge Spoils

During the required inspection coverage, the trained NMFS-approved observer shall inspect the galvanized screens and baskets at the completion of each loading cycle for evidence of sea turtles. The Endangered Species Observation Form shall be completed for each loading cycle, whether listed species are present or not (Appendix G). If any whole (alive or dead) or turtle parts are taken incidental to the project(s), the NMFS Section 7 Coordinator (978-281-9328) must be contacted within 24 hours of the take. An incident report for sea turtle take (Appendix H) shall also be completed by the observer and sent to Julie Crocker via FAX (978) 281-9394 within 24 hours of the take. Incident reports shall be completed for every take regardless of the state of decomposition. NMFS will determine if the take should be attributed to the incidental take level, after the incident report is received. Every incidental take (alive or dead, decomposed or fresh) should be photographed, and photographs shall be sent to NMFS either electronically (julie.crocker@noaa.gov) or through the mail. Weekly reports, including all completed load sheets, photographs, and relevant incident reports, as well as a final report, shall be submitted to NMFS NER, Protected Resources Division, 55 Great Republic Drive, Gloucester, MA 01930-2298.

D. Information to be Collected

For each sighting of any endangered or threatened marine species (including whales as well as sea turtles), record the following information on the Endangered Species Observation Form (Appendix G):

1) Date, time, coordinates of vessel
2) Visibility, weather, sea state
3) Vector of sighting (distance, bearing)
4) Duration of sighting
5) Species and number of animals
6) Observed behaviors (feeding, diving, breaching, etc.)
7) Description of interaction with the operation

E. Disposition of Parts

If any whole turtles or shortnose sturgeon (alive or dead, decomposed or fresh) or turtle or shortnose sturgeon parts are taken incidental to the project(s), Julie Crocker (978) 282-8480 or Pat Scida (978) 281-9208 must be contacted within 24 hours of the take. All whole dead sea turtles or shortnose sturgeon, or turtle or shortnose sturgeon parts, must be photographed and described in detail on the Incident Report of Sea Turtle Mortality (Appendix H). The photographs and reports should be submitted to Julie Crocker, NMFS, Protected Resources Division, 55 Great Republic Drive, Gloucester, MA 01930-2298. After NMFS is notified of the take, it may instruct the observer to save the animal for future analysis if there is freezer space. Regardless, any dead **Kemp's ridley** sea turtles shall be photographed, placed in plastic bags, labeled with location, load number, date, and time taken, and placed in cold storage. Dead turtles or turtle parts will be further labeled as recent or old kills based on evidence such as fresh blood, odor, and length of time in water since death. Disposition of dead sea turtles will be determined by NMFS at the time of the take notification. If the species is unidentifiable or if there are entrails that may have come from a turtle, the subject should be photographed, placed in plastic bags, labeled with location, load number, date and time taken, and placed in cold storage. Dead Kemp's ridley or unidentifiable species or parts will be collected by NMFS or NMFS-approved personnel (contact Julie Crocker at (978) 282-8480). Live turtles (both injured and uninjured) should be held onboard the dredge until transported as soon as possible to the appropriate stranding network personnel for rehabilitation (Appendix C). No live turtles should be released back into the water without first being checked by a qualified veterinarian or a rehabilitation facility. Virginia and Maryland stranding network members (for rehabilitating turtles) include Mark Swingle [(757)-385-0326 or (757)-437-6022] and/or Susan Barco [(757)-437-7765] at the Virginia Marine Science Museum [Hotline: (757)437-6159], and Dr. Brent Whitaker [(410-576-3852] and/or Jennifer Dittmar [(410)-986-2377] of the National Aquarium in Baltimore [Hotline: (410)373-0083]. Mark Swingle/Susan Barco, Brent Whitaker/Jennifer Dittmar, and the NMFS Stranding Hotline at (978)-281-9351 should also be contacted immediately for any marine mammal injuries or mortalities.

III. OBSERVER REQUIREMENTS

Submission of resumes of endangered species observer candidates to NMFS for final approval ensures that the observers placed onboard the dredges are qualified to document takes of endangered and threatened species, to confirm that incidental take levels are not exceeded, and to provide expert advice on ways to avoid impacting endangered and threatened species. NMFS does not offer certificates of approval for observers, but approves observers on a case-by-case basis.

