NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT
BIOLOGICAL OPINION

Agency: Federal Energy Regulatory Commission (FERC) and the Army Corps of Engineers (ACOE), Philadelphia District

Activity Considered: Issuance of Order under the Natural Gas Act by FERC to BP/Crown Landing LLC to site, construct and operate an LNG terminal on the banks of Delaware River and the issuance of permits under the Rivers and Harbors Act by the ACOE for associated dredging and construction
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Conducted by: National Marine Fisheries Service
Northeast Region

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Approved by: Chris Mantzaris for Patricia Kurkul

This constitutes the biological opinion (Opinion) of NOAA's National Marine Fisheries Service (NMFS) on the effects of the issuance of an Order by the Federal Energy Regulatory Commission (FERC) to British Petroleum/Crown Landing LLC (Crown Landing) to site, construct and operate a Liquefied Natural Gas (LNG) import terminal on the banks of Delaware River and the effects of the US Army Corps of Engineers (ACOE) issuing two permits to Crown Landing for the construction of this facility. This Opinion is based on information provided in the Draft Environmental Impact Statement (DEIS) for the Crown Landing LNG and Logan Lateral Projects dated February 2005 and the Biological Assessment (BA) prepared by Environmental Resource Management and submitted to NMFS by FERC, NMFS October 25, 1996 Opinion on dredging in the Philadelphia District of the Army Corps of Engineers (ACOE), a May 25, 1999 supplement to that Opinion, the February 2, 2001 Opinion on the Delaware River Main Channel Blasting Project, scientific papers and other sources of information. A complete administrative record of this consultation will be kept at the NMFS Northeast Regional Office. Formal consultation was initiated on June 23, 2005.

CONSULTATION HISTORY

In early 2003, Crown Landing requested information from NMFS regarding the potential effects of the siting, construction and operation of a proposed LNG import facility on federally listed species under NMFS jurisdiction. Staff from NMFS Habitat Conservation Division (HCD) responded to this request and indicated that a population of the federally endangered shortnose sturgeon (*Acipenser brevirostrum*) exists in the Delaware River and may occur in the project area. In this May 5, 2003 memo, NMFS HCD also recommended that to protect shortnose sturgeon and other anadromous fish species in-water work should be prohibited from March 15 through June 30 of any year. In a subsequent letter to FERC dated June 15, 2004, NMFS HCD recommended in-water work restrictions from March 15 through August 1 of any year.

Coordination continued between NMFS, FERC and the applicant through 2004 and early 2005. NMFS provided comments on the Administrative Draft Environmental Impact Statement on November 5, 2004. In these comments, NMFS indicated that because the project may affect listed species, consultation pursuant to Section 7 of the ESA would be required.

On February 18, 2005, FERC and the ACOE published a joint notice of availability of the Draft EIS (DEIS) and a Public Notice regarding an application by Crown Landing for ACOE authorization for in-water work associated with construction of the facility. In a letter dated April 18, 2005, NMFS submitted comments on the DEIS and Public Notice. In the DEIS, FERC determined that the project was likely to adversely affect shortnose sturgeon. As such, in the April 2005 comment letter, NMFS indicated that as FERC was the lead federal agency for this project, FERC should prepare a BA on the effects of the project on listed species and submit a request for formal consultation. As the ACOE will be issuing permits for construction and associated dredging, ACOE also has an obligation under Section 7 to ensure that their actions are not likely to jeopardize the continued existence of any listed species. As noted in the Section 7 regulations (at 50CFR402.07), "when a particular action involves more than one federal agency, the consultation…responsibilities may be fulfilled through a lead agency." The ACOE and FERC have determined that FERC is the lead federal agency for this consultation; as such, FERC prepared a BA and letter requesting consultation which was received by NMFS on June 23, 2005. In the BA, FERC determined that the proposed project was likely to adversely affect shortnose sturgeon and was not likely to adversely affect listed whales or sea turtles. As NMFS believed it had all the information necessary to initiate formal consultation, the date of the June 23, 2005 letter served as the date of initiation of formal consultation.

Additional information has been received from FERC and Crown Landing throughout the consultation period. On September 20, 2005, NMFS received a report (which was subsequently filed with FERC) on the results of Shortnose and Atlantic sturgeon surveys being conducted near the project area. Researchers working on behalf of Crown Landing were working to document the use of this region of the Delaware River by sturgeon species to better understand the impacts of the proposed project on sturgeon. This report included survey results from April through August 2005. On December 23, 2005, NMFS received a second report, also subsequently filed with FERC, on the preliminary results of the sturgeon surveys conducted from September through December 2005. On January 24, 2006, Julie Crocker of NMFS received an e-mail from Danny Laffoon of FERC outlining several changes to the project design. Additional changes to the project design and details on the construction timeline were sent by Mr. Laffoon to Ms. Crocker in an e-mail dated January 30, 2006.

Modifications to Crown Landing's ship strike mitigation plan have also been received throughout the consultation period. On November 10, 2005, Kristen Koyama of NMFS sent an email to project consultants detailing recommended ship strike avoidance measures. Crown Landing responded to these recommended measures in a letter to NMFS dated January 3, 2006. Ms. Koyama followed up on this response in a phone call to Jason Willey of ERM (the applicant's consultant) on January 20, 2006, requesting clarification of Crown Landing's proposed mitigation plan. In a letter dated January 27, 2006, Crown Landing sent a revised ship strike mitigation plan to NMFS. Representatives from Crown Landing met with Ms. Koyama on March 1, 2006 to further discuss implementation of the proposed ship strike mitigation plan. Crown Landing conveyed a final ship strike mitigation plan to NMFS in a letter dated March 30, 2006.

DESCRIPTION OF THE PROPOSED ACTION

On September 16, 2004, Crown Landing, LLC, a BP Energy Company affiliate filed an application with FERC under section 3(a) of the Natural Gas Act (NGA) for a proposed LNG import terminal. FERC is proposing to authorize Crown Landing to site, construct and operate an LNG import terminal on the banks of the Delaware River (River Kilometer (RKM) 126) in Logan Township, Gloucester County, New Jersey. The Crown Landing LNG important terminal (Project) will consist of facilities capable of unloading LNG carriers, storing LNG, vaporizing the LNG, and sending out the natural gas via a pipeline system. Marine facilities at the Project will consist of an LNG pier and berth in the Delaware River. Crown Landing estimates that LNG shipments will occur approximately once every two to three days, and that the Project will receive a maximum of 150 shipments per year.

The facility will be located on the eastern bank of the Delaware River near the mouth of Oldmans Creek. The project location is approximately 20 miles downstream of Philadelphia and 8 miles upstream of Wilmington, Delaware and borders the Marcus Hook Anchorage Area. The river is approximately 1.2 miles wide at the project location. Please see Appendix A for a map of the project location.

Texas Eastern Transmission, LP (Texas Eastern) also filed an application on September 17, 2004 with FERC under section 7(c) of the NGA for an associated natural gas pipeline. FERC proposes to grant a Certificate of Public Convenience and Necessity (Certificate) to site, construct, and operate a new natural gas pipeline and ancillary facilities to connect the proposed LNG terminal to Texas Eastern's interstate gas transmission facilities. As all work associated with the pipeline will occur on land or in waterbodies where no listed species under NMFS jurisdiction are present, the pipeline will have no effect on such listed species. As such, the effects of FERC's approval of the Certificate will not be considered further in this Opinion.

Dredging

In order to accommodate the LNG vessels, the berthing area must be deepened. As noted above, Crown Landing has applied to the ACOE for authorization under Section 10 of the Rivers and Harbors Act to dredge the berthing area (Permit Number CENAP-OP-R-200500146-15). This permit will be issued to Crown Landing when the ACOE has received confirmation that the applicant has fulfilled their obligations under Section 307(c) of the Coastal Zone Management Act of 1972, and Section 401 of the Clean Water Act. These statutes require the applicant to receive certification from the state in which the activity will occur that the project complies with the approved State Coastal Zone Management Program and to receive a Water Quality Certificate from the state. The ACOE will include any Terms and Conditions required by the Incidental Take Statement that accompanies this Opinion as special conditions of the permit.

Construction of the berth will require the initial dredging of approximately 1.24 million cubic yards (cy) of material from the Delaware River. Hydraulic pipeline dredges will be used for all dredging operations. A condition that no dredging is to occur from March 15 through August 1 of any year will be incorporated into all permits for dredging at the Project. Crown Landing has indicated that due to icing conditions in the winter, all dredging will occur from August 1 – December 31. The initial phase of dredging is expected to take 98 working days.

Operation of the berth will require maintenance dredging. The sedimentation rate for the berth is estimated at 67,000 to 97,000 cy per year based on sediment transport analysis of this portion of the Delaware River. Maintenance dredging is expected to occur annually, using standard hydraulic dredging techniques (pipeline dredge), removing the 67-97,000 cy of material that has been deposited in the berth during the year. Annual maintenance dredging is expected to take 1-2 weeks to complete and will also be completed during the August 1 – December 31 timeframe.

All dredged material (initial and maintenance) will be pumped directly to the New Jersey Department of Environmental Protection (NJDEP) and US Army Corps of Engineers (ACOE) permitted Weeks Marine Confined Disposal Facility (CDF), which is an upland site located in New Jersey approximately 4 miles upriver of the Crown Landing site.

Construction

The ship unloading facility will be located in the Delaware River adjacent to the Marcus Hook anchorage area and will consist of an angled pier with a 2,000-foot long by 50-foot wide trestle and a single berth designed to accommodate LNG carriers from 138,000 to 200,000 cubic meters (m^3) in capacity. The berth and pier will be configured to accommodate only one LNG carrier at a time. The in-water work associated with these activities will also be authorized by the ACOE permit described above.

The unloading facility will also have a 6,000 square foot unloading platform and a single berth with four breasting dolphins equipped with fenders and quick release hooks and five mooring dolphins equipped with quick release hooks for mooring the LNG carrier. Walkways connecting the dolphins to the platform will provide personnel access and a gangway between the ship and the dolphins will provide crew access. The trestle will provide structural support for cryogenic lines, a spill containment trough, and utility lines connecting the unloading facility with onshore facilities and would accommodate two travel lines for light vehicles. A control room will also be located on the pier. An LNG transfer system will be installed on the unloading platform to transfer the LNG from the ship to the storage tanks. The transfer system will consist of three 16-inch liquid unloading arms and will be transported from the pier through a 44-inch diameter liquid unloading line to the storage tanks. Construction of the pier and dolphins will result in the permanent loss of approximately 1,800 square feet (0.04 acres) of benthic substrate within the footprints of the individual pilings. All relevant permits will include a restriction to prohibit pile driving from March 15 through August 1 of any year. All LNG storage and process facilities will be located on land.

The first step in construction of the ship unloading facility will be dredging of the slip berth (see above). The pier will then be constructed using an “over the top” method, which involves using land-based equipment to build the pier from the shore out into the river. A large crawler crane will be used to drive the steel piles and to pick up and set the structural elements of the pier. Once the piles are in place, either pre-cast concrete or fabricated steel pile caps or pre-cast girders or fabricated steel beams will be installed. A concrete deck with a railing or barriers will be cast in place to contain the piping and form a roadway on the pier.

The final step in construction will be of the berth structure, including the unloading platform and dolphins. The platform and dolphins will consist of cast-in-place or pre-cast concrete decks with steel pipe pile foundations. Once the deck is completed, the unloading arms, fenders, mooring equipment, and walkways will be installed. The berth structure will be constructed with large equipment on a barge in the river.

Hydrostatic Testing
Crown Landing will conduct hydrostatic testing for each of the three proposed LNG storage tanks, which will require approximately 25 million gallons of water withdrawn from the Delaware water for each tank (total approximately 75 million gallons of water). This water will be pumped from the River through a 2mm slot wedge-wire screened intake at intake screen approach velocities below 0.5 feet per second. The tanks will be filled and emptied over a two to three week period. The holding period will be about one day. Crown Landing proposes to locate the hydrostatic test water intake in the berth, suspended from the pier approximately 6 to 8 feet below the mean water level. The proposed depth for the intake is based on an analysis of the vertical distribution in the water column of the dominant ichthyoplankton species that are likely to occur in the project area. The intake has been placed at the depth where the lowest concentration of ichthyoplankton is likely to be found.

Vessel Operations
As noted above, the Crown Landing terminal will receive a maximum of 150 LNG shipments annually. Shipments will originate from Trinidad and the West African countries of Nigeria and Algeria. As noted in the DEIS, an internationally recognized Traffic Separation Scheme established by the International Maritime Organization (IMO) serves vessel traffic in the approach of the Delaware Bay and River. This provides inbound and outbound routes which are separated by a central buffer zone. LNG ships would access the Crown Landing terminal via the navigation channel in the Delaware Bay and River. LNG vessels transiting from foreign countries would transit the Atlantic Ocean and eventually enter either the Delaware to Cape Henlopen or the Five Fathom Bank to Cape Henlopen shipping lane and then be directed from Cape Henlopen to the facility by a pilot from the Delaware River pilots.

The LNG carriers that will deliver LNG to Crown Landing are expected to range from 138,000m^3 (the size of most existing BP LNG carriers[1]) to a maximum of 200,000m^3. To ensure that the LNG carriers are handled safely in transit along the River and at berth, tugs will be used to assist in positioning the LNG carriers at the project. At least one tug will remain with the LNG carrier throughout its stay at the pier. Two additional tugs will be used to assist the LNG carrier when approaching the pier and while docking and undocking. LNG carriers and accompanying tugs will transit the Delaware River in the existing Federal navigation channel.

In a letter dated March 30, 2006, Crown Landing proposed to implement operational measures to reduce the risk of ship strike to Northern right whales along the transit route of the LNG vessels. Specifically, Crown Landing has agreed to require all ships contracted with the facility to slow their forward speed to 12 knots from November through April within a 30 nm radius of the Delaware

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1 A LNG carrier with a capacity of 138,000m^3 has the following ship dimensions: 914’ length, 138’ beam, 38’ loaded draught, 32’ ballast draught, 85’ depth of hull; a LNG carrier with the maximum capacity of 200,000m^3 will likely have the following ship dimensions: 1056’ length; 167’ beam, 38’ loaded draught, 32’ ballast draught, 88’ depth of hull.

Bay entrance, subject to the requirement of safe navigation. In addition, Crown Landing will forward outreach materials provided by NMFS related to prudent vessel operations in the vicinity of right whales to LNG carriers during their in-bound transit, and provide NMFS with an email address to which up-to-date right whale sighting information can be sent. These measures will be incorporated into the analysis of effects for the proposed action.

Ballast Water Intakes

To maintain the stability of the LNG carriers, the carriers will take on ballast water from the River as they offload LNG. As noted above, Crown Landing estimates that LNG shipments will occur approximately once every two to three days, and that the project will receive a maximum of 150 shipments per year. The 138,000m^3-capacity carriers require about 10 hours to take on approximately 52,000m^3 of ballast water at an average intake rate of 5200 cubic meters per hour (m^3/h). The larger 200,000m^3-capacity carriers are projected to require approximately 75,500m^3 of ballast water and also would take approximately 10 hours to take on this volume. The 138,000m^3 Trader Class carriers have three ballast water intakes, each with ballast pumps rated at 3,000m^3/hour. Typically, two pumps operate during ballasting, with the third pump as stand-by. The average intake rate is 5200m^3/h, with the average water intake velocity estimated at approximately one foot per second. Intake velocities for other LNG carriers are expected to be similar.

The total area of the two lower ballast water intake openings is 3.55 square meters. The openings are protected by bar-type grids having 4.5mm bars spaced 25mm apart. The highest and lowest points of the openings are 8.38 and 9.46m below the ship's waterline. The upper (third) opening has strainers with a 5mm mesh fitted inboard of the suction valves prior to the ballast pump. Crown Landing will implement restrictions stating that LNG carriers are to withdraw the minimum amount of ballast water (approximately 8 million gallons) needed for carrier stability while at berth and limiting ballast water intake velocities to one foot per second.

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 area affected by construction and dredging activities as well as the area transited by LNG vessels coming to and from the Crown Landing facility.

Construction activities will be limited to the Crown Landing site in the Delaware River. While the direct effects of the project will be restricted to the area under construction, indirect effects will extend further out into the Delaware River where increased sediment will be present due to the dredging and pressure waves associated with pile driving will travel. The DEIS presents an analysis of modeling of the proposed dredging. The model predicted that the sediment plume generated by a hydraulic dredge would exceed background levels of total suspended solids for a distance of 1,150 feet. The DEIS indicates that sound waves from pile driving will dissipate to a level below 155dB (the minimum level which may affect aquatic species) at a distance of 1,860 feet. Thus, the action area is considered to include that area of the Delaware River located within a 1,860-foot radius from the berth. This will encompass the area where an increase in suspended sediment is likely to occur and where sound waves are at 155dB or above.

As noted in the description of the action, LNG vessels will travel to the Crown Landing facility from foreign ports. The DEIS indicates that LNG is expected to be received from Trinidad and West Africa (Nigeria or Algeria). Crown Landing has indicated three approximate primary carrier routes to the Delaware Bay shipping lane (that begins in the vicinity of Five Fathom Bank). There are two shipping lanes running from Five Fathom Bank and ending at Cape Henlopen that may be used by LNG vessels in transit. Once at the mouth of Delaware Bay (i.e., Cape Henlopen), the vessels will travel in the Delaware River Federal Navigation Channel. The further the vessels are from US waters, the more uncertain the area affected by the vessels is. As a result, it is difficult to define the action area beyond the US EEZ boundary. However, NMFS expects direct and indirect effects on listed species to overlap with the action area within the US EEZ and inshore waters.

LISTED SPECIES IN THE ACTION AREA

Several species listed under NMFS' jurisdiction occur in the action area for this consultation. A population of endangered shortnose sturgeon exists in the Delaware River. Several species of listed sea turtles occur in the action area, including in the lower Delaware Bay during the warmer months. Listed whales also occur in the action area although these species are not likely to occur in Delaware Bay.

The hawksbill turtle (*Eretmochelys imbricata*) is relatively uncommon in the waters of the continental US. Hawksbills prefer coral reefs, such as those found in the Caribbean and Central America. However, there are accounts of hawksbills in south Florida and a number are encountered in Texas each year. Most of the Texas records report small turtles, probably in the 1-2 year class range. Many captures or strandings are of individuals in an unhealthy or injured condition (Hildebrand 1982). The lack of sponge-covered reefs and the cold winters in the northern Gulf of Mexico probably prevent hawksbills from establishing a viable population in this area. No takes of hawksbill sea turtles have been recorded in northeast or mid-Atlantic fisheries covered by the NEFSC observer program. In the north Atlantic, small hawksbills have stranded as far north as Cape Cod, Massachusetts (STSSN database). Many of these strandings were observed after hurricanes or offshore storms. There have been no verified observations of hawksbills in the action area outside of rare stranding events. Based on this information, NMFS has determined that hawksbill sea turtles are not likely to occur in the action area. As such, effects of the action on hawksbills will not be considered further in this consultation.

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:

Cetaceans	
Sperm whale (*Physeter macrocephalus*)	Endangered
Right whale (*Eubalaena glacialis*)	Endangered
Humpback whale (*Megaptera novaeangliae*)	Endangered
Fin whale (*Balaenoptera physalus*)	Endangered
Sea Turtles	
Loggerhead sea turtle (*Caretta caretta*)	Threatened
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered

Kemp's ridley sea turtle (*Lepidochelys kempi*)	Endangered
Green sea turtle (*Chelonia mydas*)	Endangered/Threatened[2]

Fish

Shortnose sturgeon (*Acipenser brevirostrum*)	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. Background information on the range-wide status of these species and a description of critical habitat can be found in a number of published documents including recent shortnose sturgeon (NMFS 1998b) and sea turtle (NMFS and USFWS 1995, USFWS 1997, TEWG 2000, NMFS SEFSC 2001) status reviews and stock assessments, Recovery Plans for the humpback whale (NMFS 1991a), right whale (NMFS 2005), fin and sei whale (NMFS 1998a), and the 1998 marine mammal stock assessment report (Waring et al. 1999).

Sperm Whale

Sperm whales are the largest of the odontocetes (toothed whales) and the most sexually dimorphic cetaceans, with males considerably larger than females. Sperm whales are found throughout the world's oceans in deep waters between about 60° N and 60° S latitudes. During the past two centuries, commercial whalers took about 1,000,000 sperm whales. Despite this high level of take, the sperm whale remains the most abundant of the large whale species. Currently, there is no reliable estimate for the total number of sperm whales worldwide. The best estimate, that there are between 200,000 and 1,500,000 sperm whales, is based on extrapolations from only a few areas that have useful estimates. The sperm whale was listed as endangered throughout its range on June 2, 1970 under the Endangered Species Conservation Act of 1969.

Sperm whales tend to inhabit areas with a water depth of 600 meters or more, and are uncommon in waters less than 300 meters deep. Female sperm whales are generally found in deep waters (at least 1000 m) of low latitudes (less than 40°, except in the North Pacific where they are found as high as 50°). These conditions generally correspond to sea surface temperatures greater than 15°C, and while female sperm whales are sometimes seen near oceanic islands, they are typically far from land. Immature males will stay with female sperm whales in tropical and subtropical waters until they begin to slowly migrate towards the poles, anywhere between ages 4 and 21 years old. Older, larger males are generally found near the edge of pack ice in both hemispheres. On occasion, however, these males will return to the warm water breeding area.

In winter, sperm whales are concentrated east and northeast of Cape Hatteras. In spring, the center of distribution shifts northward to east of Delaware and Virginia, and is widespread throughout the central portion of the mid-Atlantic bight and the southern portion of Georges Bank. In summer, the distribution is similar but also includes the areas east and north of Georges Bank and into the

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.

Northeast Channel region, as well as the continental shelf (inshore of the 100 m isobath) south of New England. In the fall, sperm whale occurrence south of New England on the continental shelf if at its highest levels, and there remains a continental shelf edge occurrence in the mid-Atlantic bight. While they may be encountered almost anywhere on the high seas their distribution shows a preference for continental margins, sea mounts, and areas of upwelling, where food is abundant (Leatherwood and Reeves 1983). Waring *et al.* (1993) suggest sperm whale distribution is closely correlated with the Gulf Stream edge. Sperm whales migrate to higher latitudes during summer months, when they are concentrated east and northeast of Cape Hatteras. Bull sperm whales migrate much farther poleward than the cows, calves, and young males. Because most of the breeding herds are confined almost exclusively to warmer waters many of the larger mature males return in the winter to the lower latitudes to breed.

For management purposes, sperm whales inhabiting U.S. waters have been divided into five stocks: California-Oregon-Washington Stock, North Pacific (Alaska), Hawaii, Northern Gulf of Mexico Stock, and North Atlantic Stock. Only whales from the North Atlantic stock are likely to occur in the action area. In the western North Atlantic the species ranges from Greenland to the Gulf of Mexico and the Caribbean. The sperm whales that occur in the eastern U.S. EEZ are believed to represent only a portion of the total stock (Blaylock *et al.* 1995). The best available abundance estimate for the North Atlantic stock is 4,702 with a minimum population estimate of 3,505 (2002 SAR).