A. Qualifications

Observers must be able to:

1) differentiate between leatherback (*Dermochelys coriacea*), loggerhead *Caretta caretta*), Kemp's ridley *(Lepidochelys kempii*), green (*Chelonia mydas*), and hawksbill *(Eretmochelys imbricata*) turtles and their parts, and shortnose (*Acipenser brevirostrum*) and Atlantic (*Acipenser oxyrinchus oxyrinchus*) sturgeon and their parts;
2) handle live sea turtles and sturgeon and resuscitate and release them according accepted procedures;
3) correctly measure the total length and width of live and whole dead sea turtle and sturgeon species;
4) observe and advise on the appropriate screening of the dredge's overflow, skimmer funnels, and dragheads; and
5) identify marine mammal species and behaviors.

B. Training

Ideally, the applicant will have educational background in marine biology, general experience aboard dredges, and hands-on field experience with the species of concern. For observer candidates who do not have sufficient experience or educational background to gain immediate approval as endangered species observers, the below observer training is necessary to be considered admissible by NMFS. We can assist the USACE by identifying groups or individuals capable of providing acceptable observer training. Therefore, at a minimum, observer training must include:

1) instruction on how to identify sea turtles and sturgeon and their parts;
2) instruction on appropriate screening on hopper dredges for the monitoring of sea turtles and sturgeon (whole or parts);
3) demonstration of the proper handling of live sea turtles and sturgeon incidentally captured during project operations. Observers may be required to resuscitate sea turtles according to accepted procedures prior to release;

4) instruction on standardized measurement methods for sea turtle and sturgeon lengths and widths; and
5) instruction on how to identify marine mammals; and
6) instruction on dredging operations and procedures, including safety precautions onboard a vessel.

APPENDIX C

Sea Turtle Handling and Resuscitation

It is unlikely that sea turtles will survive entrainment in a hopper dredge, as the turtles found in the dragheads are usually dead, dying, or dismantled. However, the procedures for handling live sea turtles follow in case the unlikely event should occur. These guidelines are adapted from 50 CFR § 223.206(d)(1).

Please photograph all turtles (alive or dead) and turtle parts found during dredging activities and complete the Incident Report of Sea Turtle Take (Appendix H).

<u>Dead sea turtles</u>
The procedures for handling dead sea turtles and parts are described in Appendix C-II-E.

<u>Live sea turtles</u>
When a sea turtle is found in the dredge gear, observe it for activity and potential injuries.

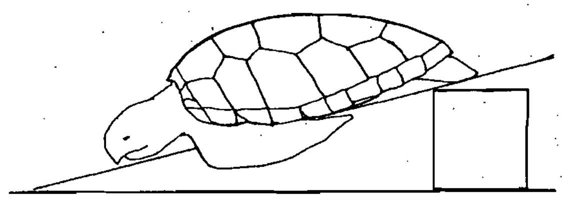
< **If the turtle is actively moving,** it should be retained onboard until evaluated for injuries by a permitted rehabilitation facility. Due to the potential for internal injuries associated with hopper entrainment, it is necessary to transport the live turtle to the nearest rehabilitation facility as soon as possible, following these steps:

1) Contact the nearest rehabilitation facility to inform them of the incident. If the rehabilitation personnel cannot be reached immediately, please contact Julie Crocker at (978) 281-9300 ext. 6530 or Pat Scida at (978) 281-9128.
2) Keep the turtle shaded and moist (e.g., with a water-soaked towel over the eyes, carapace, and flippers), and in a confined location free from potential injury.
3) Contact the crew boat to pick up the turtle as soon as possible from the dredge (within 12 to 24 hours maximum). The crew boat should be aware of the potential for such an incident to occur and should develop an appropriate protocol for transporting live sea turtles.
4) Transport the live turtle to the closest permitted rehabilitation facility able to handle such a case.

Do not assume that an inactive turtle is dead. The onset of rigor mortis and/or rotting flesh are often the only definite indications that a turtle is dead. Releasing a comatose turtle into any amount of water will drown it, and a turtle may recover once its lungs have had a chance to drain.

< **If a turtle appears to be comatose** (unconscious), contact the designated stranding/rehabilitation personnel immediately. Once the rehabilitation personnel has been informed of the incident, attempts should be made to revive the turtle at once. Sea turtles have been known to revive up to 24 hours after resuscitation procedures have been followed.

- Place the animal on its bottom shell (plastron) so that the turtle is right side up and elevate the hindquarters at least 6 inches for a period of 4 up to 24 hours. The degree of elevation depends on the size of the turtle; greater elevations are required for larger turtles.
- Periodically, rock the turtle gently left to right and right to left by holding the outer edge of the shell (carapace) and lifting one side about 3 inches then alternate to the other side.
- Periodically, gently touch the eye and pinch the tail (reflex test) to see if there is a response.
- Keep the turtle in a safe, contained place, shaded, and moist (e.g., with a water-soaked towel over the eyes, carapace, and flippers) and observe it for up to 24 hours.
- If the turtle begins actively moving, retain the turtle until the appropriate rehabilitation personnel can evaluate the animal. The rehabilitation facility should eventually release the animal in a manner that minimizes the chances of re-impingement and potential harm to the animal (i.e., from cold stunning).
- Turtles that fail to move within several hours (up to 24) must be handled in the manner described in Appendix C-II-E, or transported to a suitable facility for necropsy (if the condition of the sea turtle allows and the rehabilitation facility wants to necropsy the animal).



Stranding/rehabilitation contacts

Sea Turtles in Virginia

< Virginia Marine Science Museum (Hotline: (757)-437-6159)
Mark Swingle, Phone: (757)-385-0326 or (757)-437-6022
Susan Barco, Phone: (757)-437-7765

Marine Mammals

< Mark Swingle/Susan Barco (VA)
< Dr. Whitaker/Jennifer Dittmar (MD) [(410)-576-3852/ (410)-986-2377]
< NMFS Stranding Hotline at (978)-281-9351

APPENDIX D
Protocol for Collecting Tissue from Sea Turtles for Genetic Analysis

Materials for collecting genetic samples:

- surgical gloves
- alcohol swabs
- betadine swabs
- sterile disposable biopsy punches
- sterile disposable scalpels
- permanent marker to externally label the vials
- scotch tape to protect external labels on the vials
- pencil to write on internal waterproof label
- waterproof label, 1/4" x 4"
- screw-cap vial of saturated NaCl with 20% DMSO*, wrapped in parafilm
- piece of parafilm to wrap the cap of the vial after sample is taken
- vial storage box

* The 20% DMSO buffer within the vials is nontoxic and nonflammable. Handling the buffer without gloves may result in exposure to DMSO. This substance soaks into skin very rapidly and is commonly used to alleviate muscle aches. DMSO will produce a garlic/oyster taste in the mouth along with breath odor. The protocol requires that you wear gloves each time you collect a sample and handle the buffer vials. DO **NOT** store the buffer where it will experience extreme heat. The buffer must be stored at room temperature or cooler, such as in a refrigerator.

Please collect two small pieces of muscle tissue from ***all*** live or dead sea turtles. A muscle sample can be obtained no matter what stage of decomposition a carcass is in. Please utilize the equipment in these kits for genetic sampling of *turtles only* and contact Kate Sampson when you need additional supplies.

Sampling protocol for live turtles:

1. Stabilize the turtle on its plastron. When turtles are placed on their carapace they tend to flap their flippers aggressively and injuries can happen. Exercise caution around the head and jaws.

2. The biopsy location is the dorsal surface of the rear flipper, 5-10 cm from the posterior (trailing) edge and close to the body. Put on a pair of surgical gloves and wipe this area with a Betadine swab. **Insert photo**

3. Wipe the hard surface (plastic dive slate, biopsy vial cap or other available clean surface) that will be used under the flipper with an alcohol swab and place this surface underneath the Betadine treated flipper.

4. Using a new (sterile and disposable) plastic skin biopsy punch, gently press the biopsy punch into the flesh, as close to the posterior edge of the rear flipper as possible. Press down with moderate force and rotate the punch one or two complete turns to make a circular cut all the way through the flipper. The biopsy tool has a sharp cutting edge so exercise caution at all times.