Sperm whale sightings recorded from the NOAA vessel Oregon II from 1991 - 1997 are concentrated just beyond the 100 m depth contour in the northern Gulf of Mexico, east of the Mississippi River Delta. Recent studies conducted jointly by researchers from NMFS and Texas A&M indicate that these offshore waters are an important area for Gulf sperm whales. This is the only known breeding and calving area in the Gulf, for what is believed to be an endemic population.

Sperm whales feed primarily on medium to large-sized mesopelagic squids *Architeuthis* and *Moroteuthis*. Sperm whales, especially mature males in higher latitude waters, also take significant quantities of large demersal and mesopelagic sharks, skates, and bony fishes (Clarke 1962, 1980). Sperm whale populations are organized into two types of groupings: breeding schools and bachelor schools. Older males are often solitary (Best 1979). Breeding schools consist of females of all ages and juvenile males. The mature females ovulate April through August in the Northern Hemisphere. During this season one or more large mature bulls temporarily join each breeding school. A single calf is born at a length of about 4 meters after a 15 month gestation period. A mature female will produce a calf every 3-6 years. Females attain sexual maturity at the mean age of nine years and a length of about nine meters. Males have a prolonged puberty and attain sexual maturity at about age 20 and a body length of 12 meters. Bachelor schools consist of maturing males who leave the breeding school and aggregate in loose groups of about 40 animals. As the males grow older they separate from the bachelor schools and remain solitary most of the year (Best 1979).

Sperm whales were hunted in America from the 17th century through the early 1900's. The International Whaling Commission (IWC) estimates that nearly a quarter-million sperm whales were killed worldwide in whaling activities between 1800 and 1900 (IWC 1971). With the advent of modern whaling the larger rorqual whales were targeted. However as their numbers decreased, greater attention was paid to smaller rorquals and sperm whales. From 1910 to 1982 there were nearly 700,000 sperm whales killed worldwide from whaling activities (Clarke 1954; Committee for Whaling Statistics 1959 -1983). In recent years the catch of sperm whales has been drastically reduced as a result of the imposition of catch quotas. NMFS believes there are insufficient data to determine population trends for this species (Blaylock *et al.* 1995).

Because of their generally more offshore distribution and their benthic feeding habits, sperm whales are less subject to entanglement than are right or humpback whales. However, sperm whales have been taken in the pelagic drift gillnet fishery for swordfish. Also, interactions between sperm whales and longlines for sable fish have been noted in Alaska waters. Three sperm whale entanglements in the North Atlantic have been documented from August 1993 to May 1998.

Due to their offshore distribution, sperm whales tend to strand infrequently. Eighteen sperm whale strandings have been documented along the US Atlantic coast during 1994-2000 (2002 SAR). In eastern Canada, 40 strandings were reported between 1970-1998. Two ship strikes, one in 1994 and one in 2000 have been reported.

As noted above, there are estimated to be 4,702 sperm whales in the North Atlantic. According to the 2002 Stock Assessment Report, there are insufficient data to determine the population trends for this species. Sperm whales would likely occur in the action area from April through October.

Right Whale

Right whales were probably the first large whale to be hunted on a systematic, commercial basis (Clapham et al. 1999). Records indicate that right whales in the North Atlantic were subject to commercial whaling as early as 1059 (Aguilar 1986). Commercial whaling for right whales along the U.S. Atlantic coast peaked in the 18th century, but right whales continued to be taken opportunistically along the coast and in other areas of the North Atlantic into the early 20th century (Kenney 2002). Right whales have occurred historically in all the world's oceans from temperate to subarctic latitudes (Perry et al. 1999). In both hemispheres, they are observed at low latitudes and in nearshore waters where calving takes place in the winter months, and in higher latitude foraging grounds in the summer (Clapham et al. 1999; Perry et al. 1999).

In 2000, the IWC reviewed the taxonomic nomenclature for right whales. Based on the results of genetic studies, the IWC formally recognized North Pacific, North Atlantic, and southern hemisphere right whales as three separate species (Best et al. 2001). In April 2003, NMFS published a final rule in the Federal Register (68 FR 17560) that amended the ESA-listing for right whales by recognizing three separate species: North Atlantic right whale (*Eubalaena glacialis*), North Pacific right whale (*Eubalaena japonica*), and southern right whale (*Eubalaena australis*). However, on January 11, 2005, another final rule was published (70 FR 1830) that removed the April 2003 final rule on the grounds that it was procedurally and substantively flawed. As a result, the ESA-listing for right whales has reverted to that in effect prior to the April 2003 rule; all right whales are listed as endangered either as Northern right whales (*Eubalaena glacialis*) or Southern right whales (*Eubalaena australis*).

Pacific Ocean. Very little is known of the size and distribution of the North Pacific right whale stocks. Two stocks are generally recognized: a western Pacific stock in the Sea of Okhotsk and an eastern Pacific stock. The number of right whales for each stock are considered to be very low. In the eastern Pacific, sightings have been made along the coasts of Washington, Oregon, California, and Baja California south to about 27° N (Scarff 1986; NMFS 1991b) and also in Hawaii (Herman et al. 1980; Barlow et al. 1998). However, right whales were not sighted consistently in any of these areas. In 1996, a group of 3 to 4 right whales were observed in the middle shelf of the Bering Sea, west of Bristol Bay and east of the Pribilof Islands (Goddard and Rugh 1998). Surveys conducted in July of 1997–2000 in Bristol Bay reported observations of lone animals or small groups of right whales in the same area as the 1996 sighting (Hill and DeMaster 1998, Perry et al. 1999). In 2004, the National Marine Mammal Laboratory undertook a North Pacific right whale tagging project as part of the Cetacean Assessment and Ecology Program to further investigate the presence of right whales in the eastern North Pacific (AFSC 2004). Researchers used sonobuoys to locate right whales (AFSC 2004). Two whales were located and satellite tagged (AFSC 2004). While tracking one of these whales, the scientists located 25 individual whales, more than doubling the number of known whales in the North Pacific (AFSC 2004). Although no estimate of abundance can be made at this time, all indications are that the number of eastern North Pacific right whales and, in general, all North Pacific right whales is very small.

Southern Hemisphere. A review of southern hemisphere right whales is provided in Perry et al. (1999). Since these right whales do not occur in U.S. waters, there is no recovery plan or stock assessment report for southern hemisphere right whales. Southern hemisphere right whales appear to be the most numerous of the right whales. Perry et al. (1999) provide a best estimate of abundance for southern hemisphere right whales as 7,000 based on estimates from separate breeding areas. In addition, unlike North Pacific or North Atlantic right whales, southern hemisphere right whales have shown some signs of recovery in the last 20 years. However, like other right whales, southern hemisphere right whales were heavily exploited (Perry et al. 1999). In addition, Soviet catch records made available in the 1990s (Zemsky et al. 1995) revealed that southern hemisphere right whales continued to be targeted well into the 20th century. Therefore, any indications of recovery should be viewed with caution.

Atlantic Ocean. As described above, scientific literature on right whales has historically recognized distinct eastern and western populations or subpopulations in the North Atlantic Ocean (IWC 1986). Current information on the eastern stock is lacking and it is unclear whether a viable population in the eastern North Atlantic still exists (Brown 1986, NMFS 1991b). Photo-identification work has shown that some of the whales observed in the eastern Atlantic were previously identified as western Atlantic right whales (Kenney 2002). This Opinion will focus on the western North Atlantic subpopulation of right whales which occurs in the action area.

Right whale life history, habitat and distribution

Western North Atlantic right whales (hereafter referred to as "right whales") generally occur from the southeast U.S. to Canada (e.g., Bay of Fundy and Scotian Shelf) (Kenney 2002; Waring et al. 2002). Like other right whale species, they follow an annual pattern of migration between low latitude winter calving grounds and high latitude summer foraging grounds (Perry et al. 1999; Kenney 2002). Telemetry data have shown lengthy and somewhat distant excursions into deep water off of the continental shelf (Mate et al. 1997) as well as extensive movements over the continental shelf during the summer foraging period (Mate and Nieukirk 1992; Mate et al. 1997; Bowman 2003; Baumgartner and Mate 2005). Photo-identification data have also indicated excursions of animals as far as Newfoundland, the Labrador Basin, southeast of Greenland (Knowlton et al. 1992), and Norway (Best et al. 2001). In the winter, only a portion of the known right whale population is seen on the calving grounds. The winter distribution of the remaining right whales remains uncertain (Waring et al. 2002). 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. 2002).

Unknowns about right whale habitat persist. For example, some female right whales have never been observed on the Georgia/Florida calving grounds but have been observed with a calf on the summer foraging grounds (Best et al. 2001). It is unknown whether these females are calving in an unidentified calving area or have just been missed during surveys off of Florida and Georgia (Best et al. 2001). The absence of some known (photo-identified) whales from identified habitats for months or years at a time suggests the presence of an unknown feeding ground (Kenney 2002). Finally, while behavior suggestive of mating is frequently observed on the foraging grounds, conception is not likely to occur at that time given the known length of gestation in other baleen whales. More likely, mating and conception occur in the winter (Kenney 2002). Based on genetics data, it has been suggested that two mating areas may exist with a somewhat different population composition (Best et al. 2001). The location of the mating area(s) is unknown.

Critical habitat for right whales has been designated in accordance with the ESA. Following a petition from the Right Whale Recovery Team, NMFS designated three critical habitat areas for right whales in 1994. These areas are: (1) portions of Cape Cod Bay and Stellwagen Bank, (2) the Great South Channel, and (3) coastal waters off of Georgia and Florida’s east coast (NMFS 1994). Right whale critical habitat in Northeast waters were designated for their importance as right whale foraging sites while the southeast critical habitat area was identified for its importance as a calving and nursery area (NMFS 1994). In 2002, NMFS received a petition to revise designated critical habitat for right whales by combining and expanding the existing Cape Cod Bay and Great South Channel critical habitats in the Northeast and by expanding the existing critical habitat in the Southeast (NMFS 2003). In response to the petition, NMFS (2003) recognized that there was new information on right whale distribution in areas outside of the designated critical habitat. However, the ESA requires that critical habitat be designated based on identification of specific habitat features essential to the conservation of the species rather than just known distribution (NMFS 2003). NMFS, therefore, denied the petition to revise critical habitat as requested by the petitioner, but also outlined an approach to investigate factors that may lead to other revisions to critical habitat (NMFS 2003).

There are relatively few right whales remaining in the western North Atlantic, although the exact number is unknown. As is the case with most wild animals, an exact count cannot be obtained. However, abundance can be reasonably estimated as a result of the extensive study of this subpopulation. IWC participants from a 1999 workshop agreed that it was reasonable to state that the number of western North Atlantic right whales as of 1998 was probably around 300 (+/- 10%) (Best et al. 2001). This conclusion was principally based on a photo-identification catalog that, as of July 1999, was comprised of more than 14,000 photographed sightings of 396 individuals, 11 of which were known to be dead and 87 of which had not been seen in more than 6 years. In addition, it was noted that relatively few new non-calf whales (whales that were never sighted and counted in the population as calves) had been sighted in recent years (Best et al. 2001), which suggests that the

396 individuals was a close approximation of the entire population.

A total of 125 right whale calves has been observed since the 1999 workshop, including a record calving season in 2000/2001 with 31 right whale births (B. Pike, New England Aquarium, pers. comm.). Calving numbers have been sporadic, with large differences among years. The three calving years (1997-2000) prior to the record year in 2000/2001 provided low recruitment with only 10 calves born, while the last six calving seasons (2000-2006) have been remarkably better with 31, 21, 19, 16, 28, and 19 births, respectively. The calf count of 19 animals for the latest calving season (2005/2006) is still preliminary and additional calves may be observed on the summer foraging grounds (B. Zoodsma, SERO, pers. comm.). However, the subpopulation has also continued to experience losses of calves, juveniles and adults. As of December 1, 2004, there were 459 individually identified right whales in the photo-identification catalog of which 18 were known to be dead, and 330 had been sighted during the previous six years (B. Pike pers. comm.)[3].

As is the case with other mammalian species, there is an interest in monitoring the number of females in this right whale subpopulation since their numbers will affect the subpopulation trend (whether declining, increasing or stable). Participants at the 1999 IWC workshop reviewed the sex composition of the right whale subpopulation based on sighting and genetics data (Best et al. 2001). Of the 385 right whales presumed alive at the end of 1998 (excludes the 11 known to have died but includes the 87 that had not been seen in at least 6 years), 157 were males, 153 were females, and 75 were of unknown sex (Best et al. 2001). Sightings data were also used to determine the number of presumably mature females (females known to be at least 9 years old) in the subpopulation and the number of females who had been observed with a calf at least once. For the period 1980-1998, there were at least 90 (presumed live) females age 9 years or greater. Of these, 75 had produced a calf during that same period (Best et al. 2001; Kraus et al. 2001). As described above, the 2000/2001 - 2004/2005 calving seasons have had relatively high calf production and have included additional first time mothers (e.g., eight new mothers in 2000/2001). These potential "gains" have been offset, however, by continued losses to the subpopulation including the death of mature females as a result of anthropogenic mortality (Cole et al. 2005 DRAFT). Five right whale mortalities were recorded from November 2004 through May 2005. Included in this number were two pregnant females and two other females of breeding age. The 2004 - 2005 mortalities have been documented by NMFS; however, this information has not been fully examined and verified by the ASRG process. A determination of the total levels of anthropogenic mortality and serious injury for 2004 and 2005 will be made following the ASRG's review of all of the available data and information.

Data collected in the 1990s suggested that right whales were experiencing a slow but steady recovery (Knowlton et al. 1994). However, Caswell et al. (1999) used photo-identification data and modeling to estimate survival and concluded that right whale survival decreased from 1980 to 1994. Modified versions of the Caswell et al. (1999) model as well as several other models were reviewed at the 1999 IWC workshop (Best et al. 2001). Despite differences in approach, all of the models indicated a decline in right whale survival in the 1990s relative to the 1980s with female survival, in

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

particular, affected (Best et al. 2001; Waring et al. 2002). 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, particularly of females, has continued to decline (Clapham et al. 2002).

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. (2001) reviewed reproductive parameters for the period 1980-1998 and found that calving intervals increased from 3.67 years in 1992 to 5.8 years in 1998. In addition, as of 1999, only 70% of presumably mature females (females aged 9 years or older) were known to have given birth (Best et al. 2001).

Factors that have been suggested as affecting the right whale reproductive rate include reduced genetic diversity, pollutants, and nutritional stress. However, there is currently no evidence available to determine their potential effect, if any, on right whales. The size of the western North Atlantic subpopulation of right whales at the termination of whaling is unknown but is generally believed to have been very small. Such an event may have resulted in a loss of genetic diversity which could affect the ability of the current population to successfully reproduce (i.e., decreased conceptions, increased abortions, and increased neonate mortality). Studies by Schaeff et al. (1997) and Malik et al. (2000) indicate that western North Atlantic right whales are less genetically diverse than southern right whales. However, several apparently healthy populations of cetaceans, such as sperm whales and pilot whales, have even lower genetic diversity than observed for western North Atlantic right whales (IWC 2001). Similarly, while contaminant studies have confirmed that right whales are exposed to and accumulate contaminants, researchers could not conclude that these contaminant loads were negatively affecting right whale reproductive success since concentrations were lower than those found in marine mammals proven to be affected by PCBs and DDT (Weisbrod et al. 2000). Finally, although North Atlantic right whales seem to have thinner blubber than right whales from the South Atlantic (Kenney 2000), there is no evidence at present to demonstrate that the decline in birth rate and increase in calving interval is related to a food shortage. Nevertheless, a connection among right whale reproduction and environmental factors may yet be found. Modeling work by Caswell et al. (1999) and Fujiwara and Caswell (2001) suggests that the North Atlantic Oscillation (NAO), a naturally occurring climactic event, does affect the survival of mothers and the reproductive rate of mature females, and it also seems to affect calf survival (Clapham et al. 2002). Further work is needed to assess the magnitude and manner in which the NAO may affect right whale reproductive success.

Threats to right whale recovery

There is general agreement that right whale recovery is negatively affected by anthropogenic mortality. Fifty -five right whale mortalities were reported from Florida to the Canadian Maritimes during the period of 1970-2003 (Moore et al. 2004; Cole et al. 2005 DRAFT). Eight additional mortalities were reported for the period 2004 through July 1, 2005 (Kraus et al. 2005). 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 have been observed.

Considerable effort has been made to examine right whale carcasses for the cause of death (Moore et al. 2004). 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. Moore et al. (2004) provide information on the examination of 30 right whale carcasses during the period of 1970-2002. Cole et al. (IN DRAFT) provides supporting information for some of these as well as for the right whale mortality documented in 2003. Of the 31 animals examined, ship strike was identified as the cause of death or probable cause of death for 15 (11 adults/juveniles; 4 calves) and entanglement in fishing gear was identified as the cause of death for 4 (all adults/juveniles) (Moore et al. 2004; Cole et al. IN DRAFT). A cause of death was undeterminable for 12 animals, 8 of which were calves (Moore et al. 2004). Preliminary information on the eight right whale mortalities for 2004 - July 1, 2005, has been released (Kraus et al. 2005; SEIT 2005). Ship strikes and entanglement in fishing gear are suggested as the primary cause of death for some of these (Kraus et al. 2005; SEIT 2005). However, the ASRG has not yet made a final determination for any of the eight whale mortalities documented for 2004- July 1, 2005.

Ship strikes and entanglements are not always fatal to right whales. Scarification analysis of living animals provides additional information on the frequency of right whale interactions with vessels and rope/line. Based on photographs of catalogued animals from 1935 through 1995, Hamilton et al. (1998) estimated that 61.6 percent of right whales exhibit injuries caused by entanglement and 6.4 percent exhibit signs of injury from vessel strikes. In addition, several whales have apparently been entangled on more than one occasion. Right whales may suffer long term effects of such interactions even when they survive the initial interaction. For example, some right whales that have been entangled were subsequently involved in ship strikes (Hamilton et al. 1998) suggesting that the animal may have become debilitated by the entanglement to such an extent that it was less able to avoid a ship. A necropsy of a right whale found dead in 2005 suggests that the animal died of an infection after the scars from a previous ship strike interaction opened up during her first pregnancy.

Right Whale Status and Trends

Although no estimate of abundance can be made at this time, all indications are that the number of North Pacific right whales is very small. In 2004, researchers located and identified a total of 25 individual right whales in the eastern North Pacific (AFSC 2004). While this represents more than double the previous number of known whales in the eastern North Pacific (AFSC 2004), it demonstrates the very low numbers of North Pacific right whales. In contrast, southern hemisphere right whales number in the thousands and have shown some signs of recovery in the last 20 years. However, like other right whales, southern hemisphere right whales were heavily exploited (Perry et al. 1999). Therefore, any indications of recovery should be viewed with caution.

As noted above, in the Atlantic there are an estimated 300 right whales (+/- 10%) (Best et al. 2001). The 2000/2001 - 2005/2006 calving seasons have had relatively high calf production and have included additional first time mothers. These potential "gains" have been offset, however, by continued losses to the subpopulation including the death of mature females as a result of anthropogenic mortality (Cole et al. 2005 DRAFT).

Sixty-three right whale mortalities were reported from Florida to the Canadian Maritimes during the period from 1970-July 1, 2005 (Moore et al. 2004; Cole et al. IN DRAFT; Kraus et al. 2005). 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. Ship strikes and fishing gear entanglements were identified as the primary cause of death for many of these. Scarification analysis indicates that some whales do survive encounters with ships and fishing gear. However, the long-term consequences of these interactions are unknown.

A number of different modeling exercises using the extensive data collected on this subpopulation have come to the same conclusion; right whale survival continues to decline (Clapham et al. 2002). Based on recent reviews of the status of the right whales, their reproductive rate (the number of calves that are born in the population each year) appears to be declining, which could increase the whales' extinction risk (Caswell et al. 1999, Fujiwara and Caswell 2001, IWC 2001). Based on the information currently available, for the purposes of this Opinion, NMFS believes that the western North Atlantic right whale subpopulation numbers 300 (+/- 10%) and is declining.

Humpback Whale

Humpback whales inhabit all major ocean basins from the equator to subpolar latitudes. They generally follow a predictable migratory pattern in both hemispheres, feeding during the summer in the higher near-polar latitudes and migrating to lower latitudes where calving and breeding takes place in the winter (Perry et al. 1999).

Humpback whales range widely across the North Pacific during the summer months; from Port Conception, CA, to the Bering Sea (Johnson and Wolman 1984, Perry et al. 1999). Although the IWC recognizes only one stock (Donovan 1991) there is evidence to indicate multiple populations or stocks occur within the North Pacific Basin (Perry et al. 1999, Carretta et al. 2001). For the purposes of managing this species under the MMPA NMFS recognizes three management units within the U.S. EEZ. These are: the eastern North Pacific stock, the central North Pacific stock and the western North Pacific stock (Carretta et al. 2001). There are indications that the eastern North Pacific stock is increasing in abundance (Carretta et al. 2001) and the central North Pacific stock appears to have increased in abundance between the 1980s -1990s (Angliss et al. 2001). There is no reliable population trend data for the western North Pacific stock (Angliss et al. 2001).

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

Six separate feeding areas are utilized in northern waters during the summer months (Waring et al. 1999). Humpbacks feed on a number of species of small schooling fishes, particularly sand lance and Atlantic herring, by targeting fish schools and filtering large amounts of water for the associated prey. Humpback whales have also been observed feeding on krill (Wynne and Schwartz 1999).

In winter, whales from the six feeding areas mate and calve primarily in the West Indies where spatial and genetic mixing among these groups occur (Waring et al. 2000). Various papers (Clapham and Mayo 1990; Clapham 1992; Barlow and Clapham 1997; Clapham et al. 1999) summarized information gathered from a catalogue of photographs of 643 individuals from the western North Atlantic population of humpback whales. These photographs identified reproductively mature western North Atlantic humpbacks wintering in tropical breeding grounds in the Antilles, primarily on Silver and Navidad Banks, north of the Dominican Republic. The primary winter range also includes the Virgin Islands and Puerto Rico (NMFS 1991a). Calves are born from December through March and are about 4 meters at birth. Females give birth approximately every 2 to 3 years. Sexual maturity is reached between 4 and 6 years of age for females and between 7 and 15 years for males. Size at maturity is about 12 meters.

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

Photographic mark-recapture analyses from the Years of the North Atlantic Humpback (YONAH) project gave an ocean-basin-wide estimate of 10,600 (95% c.i. = 9,300 - 12,100) (Waring et al. 2000). For management purposes under the MMPA, the estimate of 10,600 is regarded as the best available estimate for the North Atlantic population (Waring et al. 2000).