5. Repeat the procedure on the other rear flipper (one sample per rear flipper) with the same biopsy punch so that you now have two samples from this animal.

6. Remove the tissue plugs by knocking them directly from the biopsy punch into a single vial containing 20% DMSO saturated with salt. It is important to ensure that the tissue samples do not come into contact with any other surface or materials during this transfer.

7. Wipe the biopsy area with another Betadine swab.

8. Dispose of the used biopsy punch in a sharps container. It is very important to use a new biopsy punch and gloves for each animal to avoid cross contamination.

Sampling protocol for dead turtles:

1. The best place to obtain the muscle sample is on the ventral side where the front flippers insert near the plastron. It is not necessary to cut very deeply to get muscle tissue.

2. Using a new (sterile and disposable) scalpel cut out two pieces of muscle of a size that will fit in the vial.

3. Transfer both samples directly from the scalpel to a single vial of 20% DMSO saturated with salt.

4. Dispose of the used scalpel in a sharps container. It is very important to use a new scalpel and gloves for each animal to avoid cross contamination.

Labeling of sample vials:

1. Use a pencil to write stranding ID, date, species and SCL on a waterproof label and place it in the vial with the samples.

2. Use a permanent marker to label stranding ID, date, species and SCL on the outside of the vial.

3. Apply a piece of clear scotch tape over the label on the outside of the vial to protect it from being erased or smeared.

4. Wrap Parafilm around the cap of the vial by stretching as you wrap.

5. Place the vial in the vial storage box.

6. Complete the Sea Turtle Biopsy Sample Collection Log (Appendix E).

7. Attach a copy of the STSSN form (Appendix F) to the Collection Log - be sure to indicate on the STSSN form that a genetic sample was taken.

At the end of the calendar year submit all genetic samples to:

Kate Sampson
NOAA/NMFS/NER
Protected Resources Division
55 Great Republic Drive
Gloucester, MA 01930
O: (978) 282-8470
C: (978) 479-9729

APPENDIX E
Sea Turtle Biopsy Sample Collection Log

				Stranding Date																				
NER ID	SPECIES CODE	FIELD ID	FLIPPER TAG	YEAR	MONTH	DAY	Sample Date (if diff. from stranding date) (mm/dd/yy)	COUNTY	STATE	CAPTURE TYPE	SEX	SCL (cm)	CCL (cm)	TTYPE	TSTORE	LAT D	LAT M	N OR S	LONG D	LONG M	E OR W	OCEAN BASIN	DATE XFER	WHERE?
																						Atlantic		
																						Atlantic		
																						Atlantic		
																						Atlantic		
																						Atlantic		
																						Atlantic		
																						Atlantic		
																						Atlantic		
																						Atlantic		
																						Atlantic		
																						Atlantic		
																						Atlantic		
																						Atlantic		
																						Atlantic		

Notes:

Leave Blank: NMFS to fill in
Species Code: Use CC, DC, LK, EI or CM
Year/Month/Day: Stranding Data (should also be listed on vial)
Capture Type: Use Stranding or Incidental Capture
Ttype: Tissue Type, will likely be muscle

SEA TURTLE STRANDING AND SALVAGE NETWORK – STRANDING REPORT

OBSERVER'S NAME / ADDRESS / PHONE:
First ____________ M.I.____ Last ____________
Affiliation ____________
Address ____________
____
Area code/Phone number ____________

STRANDING DATE:
Year 20☐☐ Month ☐☐Day☐☐
Turtle number by day ☐☐

State coordinator must be notified within 24 hrs; this was done by* ☐*phone (860)572-5955 x107* ☐*email* ☐*fax (860)572-5969

SPECIES: (check one)
☐ CC = Loggerhead
☐ CM = Green
☐ DC = Leatherback
☐ EI = Hawksbill
☐ LK = Kemp's Ridley
☐ LO = Olive Ridley
☐ UN = Unidentified
Check Unidentified if not positive. Do Not Guess.

STRANDING LOCATION: ☐Offshore (Atlantic or Gulf beach) ☐Inshore (bay, river, sound, inlet, etc)
State ____________ County____________
Descriptive location (be specific)____________
____
____
Latitude ____________ Longitude ____________

Carcass necropsied? ☐Yes☐No
Photos taken? ☐Yes ☐No
Species verified by state coordinator? ☐ Yes ☐ No

CONDITION: (check one)
☐ 0 = Alive
☐ 1 = Fresh dead
☐ 2 = Moderately decomposed
☐ 3 = Severely decomposed
☐ 4 = Dried carcass
☐ 5 = Skeleton, bones only

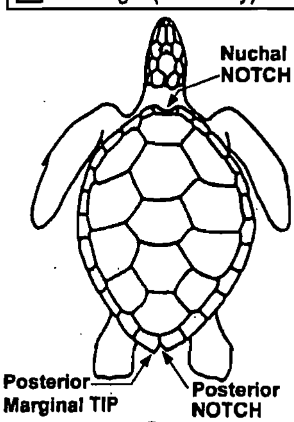
FINAL DISPOSITION: (check)
☐1 = Left on beach where found; painted? ☐Yes* ☐No(5)
☐2 = Buried: ☐ on beach / ☐ off beach; carcass painted before buried? ☐ Yes* ☐ No
☐3 = Salvaged: ☐ all / ☐ part(s), what/why? ____________
____
____
☐4 = Pulled up on beach/dune; painted? ☐Yes* ☐No
☐6 = Alive, released
☐7 = Alive, taken to rehab. facility, where? ____________
____
☐8 = Left floating, not recovered; painted? ☐Yes* ☐No
☐9 = Disposition unknown, explain ____________
____
***If painted, what color?** ____________

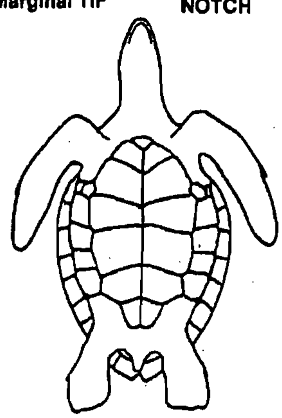
SEX:
☐ Undetermined
☐ Female ☐ Male
Does tail extend beyond carapace?
☐ Yes; how far?______ cm / in
☐ No
How was sex determined?
☐ Necropsy
☐ Tail length (adult only)

TAGS: ***Contact state coordinator before disposing of any tagged animal!!***
Checked for flipper tags? ☐ Yes ☐ No
Check all 4 flippers. If found, record tag number(s) / tag location / return address
____
____
____
PIT tag scan? ☐ Yes ☐ No
If found, record number / tag location
____
____
Coded-wire tag scan? ☐ Yes ☐ No
If positive response, record location (flipper)
____
Checked for living tag? ☐Yes ☐ No
If found, record location (scute number & side)
____

CARAPACE MEASUREMENTS: (*see drawing*)

Using calipers		**Circle unit**
Straight length (NOTCH-TIP)	________	cm / in
Minimum length (NOTCH-NOTCH)	________	cm / in
Straight width (Widest Point)	________	cm / in
Using non-metal measuring tape		**Circle unit**
Curved length (NOTCH–TIP)	________	cm / in
Minimum length (NOTCH-NOTCH)	________	cm / in
Curved width (Widest Point)	________	cm / in
		Circle unit
Weight ☐ actual / ☐ est.	________	kg / lb





Mark wounds / abnormalities on diagrams at left and describe below (note tar or oil, gear or debris entanglement, propeller damage, epibiota, papillomas, emaciation, etc.). **Please note if no wounds / abnormalities are found.**
____
____
____
____
____
____

APPENDIX G
ENDANGERED SPECIES OBSERVER FORM
Borrow Area Dredging
NASA Wallops Island Project

Daily Report

Date: ______________________________
Geographic Site: ____
Location: Lat/Long ____________________ Vessel Name ____________________

Weather conditions: ____
____

Water temperature: Surface ____________ Below midwater (if known) ____________

Condition of screening apparatus: ______________________________________
____
____

Incidents involving endangered or threatened species? (Circle) Yes No
(*If yes, fill out Incident Report of Sea Turtle/Shortnose Sturgeon Mortality*)

Comments (type of material, biological specimens, unusual circumstances, etc:)
____
____
____