Threats to Humpback Whales

As is the case with other large whales, the major known sources of anthropogenic mortality and injury of humpback whales are commercial fishing gear entanglements and ship strikes. Sixty percent of Mid-Atlantic humpback whale mortalities that were closely investigated showed signs of entanglement or vessel collision (Wiley et al. 1995). Between 1992 and 2002 at least 103 humpback whale entanglements and 10 ship strikes were recorded. There were also many carcasses that washed ashore or were spotted floating at sea for which the cause of death could not be determined. Based on photographs of the caudal peduncle of humpback whales, Robbins and Mattila (1999) estimated that at least 48 percent, and possibly as many as 78 percent, of animals in the Gulf of Maine exhibit scarring caused by entanglement. These estimates are based on sightings of free-swimming animals that initially survive the encounter. Because some whales may drown immediately, the actual number of interactions may be higher.

Humpback whales, like other baleen whales, may also be adversely affected by habitat degradation, habitat exclusion, acoustic trauma, harassment, or reduction in prey resources due to trophic effects resulting from a variety of activities including the operation of commercial fisheries, coastal development and vessel traffic. However, evidence of these is lacking. There are strong indications that a mass mortality of humpback whales in the southern Gulf of Maine in 1987/1988 was the result of the consumption of mackerel whose livers contained high levels of a red-tide toxin. It has been suggested that red tides are somehow related to increased freshwater runoff from coastal development but there is insufficient data to link this with the humpback whale mortality (Clapham et al. 1999). Changes in humpback distribution in the Gulf of Maine have been found to be associated with changes in herring, mackerel, and sand lance abundance associated with local fishing pressures (Waring et al. 2000). However, there is no evidence that humpback whales were adversely affected by these trophic changes.

Humpback Whales Status

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

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 Indes. The overall distribution may be based on prey availability as this species preys opportunistically on both invertebrates and fish (Watkins et al. 1984). Fin whales feed by filtering large volumes of water for the associated prey. Fin whales are larger and faster than humpback and right whales and are less concentrated in nearshore environments.

Within U.S. waters of the Pacific, fin whales are found seasonally off of the coast of North America and Hawaii, and in the Bering Sea during the summer (Angliss et al. 2001). NMFS recognizes three fin whale stocks in the Pacific for the purposes of managing this species under the MMPA. These are: Alaska (Northeast Pacific), California/Washington/Oregon, and Hawaii (Angliss et al. 2001). Reliable estimates of current abundance for the entire Northeast Pacific fin whale stock are not available (Angliss et al. 2001). Stock structure for fin whales in the southern hemisphere is unknown. Prior to commercial exploitation, the abundance of southern hemisphere fin whales is estimated to have been at 400,000 (IWC 1979, Perry et al. 1999). There are no current estimates of abundance for southern hemisphere fin whales. Since these fin whales do not occur in U.S. waters, there is no recovery plan or stock assessment report for the southern hemisphere fin whales.

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

During 1978-1982 aerial surveys, fin whales accounted for 24% of all cetaceans and 46% of all large cetaceans sighted over the continental shelf between Cape Hatteras and Nova Scotia (Waring *et al.*1998). Underwater listening systems have also demonstrated that the fin whale is the most acoustically common whale species heard in the North Atlantic (Clark 1995). The single most important area for this species appeared to be from the Great South Channel, along the 50m isobath past Cape Cod, over Stellwagen Bank, and past Cape Ann to Jeffrey's Ledge (Hain *et al.*1992).

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

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.

Various estimates have been provided to describe the current status of fin whales in western North Atlantic waters. One method used the catch history and trends in Catch Per Unit Effort to obtain an estimate of 3,590 to 6,300 fin whales for the entire western North Atlantic (Perry *et al.* 1999). Hain *et al.* (1992) estimated that about 5,000 fin whales inhabit the Northeastern U.S. continental shelf waters. The 2003 SAR gives a best estimate of abundance for fin whales of 2,814 (CV = 0.21). The minimum population estimate for the western North Atlantic fin whale is 2,362 (Waring *et al.* 2001). However, this is considered an underestimate since the estimate was derived from surveys over a limited portion of the western North Atlantic.

Threats to fin whale recovery

The major known sources of anthropogenic mortality and injury of fin whales include entanglement in commercial fishing gear and ship strikes. Of 18 fin whale mortality records collected between 1991 and 1995, four were associated with vessel interactions, although the proximal cause of mortality was not known. From 1996-July 2001, there were nine observed fin whale entanglements and at least four ship strikes. It is believed to be the most commonly struck cetacean by large vessels (Laist *et al.* 2001). In addition, hunting of fin whales continued well into the 20th century. Fin whales were given total protection in the North Atlantic in 1987 with the exception of a subsistence whaling hunt for Greenland (Gambell 1993, Caulfield 1993). However, Iceland reported a catch of 136 whales in the 1988/89 and 1989/90 seasons, and has since ceased reporting fin whale kills to the IWC (Perry *et al.* 1999). In total, there have been 239 reported kills of fin whales from the North Atlantic from 1988 to 1995. Fin whales may also be adversely affected by habitat degradation, habitat exclusion, acoustic trauma, harassment, or reduction in prey resources due to trophic effects resulting from a variety of activities.

Summary of Fin Whale Status

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

Information on the abundance and population structure of fin whales worldwide is limited. NMFS recognizes three fin whale stocks in the Pacific for the purposes of managing this species under the MMPA. Reliable estimates of current abundance for the entire Northeast Pacific fin whale stock are not available (Angliss *et al.* 2001). Stock structure for fin whales in the southern hemisphere is unknown and there are no current estimates of abundance for southern hemisphere fin whales.

Loggerhead sea turtles

Loggerhead sea turtles are found in temperate and subtropical waters and inhabiting pelagic waters, continental shelves, bays, estuaries and lagoons. Loggerhead sea turtles are the most abundant species of sea turtle in U.S. waters, commonly occurring throughout the inner continental shelf from Florida through Cape Cod, Massachusetts, and may occur as far north as Nova Scotia when oceanographic and prey conditions are favorable (NEFSC survey data 1999). The loggerhead was listed as threatened under the ESA on July 28, 1978.

In the Pacific Ocean, major loggerhead nesting grounds are generally located in temperate and subtropical regions with scattered nesting in the tropics. The abundance of loggerhead turtles on nesting colonies throughout the Pacific basin have declined dramatically over the past 10-20 years. Loggerhead sea turtles in the Pacific are represented by a northwestern Pacific nesting aggregation (located in Japan) and a smaller southwestern nesting aggregation that occurs in Australia (Great Barrier Reef and Queensland), New Caledonia, New Zealand, Indonesia, and Papua New Guinea. Data from 1995 estimated the Japanese nesting aggregation at 1,000 female loggerhead turtles (Bolten *et al*. 1996). More recent estimates are unavailable, however, qualitative reports infer that the Japanese nesting aggregation has declined since 1995 and continues to decline (Tillman 2000). Genetic analyses of female loggerheads nesting in Japan indicates the presence of genetically distinct nesting colonies (Hatase *et al.* 2002). As a result, Hatase *et al.* (2002) suggest that the loss of one of these colonies would decrease the genetic diversity of loggerheads that nest in Japan, and recolonization of the site would not be expected on an ecological time scale. In Australia, long-term census data has been collected at some rookeries since the late 1960's and early 1970's, and nearly all data show marked declines in nesting populations since the mid-1980's (Limpus and Limpus 2003). No recent, quantitative estimates of the size of the nesting aggregation in the southwest Pacific is available, but the nesting aggregation in Queensland, Australia, was as low as 300 females in 1997.

Pacific loggerhead turtles are captured, injured, or killed in numerous Pacific fisheries including Japanese longline fisheries in the western Pacific Ocean and South China Seas; direct harvest and commercial fisheries off Baja California, Mexico, commercial and artisanal swordfish fisheries off Chile, Columbia, Ecuador, and Peru; purse seine fisheries for tuna in the eastern tropical Pacific Ocean, and California/Oregon drift gillnet fisheries. Loggerhead turtle colonies in the 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 (e.g., egg poaching).

In the Atlantic Ocean, Loggerheads commonly occur throughout the inner continental shelf from Florida through Cape Cod, Massachusetts although their presence varies with the seasons due to changes in water temperature (Braun and Epperly 1996; Epperly *et al.* 1995a, Epperly *et al.* 1995b; Shoop and Kenney 1992). Aerial surveys of loggerhead turtles north of Cape Hatteras indicate that they are most common in waters from 22 to 49 meters deep although they range from the beach to waters beyond the continental shelf (Shoop and Kenney 1992). The presence of loggerhead turtles in an area is also influenced by water temperature. Loggerheads have been observed in waters with surface temperatures of 7-30°C but water temperatures of 11°C are favorable to sea turtles (Epperly *et al.* 1995b; Shoop and Kenney 1992). As coastal water temperatures warm in the spring, loggerheads begin to migrate to North Carolina inshore waters (*e.g.*, Pamlico and Core Sounds) and also move up the coast (Braun-McNeill and Epperly 2004; Epperly *et al.* 1995a; Epperly *et al.* 1995b; Epperly *et al.* 1995c), occurring in Virginia foraging areas as early as April and on the most northern foraging grounds in the Gulf of Maine in June. The trend is reversed in the fall as water temperatures cool. The large majority leave the Gulf of Maine by mid-September but some may remain in Mid-Atlantic and Northeast areas until late Fall. By December loggerheads have migrated from inshore North Carolina waters and more northern coastal waters to waters offshore of North Carolina, particularly off of Cape Hatteras, and waters further south where the influence of the Gulf Stream provides temperatures favorable to sea turtles (Epperly *et al.* 1995b; Shoop and Kenney 1992).

In the western Atlantic, most loggerhead sea turtles nest from North Carolina to Florida and along the Gulf coast of Florida. In 1996, the Turtle Expert Working Group (TEWG) met on several occasions and produced a report assessing the status of the loggerhead sea turtle population in the western North Atlantic. The southeastern U.S. nesting aggregation is the second largest and represents about 35 percent of the nests of this species. From a global perspective, this U.S. nesting aggregations is, therefore, critical to the survival of this species.

Based on analysis of mitochondrial DNA (mtDNA), which is maternally inherited, the TEWG theorized that nesting assemblages represent distinct genetic entities, and that there are at least four loggerhead subpopulations in the western North Atlantic separated at the nesting beach (TEWG 1998, 2000). A fifth subpopulation was identified in NMFS SEFSC 2001. There are at least five western Atlantic subpopulations, divided geographically as follows: (1) a northern nesting subpopulation, occurring from North Carolina to northeast Florida at about 29°N (approximately 7,500 nests in 1998); (2) a south Florida nesting subpopulation, occurring from 29°N on the east coast to Sarasota on the west coast (approximately 83,400 nests in 1998); (3) a Florida Panhandle nesting subpopulation, occurring at Eglin Air Force Base and the beaches near Panama City, Florida (approximately 1,200 nests in 1998); (4) a Yucatán nesting subpopulation, occurring on the eastern Yucatán Peninsula, Mexico (TEWG 2000); and (5) a Dry Tortugas nesting subpopulation, occurring in the islands of the Dry Tortugas, near Key West, Florida (approximately 200 nests per year) (NMFS SEFSC 2001). Genetic analyses conducted at these nesting sites indicate that they are distinct subpopulations (TEWG 2000). Natal homing to the nesting beach is believed to provide the genetic barrier between these nesting aggregations, preventing recolonization from turtles from other nesting beaches. Fine-scale analysis of mtDNA work from Florida rookeries indicate that population separations begin to appear between nesting beaches separated by more than 50-100 km of coastline that does not host nesting (Francisco et al. 1999) and tagging studies are consistent with this result (Richardson 1982, Ehrhart 1979, LeBuff 1990, CMTTP: in NMFS SEFSC 2001). Nest site relocations greater than 100 km occur, but are rare (Ehrhart 1979; LeBuff 1974, 1990; CMTTP; Bjorndal et at. 1983: in NMFS SEFSC 2001). In addition, a recent study by Bowen *et al*. (2004) lends support to the hypothesis that juvenile loggerhead sea turtles exhibit homing behavior with respect to using foraging areas in the vicinity of their nesting beach. Therefore, coastal hazards that affect declining nesting populations may also affect the next generation of turtles when they are feeding in nearby habitats (Bowen *et al*. 2004).

Loggerheads from any of these nesting sites may occur within the action area. However, the majority of the loggerhead turtles in the action area are expected to have come from the northern nesting subpopulation and the south Florida nesting subpopulation with a smaller portion from the Yucatan subpopulation. Rankin-Baransky et. al. examined the genetic composition of loggerheads stranded in the Northeast and determined that 25% were from the northern nesting subpopulation, 59% from the south Florida subpopulation and 16% from the Yucatan subpopulation. Bass et al.

(1995) reports that of the sea turtles foraging in Virginia waters, approximately half are from the northern nesting subpopulation and half from the south Florida nesting subpopulation with very few loggerheads from the Mexican subpopulation (less than .07%) occurring in Chesapeake Bay. As the action area for this consultation includes Northeast and Mid-Atlantic waters, it is likely that loggerheads from these three subpopulations may occur in the action area. Loggerheads from other subpopulations have not been shown to occur in these waters in detectable numbers. As such, in this Opinion NMFS will consider effects of the action on loggerheads from the northern subpopulation, the south Florida subpopulation and the Yucatan subpopulation.

Mating takes place in late March-early June, and eggs are laid throughout the summer, with a mean clutch size of 100-126 eggs in the southeastern U.S. Individual females nest multiple times during a nesting season, with a mean of 4.1 nests/individual (Murphy and Hopkins 1984). Nesting migrations for an individual female loggerhead are usually on an interval of 2-3 years, but can vary from 1-7 years (Dodd 1988). In the western Atlantic, most loggerhead sea turtles nest from North Carolina to Florida and along the gulf coast of Florida.

Like other sea turtles, loggerhead hatchlings enter the pelagic environment upon leaving the nesting beach. Loggerhead sea turtles originating from the western Atlantic nesting aggregations are believed to lead a pelagic existence in the North Atlantic Gyre for as long as 7-12 years before settling into benthic environments where they opportunistically forage on crustaceans and mollusks (Wynne and Schwartz 1999). However, some loggerheads may remain in the pelagic environment for longer periods of time or move back and forth between the pelagic and benthic environment (Witzell 2002). Loggerheads that have entered the benthic environment appear to undertake routine migrations along the coast that appear to be limited by seasonal water temperatures. Loggerhead sea turtles are found in Virginia foraging areas as early as April but are not usually found on the most northern foraging grounds in the Gulf of Maine until June. The large majority leave the Gulf of Maine by mid-September but some may remain in Mid-Atlantic and Northeast areas until late fall. Loggerheads appear to concentrate in nearshore and southerly areas influenced by warmer Gulf Stream waters off North Carolina during November and December (Epperly et al. 1995a). Support for these loggerhead movements are provided by the collected work of Morreale and Standora (1998) who showed through satellite tracking that 12 loggerheads traveled along similar spatial and temporal corridors from Long Island Sound, New York, in a time period of October through December, within a narrow band along the continental shelf before taking up residence for one or two months south of Cape Hatteras.

A number of stock assessments (TEWG 1998; 2000; NMFS SEFSC 2001; Heppell *et al.* 2003) have examined the stock status of loggerheads in the waters of the U.S., but have been unable to develop any reliable estimates of absolute population size. Due to the difficulty of conducting comprehensive population surveys away from nesting beaches, nesting beach survey data are used to index the status and trends of loggerheads (USFWS and NMFS 2003).

Between 1989 and 1998, the total number of nests laid along the U.S. Atlantic and Gulf coasts ranged from 53,014 to 92,182, annually with a mean of 73,751 (TEWG 2000). The south Florida nesting group is the largest known loggerhead nesting assemblage in the Atlantic and one of only two loggerhead nesting assemblages worldwide that has greater than 10,000 females nesting per year (USFWS and NMFS 2003; USFWS Fact Sheet). Annual nesting totals have ranged from

48,531 - 83,442 annually over the past decade (USFWS and NMFS 2003). South Florida nests make up the majority (90.7%) of all loggerhead nests counted along the U.S. Atlantic and Gulf coasts during the period 1989-1998. The northern subpopulation is the second largest loggerhead nesting assemblage within the U.S. but much smaller than the south Florida nesting group. Of the total number of nests counted along the U.S. Atlantic and Gulf coasts during the period 1989-1998, 8.5% were attributed to the northern subpopulation. The number of nests for this subpopulation have ranged from 4,370 - 7,887 for the period 1989-1998, for an average of approximately 1,524 nesting females per year (USFWS and NMFS 2003). The remaining three subpopulations (the Dry Tortugas, Florida Panhandle, and Yucatán) are much smaller subpopulations. Annual nesting totals for the Florida Panhandle subpopulation ranged from 113-1,285 nests for the period 1989-2002 (USFWS and NMFS 2003). The Yucatán nesting group was reported to have had 1,052 nests in 1998 (TEWG 2000). Nest counts for the Dry Tortugas subpopulation ranged from 168-270 during the 9-year period from 1995-2003.

While nesting beach data is a useful tool for assessing sea turtle populations, the detection of nesting trends requires consistent data collection methods over long periods of time (USFWS and NMFS 2003). In 1989, a statewide sea turtle Index Nesting Beach Survey (INBS) program was developed and implemented in Florida, and similar standardized daily survey programs have been implemented in Georgia, South Carolina, and North Carolina (USFWS and NMFS 2003). Although not part of the INBS program, nesting survey data are also available for the Yucatán Peninsula, Mexico (USFWS and NMFS 2003). However, the currently available nesting data is still too limited to indicate statistically reliable trends for these loggerhead subpopulations. To date, analysis of nesting data from the INBS program, including nesting data through 2003, indicate that there is no discernable trend for the south Florida, northern or Florida Panhandle subpopulations (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, Statewide and Index Nesting Beach Survey Programs; USFWS and NMFS 2003). Nesting surveys for the Dry Tortugas subpopulation are conducted as part of Florida's statewide survey program. Survey effort has been relatively stable during the 9-year period from 1995-2003 (although the 2002 year was missed) but given the relatively short period of survey effort, no conclusion can be made at this time on the trend of this subpopulation (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, Statewide Nesting Beach Survey Data). Similarly, although Zurita *et al.* (2003) did find significant increases in loggerhead nesting on seven beaches at Quintana Roo, Mexico, nesting survey effort overall has been inconsistent among the Yucatán nesting beaches and no trend can be determined for this subpopulation given the currently available data. More reliable nesting trend information is available from some south Florida and northern subpopulation nesting beaches that have been surveyed for longer periods of time. Using the information gathered from these select south Florida and northern subpopulation nesting beaches, the Turtle Expert Working Group (TEWG) concluded that the south Florida subpopulation was increasing based on nesting data over the last couple of decades, and that the northern subpopulation was stable or declining (TEWG 2000).

Sea turtle biologists are cautiously watching nest counts for the subpopulations. Nest counts appear to be down for the past five years. Loggerheads do exhibit a cyclical pattern to nesting such that in some years nest counts are high while in others they are low (*e.g.*, not all mature females nest in a year). Natural events, such as hurricanes, can destroy many nests and can negatively affect nesting trends even in years when the nesting itself was successful. The hurricane seasons of 2004 and

2005 destroyed many nests. It is unknown at this time whether the nest counts over the past five years represent an actual decline in the loggerhead subpopulations or reflect the effects of bad hurricane seasons. In addition, since nest counts are a reflection of only one sex and age class in the subpopulation (mature females), using nesting trend data to make conclusions about the status of the entire subpopulation requires making certain assumptions. These are that the current impacts to mature females are experienced to the same degree amongst all age classes regardless of sex, and/or that the impacts that led to the current abundance of nesting females are affecting the current immature females to the same extent. While there is no current evidence to support or refute these assumptions, multiple management actions have been implemented in the U.S. that either directly or indirectly address the known sources of mortality for loggerhead sea turtles (*e.g.*, fishery interactions, power plant entrainment, destruction of nesting beaches, etc.).

Based upon annual nesting totals from all beaches over the last 25 years, the South Florida subpopulation of loggerheads appears to be increasing. However, a more recent analysis limited to nesting data from the INBS program from 1989 to 2002, a period encompassing index surveys that are more consistent and more accurate than surveys in previous years, has shown no detectable trend (B. Witherington, Florida Fish and Wildlife Conservation Commission, pers. comm., 2002).

Several published reports have presented the problems facing long-lived species that delay sexual maturity (Crouse et al. 1987; Crowder et al. 1994; Crouse 1999). In general, these reports concluded that animals that delay sexual maturity and reproduction must have high annual survival as juveniles through adults to ensure that enough juveniles survive to reproductive maturity and then reproduce enough times to maintain stable population sizes. Crouse (1999) concluded that relatively small decreases in annual survival rates of both juvenile and adult loggerhead sea turtles will adversely affect large segments of the total loggerhead sea turtle population. The survival of hatchlings seems to have the least amount of influence on the survivorship of the species, but historically, the focus of sea turtle conservation has been involved with protecting the nesting beaches. While nesting beach protection and hatchling survival are important, recovery efforts and limited resources might be more effective by focusing on the protection of juvenile and adult sea turtles.

One of the difficulties associated with using loggerhead nesting trend data as an indicator of subpopulation status is the late age to maturity for loggerhead sea turtles. Past literature gave an estimated age at maturity for loggerhead sea turtles of 21-35 years (Frazer and Ehrhart 1985; Frazer *et al.* 1994) with the benthic immature stage lasting at least 10-25 years. New data from tag returns, strandings, and nesting surveys suggested estimated ages of maturity ranging from 20-38 years and the benthic immature stage lasting from 14-32 years (NMFS SEFSC 2001). Caution must still be exercised, however, when defining the benthic immature stage. Like other sea turtles, loggerhead hatchlings enter the pelagic environment upon leaving the nesting beach. It had previously been thought that after approximately 7-12 years in the pelagic environment, immature loggerheads entered the benthic environment and undertook seasonal north and south migrations along the coast. However, the use of pelagic and benthic environments by loggerhead sea turtles is now suspected of being much more complex (Witzell 2002). Loggerheads may remain in the pelagic environment for longer periods of time or move back and forth between the pelagic and benthic environment (Witzell 2002). Captures of sea turtles in the U.S. pelagic longline fishery have shown that large loggerhead sea turtles (mature and/or immature) routinely inhabit offshore habitats during non-winter months in the northwest North Atlantic Ocean (Witzell 2002; 1999). It has been suggested that some of these turtles might be associated with warm water fronts and eddies and might form offshore feeding aggregations in areas of high productivity (Witzell 2002; 1999).

In 2001, NMFS (SEFSC) reviewed and updated the stock assessment for loggerhead sea turtles of the western Atlantic (NMFS SEFSC 2001). The assessment reviewed and updated information on nesting abundance and trends, estimation of vital rates (including age to maturity), evaluation of genetic relationships between populations, and evaluation of available data on other anthropogenic effects on these populations since the TEWG reports (1998; 2000). In addition, the assessment also looked at the impact of the U.S. pelagic longline fishery on loggerheads with and without the proposed changes in the Turtle Excluder Device (TED) regulations for the shrimp fishery using a modified population model from Heppell *et al*. (2003)[4]. NMFS SEFSC (2001) modified the model developed by Heppell *et al*. (2003) to include updated vital rate information (*e.g.*, new estimates of the duration of life stages and time to maturity) and, unlike Heppell *et al*. (2003), also considered sex ratios other than 1:1 (NMFS SEFSC 2001). The latter is an important point since studies have suggested that the proportion of females produced by the northern subpopulation is only 35% while the proportion of females produced by the south Florida subpopulation is 80% (NMFS SEFSC 2001).

The assessment looked at the impact of the proposed changes in the Turtle Excluder Device (TED) regulations for the shrimp fishery, as well as the U.S. pelagic longline fishery on loggerheads. NMFS SEFSC (2001) constructed models based on a 30% decrease in small benthic juvenile mortality based on research findings of (existing) TED effectiveness (Crowder *et al*. 1995; NMFS SEFSC 2001; Heppell *et al*. 2003). Model runs were then compared with respect to the change in population status as a result of implementing the requirement for larger TEDs (Epperly *et al*. 2002) alone, and also when combined with other changes in survival rate from the pelagic long line fishery. The results of the modeling indicated that the proposed change in the TED regulations which would allow larger benthic immature loggerheads and sexually mature loggerheads to escape from shrimp trawl gear would have a positive or at least stabilizing influence on the subpopulation in nearly all scenarios. Coupling the anticipated effect of the proposed TED changes with changes in the survival rate of pelagic immature loggerheads revealed that subpopulation status would be positive or at least stable. Coupling the anticipated effect of the proposed TED changes with changes in the survival rate of pelagic immature loggerheads revealed that subpopulation status would be positive or at least stable when pelagic immature survival was changed by 0 to +10% in all but the most conservative model scenarios.

Given the late age at maturity for loggerhead sea turtles and the normal fluctuations in nesting, changes in populations size as a result of the larger TED requirements and measures to address pelagic immature survival in the U.S. Atlantic longline fishery for swordfish are unlikely to be evident in nesting beach censuses for many years to come. NMFS' SEFSC (2001) assessment was reviewed by three independent experts from the Center for Independent Experts, in 2001. As a result, NMFS SEFSC's stock assessment report, the reviews of it, and the body of scientific

4 Although Heppell *et al*. is a later publication, NMFS SEFSC 2001 is actually a more up-to-date version of the modeling approach. Due to differences in publication times, Heppell *et al*. (2003) was published after NMFS SEFSC 2001.

literature upon which these documents were derived represent the best available scientific and commercial information for Atlantic loggerheads.

Threats to loggerhead sea turtle recovery

The diversity of a sea turtle's life history leaves them susceptible to many natural and human impacts, including impacts while they are on land, in the benthic environment, and in the pelagic environment. Hurricanes are particularly destructive to sea turtle nests. Sand accretion and rainfall that result from these storms as well as wave action can appreciably reduce hatchling success. For example, in 1992, all of the eggs over a 90-mile length of coastal Florida were destroyed by storm surges on beaches that were closest to the eye of Hurricane Andrew (Milton *et al.* 1994). Reports suggest that extensive loggerhead nest destruction occurred in Florida and other southern states in 2004 due to damage from multiple hurricanes and storm events. Other sources of natural mortality include cold stunning and biotoxin exposure. For example, in the winter of 2004/2005, 2 loggerheads died due to cold stunning on Cape Cod beaches and in the winter of 2005/2006, six loggerheads were cold stunned, with 2 deaths (S. McNulty, NMFS, pers. comm.).

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

Sea turtles, including loggerhead sea turtles, are affected by a completely different set of anthropogenic threats in the marine environment. These include oil and gas exploration, coastal development, and transportation; marine pollution; underwater explosions; hopper dredging, offshore artificial lighting; power plant entrainment and/or impingement; entanglement in debris; ingestion of marine debris; marina and dock construction and operation; boat collisions; poaching, and fishery interactions. In the pelagic environment loggerheads are exposed to a series of long-line fisheries that include the U.S. Atlantic tuna and swordfish longline fisheries, an Azorean long-line fleet, a Spanish long-line fleet, and various fleets in the Mediterranean Sea (Aguilar *et al.* 1995; Bolten *et al.* 1994; Crouse 1999). In the waters off the coastal U.S., loggerheads are exposed to a suite of fisheries in Federal and State waters including trawl, purse seine, hook and line, gillnet, pound net, longline, dredge, and trap fisheries (see further discussion in the Environmental Baseline of this Opinion).

Power plants can also pose a danger of injury and mortality for loggerheads. In Florida, thousands of sea turtles have been entrained in the St. Lucie Nuclear Power Plant's intake canal over the past several decades (Bresette *et al*. 2003). From May 1976 - November 2001, 7,795 sea turtles were captured in the intake canal (Bresette *et al*. 2003). Approximately 57% of these were loggerheads

(Bresette *et al*. 2003). Procedures are in place to capture the entrained turtles and release them. This has helped to keep mortality below 1% since 1990 (Bresette *et al*. 2003). The Oyster Creek and Salem Nuclear Generating Stations in New Jersey are also known to capture sea turtles although the numbers are far less than those observed at St. Lucie, FL. As is the case at St. Lucie, procedures are in place for checking for the presence of sea turtles and rescuing sea turtles that are found within the intake canals. Only two loggerheads have been recovered from the Oyster Creek intakes since 2000 and both turtles were released alive. Three loggerheads have been recovered from the Salem intakes since 2000, with one turtle released alive. Dredging activities also pose a danger of injury and mortality for loggerheads. Sea turtle deaths in dredging operations have been documented throughout the eastern U.S. At least 50 loggerheads have been documented to have been killed in northeast dredging projects since 1994, including 4 loggerheads killed during dredging operations in the ACOE Philadelphia District.

Summary of Status for Loggerhead Sea Turtles

The loggerhead sea turtle is listed throughout its range as threatened under the ESA. In the Pacific Ocean, loggerhead turtles are represented by a northwestern Pacific nesting aggregation (located in Japan) and a smaller southwestern nesting aggregation that occurs in Australia (Great Barrier Reef and Queensland), New Caledonia, New Zealand, Indonesia, and Papua New Guinea. The abundance of loggerhead turtles on nesting colonies throughout the Pacific basin have declined dramatically over the past 10 to 20 years by the combined effects of human activities that have reduced the number of nesting females and reduced the reproductive success of females that manage to nest (*e.g.*, due to egg poaching).

There are at least five western Atlantic loggerhead subpopulations (NMFS SEFSC 2001; TEWG 2000; Márquez 1990). As noted above, cohorts from three of these populations, the south Florida, Yucatán, and northern subpopulations, are likely to occur in the action area for this consultation. The south Florida nesting group is the largest known loggerhead nesting assemblage in the Atlantic and one of only two loggerhead nesting assemblages worldwide that have greater than 10,000 females nesting per year (USFWS and NMFS 2003; USFWS Fact Sheet). The northern subpopulation is the second largest loggerhead nesting assemblage within the U.S.. Nesting data through 2003, indicate that there is no discernable trend in the south Florida or northern nesting subpopulation (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, Statewide and Index Nesting Beach Survey Programs; USFWS and NMFS 2003). The remaining three subpopulations (the Dry Tortugas, Florida Panhandle, and Yucatán) are much smaller subpopulations but no less relevant to the continued existence of the species. The most recent nesting data indicates that there are no detectable trends in the status of nesting for these subpopulations (Florida Fish and Wildlife Conservation Commission, Florida Marine Research Institute, Statewide Nesting Beach Survey Data).

Several published reports have presented the problems facing long-lived species that delay sexual maturity (Crouse et al., 1987, Crowder et al., 1994, Crouse 1999). In general, these reports concluded that animals that delay sexual maturity and reproduction must have high annual survival as juveniles through adults to ensure that enough juveniles survive to reproductive maturity and then reproduce enough times to maintain stable population sizes. This general rule applies to sea turtles, particularly loggerhead sea turtles, as the rule originated in studies of sea turtles (Crouse et al., 1987, Crowder et al., 1994, Crouse 1999). Crouse (1999) concluded that relatively small decreases in annual survival rates of both juvenile and adult loggerhead sea turtles will adversely affect large segments of the total loggerhead sea turtle population. The survival of hatchlings seems to have the least amount of influence on the survivorship of the species, but historically, the focus of sea turtle conservation has been involved with protecting the nesting beaches. While nesting beach protection and hatchling survival are important, recovery efforts and limited resources might be more effective by focusing on the protection of juvenile and adult sea turtles.

Although these subpopulations mix on the foraging grounds, cohorts from the northern subpopulation and the south Florida subpopulation appear to be predominant on the northern foraging grounds. Although nesting data from 1990 to the present for the northern loggerhead subpopulation suggests that nests have been increasing annually (2.8 - 2.9%) (NMFS SEFSC 2001), there are confidence intervals about these estimates that include no growth. In addition, over half of the hatchlings produced are males (NMFS SEFSC 2001). In contrast, nest rates for the south Florida subpopulation appear to be increasing (approximately 83,400 nests laid in 1998). Over 80% of the hatchlings produced are females. The Yucatán nesting group was reported to have had 1,052 nests in 1998 (TEWG 2000). Although Zurita *et al.* (2003) did find significant increases in loggerhead nesting on seven beaches at Quintana Roo, Mexico, nesting survey effort overall has been inconsistent among the Yucatán nesting beaches and no trend can be determined for this subpopulation.

All loggerhead subpopulations are faced with a multitude of natural and anthropogenic effects. Many anthropogenic effects occur as a result of activities outside of U.S. jurisdiction (*i.e.*, fisheries in international waters). For the purposes of this consultation, NMFS will assume that the northern subpopulation of loggerhead sea turtles is declining (the conservative estimate) or stable (the optimistic estimate), and the southern Florida and Yucatan subpopulations of loggerhead sea turtles are increasing (the optimistic estimate) or stable (the conservative estimate).

Leatherback sea turtle
Leatherback sea turtles are widely distributed throughout the oceans of the world, and are found in waters of the Atlantic and Pacific Oceans, the Caribbean Sea, and the Gulf of Mexico (Ernst and Barbour 1972). Leatherback sea turtles are the largest living turtles and range farther than any other sea turtles species; their large size and tolerance of relatively low temperatures allows them to occur in northern waters such as off Labrador and in the Barents Sea (NMFS and USFWS 1995). In 1980, the leatherback population was estimated at approximately 115,000 adult females globally (Pritchard 1982). By 1995, this global population of adult females had declined to 34,500 (Spotila *et al.* 1996).

Pacific Ocean. Based on published estimates of nesting female abundance, leatherback populations have collapsed or have been declining at all major Pacific basin nesting beaches for the last two decades (Spotila et al., 1996; NMFS and USFWS 1998b; Sarti et al. 2000; Spotila et al. 2000). Leatherback turtles had disappeared from India before 1930, have been virtually extinct in Sri Lanka since 1994, and appear to be approaching extinction in Malaysia (Spotila et al. 2000). Nesting assemblages of leatherback turtles along the coasts of the Solomon Islands, which supported important nesting assemblages historically, are also reported to be declining (D. Broderick, personal communication, in Dutton *et al*. 1999). In Fiji, Thailand, Australia, and Papua-New Guinea (East Papua), leatherback turtles have only been known to nest in low densities and scattered colonies. Although all causes of the declines in Pacific leatherback turtle colonies have not been documented, the Pacific population has continued to decline leading some researchers to conclude that the leatherback is on the verge of extinction in the Pacific Ocean (*e.g.*, Spotila *et al*. 1996; Spotila *et al*. 2000).

Only an Indonesian nesting assemblage has remained relatively abundant in the Pacific basin. The largest, extant leatherback nesting assemblage in the Indo-Pacific lies on the north Vogelkop coast of Irian Jaya (West Papua), Indonesia, with over 1,000 nesting females during the 1996 season (Suarez *et al*. 2000). During the early-to-mid 1980s, the number of female leatherback turtles nesting on the two primary beaches of Irian Jaya appeared to be stable. More recently, however, this population has come under increasing threats that could cause this population to experience a collapse that is similar to what occurred at Terengganu, Malaysia. In 1999, for example, local Indonesian villagers started reporting dramatic declines in sea turtle populations near their villages (Suarez 1999); unless hatchling and adult turtles on nesting beaches receive more protection, this population will continue to decline. Declines in nesting assemblages of leatherback turtles have been reported throughout the western Pacific region where observers report that nesting assemblages are well below abundance levels that were observed several decades ago (for example, Suarez 1999).

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

In the eastern Pacific Ocean, nesting populations of leatherback turtles are declining along the Pacific coast of Mexico and Costa Rica. According to reports from the late 1970s and early 1980s, three beaches located on the Pacific coast of Mexico support as many as half of all leatherback turtle nests. Since the early 1980s, the eastern Pacific Mexican population of adult female leatherback turtles has declined to slightly more than 200 during 1998-99 and 1999-2000 (Sarti et al. 2000). Spotila et al. (2000) reported the decline of the leatherback turtle population at Playa Grande, Costa Rica, which had been the fourth largest nesting colony in the world. Between 1988 and 1999, the nesting colony declined from 1,367 to 117 female leatherback turtles. Based on their models, Spotila et al. (2000) estimated that the colony could fall to less than 50 females by 2003-2004.

In the eastern Pacific Ocean, leatherback turtles are captured, injured, or killed in commercial and artisanal swordfish fisheries off Chile, Columbia, Ecuador, and Peru, purse seine fisheries for tuna in the eastern tropical Pacific Ocean, and California/Oregon drift gillnet fisheries. Because of the limited available data, we cannot accurately estimate the number of leatherback turtles captured, injured, or killed through interactions with these fisheries. However, between 8 and 17 leatherback turtles were estimated to have died annually between 1990 and 2000 in interactions with the California/ Oregon drift gillnet fishery; 500 leatherback turtles are estimated to die annually in Chilean and Peruvian fisheries; 200 leatherback turtles are estimated to die in direct harvests in Indonesia; and before 1992, the North Pacific driftnet fisheries for squid, tuna, and billfish captured an estimated 1,002 leatherback turtles each year, killing about 111 of them each year.

Atlantic Ocean. Evidence from tag returns and strandings in the western Atlantic suggests that adult leatherback sea turtles engage in routine migrations between boreal, temperate and tropical waters (NMFS and USFWS 1992). A 1979 aerial survey of the outer Continental Shelf from Cape Hatteras, North Carolina to Cape Sable, Nova Scotia showed leatherbacks to be present throughout the area with the most numerous sightings made from the Gulf of Maine south to Long Island. Leatherbacks were sighted in water depths ranging from 1-4151 m but 84.4% of sightings were in waters less than 180 m (Shoop and Kenney 1992). Leatherbacks were sighted in waters within a sea surface temperature range similar to that observed for loggerheads; from 7-27.2°C (Shoop and Kenney 1992). However, leatherbacks appear to have a greater tolerance for colder waters in comparison to loggerhead sea turtles since more leatherbacks were found at the lower temperatures as compared to loggerheads (Shoop and Kenney 1992). This aerial survey estimated the leatherback population for the northeastern U.S. at approximately 300-600 animals (from near Nova Scotia, Canada to Cape Hatteras, North Carolina). However, the estimate was based on turtles visible at the surface and does not include those that were below the surface out of view. Therefore, it likely underestimates the leatherback population for the northeastern U.S. Estimates of leatherback abundance of 1,052 turtles (C.V.= 0.38) and 1,174 turtles (C.V.= 0.52) were obtained from surveys conducted from Virginia to the Gulf of St. Lawrence in 1995 and 1998, respectively (Palka 2000). However, since these estimates were also based on sightings of leatherbacks at the surface, the author considered the estimates to be negatively biased and the true abundance of leatherbacks may be 4.27 times the estimates (Palka 2000).

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

Leatherbacks are predominantly a pelagic species and feed on jellyfish (*i.e.*, *Stomolophus*, *Chryaora*, and *Aurelia* (Rebel 1974)), and tunicates (salps, pyrosomas). Leatherbacks may come into shallow waters if there is an abundance of jellyfish nearshore. For example, leatherbacks occur annually in Cape Cod Bay and Vineyard and Nantucket Sounds in Massachusetts during the summer and fall months.

Data collected in southeast Florida clearly indicate increasing numbers of nests for the past twenty years (9.1-11.5% increase), although it is critical to note that there was also an increase in the survey area in Florida over time (NMFS SEFSC 2001). The largest leatherback rookery in the western Atlantic remains along the northern coast of South America in French Guiana and Suriname. More than half the present world leatherback population is estimated to be nesting on the beaches in and close to the Marowijne River Estuary in Suriname and French Guiana (Hilterman and Goverse 2004). Nest numbers in Suriname have shown an increase and the long-term trend for the Suriname and French Guiana nesting group seems to show an increase (Hilterman and Goverse 2004). In 2001, the number of nests for Suriname and French Guiana combined was 60,000, one of the highest numbers observed for this region in 35 years (Hilterman and Goverse 2004). Studies by Girondot et al. (in review) also suggest that the trend for the Suriname - French Guiana nesting population over the last 36 years is stable or slightly increasing.

Tag return data emphasize the link between these South American nesters and animals found in U.S. waters. For example, a nesting female tagged May 29, 1990, in French Guiana was later recovered and released alive from the York River, VA. Another nester tagged in French Guiana on June 21, 1990, was later found dead in Palm Beach, Florida (STSSN). Many other examples also exist. For example, leatherbacks tagged at nesting beaches in Costa Rica have been found in Texas, Florida, South Carolina, Delaware, and New York (STSSN database). Leatherback turtles tagged in Puerto Rico, Trinidad, and the Virgin Islands have also been subsequently found on U.S. beaches of southern, Mid-Atlantic and northern states (STSSN database).

Threats to Leatherback recovery

Of the Atlantic turtle species, leatherbacks seem to be the most vulnerable to entanglement in fishing gear. This susceptibility may be the result of their body type (large size, long pectoral flippers, and lack of a hard shell), and their attraction to gelatinous organisms and algae that collect on buoys and buoy lines at or near the surface, and perhaps to the lightsticks used to attract target species in longline fisheries. They are also susceptible to entanglement in gillnets (used in various fisheries) and capture in trawl gear (*e.g.*, shrimp trawls). Sea turtles entangled in fishing gear generally have a reduced ability to feed, dive, surface to breathe or perform any other behavior essential to survival (Balazs 1985). They may be more susceptible to boat strikes if forced to remain at the surface, and entangling lines can constrict blood flow resulting in tissue necrosis.

Leatherbacks are exposed to pelagic longline fisheries in many areas of their range. According to observer records, an estimated 6,363 leatherback sea turtles were caught by the U.S. Atlantic tuna and swordfish longline fisheries between 1992-1999, of which 88 were released dead (NMFS SEFSC 2001). Since the U.S. fleet accounts for only 5-8% of the hooks fished in the Atlantic Ocean, adding up the under-represented observed takes of the other 23 countries actively fishing in the area would likely result in annual take estimates of thousands of leatherbacks over different life stages (NMFS SEFSC 2001).

Leatherbacks are susceptible to entanglement in the lines associated with trap/pot gear used in several fisheries. From 1990-2000, 92 entangled leatherbacks were reported from New York through Maine (Dwyer *et al.* 2002). Additional leatherbacks stranded wrapped in line of unknown origin or with evidence of a past entanglement (Dwyer *et al.* 2002). A review of leatherback mortality documented by the STSSN in Massachusetts suggests that vessel strikes and entanglement in fixed gear (primarily lobster pots and whelk pots) are the principal sources of this mortality (Dwyer *et al.* 2002). Fixed gear fisheries in the Mid-Atlantic have also contributed to leatherback entanglements. For example, in North Carolina, two leatherback sea turtles were reported entangled in a crab pot buoy inside Hatteras Inlet (D. Fletcher, pers. comm. to Sheryan Epperly, NMFS SEFSC 2001). A third leatherback was reported entangled in a crab pot buoy in Pamlico

Sound off of Ocracoke. This turtle was disentangled and released alive; however, lacerations on the front flippers from the lines were evident (D. Fletcher, pers. comm. to Sheryan Epperly, NMFS SEFSC 2001). In the Southeast, leatherbacks are vulnerable to entanglement in Florida's lobster pot and stone crab fisheries as documented on stranding forms. In the U.S. Virgin Islands, where one of five leatherback strandings from 1982 to 1997 were due to entanglement (Boulon 2000), leatherbacks have been observed with their flippers wrapped in the line of West Indian fish traps (R. Boulon, pers. comm. to Joanne Braun-McNeill, NMFS SEFSC 2001). Since many entanglements of this typically pelagic species likely go unnoticed, entanglements in fishing gear may be much more common.

Leatherback interactions with the southeast shrimp fishery, which operates from North Carolina through southeast Florida (NMFS 2002), are also common. The National Research Council Committee on Sea Turtle Conservation identified incidental capture in shrimp trawls as the major anthropogenic cause of sea turtle mortality (NRC 1990). Leatherbacks are likely to encounter shrimp trawls working in the coastal waters off the Atlantic coast (from Cape Canaveral, Florida through North Carolina) as they make their annual spring migration north. For many years, TEDs that were required for use in the southeast shrimp fishery were less effective for leatherbacks as compared to the smaller, hard-shelled turtle species, because the TED openings were too small to allow leatherbacks to escape. To address this problem, on February 21, 2003, NMFS issued a final rule to amend the TED regulations. Modifications to the design of TEDs are now required in order to exclude leatherbacks as well as large benthic immature and sexually mature loggerhead and green turtles.

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

Gillnet fisheries operating in the nearshore waters of the Mid-Atlantic states are also suspected of capturing, injuring and/or killing leatherbacks when these fisheries and leatherbacks co-occur. Data collected by the NEFSC Fisheries Observer Program from 1994 through 1998 (excluding 1997) indicate that a total of 37 leatherbacks were incidentally captured (16 lethally) in drift gillnets set in offshore waters from Maine to Florida during this period. Observer coverage for this period ranged from 54% to 92%. In North Carolina, a leatherback was reported captured in a gillnet set in Pamlico Sound in the spring of 1990 (D. Fletcher, pers.comm. to Sheryan Epperly, NMFS SEFSC 2001). It was released alive by the fishermen after much effort. Five other leatherbacks were released alive from nets set in North Carolina during the spring months: one was from a net (unknown gear) set in the nearshore waters near the North Carolina/Virginia border (1985); two others had been caught in gillnets set off of Beaufort Inlet (1990); a fourth was caught in a gillnet set off of Hatteras Island (1993), and a fifth was caught in a sink net set in New River Inlet (1993). In addition to these, in September 1995 two dead leatherbacks were removed from a large (11-inch) monofilament shark gillnet set in the nearshore waters off of Cape Hatteras, North Carolina (STSSN unpublished data reported in NMFS SEFSC 2001).

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

Poaching is not known to be a problem for nesting populations in the continental U.S. However, the NMFS SEFSC (2001) noted that poaching of juveniles and adults was still occurring in the U.S. Virgin Islands. In all, four of the five strandings in St. Croix were the result of poaching (Boulon 2000). A few cases of fishermen poaching leatherbacks have been reported from Puerto Rico, but most of the poaching is for eggs.

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

Summary of Status for Leatherback Sea Turtles

The global status and trend of leatherback turtles is difficult to summarize. In the Pacific Ocean, the abundance of leatherback turtles on nesting colonies has declined dramatically over the past 10 to 20 years: nesting colonies 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). At current rates of decline, leatherback turtles in the Pacific basin are a critically endangered species with a low probability of surviving and recovering in the wild.

The largest leatherback rookery in the western Atlantic remains along the northern coast of South America in French Guiana and Suriname. More than half the present world leatherback population is estimated to be nesting on the beaches in and close to the Marowijne River Estuary in Suriname and French Guiana (Hilterman and Goverse 2004). Nest numbers in Suriname have shown an increase and the long-term trend for the Suriname and French Guiana nesting group seems to show an increase (Hilterman and Goverse 2004). In 2001, the number of nests for Suriname and French

Guiana combined was 60,000, one of the highest numbers observed for this region in 35 years (Hilterman and Goverse 2004). Studies by Girondot *et al*. (in review) also suggest that the trend for the Suriname - French Guiana nesting population over the last 36 years is stable or slightly increasing.

In the Atlantic Ocean, the status and trends of leatherback turtles appears much more variable. Some of the same factors that led to precipitous declines of leatherbacks in the Pacific also affect leatherbacks in the Atlantic. Leatherbacks are captured and killed in many kinds of fishing gear and interact with fisheries in U.S. state and federal waters as well as in international waters. Poaching is a problem and affects leatherbacks that occur in U.S. waters. Leatherbacks also appear to be more susceptible to death or injury from ingesting marine debris than other turtle species. The number of female leatherbacks reported at some nesting sites in the Atlantic Ocean has increased, while at others they have decreased. Some of the same factors that led to precipitous declines of leatherbacks in the Pacific also affect leatherbacks in the Atlantic: leatherbacks are captured and killed in many kinds of fishing gear and interact with fisheries in State, Federal and international waters; poaching is a problem and affects leatherbacks that occur in U.S. waters; and leatherbacks also appear to be more susceptible to death or injury from ingesting marine debris than other turtle species. Nevertheless, the trend of the Atlantic population is uncertain. For the purposes of this Opinion, NMFS will assume that the Atlantic population of leatherback sea turtles is declining (the conservative estimate) or stable (the optimistic estimate).

Kemp's Ridley Sea Turtles

The Kemp's ridley is the most endangered sea turtle species. The only major nesting site for ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963). When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand 1963), but the population has been drastically reduced from these historical numbers. However, the TEWG (1998, 2000) indicated that the Kemp's ridley population appears to be in the early stage of a recovery trajectory. 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. Nesting data, estimated number of adults, and percentage of first time nesters have all increased from lows experienced in the 1970s and 1980s. From 1985 to 1999, the number of nests observed at Rancho Nuevo and nearby beaches has increased at a mean rate of 11.3 percent per year, allowing cautious optimism that the population is on its way to recovery. For example, data from nests at Rancho Nuevo, North Camp and South Camp, Mexico, have indicated that the number of adults declined from a population that produced 6,000 nests in 1966 to a population that produced 924 nests in 1978 and 702 nests in 1985, then increased to produce 1,940 nests in 1995 and about 3,400 nests in 1999. Total nests for the state of Tamaulipas and Veracruz in 2003 was 8,323 (E. Possardt, USFWS, pers. comm.); Rancho Nuevo alone documented 4,457 nests. Estimates of adult abundance followed a similar trend from an estimate of 9,600 in 1966 to 1,050 in 1985 and 3,000 in 1995. The increased recruitment of new adults is illustrated in the proportion of neophyte, or first time nesters, which has increased from 6 to 28 percent from 1981 to 1989 and from 23 to 41 percent from 1990 to 1994. The population model in the TEWG report projected that Kemp's ridleys could reach the intermediate recovery goal identified in the Recovery Plan, of 10,000 nesters by the year 2020, if the assumptions of age to sexual maturity and age specific survivorship rates plugged into their model are correct. The population growth rate does not appear as steady as originally forecasted by the TEWG, but annual fluctuations, due in part to irregular internesting periods, are normal for other sea turtle populations. Also, as populations increase and expand, nesting activity would be expected to be more variable.

Kemp's ridley nesting occurs from April through July each year. Little is known about mating but it is believed to occur at or before the nesting season in the vicinity of the nesting beach. Hatchlings emerge after 45-58 days. Once they leave the beach, neonates presumably enter the Gulf of Mexico where they feed on available sargassum and associated infauna or other epipelagic species (USFWS and NMFS 1992). The presence of juvenile turtles along both the Atlantic and Gulf of Mexico coasts of the U.S., where they are recruited to the coastal benthic environment, indicates that post-hatchlings are distributed in both the Gulf of Mexico and Atlantic Ocean (TEWG 2000). The location and size classes of dead turtles recovered by the STSSN suggests that benthic immature developmental areas occur in many areas along the U.S. coast and that these areas may change given resource quality and quantity (TEWG 2000).

Juvenile Kemp's ridleys use northeastern and mid-Atlantic coastal waters of the U.S. Atlantic coastline as primary developmental habitat during summer months, with shallow coastal embayments serving as important foraging grounds. Ridleys found in mid-Atlantic waters are primarily post-pelagic juveniles averaging 16 inches in carapace length, and weighing less than 44 pounds (Terwilliger and Musick 1995). Next to loggerheads, Kemp's ridleys are the second most abundant sea turtle in Virginia and Maryland waters, arriving in these areas during May and June (Keinath *et al.* 1987; Musick and Limpus 1997). In the Chesapeake Bay, where the juvenile population of Kemp's ridley sea turtles is estimated to be 211 to 1,083 turtles (Musick and Limpus 1997), ridleys frequently forage in submerged aquatic grass beds for crabs (Musick and Limpus 1997). Blue crabs and spider crabs are key components of the Virginia Kemp's ridley diet, as noted during examination of stranded sea turtle stomach contents (Seney 2003). Upon leaving Chesapeake Bay in autumn, juvenile ridleys migrate down the coast, passing Cape Hatteras in December and January (Musick and Limpus 1997). These larger juveniles are joined there by juveniles of the same size from North Carolina sounds and smaller juveniles from New York and New England to form one of the densest concentrations of Kemp's ridleys outside of the Gulf of Mexico (Musick and Limpus 1997; Epperly *et al.* 1995a; Epperly *et al.* 1995b).

Kemp's ridleys face many of the same natural threats as loggerheads, including destruction of nesting habitat from storm events, natural predators at sea, and oceanic events such as cold-stunning. Although cold-stunning can occur throughout the range of the species, it may be a greater risk for sea turtles that utilize the more northern habitats of Cape Cod Bay and Long Island Sound. For example, in the winter of 1999/2000, there was a major cold-stunning event where 218 Kemp's ridleys, 54 loggerheads, and 5 green turtles were found on Cape Cod beaches (R. Prescott, pers. comm.). In the winter of 2003/2004, 79 Kemp's ridleys were found cold stunned on Cape Cod beaches. In the winter of 2003/2004, 32 Kemp's ridleys were found, with 19 deaths. Numbers from the 2005/2006 season are still preliminary but suggest that 29 Kemp's ridleys were coldstunned, with 15 animals dying (S. McNulty, NMFS, pers. comm.). Annual cold stun events do not always occur at this magnitude; the extent of episodic major cold stun events may be associated with numbers of turtles utilizing Northeast waters in a given year, oceanographic conditions and the occurrence of storm events in the late fall. Although many cold-stun turtles can survive if found early enough, cold-stunning events can represent a significant cause of natural mortality.

Anthropogenic impacts to the Kemp's ridley population are similar to those discussed above. Like other turtle species, the severe decline in the Kemp's ridley population appears to have been heavily influenced by a combination of exploitation of eggs and impacts from fishery interactions. From the 1940s through the early 1960s, nests from Ranch Nuevo were heavily exploited (USFWS and NMFS 1992), but beach protection in 1966 helped to curtail this activity (USFWS and NMFS 1992). Following World War II, there was a substantial increase in the number of trawl vessels, particularly shrimp trawlers, in the Gulf of Mexico where the adult Kemp's ridley turtles occur. Information from fishers helped to demonstrate the high number of turtles taken in these shrimp trawls (USFWS and NMFS 1992). Subsequently, NMFS has worked with the industry to reduce turtle takes in shrimp trawls and other trawl fisheries, including the development and use of TEDs. Sea sampling coverage in the Northeast otter trawl fishery, and southeast shrimp and summer flounder bottom trawl fisheries have recorded takes of Kemp's ridley turtles. Although changes in the use of shrimp trawls and other trawl gear has helped to reduce mortality of Kemp's ridleys, this species is also affected by other sources of anthropogenic impacts similar to those discussed above. For example, in the spring of 2000, a total of five Kemp's ridley carcasses were recovered from the same North Carolina beaches where 275 loggerhead carcasses were found. Cause of death for most of the turtles recovered was unknown, but the mass mortality event was suspected to have been from a large-mesh gillnet fishery operating offshore in the preceding weeks. The five ridley carcasses that were found are likely to have been only a minimum count of the number of Kemp's ridleys that were killed or seriously injured as a result of the fishery interaction since it is unlikely that all of the carcasses washed ashore. Four Kemp's ridleys have been documented as killed during dredging operations in the Northeast US since 1994.

Summary of Status of Kemp's Ridley Sea Turtles

The only major nesting site for ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963). From 1985 to 1999, the number of nests observed at Rancho Nuevo, and nearby beaches increased at a mean rate of 11.3% per year. Current totals exceed 3000 nests per year (TEWG 2000). Kemp's ridleys mature at an earlier age (7 - 15 years) than other chelonids, thus 'lag effects' as a result of unknown impacts to the non breeding life stages would likely have been seen in the increasing nest trend beginning in 1985 (USFWS and NMFS 1992). Anthropogenic impacts to the Kemp's ridley population are similar to those discussed above for loggerhead sea turtles. Despite these, there is cautious optimism that the Kemp's ridley sea turtle population is increasing.

Green Sea Turtle

Green turtles are the largest chelonid (hard-shelled) sea turtle, with an average adult carapace of 91 cm SCL and weight of 150 kg. Ninety percent of green turtles found in Long Island Sound are between 25 and 40 cm SCL, with the largest reported being 68 cm (Burke et al. 1991). Based on growth rate studies of wild green turtles, greens have been found to grow slowly with an estimated age of sexual maturity ranging from 18 to 40 years (Balazs 1982; Frazer and Ehrhart 1985; B. Schroeder pers. comm.). Green turtles are distributed circumglobally, and can be found in the Pacific and Atlantic Oceans.

Pacific Ocean. In the Pacific Ocean, green sea turtles can be found along the west coast of the U.S., the Hawaii islands, Oceania, Guam, the Northern Mariana Islands, and American Samoa. Along the Pacific coast, green turtles have been reported as far north as British Columbia, but a large number of the Pacific coast sightings occur in northern Baja California and southern California (NMFS and USFWS 1996). The main nesting sites for the East Pacific green turtle are located in Michoacan, Mexico, and in the Galapagos Islands, Ecuador, with no known nesting of East Pacific green turtles occurring in the U.S.. Between 1982 and 1989, the estimated nesting population in Michoacan ranged from a high of 5,585 females in 1982 to a low of 940 in 1984 (NMFS and USFWS 1996). Current population estimates are unavailable.

Atlantic Ocean. In the western Atlantic, green sea turtles range from Massachusetts to Argentina, including the Gulf of Mexico and Caribbean (Wynne and Schwartz 1999). Green turtles' occurrence are infrequent north of Cape Hatteras, but they do occur in mid-Atlantic and Northeast waters (e.g., documented in Long Island Sound (Morreale 2003) and cold stunned in Cape Cod Bay (NMFS unpub. data)). For example, in the winters of 2004/2005 and 2005/2006, a total of three green sea turtles were found coldstunned on Cape Cod beaches. Green turtles were traditionally highly prized for their flesh, fat, eggs, and shell, and directed fisheries in the U.S. and throughout the Caribbean are largely to blame for the decline of the species. In the Gulf of Mexico, green turtles were once abundant enough in the shallow bays and lagoons to support a commercial fishery. In 1890, over one million pounds of green turtles were taken in the Gulf of Mexico green sea turtle fishery (Doughty 1984). However, declines in the turtle fishery throughout the Gulf of Mexico were evident by 1902 (Doughty 1984).

In the continental U.S., green turtle nesting occurs on the Atlantic coast of Florida (Ehrhart 1979). Occasional nesting has been documented along the Gulf coast of Florida, at southwest Florida beaches, as well as the beaches on the Florida Panhandle (Meylan *et al.* 1995). More recently, green turtle nesting occurred on Bald Head Island, North Carolina just east of the mouth of the Cape Fear River, on Onslow Island, and on Cape Hatteras National Seashore. Increased nesting has also been observed along the Atlantic Coast of Florida, on beaches where only loggerhead nesting was observed in the past (Pritchard 1997). Certain Florida nesting beaches have been designated index beaches. Index beaches were established to standardize data collection methods and effort on key nesting beaches. The pattern of green turtle nesting shows biennial peaks in abundance, with a generally positive trend during the ten years of regular monitoring since establishment of the index beaches in 1989, perhaps due to increased protective legislation throughout the Caribbean (Meylan et al. 1995). Recent population estimates for the western Atlantic area are not available.

While nesting activity is important in determining population distributions, the remaining portion of the green turtles life is spent on the foraging and breeding grounds. Juvenile green sea turtles occupy pelagic habitats after leaving the nesting beach. Pelagic juveniles are assumed to be omnivorous, but with a strong tendency toward carnivory during early life stages (Bjorndal 1985). At approximately 20 to 25 cm carapace length, juveniles leave pelagic habitats and enter benthic foraging areas, shifting to a chiefly herbivorous diet but may also consume jellyfish, salps, and sponges (Bjorndal 1997). Some of the principal feeding pastures in the western Atlantic Ocean include the upper west coast of Florida and the northwestern coast of the Yucatan Peninsula. Additional important foraging areas in the western Atlantic include the Mosquito and Indian River Lagoon systems and nearshore wormrock reefs between Sebastian and Ft. Pierce Inlets in Florida, Florida Bay, the Culebra archipelago and other Puerto Rico coastal waters, the south coast of Cuba, the Mosquito Coast of Nicaragua, the Caribbean Coast of Panama, and scattered areas along Colombia and Brazil (Hirth 1971). In North Carolina, green turtles are known to occur in estuarine and oceanic waters and to nest in low numbers along the entire coast. The summer developmental habitat for green turtles also encompasses estuarine and coastal waters of Chesapeake Bay and as far north as Long Island Sound (Musick and Limpus 1997).

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

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

Summary of Status of Green Sea Turtles
The global status and trend of green sea turtles is difficult to summarize. In the Pacific Ocean, green turtles are frequent along a north-south band from 15°N to 5°S along 90°W, and between the Galapagos Islands and Central American coast (NMFS and USFWS 1996), but current population estimates are unavailable. Green turtles range in the western Atlantic from Massachusetts to Argentina, including the Gulf of Mexico and Caribbean. Green turtles face many of the same natural and anthropogenic threats as loggerhead and Kemp's ridley sea turtles. In addition, green turtles are also susceptible to fibropapillomatosis which can result in death. In the continental U.S., green turtle nesting occurs on the Atlantic coast of Florida (Ehrhart 1979). Recent population estimates for the western Atlantic area are not available. However, the pattern of green turtle nesting shows biennial peaks in abundance, with a generally positive trend during the ten years of regular monitoring since establishment of index beaches in 1989. There is cautious optimism that the green sea turtle population is increasing in the Atlantic.

Shortnose Sturgeon
Shortnose sturgeon life history
Shortnose sturgeon are benthic fish that mainly occupy the deep channel sections of large rivers. They feed on a variety of benthic and epibenthic invertebrates including mollusks, crustaceans (amphipods, chironomids, isopods), and oligochaete worms (Vladykov and Greeley 1963; Dadswell 1979 *in* NMFS 1998). Shortnose sturgeon have similar lengths at maturity (45-55 cm fork length) throughout their range, but, because sturgeon in southern rivers grow faster than those in northern rivers, southern sturgeon mature at younger ages (Dadswell et al. 1984). Shortnose sturgeon are long-lived (30-40 years) and, particularly in the northern extent of their range, mature at late ages. In the north, males reach maturity at 5 to 10 years, while females mature between 7 and 13 years. Based on limited data, females spawn every three to five years while males spawn approximately

every two years. The spawning period is estimated to last from a few days to several weeks. Spawning begins from late winter/early spring (southern rivers) to mid to late spring (northern rivers) when the freshwater temperatures increase to 8-9ºC. Several published reports have presented the problems facing long-lived species that delay sexual maturity (Crouse et al. 1987; Crowder et al. 1994; Crouse 1999). In general, these reports concluded that animals that delay sexual maturity and reproduction must have high annual survival as juveniles through adults to ensure that enough juveniles survive to reproductive maturity and then reproduce enough times to maintain stable population sizes.

Total instantaneous mortality rates (Z) are available for the Saint John River (0.12 - 0.15; ages 14-55; Dadswell 1979), Upper Connecticut River (0.12; Taubert 1980b), and Pee Dee-Winyah River (0.08-0.12; Dadswell et al. 1984). Total instantaneous natural mortality (M) for shortnose sturgeon in the lower Connecticut River was estimated to be 0.13 (T. Savoy, Connecticut Department of Environmental Protection, personal communication). There is no recruitment information available for shortnose sturgeon because there are no commercial fisheries for the species. Estimates of annual egg production for this species are difficult to calculate because females do not spawn every year (Dadswell et al. 1984). Further, females may abort spawning attempts, possibly due to interrupted migrations or unsuitable environmental conditions (NMFS 1998). Thus, annual egg production is likely to vary greatly in this species. Fecundity estimates have been made and range from 27,000 to 208,000 eggs/female (Dadswell et al. 1984).

At hatching, shortnose sturgeon are blackish-colored, 7-11mm long and resemble tadpoles (Buckley and Kynard 1981). In 9-12 days, the yolk sac is absorbed and the sturgeon develops into larvae which are about 15mm total length (TL; Buckley and Kynard 1981). Sturgeon larvae are believed to begin downstream migrations at about 20mm TL. Laboratory studies suggest that young sturgeon move downstream in a 2-step migration; a 2 to 3-day migration by larvae followed by a residency period by young of the year (YOY), then a resumption of migration by yearlings in the second summer of life (Kynard 1997). Juvenile shortnose sturgeon (3-10 years old) reside in the interface between saltwater and freshwater in most rivers (NMFS 1998).

In populations that have free access to the total length of a river (e.g., no dams within the species' range in a river: Saint John, Kennebec, Altamaha, Savannah, Delaware and Merrimack Rivers), spawning areas are located at the farthest upstream reach of the river (NMFS 1998). In the northern extent of their range, shortnose sturgeon exhibit three distinct movement patterns. These migratory movements are associated with spawning, feeding, and overwintering activities. In spring, as water temperatures rise above 8ºC, pre-spawning shortnose sturgeon move from overwintering grounds to spawning areas. Spawning occurs from mid/late March to mid/late May depending upon location and water temperature. Sturgeon spawn in upper, freshwater areas and feed and overwinter in both fresh and saline habitats. Shortnose sturgeon spawning migrations are characterized by rapid, directed and often extensive upstream movement (NMFS 1998).

Shortnose sturgeon are believed to spawn at discrete sites within their natal river (Kieffer and Kynard 1996). In the Merrimack River, males returned to only one reach during a four year telemetry study (Kieffer and Kynard 1996). Squires (1982) found that during the three years of the study in the Androscoggin River, adults returned to a 1-km reach below the Brunswick Dam and Kieffer and Kynard (1996) found that adults spawned within a 2-km reach in the Connecticut River for three consecutive years. Spawning occurs over channel habitats containing gravel, rubble, or rock-cobble substrates (Dadswell et al. 1984; NMFS 1998). Additional environmental conditions associated with spawning activity include decreasing river discharge following the peak spring freshet, water temperatures ranging from 8 - 12º , and bottom water velocities of 0.4 to 0.7 m/sec (Dadswell et al. 1984; NMFS 1998). For northern shortnose sturgeon, the temperature range for spawning is 6.5-18.0ºC (Kieffer and Kynard in press). Eggs are separate when spawned but become adhesive within approximately 20 minutes of fertilization (Dadswell et al. 1984). Between 8° and 12°C, eggs generally hatch after approximately 13 days. The larvae are photonegative, remaining on the bottom for several days. Buckley and Kynard (1981) found week old larvae to be photonegative and form aggregations with other larvae in concealment.

Adult shortnose sturgeon typically leave the spawning grounds soon after spawning. Non-spawning movements include rapid, directed post-spawning movements to downstream feeding areas in spring and localized, wandering movements in summer and winter (Dadswell et al. 1984; Buckley and Kynard 1985; O'Herron et al. 1993). Kieffer and Kynard (1993) reported that post-spawning migrations were correlated with increasing spring water temperature and river discharge. Young-of-the-year shortnose sturgeon are believed to move downstream after hatching (Dovel 1981) but remain within freshwater habitats. Older juveniles tend to move downstream in fall and winter as water temperatures decline and the salt wedge recedes. Juveniles move upstream in spring and feed mostly in freshwater reaches during summer.

Juvenile shortnose sturgeon generally move upstream in spring and summer and move back downstream in fall and winter; however, these movements usually occur in the region above the saltwater/freshwater interface (Dadswell et al. 1984; Hall et al. 1991). Non-spawning movements include wandering movements in summer and winter (Dadswell et al. 1984; Buckley and Kynard 1985; O'Herron et al. 1993). Kieffer and Kynard (1993) reported that post-spawning migrations were correlated with increasing spring water temperature and river discharge. Adult sturgeon occurring in freshwater or freshwater/tidal reaches of rivers in summer and winter often occupy only a few short reaches of the total length (Buckley and Kynard 1985). Summer concentration areas in southern rivers are cool, deep, thermal refugia, where adult and juvenile shortnose sturgeon congregate (Flourney et al. 1992; Rogers and Weber 1994; Rogers and Weber 1995; Weber 1996). While shortnose sturgeon are occasionally collected near the mouths of rivers and often spend time in estuaries, they are not known to participate in coastal migrations and are rarely documented in their non-natal river.

The temperature preference for shortnose sturgeon is not known (Dadswell et al. 1984) but shortnose sturgeon have been found in waters with temperatures as low as 2 to 3ºC (Dadswell et al. 1984) and as high as 34ºC (Heidt and Gilbert 1978). However, temperatures above 28ºC are thought to adversely affect shortnose sturgeon. In the Altamaha River, temperatures of 28-30ºC during summer months create unsuitable conditions and shortnose sturgeon are found in deep cool water refuges.

Shortnose sturgeon are known to occur at a wide range of depths. A minimum depth of 0.6m is necessary for the unimpeded swimming by adults. Shortnose sturgeon are known to occur at depths of up to 30m but are generally found in waters less than 20m (Dadswell et al. 1984; Dadswell 1979). Shortnose sturgeon have also demonstrated tolerance to a wide range of salinities.

Shortnose sturgeon have been documented in freshwater (Taubert 1980; Taubert and Dadswell 1980) and in waters with salinity of 30 parts-per-thousand (ppt) (Holland and Yeverton 1973; Saunders and Smith 1978). Mcleave et al. (1977) reported adults moving freely through a wide range of salinities, crossing waters with differences of up to 10ppt within a two hour period. The tolerance of shortnose sturgeon to increasing salinity is thought to increase with age (Kynard 1996). Shortnose sturgeon typically occur in the deepest parts of rivers or estuaries where suitable oxygen and salinity values are present (Gilbert 1989).

Status and Trends of Shortnose Sturgeon Rangewide
Shortnose sturgeon were listed as endangered on March 11, 1967 (32 FR 4001), and the species remained on the endangered species list with the enactment of the ESA in 1973. Although the original listing notice did not cite reasons for listing the species, a 1973 Resource Publication, issued by the US Department of the Interior, stated that shortnose sturgeon were "in peril…gone in most of the rivers of its former range [but] probably not as yet extinct" (USDOI 1973). Pollution and overfishing, including bycatch in the shad fishery, were listed as principal reasons for the species' decline. In the late nineteenth and early twentieth centuries, shortnose sturgeon commonly were taken in a commercial fishery for the closely related and commercially valuable Atlantic sturgeon (*Acipenser oxyrinchus*). More than a century of extensive fishing for sturgeon contributed to the decline of shortnose sturgeon along the east coast. Heavy industrial development during the twentieth century in rivers inhabited by sturgeon impaired water quality and impeded these species' recovery; possibly resulting in substantially reduced abundance of shortnose sturgeon populations within portions of the species' ranges (e.g., southernmost rivers of the species range: Santilla, St. Marys and St. Johns Rivers). A shortnose sturgeon recovery plan was published in December 1998 to promote the conservation and recovery of the species (see NMFS 1998). Shortnose sturgeon are listed as "vulnerable" on the IUCN Red List.

Although shortnose sturgeon are listed as endangered range-wide, in the final recovery plan NMFS recognized 19 separate populations occurring throughout the range of the species. These populations are in New Brunswick Canada (1); Maine (2); Massachusetts (1); Connecticut (1); New York (1); New Jersey/Delaware (1); Maryland and Virginia (1); North Carolina (1); South Carolina (4); Georgia (4); and Florida (2). NMFS has not formally recognized distinct population segments (DPS)[5] of shortnose sturgeon under the ESA. Although genetic information within and among shortnose sturgeon occurring in different river systems is largely unknown, life history studies indicate that shortnose sturgeon populations from different river systems are substantially reproductively isolated (Kynard 1997) and, therefore, should be considered discrete. The 1998 Recovery Plan indicates that while genetic information may reveal that interbreeding does not occur between rivers that drain into a common estuary, at this time, such river systems are considered a single population compromised of breeding subpopulations (NMFS 1998).

Studies conducted since the issuance of the Recovery Plan have provided evidence that suggests

5 The definition of species under the ESA includes any subspecies of fish, wildlife, or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature. To be considered a DPS, a population segment must meet two criteria under NMFS policy. First, it must be discrete, or separated, from other populations of its species or subspecies. Second, it must be significant, or essential, to the long-term conservation status of its species or subspecies. This formal legal procedure to designate DPSs for shortnose sturgeon has not been undertaken.

that years of isolation between populations of shortnose sturgeon have led to morphological and genetic variation. Walsh et al. (2001) examined morphological and genetic variation of shortnose sturgeon in three rivers (Kennebec, Androscoggin, and Hudson). The study found that the Hudson River shortnose sturgeon population differed markedly from the other two rivers for most morphological features (total length, fork length, head and snout length, mouth width, interorbital width and dorsal scute count, left lateral scute count, right ventral scute count). Significant differences were found between fish from Androscoggin and Kennebec rivers for interorbital width and lateral scute counts which suggests that even though the Androscoggin and Kennebec rivers drain into a common estuary, these rivers support largely discrete populations of shortnose sturgeon. The study also found significant genetic differences among all three populations indicating substantial reproductive isolation among them and that the observed morphological differences may be partly or wholly genetic.

Grunwald et al. (2002) examined mitochondrial DNA (mtDNA) from shortnose sturgeon in eleven river populations. The analysis demonstrated that all shortnose sturgeon populations examined showed moderate to high levels of genetic diversity as measured by haplotypic diversity indices. The limited sharing of haplotypes and the high number of private haplotypes are indicative of high homing fidelity and low gene flow. The researchers determined that glaciation in the Pleistocene Era was likely the most significant factor in shaping the phylogeographic pattern of mtDNA diversity and population structure of shortnose sturgeon. The Northern glaciated region extended south to the Hudson River while the southern non-glaciated region begins with the Delaware River. There is a high prevalence of haplotypes restricted to either of these two regions and relatively few are shared; this represents a historical subdivision that is tied to an important geological phenomenon that reflects historical isolation. Analyses of haplotype frequencies at the level of individual rivers showed significant differences among all systems in which reproduction is known to occur. This implies that although higher level genetic stock relationships exist (i.e., southern vs. northern and other regional subdivisions), shortnose sturgeon appear to be discrete stocks, and low gene flow exists between the majority of populations.

Waldman et al. (2002) also conducted mtDNA analysis on shortnose sturgeon from 11 river systems and identified 29 haplotypes. Of these haplotypes, 11 were unique to northern, glaciated systems and 13 were unique to the southern non-glaciated systems. Only 5 were shared between them. This analysis suggests that shortnose sturgeon show high structuring and discreteness and that low gene flow rates indicated strong homing fidelity.

Wirgin et al. (2005), also conducted mtDNA analysis on shortnose sturgeon from 12 rivers (St. John, Kennebec, Androscoggin, Upper Connecticut, Lower Connecticut, Hudson, Delaware, Chesapeake Bay, Cooper, Peedee, Savannah, Ogeechee and Altamaha). This analysis suggested that most population segments are independent and that genetic variation among groups was high.

The best available information demonstrates differences in life history and habitat preferences between northern and southern river systems and given the species' anadromous breeding habits, the rare occurrence of migration between river systems, and the documented genetic differences between river populations, it is unlikely that populations in adjacent river systems interbreed with any regularity. This likely accounts for the failure of shortnose sturgeon to repopulate river systems from which they have been extirpated, despite the geographic closeness of persisting populations.

This characteristic of shortnose sturgeon also complicates recovery and persistence of this species in the future because, if a river population is extirpated in the future, it is unlikely that this river will be recolonized. Consequently, this Opinion will treat the nineteen separate populations of shortnose sturgeon as subpopulations (one of which occurs in the action area) for the purposes of this analysis.

Historically, shortnose sturgeon are believed to have inhabited nearly all major rivers and estuaries along nearly the entire east coast of North America. The range extended from the St John River in New Brunswick, Canada to the Indian River in Florida. Today, only 19 populations remain ranging from the St. Johns River, Florida (possibly extirpated from this system) to the Saint John River in New Brunswick, Canada. Shortnose sturgeon are large, long lived fish species. The present range of shortnose sturgeon is disjunct, with northern populations separated from southern populations by a distance of about 400 km. The species is anadromous in the southern portion of its range (i.e., south of Chesapeake Bay), while northern populations are amphidromous (NMFS 1998). Population sizes vary across the species' range. From available estimates, the smallest populations occur in the Cape Fear (~8 adults; Moser and Ross 1995) and Merrimack Rivers (~100 adults; M. Kieffer, United States Geological Survey, personal communication), while the largest populations are found in the Saint John (~100,000; Dadswell 1979) and Hudson Rivers (~61,000; Bain et al. 1998). As indicated in Kynard 1996, adult abundance is less than the minimum estimated viable population abundance of 1000 adults for 5 of 11 surveyed northern populations and all natural southern populations. Kynard 1996 indicates that all aspects of the species' life history indicate that shortnose sturgeon should be abundant in most rivers. As such, the expected abundance of adults in northern and north-central populations should be thousands to tens of thousands of adults. Expected abundance in southern rivers is uncertain, but large rivers should likely have thousands of adults. The only river systems likely supporting populations of these sizes are the St John, Hudson and possibly the Delaware and the Kennebec, making the continued success of shortnose sturgeon in these rivers critical to the species as a whole. While no reliable estimate of the size of either the total species or the shortnose sturgeon population in the Northeastern United States exists, it is clearly below the size that could be supported if the threats to shortnose sturgeon were removed.

Threats to shortnose sturgeon recovery

The Shortnose Sturgeon Recovery Plan (NMFS 1998) identifies habitat degradation or loss (resulting, for example, from dams, bridge construction, channel dredging, and pollutant discharges) and mortality (resulting, for example, from impingement on cooling water intake screens, dredging and incidental capture in other fisheries) as principal threats to the species' survival.

Several natural and anthropogenic factors continue to threaten the recovery of shortnose sturgeon. Shortnose sturgeon continue to be taken incidentally in fisheries along the east coast and are probably targeted by poachers throughout their range (Dadswell 1979; Dovel et al. 1992; Collins et al. 1996). Bridge construction and demolition projects may interfere with normal shortnose sturgeon migratory movements and disturb sturgeon concentration areas. Unless appropriate precautions are made, internal damage and/or death may result from blasting projects with powerful explosives. Hydroelectric dams may affect shortnose sturgeon by restricting habitat, altering river flows or temperatures necessary for successful spawning and/or migration and causing mortalities to fish that become entrained in turbines. Maintenance dredging of Federal navigation channels and other areas can adversely affect or jeopardize shortnose sturgeon populations. Hydraulic dredges can lethally take sturgeon by entraining sturgeon in dredge dragarms and impeller pumps.

Mechanical dredges have also been documented to lethally take shortnose sturgeon. In addition to direct effects, dredging operations may also impact shortnose sturgeon by destroying benthic feeding areas, disrupting spawning migrations, and filling spawning habitat with resuspended fine sediments. Shortnose sturgeon are susceptible to impingement on cooling water intake screens at power plants. Electric power and nuclear power generating plants can affect sturgeon by impinging larger fish on cooling water intake screens and entraining larval fish. The operation of power plants can have unforeseen and extremely detrimental impacts to water quality which can affect shortnose sturgeon. For example, the St. Stephen Power Plant near Lake Moultrie, South Carolina was shut down for several days in June 1991 when large mats of aquatic plants entered the plant's intake canal and clogged the cooling water intake gates. Decomposing plant material in the tailrace canal coupled with the turbine shut down (allowing no flow of water) triggered a low dissolved oxygen water condition downstream and a subsequent fish kill. The South Carolina Wildlife and Marine Resources Department reported that twenty shortnose sturgeon were killed during this low dissolved oxygen event.

Contaminants, including toxic metals, polychlorinated aromatic hydrocarbons (PAHs), pesticides, and polychlorinated biphenyls (PCBs) can have substantial deleterious effects on aquatic life including production of acute lesions, growth retardation, and reproductive impairment (Cooper 1989; Sinderman 1994). Ultimately, toxins introduced to the water column become associated with the benthos and can be particularly harmful to benthic organisms (Varanasi 1992) like sturgeon. Heavy metals and organochlorine compounds are known to accumulate in fat tissues of sturgeon, but their long term effects are not yet known (Ruelle and Henry 1992; Ruelle and Kennlyne 1993). Available data suggests that early life stages of fish are more susceptible to environmental and pollutant stress than older life stages (Rosenthal and Alderdice 1976).

Although there is scant information available on the levels of contaminants in shortnose sturgeon tissues, some research on other related species indicates that concern about the effects of contaminants on the health of sturgeon populations is warranted. Detectible levels of chlordane, DDE (1,1-dichloro-2, 2-bis(p-chlorophenyl)ethylene), DDT (dichlorodiphenyl-trichloroethane), and dieldrin, and elevated levels of PCBs, cadmium, mercury, and selenium were found in pallid sturgeon tissue from the Missouri River (Ruelle and Henry 1994). These compounds were found in high enough levels to suggest they may be causing reproductive failure and/or increased physiological stress (Ruelle and Henry 1994). In addition to compiling data on contaminant levels, Ruelle and Henry also determined that heavy metals and organochlorine compounds (i.e. PCBs) accumulate in fat tissues. Although the long term effects of the accumulation of contaminants in fat tissues is not yet known, some speculate that lipophilic toxins could be transferred to eggs and potentially inhibit egg viability. In other fish species, reproductive impairment, reduced egg viability, and reduced survival of larval fish are associated with elevated levels of environmental contaminants including chlorinated hydrocarbons. A strong correlation that has been made between fish weight, fish fork length, and DDE concentration in pallid sturgeon livers indicates that DDE increases proportionally with fish size (NMFS 1998).

Contaminant analysis was conducted on two shortnose sturgeon from the Delaware River in the fall of 2002. Muscle, liver, and gonad tissue were analyzed for contaminants (ERC 2002). Sixteen metals, two semivolatile compounds, three organochlorine pesticides, one PCB Aroclor, as well as polychlorinated dibenzo-p-dioxins (PCDDs), and polychlorinated dibenzofurans (PCDFs) were detected in one or more of the tissue samples. Levels of aluminum, cadmium, PCDDs, PCDFs, PCBs, DDE (an organochlorine pesticide) were detected in the "adverse affect" range. It is of particular concern that of the above chemicals, PCDDs, DDE, PCBs and cadmium, were detected as these have been identified as endocrine disrupting chemicals. Contaminant analysis conducted in 2003 of tissues from a shortnose sturgeon from the Kennebec River revealed the presence of fourteen metals, one semivolatile compound, one PCB Aroclor, Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) in one or more of the tissue samples. Of these chemicals, cadmium and zinc were detected at concentrations above an adverse effect concentration reported for fish in the literature (ERC 2003). While no directed studies of chemical contamination in shortnose sturgeon have been undertaken, it is evident that the heavy industrialization of the rivers where shortnose sturgeon are found is likely adversely affecting this species.

During summer months, especially in southern areas, shortnose sturgeon must cope with the physiological stress of water temperatures that may exceed 28ºC. Flourney et al.(1992) suspected that, during these periods, shortnose sturgeon congregate in river regions which support conditions that relieve physiological stress (i.e., in cool deep thermal refuges). In southern rivers where sturgeon movements have been tracked, sturgeon refrain from moving during warm water conditions and are often captured at release locations during these periods (Flourney et al.1992; Rogers and Weber 1994; Weber 1996). The loss and/or manipulation of these discrete refuge habitats may limit or be limiting population survival, especially in southern river systems.

Pulp mill, silvicultural, agricultural, and sewer discharges, as well as a combination of non-point source discharges, which contain elevated temperatures or high biological demand, can reduce dissolved oxygen levels. Shortnose sturgeon are known to be adversely affected by dissolved oxygen levels below 5 mg/L. Shortnose sturgeon may be less tolerant of low dissolved oxygen levels in high ambient water temperatures and show signs of stress in water temperatures higher than 28ºC (Flourney et al. 1992). At these temperatures, concomitant low levels of dissolved oxygen may be lethal.

Status of Shortnose Sturgeon in the Delaware River

Shortnose sturgeon occur in the Delaware River from the lower bay upstream to at least Lambertville, New Jersey (river mile 148). Tagging studies by O'Herron et al. (1993) found that the most heavily used portion of the river appears to be between river mile 118 below Burlington Island and river mile 137 at the Trenton Rapids. Hastings et al. (1987) used Floy T-anchor tags in a tag-and-recapture experiment from 1981 to 1984 to estimate the size of the Delaware River population in the Trenton to Florence reach. Population sizes by three estimation procedures ranged from 6,408 to 14,080 adult sturgeon. These estimates compare favorably with those based upon similar methods in similar river systems. This is the best available information on population size, but because the recruitment and migration rates between the population segment studied and the total population in the river are unknown, model assumptions may have been violated.

In the Delaware River, movement to the spawning grounds occurs in early spring (late March through early May[6]). Movement to the spawning areas is triggered in part by water temperature and

6 For example, Based on US Geological Survey (USGS) water temperature data for the Delaware River at the Trenton

fish typically arrive at the spawning locations when water temperatures are between 8-9ºC with most spawning occurring when water temperatures are between 10 and 15ºC. While actual spawning (i.e., fertilized eggs or larvae) has not been documented in this area, the concentrated use of the Scudders Falls region in the spring by large numbers of mature male and female shortnose sturgeon indicate that this is the major spawning area (O'Herron et al. 1993). The same area was identified as a likely spawning area based on the collection of two ripe females in the spring of 1965 (Hoff 1965). During the spawning period, males remain on the spawning grounds for approximately a week while females only stay for a few days (O'Herron and Hastings 1985). After spawning, which typically ceases by the time water temperatures reach 15ºC (although sturgeon have been reported on the spawning grounds at water temperatures as high as 18ºC), shortnose sturgeon move rapidly downstream to the Philadelphia area.

Shortnose sturgeon eggs generally hatch after approximately 9-12 days (Buckley and Kynard 1981). The larvae are photonegative, remaining on the bottom for several days. Buckley and Kynard (1981) found week old larvae to be photonegative and form aggregations with other larvae in concealment. Larvae are expected to begin swimming downstream at 9-14 days old (Richmond and Kynard 1995). Larvae are expected to be less than 20mm TL at this time (Richmond and Kynard 1995). This initial downstream migration generally lasts two to three days (Richmond and Kynard 1995). Studies (Kynard and Horgan 2002) suggest that larvae move approximately 7.5km/day during this initial 2 to 3 day migration. Laboratory studies indicate that young sturgeon move downstream in a 2-step migration: the initial 2-3 day migration followed by a residency period of the Young of the Year (YOY), then a resumption of migration by yearlings in the second summer of life (Buckley and Kynard 1981).

No studies have been conducted on juveniles in the Delaware River. As shortnose sturgeon demonstrate nearly identical migration patterns in all rivers, it is likely that juveniles in the Delaware River exhibit similar migration patterns to sturgeon in other river systems. As such, it is likely that yearlings are concentrated in the upper Delaware River above Philadelphia.

As noted above, due to limited information on juvenile shortnose sturgeon, it is difficult to ascertain their distribution and nursery habitat (O'Herron 2000, pers. comm.). In other river systems, older juveniles (3-10 years old) occur in the saltwater/freshwater interface (NMFS 1998). In these systems, juveniles moved back and forth in the low salinity portion of the salt wedge during summer. In the Delaware River the oligohaline/fresh interface can range from as far south as Wilmington, Delaware, north to Philadelphia, Pennsylvania, depending upon meteorological conditions such as excessive rainfall or drought. As a result, it is possible that in the Delaware River, juveniles could range from Artificial Island (river mile 54) to the Schuylkill River (river mile 92) (O'Herron 2000, pers. comm.). The distribution of juveniles in the river is likely highly influenced by flow and salinity. In years of high flow (for example, due to excessive rains or a significant spring runoff), the salt wedge will be pushed seaward and the low salinity reaches preferred by juveniles will extend further downriver. In these years, shortnose sturgeon juveniles

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gage (USGS gage 01463500; the site closest to the Scudders Falls area), water temperature reached 10ºC on April 14, 2003. Mean water temperatures at Trenton reached 15ºC on April 30, 2003. Based on this information, the majority of shortnose sturgeon spawning occurred between April 14 and April 30 in 2003. In 2004, water temperauture reached 8ºC on March 27, 10ºC on March 28, and 15ºC on April 20. The majority of spawning in 2004 likely occurred from March 28 – April 20. Due to a fault with the gauge, no water temperature data for the spring of 2005 is available.

are likely to be found further downstream in the summer months. In years of low flow, the salt wedge will be higher in the river and in these years juveniles are likely to be concentrated further upstream.

O'Herron believes that if juveniles are present within this range they would likely aggregate closer to the downstream boundary in the winter when freshwater input is normally greater (O'Herron 2000, pers. comm.). Research in other river systems indicates that juveniles are typically found over silt and sand/mud substrates in deep water of 10-20m. Juvenile sturgeon primarily feed in 10 to 20 meter deep river channels, over sand-mud or gravel-mud bottoms (Pottle and Dadswell 1979). However, little is known about the specific feeding habits of juvenile shortnose sturgeon in the Delaware River.

As noted above, after spawning, adult shortnose sturgeon migrate rapidly downstream to the Philadelphia area. After adult sturgeon migrate to the area around Philadelphia, many adults return upriver to between river mile 127 and 134 within a few weeks, while others gradually move to the same area over the course of the summer (O'Herron 1993). By November, adult sturgeon have returned to the overwintering grounds around Duck Island and Newbold Island. These patterns are generally supported by the movement of radio-tagged fish in the region between river mile 125 and river mile 148 as presented by Brundage (1986).

Shortnose sturgeon appear to be strictly benthic feeders (Dadswell 1984). Adults eat mollusks, insects, crustaceans and small fish. Juveniles eat crustaceans and insects. While shortnose sturgeon forage on a variety of organisms, in the Delaware River, sturgeon primarily feed on the Asiatic river clam (*Corbicula manilensis*). *Corbicula* is widely distributed at all depths in the upper tidal Delaware River, but it is considerably more numerous in the shallows on both sides of the river than in the navigation channels. Foraging is heaviest immediately after spawning in the spring and during the summer and fall, and lighter in the winter.

Historically, sturgeon were relatively rare below Philadelphia due to poor water quality. In the past decade, the water quality in the Philadelphia area has improved leading to an increased use of the lower river by shortnose sturgeon. Few studies have been conducted to document the use of the river below Philadelphia by sturgeon. Brundage and Meadows (1982) have reported incidental captures in commercial gillnets in the lower Delaware. During a study focusing on Atlantic sturgeon, Shirey et al. (1999) captured 9 shortnose sturgeon in 1998. During the June through September study period, Atlantic and shortnose sturgeon were found to use the area on the west side of the shipping channel between Deep Water Point, New Jersey and the Delaware-Pennsylvania line. The most frequently utilized areas within this section were off the northern and southern ends of Cherry Island Flats in the vicinity of the Marcus Hook Bar. A total of 25 shortnose sturgeon have been captured by Shirey in this region of the river from 1992 - 2004, with capture rates ranging from 0-10 fish per year (Shirey, personal communication, April 2006). Shortnose sturgeon have also been documented on the trash racks of the Salem nuclear power plant in Salem, New Jersey. The intakes for this plant are located in Delaware Bay. While the available information does not identify the area below Philadelphia as a concentration area for adult shortnose sturgeon, it is apparent that this species does occur in the lower Delaware River and upper Delaware Bay.

From November through March, adult sturgeon overwinter in dense sedentary aggregations in the upper tidal reaches of the Delaware between river mile 118 and 131. The areas around Duck Island and Newbold Island seem to be regions of intense overwintering concentrations. However, unlike sturgeon in other river systems, shortnose sturgeon in the Delaware do not appear to remain as stationary during overwintering periods. Overwintering fish have been found to be generally active, appearing at the surface and even breaching through the skim ice (O'Herron 1993). Due to the relatively active nature of these fish, the use of the river during the winter is difficult to predict. However, O'Herron et al. (1993) found that the typical overwintering movements are fairly localized and sturgeon appear to remain within 1.24 river miles of the aggregation site (O'Herron and Able 1986). The overwintering location of juvenile shortnose sturgeon is not known but believed to be on the freshwater side of the oligohaline/fresh water interface (O'Herron 1990). In the Delaware River, the oligohaline/freshwater interface occurs in the area between Wilmington, Delaware and Marcus Hook, Pennsylvania (O'Herron 1990).

Shortnose sturgeon in the project area

In May 2005, a one-year survey for juvenile sturgeon in the Delaware River in the vicinity of the Crown Landing project was initiated. The objective of the survey is to obtain information on the occurrence and distribution of juvenile shortnose and Atlantic sturgeon. Sampling for juvenile sturgeon was performed using trammel nets and small mesh gill nets. The nets were set at three stations, one located adjacent to the project site, one at the upstream end of the Marcus Hook anchorage (approximately 2.7 miles upstream of the project site), and one near the upstream end of the Cherry Island Flats (approximately 3.8 miles downstream of the site). Nets were set within three depth ranges at each station: shallow (<10 feet at MLW), intermediate (10-20 feet at MLW) and deep (20-30+ feet at MLW). Each station/depth zone was sampled once per month. Nets were fished for at least 4 hours when water temperatures were less than 27°C and limited to 2 hours when water temperature was greater than 27°C. The sampling from April through August 2005 yielded 3,014 specimens of 22 species, including 3 juvenile shortnose sturgeon. Juvenile shortnose sturgeon were collected one each during the June, July and August sampling events. Two of the shortnose sturgeon were collected adjacent to the project site and one was taken at the downstream sampling station. Total length ranged from 311-367mm. Preliminary results from the September – December sampling show that one juvenile shortnose sturgeon was caught in September (adjacent to the project site) and one in November (specific location unreported). One adult shortnose sturgeon was captured in October at the downstream site. All of the shortnose sturgeon were collected in deep water sets (greater than 20 feet). These depths are consistent with the preferred depths for foraging shortnose sturgeon juveniles reported in the literature (NMFS 1998). The capture of an adult in the Cherry Island Flats area (the downstream site) is consistent with the capture location of several adult sturgeon reported by Shirry et al. 1999.

Brundage compiled a report presenting an analysis of telemetry data from two receivers located upstream (Torresdale RKM 150 and Tinicum RKM 139) and two receivers located downstream of the Crown Landing site (Bellevue RKM 117 and New Castle RKM 93), during April through December 2003. The objective of the study was to provide information on the occurrence and movements of shortnose sturgeon in the general vicinity of the site. A total of 60 shortnose sturgeon had been tagged with ultrasonic transmitters: 30 in fall 2002, 13 in early summer 2003 and 13 in fall 2003. All fish tagged were adults tagged after collection in gill nets in the upper tidal Delaware River, between RKM 203-212. Of the 60 tagged sturgeon, 39 (65%) were recorded at Torresdale, 22 (36.7%) were recorded at Tinicum, 16 (26.7%) at Bellevue and 18 (30%) at New

Castle. The number of tagged sturgeon recorded at each location varied with date of tagging. Of the 30 sturgeon tagged in fall 2002, 26 were recorded at Torresdale, 17 at Tinicum, 11 at Bellevue and 13 at New Castle. Only two of the 13 tagged in fall 2003 were recorded, both at Torresdale only. Brundage concludes that seasonal movement patterns and time available for dispersion likely account for this variation, particularly for the fish tagged in fall 2003. Eleven of the 30 shortnose sturgeon tagged in fall 2002 and 5 of the 17 fish tagged in summer 2003 were recorded at all four locations. Some of the fish evidenced rapid movements from one location sequentially to the next in upstream and/or downstream direction. These periods of rapid sequential movement tended to occur in the spring and fall, and were probably associated with movement to summer foraging and overwintering grounds, respectively. As a group, the shortnose sturgeon tagged in summer 2003 occurred a high percentage of time within the range of the Torresdale receiver. The report concludes that the metrics indicate that the Torresdale Range of the Delaware River is utilized by adult shortnose sturgeon more frequently and for greater durations than the other three locations. Of the other locations, the New Castle Range appears to be the most utilized region. At all ranges, shortnose were detected throughout the study period, with most shortnose sturgeon detected in the project area between April and October. The report indicates that most adult shortnose sturgeon used the project area as a short-term migratory route rather than a long-term concentration or foraging area. Adult sturgeon in the project area are highly mobile, and as noted above, likely using the area as a migration route.

Based on the best available information, eggs, larvae and young of the year are not likely to occur at the project site. Information on the use of the river by juveniles is lacking and the information available is extremely limited (i.e., 5 captures). Juvenile shortnose sturgeon have been detected at the site from June - November, although only in deep water. Based on an analysis presented in the BA, the April – August time frame is when flows in the Delaware River are highest and the time when the project area is likely to experience the low salinity levels preferred by juveniles. Beginning in August, flows decrease and the salt wedge begins to move upstream, which may preclude juveniles from using the site. Based on this information, it is likely that juvenile shortnose sturgeon are present at the project site at least during the April – August time frame. The capture of juvenile shortnose sturgeon through November of 2005 suggests that if water conditions are appropriate, juveniles may also be present in the project area through the fall. While it is possible, based on habitat characteristics, that this area of the river is used as an overwintering site for juveniles, there is currently no evidence to support this presumption. The best available information suggests that adult shortnose sturgeon are using the project site as a migration corridor between downstream foraging sites (possibly located near Cherry Island flats) and the upstream spawning and overwintering areas. Adults are likely to transit the area between April and early December, with the majority of shortnose sturgeon adults moving to the overwintering area by mid-November when water temperatures drop to 10°C. This assumption is supported by water quality data from the USGS stream gauge in Philadelphia which indicates that water temperatures typically fall to 10°C (thought to be the trigger for movement to overwintering areas) in mid-late November and return to above 10°C in early April[7].

ENVIRONMENTAL BASELINE

7 For example, in 2004 temperatures reached 10°C on April 2 and dropped to 10°C on November 13. In 2005 temperatures were above 10°C between April 11 and November 23.

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, water quality, scientific research, shipping and other vessel traffic and fisheries, 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. Similarly, recovery actions NMFS has undertaken under both the Marine Mammal Protection Act (MMPA) and the ESA are addressing the problem of take of whales in the fishing and shipping industries. Additionally, NMFS has consulted on dredging and construction projects authorized by the ACOE. Consultations are detailed below.

Delaware River Federal Navigation Project – Dredging
The construction and maintenance of Federal navigation channels is a source of sturgeon mortality. The Delaware River Federal Navigation Channel is maintained by the ACOE, and the ACOE works in the Delaware River under the constraints of a general Opinion issued in 1996 and supplemented in 1999. The Delaware Main Channel is dredged using a hopper dredge, but the other smaller channels in the Delaware River usually employ a hydraulic pipeline dredge. The 1996 Opinion concluded that shortnose sturgeon may be adversely affected by entrainment and harassment during dredging projects that occur in the Delaware River. This Opinion outlined terms and conditions that would minimize potential impacts. However, dredging projects have caused shortnose sturgeon mortality and may have affected shortnose sturgeon distribution and foraging habitat.

Dredging in the Delaware River has resulted in the mortality of several shortnose sturgeon. In mid-March 1996, three subadult shortnose sturgeon were found in a dredge discharge pool on Money Island, near Newbold Island. The dead sturgeon were found on the side of the spill area into which the hydraulic pipeline dredge was pumping, and the presence of large amounts of roe in two specimens (i.e., fish were in breeding condition) indicates that the fish were alive and in good condition prior to entrainment. In January 1998, three shortnose sturgeon were discovered in the hydraulic maintenance dredge spoil in the Florence to Trenton section of the upper Delaware River. Recent actions in the Kennebec River in Maine indicate that shortnose sturgeon can also be killed by mechanical and hopper dredges. While mechanical and hopper dredging takes place in the Delaware River, no takes have been attributed to this dredge type in this river.

Since dredging involves removing the bottom material down to a specified depth, the benthic environment could be severely impacted by dredging operations. As shortnose sturgeon are benthic species, the alteration of the benthic habitat could have affected sturgeon prey distribution and/or foraging ability. Dredging continues to occur in the Delaware River. The adherence to seasonal restrictions has minimized the potential for shortnose sturgeon takes and none have been reported since 1999. A major dredging project, the Delaware River Main Channel Deepening Project, has been scheduled since 1999. This project will involve the removal of approximately 26 million cubic yards of material by hopper and pipeline dredge from Delaware Bay to Philadelphia. The effects of this project were considered in the Opinion issued by NMFS to ACOE in 1999. Due to difficulties in obtaining a permit from the State of Delaware for the work, this project has not yet been started. The ITS issued to ACOE for dredging projects in the Philadelphia District exempts the annual take of up to 4 shortnose sturgeon during dredging operations of any type.

Delaware River Federal Navigation Project – Blasting
On February 2, 2001, NMFS issued an Opinion to the ACOE on the effects of proposed rock blasting required for the construction of the Delaware River Main Channel Deepening Project. In this Opinion, NMFS estimated that rock blasting conducted from December 1 – March 15 was likely to result in the observed take of two shortnose sturgeon from injury or mortality. The Opinion concluded that the action may adversely affect but is not likely to jeopardize the continued existence of shortnose sturgeon. To date this project has not been conducted.

Emergency Repairs of the Flood Protection Levy at Morrisville, Pennsylvania
During the winter of 2003, a storm sewer pipe that penetrated the flood protection levy located in Morrisville, Pennsylvania collapsed during a high river flow event. The pipe collapse caused the earth and stone riprap over the pipe to settle into two large riverside sinkholes exposing the underlying earthen levy to river erosion. The sinkholes and collapsed pipe created a safety issue for the residents of Morrisville due to the possibility of flooding caused by failure of the levy or the backing up of stormwater during heavy rains. The ACOE attempted to make all necessary repairs before the shortnose sturgeon spawning season. However, due to high river flows, the repair work was not accomplished before the water temperatures reached 8°C (which occurred on April 13, 2003). On May 1, 2003, the ACOE requested the initiation of an emergency consultation pursuant to Section 7 of the ESA and approval to suspend a previously negotiated time of year restriction and allow the emergency repairs to the storm sewer pipe to proceed. The emergency repairs began with the installation of a cofferdam on May 27, 2003 and the emergency repair work was completed on August 29, 2003. A pump was run continuously to dewater the cofferdam so work could proceed in the dry.

NMFS issued a Biological Opinion on April 19, 2004 assessing the impacts of the emergency work on shortnose sturgeon. The Opinion concluded that based on the timing of spawning, the likely dates that the majority of larvae had left the action area and the location of the project (i.e., on the river bank), the number of shortnose sturgeon larvae that were directly affected by the emergency action was likely a very small percentage of the total number of larvae spawned in 2003. Take consisted of shortnose sturgeon larvae and occurred in the form of harassment (successful passage through the pump) and mortality (resulting from entrainment in the pump). In the Opinion, NMFS determined that an unquantifiable but very small percentage of the total number of shortnose sturgeon larvae spawned in 2003 were taken by this action, and only 10% of the take incidental to this emergency action was lethal. The Opinion concluded that the action had adversely affected but was not likely to jeopardize the continued existence of shortnose sturgeon.

Emergency Clean-Up Actions associated with the M/V Athos I Spill

On November 26, 2004, during docking operations at the Citgo facility in Paulsboro, New Jersey (RM 90), the hull of the tank vessel M/V Athos I was punctured by a submerged object causing the discharge of approximately 473,000 gallons of crude oil (low aromatic, sweet, product code: 1267) into the Delaware River. The emergency cleanup action was initiated under US Coast Guard (USCG) oversight. Pursuant to the emergency consultation procedures outlined in Section 7 of the ESA, the USCG initiated emergency consultation on the effects of the cleanup action on shortnose sturgeon. In a letter dated January 20, 2006, NMFS concluded that "while it is likely that the spill itself negatively impacted shortnose sturgeon in the Delaware River, likely by introducing contaminants into the environment and by altering normal behaviors, there is no evidence that suggests that the cleanup and response activities had an adverse affect on shortnose sturgeon. The removal of oil by mechanical means and the removal of oiled wildlife likely beneficially affected shortnose sturgeon as it minimized, to the extent possible, the potential for shortnose sturgeon to come into contact with the oil or to be contaminated by toxins through the food chain." In this letter NMFS concurred with the determination made by the USCG that the response activities associated with the November 26, 2004 spill of the M/V Athos I did not adversely affect shortnose sturgeon.

Scientific Studies
Shortnose sturgeon in this region have been the focus of a long history of scientific research, beginning in approximately 1962. As a result of techniques associated with these sampling studies, shortnose sturgeon have been subjected to capturing, handling, and tagging. It is possible that research in the action area may have influenced and/or altered the migration patterns, reproductive success, foraging behavior, and survival of shortnose sturgeon. Through 2001, Environmental Research and Consulting Inc. (principal investigators John O'Herron and Hal Brundage) reported the captures, handling and tagging of over 3000 shortnose sturgeon. Eleven accidental shortnose sturgeon mortalities were reported during that time.

Currently, only one valid research permit for shortnose sturgeon in the Delaware River is in place (Permit No. 1486, issued December 22, 2004 to Mr. Hal Brundage). This permit authorizes the capture, handling and tagging of 1,750 adult and juvenile shortnose sturgeon annually. Internal ultrasonic tagging, Floy T-bar tagging, PIT tagging and tissue and genetic sampling is authorized for a subset of the captured fish. The permit also authorizes the accidental mortality of up to 25 adult and 25 juvenile shortnose sturgeon over the five year life of the permit. A Biological Opinion was completed on December 21, 2004 which concluded that this action may adversely affect but is not likely to jeopardize the continued existence of shortnose sturgeon. This permit is valid for five years. It should be noted that the sturgeon surveys completed for the Crown Landing project were completed under the authorities of this permit.

Vessel Operations
Potential adverse effects from federal vessel operations in the action area of this consultation include operations of the US Navy (USN) and the US Coast Guard (USCG), which maintain the largest federal vessel fleets, the EPA, the National Oceanic and Atmospheric Administration (NOAA), and the ACOE. NMFS has conducted formal consultations with the USCG, the USN, and is currently in early phases of consultation with the other federal agencies on their vessel operations (e.g., NOAA research vessels). In addition to operation of ACOE vessels, NMFS has consulted with the ACOE to provide recommended permit restrictions for operations of contract or private

vessels around whales. Through the section 7 process NMFS has and will continue to establish conservation measures for all these agency vessel operations to avoid adverse effects to listed species. At the present time, however, they represent some level of potential interaction. Refer to the biological opinions for the USCG (September 15, 1995; July 22, 1996; and June 8, 1998) and the USN (May 15, 1997) for detail on the scope of vessel operations for these agencies and conservation measures being implemented as standard operating procedures.

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.

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, Lobster and Spiny Dogfish fisheries. These consultations are summarized below. These fisheries overlap with the action area in the ocean to varying degrees. None of these fisheries occur in the Delaware River.

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. NMFS reinitiated consultation on the Multispecies FMP on May 4, 2000, in order to reevaluate the ability of the Reasonable and Prudent Alternative (RPA) to avoid the likelihood of jeopardy to right whales. The Opinion, signed on June 14, 2001, concluded that continued implementation of the Multispecies FMP may adversely affect loggerhead, Kemp's ridley and green sea turtles and is likely to jeopardize the existence of the northern right whale. A new RPA was also included to avoid the likelihood that the operation of the gillnet sector of the multispecies fishery would result in jeopardy to northern right whales. The ITS exempted the lethal or non-lethal take of one loggerhead sea turtle, and one green, leatherback, or Kemp's ridley turtle annually.

The federal *Monkfish fishery* occurs in all waters under federal jurisdiction from Maine to the North Carolina/South Carolina border. The monkfish fishery uses several gear types that may entangle protected species. In 1999, observers documented that turtles were taken in excess of the ITS as a result of entanglements in monkfish gillnet gear. NMFS reinitiated consultation on the Monkfish FMP on May 4, 2000, in part, to reevaluate the affect of the monkfish gillnet fishery on sea turtles. The Opinion also considered new information on the status of the northern right whale and new Atlantic Large Whale Take Reduction Plan (ALWTRP) measures, and the ability of the RPA to avoid the likelihood of jeopardy to right whales. The Opinion concluded that continued implementation of the Monkfish FMP was likely to jeopardize the existence of the northern right whale. A new RPA was provided that was expected to remove the threat of jeopardy to northern right whales. In addition, a new ITS was provided for the take of sea turtles in the fishery. However, consultation was once again reinitiated on the Monkfish FMP as of February 12, 2003, to consider the effects of Framework Adjustment 2 measures on ESA-listed species. This consultation was completed on April 14, 2003, and concluded that the proposed action is not likely to result in jeopardy to any ESA-listed species under NMFS jurisdiction. However, takes of sea turtles are still expected to occur, which was reflected in the ITS. The ITS 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.

The *Summer Flounder, Scup and Black Sea Bass fisheries* are known to interact with sea turtles. Significant measures have been developed to reduce the take of sea turtles in summer flounder trawls and trawls that meet the definition of a summer flounder trawl by requiring the use of TEDs throughout the year for trawl nets fished from the North Carolina/South Carolina border to Oregon Inlet, NC, and seasonally (March 16-January 14) for trawl vessels fishing between Oregon Inlet, NC and Cape Charles, VA. 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 *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 this fishery was completed on July 2, 1999, and NMFS concluded that operation of the fishery under the FMP, as amended, is 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).

The primary gear types for the *Spiny dogfish fishery* are sink gillnets, otter trawls, bottom longline, and driftnet gear. Sea turtles can be incidentally captured in all gear sectors of this fishery. Turtle takes in 2000 included one dead and one live Kemp's ridley. Since the ITS issued with the August 13, 1999, Opinion anticipated the take of only one Kemp's ridley (lethally or non-lethally), the incidental take level for the dogfish FMP was exceeded. In addition, a right whale mortality occurred in 1999 as a result of entanglement in gillnet gear that may (but was not determined to be) have originated from the spiny dogfish fishery. NMFS, therefore, reinitiated consultation on the Spiny Dogfish FMP on May 4, 2000, in order to reevaluate the ability of the RPA to avoid the likelihood of jeopardy to right whales, and the effect of the spiny dogfish gillnet fishery on sea turtles. The Opinion also considered new information on the status of the northern right whale and new ALWTRP measures. The Opinion, signed on June 14, 2001, concluded that continued implementation of the Spiny Dogfish FMP is likely to jeopardize the existence of the northern right whale. A new RPA was provided that was expected to remove the threat of jeopardy to northern 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).

The management unit for the *Tilefish* FMP is all golden tilefish under U.S. jurisdiction in the Atlantic Ocean north of the Virginia/North Carolina border. Tilefish have some unique habitat characteristics, and are found in a warm water band (47-65º F) at approximately 250 to 1200 feet deep on the outer continental shelf and upper slope of the U.S. Atlantic coast. Because of their restricted habitat and low biomass, the tilefish fishery in recent years has occurred in a relatively small area in the Mid-Atlantic Bight, south of New England and west of New Jersey. A Opinion was issued for this newly regulated fishery on March 13, 2001. An incidental take statement was provided for loggerhead and leatherback sea turtles, anticipating the annual take of 6 loggerheads (up to 3 lethal) and 1 leatherback (lethal or non-lethal).

It was previously believed that the *Scallop dredge fishery* was unlikely to take sea turtles given the slow speed and location at which the gear operates. However, 40 hard shelled turtles were observed or reported captured in the scallop dredge fishery from 1996 to October 2002. Most of these animals were captured in the Hudson Canyon Closed area, and 23 of 40 turtles were alive with no apparent injuries. Section 7 consultation was completed on this fishery, and the Opinion, dated February 24, 2003, concluded that the fishery was not likely to jeopardize listed species. Due to the availability of new information, section 7 consultation was reinitiated and a new Opinion was issued on February 23, 2004. Consultation was reinitiated following the issuance of this Opinion with an Opinion issued on December 15, 2004. The ITS anticipated the annual take of 749 loggerheads (up to 479 lethal) in scallop dredge gear and 3 loggerhead or 1 leatherback turtle (lethal or non-lethal) in scallop trawl gear.

The *Red crab fishery* is a pot/trap fishery that occurs in deep waters along the continental slope. There have been no recorded takes of ESA-listed species in the red crab fishery. However, given the type of gear used in the fishery, takes may be possible where gear overlaps with the distribution of ESA-listed species. Section 7 consultation was completed on the proposed implementation of the Red Crab FMP, and the Opinion, issued on February 6, 2002, concluded that the action is not likely to result in jeopardy to any ESA-listed species under NMFS jurisdiction. Takes of loggerhead and leatherback sea turtles are considered unlikely but possible. As such, the ITS anticipated the annual take of 1 loggerhead and 1 leatherback sea turtle (lethal or non-lethal).

The *American lobster trap fishery* has been identified as a source of gear causing serious injuries and mortality of endangered whales and leatherback sea turtles. A June 14, 2001 Opinion for this fishery concluded that operation of the lobster trap fishery is likely to jeopardize the continued existence of right whales and may adversely affect leatherback sea turtles. A Reasonable and Prudent Alternative (RPA) to avoid the likelihood that the lobster fishery would jeopardize the continued existence of right whales was implemented. However, these measures are not expected to reduce the number or severity of leatherback sea turtle interactions with the fishery. Information on leatherback entanglements in lobster trap gear is generally lacking. Leatherbacks are known, however, to be caught in lobster trap gear (Dwyer *et al*. 2002). The ITS of the October 31, 2002 Opinion anticipates the take of 2 loggerheads (lethal or non-lethal) and 9 leatherbacks biennially.

The *Squid/Mackerel/Butterfish 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. A 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).

Components of the *Highly Migratory Species (HMS)* Atlantic pelagic fishery for swordfish/tuna/shark in the EEZ occur within the action area for this consultation. Use of pelagic longline, pelagic driftnet, bottom longline, hand line (including bait nets), and/or purse seine gear in this fishery has resulted in the take of sea turtles and whales. The Northeast swordfish driftnet portion of the fishery was prohibited during an emergency closure that began in December 1996, and was subsequently extended. A permanent prohibition on the use of driftnet gear in the swordfish fishery was published in 1999. In June 2001, NMFS completed consultation on the HMS pelagic longline fishery and concluded that the pelagic longline fishery and the bottom longline fisheries for shark could capture as many as 1,417 pelagic, immature loggerhead turtles each year and could kill as many as 381 of them and was also expected to capture 875 leatherback turtles each year, killing as many as 183 of them. The Opinion concluded that the Atlantic HMS fisheries, particularly the pelagic longline fisheries, were likely to jeopardize the continued existence of loggerhead and leatherback sea turtles. An RPA was provided to avoid jeopardy to leatherback and loggerhead sea turtles as a result of operation of the HMS fisheries. Consultation was subsequently reinitiated on the HMS fishery following new information on the number of loggerhead and leatherback sea turtles captured in the fishery. NMFS completed the biological opinion for that consultation on June 1, 2004. The Opinion concluded that the continued prosecution of the HMS pelagic longline fishery was likely to jeopardize the continued existence of leatherback sea turtles, given that an estimated 805 takes (of which 266 mortalities would result) were expected to occur in 2004, and an estimated 588 takes (with 198 mortalities) were expected in subsequent years, continuing indefinitely. A new RPA was developed. As a result of implementation of the new RPA, leatherback takes are estimated to be 1,981 for the period 2004-2006 with no more than 548 mortalities, and 1764 takes for subsequent 3-year periods with no more than 252 mortalities in each 3-year period (NMFS 2004b). The continued implementation of the HMS fisheries is not expected to jeopardize the continued existence of loggerhead sea turtles. The Opinion anticipates that for the

3-year period from 2004-2006, an estimated 1,869 loggerheads are expected to be taken in the fishery with no more than 438 mortalities. For each subsequent 3-year period, 1,905 loggerheads are expected to be taken with no more than 339 mortalities (NMFS 2004b).

The *Skate fishery* is primarily a bottom trawl fishery with 94.5% of skate landings attributed to this gear type. Gillnet gear is the next most common gear type, accounting for 3.5% of skate landings. The Northeast skate complex is comprised of seven skate species. The seven species of skate are distributed along the coast of the northeast U.S. from the tide line to depths exceeding 700m (383 fathoms). There have been no recorded takes of ESA-listed species in the skate fishery. However, given that sea turtle interactions with trawl and gillnet gear have been observed in other fisheries, sea turtle takes in gear used in the skate fishery may be possible where the gear and sea turtle distribution overlap. 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.

Other than entanglement in fishing gear, effects of *fishing vessels* on listed species may involve disturbance or injury/mortality due to collisions or entanglement in anchor lines. Listed species or critical habitat may also be affected by fuel oil spills resulting from fishing vessel accidents. No collisions between commercial fishing vessels and listed species or adverse effects resulting from disturbance have been documented. However, the commercial fishing fleet represents a significant portion of marine vessel activity. In addition, commercial fishing vessels may be the only vessels active in some areas, particularly in cooler seasons. Therefore, the potential for collisions exists. Due to differences in vessel speed, collisions during fishing activities are less likely than collisions during transit to and from fishing grounds. Because most fishing vessels are smaller than large commercial tankers and container ships, collisions are less likely to result in mortality. Although entanglement in fishing vessel anchor lines has been documented historically, no information is available on the prevalence of such events. Fuel oil spills could affect animals directly or indirectly through the food chain. Fuel spills involving fishing vessels are common events. However, these spills typically involve small amounts of material that are unlikely to adversely affect listed species. Larger spills may result from accidents, although these events would be rare and involve small areas. No direct adverse effects on listed species or critical habitat resulting from fishing vessel fuel spills have been documented. Given the current lack of information on prevalence or impacts of interactions, there is no basis to conclude that the level of interaction represented by any of the various fishing vessel activities discussed in this section would be detrimental to the recovery of listed species.

Non-Federally Regulated Actions

Contaminants and Water Quality

Historically, shortnose sturgeon were rare in the area below Philadelphia, likely as a result of poor water quality precluding migration further downstream. However, in the past 20 to 30 years, the water quality has improved and sturgeon have been found farther downstream. It is likely that contaminants remain in the water and in the action area, albeit to reduced levels.

Point source discharges (i.e., municipal wastewater, industrial or power plant cooling water or waste water) and compounds associated with discharges (i.e., metals, dioxins, dissolved solids, phenols, and hydrocarbons) contribute to poor water quality and may also impact the health of sturgeon populations. The compounds associated with discharges can alter the pH or receiving waters, which may lead to mortality, changes in fish behavior, deformations, and reduced egg production and survival.

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

Contaminants have been detected in Delaware River fish. PCB's have been detected in elevated levels in several species of fish. Large portions of the Delaware River is bordered by highly industrialized waterfront development. Sewage treatment facilities, refineries, manufacturing plants and power generating facilities all intake and discharge water directly from the Delaware River. This results in large temperature variations, heavy metals, dioxin, dissolved solids, phenols and hydrocarbons which may alter the pH of the water eventually leading to fish mortality. Industrialized development, especially the presence of refineries, has also resulted in storage and leakage of hazardous material into the Delaware River. Presently 13 Superfund sites have been identified in Marcus Hook and one dumpsite has yet to be labeled as a Superfund site, but does contain hazardous waste. It is possible that the presence of contaminants in the action area may have adversely affected shortnose sturgeon abundance, reproductive success and survival.

Several characteristics of shortnose sturgeon life history including long life span, extended residence in estuarine habitats, and being a benthic omnivore, predispose this species to long term, repeated exposure to environmental contaminants and bioaccumulation of toxicants (Dadswell 1979). Toxins introduced to the water column become associated with the benthos and can be particularly harmful to benthic organisms (Varanasi 1992) like sturgeon. Heavy metals and organochlorine compounds are known to accumulate in fat tissues of sturgeon, but their long term effects are not yet known (Ruelle and Henry 1992; Ruelle and Keenlyne 1993). Available data suggest that early life stages of fish are more susceptible to environmental and pollutant stress than older life stages (Rosenthal and Alderdice 1976). Although there have not been any studies to assess the impact of contaminants on shortnose sturgeon, elevated levels of environmental contaminants, including chlorinated hydrocarbons, in several other fish species are associated with reproductive impairment (Cameron et al. 1992; Longwell et al. 1992), reduced egg viability (Von Westernhagen et al. 1981; Hansen 1985; Mac and Edsall 1991), and reduced survival of larval fish (Berlin et al. 1981; Giesy et al. 1986). Some researchers have speculated that PCBs may reduce the shortnose sturgeon's resistance to fin rot (Dovel et al. 1992).

Although there is scant information available on levels of contaminants in shortnose sturgeon tissues, some research on other, related species indicates that concern about effects of contaminants on the health of sturgeon populations is warranted. Detectable levels of chlordane, DDE, DDT, and dieldrin, and elevated levels of PCBs, cadmium, mercury, and selenium were found in pallid sturgeon tissue from the Missouri River (US Fish and Wildlife Service 1993). These compounds may affect physiological processes and impede a fish's ability to withstand stress. PCBs are believed to adversely affect reproduction in pallid sturgeon (Ruelle and Keenlyne 1993). Ruelle and Henry (1992) found a strong correlation between fish weight $r = 0.91$, $p < 0.01$), fish fork length $r = 0.91$, $p < 0.01$), and DDE concentration in pallid sturgeon livers, indicating that DDE concentration increases proportionally with fish size.

Contaminant analysis was conducted on two shortnose sturgeon from the Delaware River in the fall of 2002. Muscle, liver, and gonad tissue were analyzed for contaminants (ERC 2002). Sixteen metals, two semivolatile compounds, three organochlorine pesticides, one PCB Aroclor, as well as polychlorinated dibenzo-p-dioxins (PCDDs), and polychlorinated dibenzofurans (PCDFs) were detected in one or more of the tissue samples. Levels of aluminum, cadmium, PCDDs, PCDFs, PCBs and DDE (an organochlorine pesticide) were detected in the "adverse affect" range. It is of particular concern that of the above chemicals, PCDDs, DDE, PCBs and cadmium, were detected as these have been identified as endocrine disrupting chemicals. While no directed studies of chemical contamination in shortnose sturgeon in the Delaware River have been undertaken, it is evident that the heavy industrialization of the Delaware River is likely adversely affecting this population.

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

The Delaware Department of Natural Resources issues National Pollutant Discharge Elimination System permits for discharges in the State of Delaware. NMFS receives copies of draft permits during the Public Notice period and provides comments to the State with the goal of assuring that any permits issued do not have more than a minor detrimental effect on listed species in the receiving waters.

Private and Commercial Vessel Operations

Private and commercial vessels operate in the action area of this consultation and also have the potential to interact with whales and sea turtles. Ship strikes have been identified as a significant source of mortality to the northern right whale population (Kraus 1990) and are also known to impact all other endangered whales. Whale watch vessels operate out of Delaware Bay, primarily from Cape May, New Jersey. In addition, an unknown number of private recreational boaters frequent coastal waters; some of these are engaged in whale watching or sportfishing activities. These activities have the potential to result in lethal (through entanglement or boat strike) or non-lethal (through harassment) takes of listed species that could prevent or slow a species' recovery. Effects of harassment or disturbance which may be caused by whale watch operations are currently unknown. Information is not currently available the level of vessel activity in the action area. The advent of new technology resulting in high speed catamarans for ferry services and whale watch vessels operating in congested coastal areas contributes to the potential for impacts from privately-operated vessels in the environmental baseline. Recent federal efforts regarding mitigating impacts of the whale watch and shipping industries on endangered whales are discussed below.

Non-Federally Regulated Fishery Operations

Direct take of shortnose sturgeon is prohibited by the ESA. However, shortnose sturgeon are taken incidentally in other anadromous fisheries along the East Coast and are probably targeted by poachers (NMFS 1998). The incidental take of shortnose sturgeon in the river has not been well documented due to confusion over distinguishing between Atlantic sturgeon and shortnose sturgeon. The incidental take of shortnose sturgeon on the Hudson River has been documented in both commercial shad fisheries as well as recreational hook and line fisheries. Although, commercial fisheries are prohibited in Pennsylvania state waters, New Jersey and Delaware do permit commercial fisheries to operate in designated portions of the Delaware River (Miller 2000, pers. Comm.; Boriek 2000, pers. comm.). American shad, eel, and blue crab are the species targeted by commercial fisherman, however, in the action area the level of commercial fishing is very minimal (Miller 2000, pers. Comm.; Boriek 2000, pers. comm.). Recreational hook and line fisheries, that target largemouth bass, striped bass, white catfish and channel catfish, are permitted throughout the River (Coughman 2000, pers. comm.; Boriek 2000, pers. comm.). While there have been few documented incidental takes of shortnose sturgeon in fisheries in the Delaware River, it is possible that unreported incidental takes have occurred in recreational hook and line fisheries and commercial fisheries operating in the action area (Coughman 2000, pers. comm.).

Very little is known about the level of listed species take in fisheries that operate strictly in state waters. However, depending on the fishery in question, many state permit holders also hold federal licenses; therefore, section 7 consultations on federal actions in those fisheries address some state-water activity. Impacts on sea turtles and shortnose sturgeon 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. In 1998, 3 entanglements of humpback whales in state-water fisheries were documented.

Conservation and Recovery Actions Reducing Threats to Listed Species

Education and Outreach Activities

A number of activities are in progress that ameliorate some of the adverse effects on listed species posed by activities summarized in the Environmental Baseline. 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 and supplement outreach efforts in an attempt to increase the survival of protected species through education on proper release techniques. Education and outreach activities are also methods to reduce the risk of collision represented by the operation of private and commercial vessels. The USCG educates mariners on whale protection measures and uses its programs, such as radio broadcasts and notice to mariner publications, to alert the public to potential whale concentration areas. The USCG also participates in international activities (discussed below) to decrease the potential for commercial ships to strike a whale. An educational video on the ship strike problem entitled "Right Whales and the Prudent Mariner" was produced and is being distributed to mariners. In addition, outreach efforts under the ALWTRP for fishermen are also increasing awareness among fishermen that is expected in the long run to help reduce the adverse effects of vessel operations on threatened and endangered species in the action area.

Whales and Vessel Collision

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 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.

In 1994, NMFS established the NEIT for the northern right whale and humpback whale recovery plans. Membership of the NEIT consists of representatives from federal and state regulatory agencies and is advised by a panel of scientists with expertise in right and humpback whale biology. The Recovery Plans describe steps to reduce impacts to levels that will allow the two species to recover and rank the various recovery actions in order of importance. The NEIT provides advice to the various federal and state agencies or private entities on achieving these national goals within the Northeast Region. The NEIT agreed to focus on habitat and vessel related issues and rely on the take reduction planning process under the MMPA for reducing takes in commercial fisheries. Through the deliberations of the NEIT, NMFS has implemented a number of activities that reduce the potential for adverse effects to endangered whales from the aforementioned state, federal, and private activities. For example, the NEIT was the driving force behind the outreach activities described above which promote awareness of the right whale ship strike problem among commercial ship operators.

The Northeast Sighting Advisory System (SAS), originally called the "Early Warning System", was designed to document the presence of right whales in and around critical habitat and nearby shipping/traffic separation lanes in order to avert ship strikes. Through a fax-on-demand system, fishermen and other vessel operators can obtain SAS sighting reports and, in some cases, make necessary adjustments in operations to decrease the potential for interactions with right whales. The SAS activity has also served as the only form of active entanglement monitoring in the critical habitat areas, and several entanglements in both the Cape Cod Bay and Great South Channel areas have been reported by SAS flights. Some of these sighting efforts have resulted in successful disentanglement of right whales. SAS flights have also contributed to 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.

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

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

Through deliberations of the NEIT and its Ship Strike Committee, NMFS and the National Ocean Service (NOS) recently revised the whale watch guidelines for the Northeast, including the Studds-Stellwagen National Marine Sanctuary.

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. A key component of the strategy is the Advance Notice of Proposed Rulemaking (ANPR) published in June 2004 (69 FR 30857) which outlines regulatory speed and routing measures that would reduce the risk of vessel collisions with right whales. The rulemaking process is ongoing, but NMFS intends to publish final regulations in the near future.

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

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

The NEIT has contracted the development of a comprehensive merchant mariner education module for use and distribution to maritime academies along the east coast. The purpose of this program is to inform both new captains and those being re-certified about right whales and operational guidelines for minimizing the risk of collision. The module is in the final stages of development, and the NEIT will soon develop a strategy to implement the program in various academies.

In addition, NMFS continues to research various 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.

Whales and Entanglement in Fishing Gear
The Atlantic Large Whale Take Reduction Plan (ALWTRP) is a major component of NMFS activities to reduce threats to listed large whales. It is a multi-faceted plan that includes both regulatory and non-regulatory actions. Regulatory actions are directed at reducing serious entanglement injuries and mortality of right, humpback and fin whales from fixed gear fisheries (*i.e.*, trap and gillnet fisheries). The measures identified in the ALWTRP will also benefit minke whales (a non ESA-listed species).

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

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

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

Although the Sighting Advisory System (SAS) was developed primarily as a method of locating right whales and alerting mariners to right whale sighting locations in a real time manner, the SAS also addresses entanglement threats. Fishermen can obtain SAS sighting reports and make necessary adjustments in operations to decrease the potential for interactions with right whales. The SAS has also served as the only form of active entanglement monitoring in the Cape Cod Bay and Great South Channel critical habitats. Some of these sighting efforts have resulted in successful disentanglement of right whales.

Summary and Synthesis of the Status of the Species and Environmental Baseline

The purpose of the Environmental Baseline is to analyze the status of the species in the action area. Generally speaking, the status of sea turtle and whale species overall is the same as the status of these species in the action area given their migratory nature. For shortnose sturgeon, however, the status of the species in the action area is the status of shortnose sturgeon in the Delaware River population.

Impacts from actions occurring in the Environmental Baseline for the action area have the potential to impact shortnose sturgeon, sea turtles and whales. Despite regulations on fisheries actions, improvements in dredge technologies and improvements in water quality, shortnose sturgeon, sea turtles and whales still face numerous threats in this area, primarily from habitat alteration and interactions with fishing gear and dredging operations.

Without more information on the status of these species, including reliable population estimates, it is difficult to speculate about the long term survival and recovery of these species. However, the best available information has led NMFS to make the determinations about species status as stated below.

Summary of status of whale species

The best available abundance estimate for *sperm whales* in the U.S. North Atlantic, 4,702, is the sum of two estimates from 1998 U.S. Atlantic surveys, where the estimate from the northern U.S. Atlantic is 2,848 and from the southern U.S. Atlantic is 1,854 sperm whales. There are currently insufficient data to determine population trends. As this species continues to be subject to natural and anthropogenic mortality, this population is at best stable and at worst declining.

Based on recent estimates, NMFS considers the best approximation for the number of *Northern right whales* to be 300 +/- 10%. Losses of adult whales due to ship strikes and entanglements in fishing gear continue to depress the recovery of this species and the right whale population continues to be declining.

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

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

Summary of status of sea turtle species

As noted in the status of the species section, *loggerhead sea turtles* in the action area are likely to be from the northern or South Florida nesting subpopulations or the Yucatan subpopulation. The South Florida nesting subpopulation is the largest known loggerhead nesting assemblage in the Atlantic. Nesting totals from beaches used by the South Florida subpopulation suggests that this subpopulation may be increasing or is at least stable. The northern nesting subpopulation is the second largest loggerhead nesting assemblage in the Atlantic. Nesting data has led the TEWG to conclude that the northern subpopulation is likely declining and at best is stable.   While researchers have documented significant increases in loggerhead nesting on seven beaches at Quintana Roo, Mexico, nesting survey effort overall has been inconsistent among the Yucatán nesting beaches and no trend can be determined for this subpopulation given the currently available data. No reliable estimate of the total number of loggerheads in any of the subpopulations or the species as a whole exists.

Based on the available information it is difficult to determine the current status of the Atlantic *leatherback* population. For example, the number of female leatherbacks reported at some nesting sites in the Atlantic has increased while at other sites the number has decreased. Leatherbacks continue to be captured and killed in many kinds of fisheries and it is likely that the population is declining and at best is stable. No reliable estimate of the total number of leatherbacks in the Atlantic exists.

The *Kemp's ridley* is the most endangered sea turtle species with only one major nesting site remaining. While recent population estimates for this species are not available, patterns of Kemp's ridley nesting data suggests that this population is increasing or is at least stable.

Recent population estimates of the number of *green sea turtles* in the western Atlantic are unavailable. The pattern of nesting abundance for this species has shown a generally positive trend since monitoring began in 1989 suggesting that this population may be increasing or is at least stable.

Summary of status of shortnose sturgeon
Historically, shortnose sturgeon are believed to have inhabited nearly all major rivers and estuaries along nearly the entire east coast of North America. Today, only 19 populations remain. The present range of shortnose sturgeon is disjunct, with northern populations separated from southern populations by a distance of about 400 km. Population sizes range from under 100 adults in the Cape Fear and Merrimack Rivers to tens of thousands in the St. John and Hudson Rivers. As indicated in Kynard 1996, adult abundance is less than the minimum estimated viable population abundance of 1000 adults for 5 of 11 surveyed northern populations and all natural southern populations. The only river systems likely supporting populations close to expected abundance are the St John, Hudson and possibly the Delaware and the Kennebec (Kynard 1996), making the continued success of shortnose sturgeon in these rivers critical to the species as a whole.

Population sizes of the Delaware River population by three estimation procedures ranged from 6,408 to 14,080 adult sturgeon. This is the best available information on population size, but because the recruitment and migration rates between the population segment studied and the total population in the river are unknown, model assumptions may have been violated. Based on comparison to older population estimates, NMFS assumes that this population is increasing or at worst is stable.

While no reliable estimate of the size of either the shortnose sturgeon population in the Northeastern US or of the species throughout its range exists, it is clearly below the size that could be supported if the threats to shortnose sturgeon were removed. Based on the number of adults in population for which estimates are available, there are at least 104,662 adult shortnose sturgeon, including 18,000 in the Saint John River in Canada. Based on the best available information, NMFS believes that the status of shortnose sturgeon throughout their range is at best stable, with gains in populations such as the Hudson, Delaware and Kennebec, offsetting the continued decline of southern river populations, and at worst declining. The lack of information on the status of populations such as that in the Chesapeake Bay add uncertainty to determination on the status of this species as a whole.

EFFECTS OF THE ACTION

This section of a 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 the shortnose sturgeon in the Delaware River and their habitat within the context of the species current status, the environmental baseline and cumulative effects. Sea turtles and listed whales are not expected to occur in the area to be affected by the construction of the LNG facility. As such, they are not likely to be affected by the construction or dredging required to build the terminal. Therefore, the following discussion of the effects of construction, including dredging, will only discuss effects to shortnose sturgeon.

Dredging and Construction of the LNG Facility

As noted in the description of the action, dredging and in-water construction will occur between August 1 and December 31. As noted above in the Status of the Species sections, the youngest life stage of shortnose sturgeon likely to occur at the project site are juveniles (3-10 years old). Information on the distribution of juveniles in the river is lacking. Previous studies have speculated, based on the distribution of juveniles in other river systems, that juveniles in the Delaware river are likely to occur in deep water (greater than 10 meters) near the saltwater/freshwater interface. As noted above, this area changes throughout the year and between years based on flow and seasonal runoff. Shortnose sturgeon juveniles have been documented in deep water near the project site in June, July, August and November. This is consistent with expectations on distribution of this life stage. As juveniles have been captured near the project site through November, it is also likely that juveniles are present in the late summer and fall.

Adult shortnose sturgeon are present in the project area from April – December with the highest concentration likely present during April – October. The available information suggests that adults are using the area as a migration corridor and not as a concentration area. Data indicate that some of the sturgeon that have been observed in the vicinity of the site during the spring and fall may be moving between overwintering and summer foraging areas. Analysis of the available data suggests that shortnose sturgeon are highly mobile at this time of year and that they are likely moving in and out of the Marcus Hook area. Adult shortnose sturgeon are typically found in deep water near the bottom. For example, a tagging study completed by O'Herron et al. (1993) demonstrated that approximately 95% of the time, shortnose sturgeon were found at depths consistent with the navigation channel and only 4% of the time were shortnose sturgeon found in shallow (less than 12 feet) water and only 1% of the time were they found in water of intermediate depth. As the berthing area is currently between 4 and 10 feet deep, it is not likely to be visited often by shortnose sturgeon.

While adult shortnose sturgeon may be foraging while they are in the Marcus Hook area, this area is not likely to be a preferred foraging area. As noted above, shortnose sturgeon are typically found in deep water. While shortnose sturgeon have been documented to use shallow mud flats while foraging (in the Kennebec River, Squiers et al. 1982), the area was covered with rooted aquatic plants. Benthic sampling has demonstrated that the berthing area lacks rooted vegetation and demonstrates low biomass. As it is not known to support shortnose sturgeon forage items, it is unlikely to be used by foraging shortnose sturgeon. Additionally, the majority of adult shortnose sturgeon from the Delaware River population are likely to spend only a short time in the river below Philadelphia after spawning and most of these fish will have returned to the upriver concentration areas before August with all adults expected to move to the upstream overwintering area by late November when water temperatures have dropped below 10ºC. Based on current bathymetry (currently the site is 4-10 feet at MLW) and benthic sampling which demonstrated that the proposed berthing area lacked vegetation and demonstrated low biomass, the proposed berthing area is unlikely to be high use area for foraging or resting sturgeon and is unlikely to be used as a thermal refuge. However, as noted above, the area is used as a migration corridor.

As shortnose sturgeon have been documented in the project area during the time of year proposed for dredging, interactions between shortnose sturgeon and the dredge operations are likely to occur. Shortnose sturgeon may be directly affected by being entrained in dredge equipment, by exposure to the sediment plume released during dredging operations and by the destruction of benthic resources in the area to be dredged.

Dredging Operations

Interactions between shortnose sturgeon and dredge operations have been fairly well documented. In the Northeast, lethal takes of shortnose sturgeon have been documented in dredge operations in the Delaware and Kennebec Rivers