Observer's Name: ______________________________________
Observer's Signature: ___________________________________

Species	# of Sightings	# of Animals	Comments

APPENDIX H

Incident Report of Sea Turtle Take

Species ______________ Date ________________ Time (specimen found) _________________

Geographic Site ____
Location: Lat/Long ____
Vessel Name _________________________ Load # ______________________________
Begin load time ________________________ End load time_________________________
Begin dump time _______________________ End dump time _________________________

Sampling method ____
Condition of screening ____
Location where specimen recovered____
____

Draghead deflector used? YES NO Rigid deflector draghead? YES NO
Condition of deflector ____
____

Weather conditions____
____

Water temp: Surface ________________ Below midwater (if known) ______________________

Species Information: *(please designate cm/m or inches.)*
Head width ____________________________ Plastron length ____________________________
Straight carapace length _________________ Straight carapace width______________________
Curved carapace length __________________ Curved carapace width ______________________

Condition of specimen/description of animal (please complete attached diagram)
____
____
____

Turtle Decomposed: NO SLIGHTLY MODERATELY SEVERELY

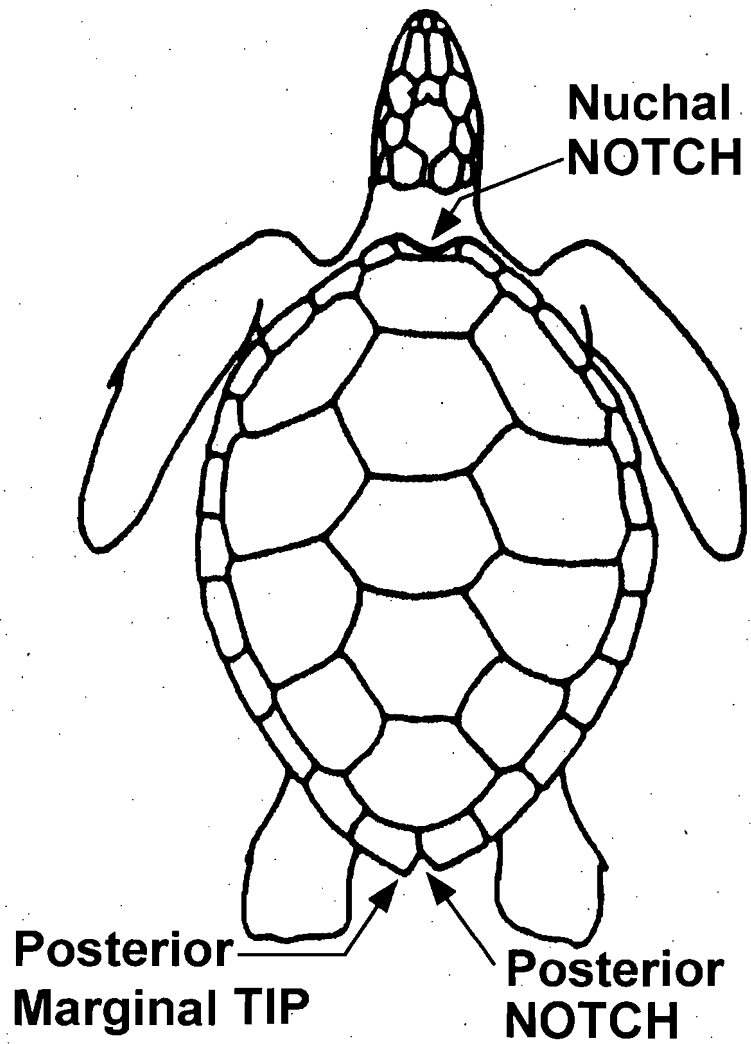
Turtle tagged: YES NO *Please record all tag numbers.* Tag # ________________________
Genetic sample taken: YES NO
Photograph attached: YES NO
(please label *species, date, geographic site* and *vessel name* on back of photograph)

Comments/other (include justification on how species was identified) ____________________
____
____

Observer's Name ____
Observer's Signature ____________________________________

Incident Report of Sea Turtle Take

Draw wounds, abnormalities, tag locations on diagram and briefly describe below.



Description of animal: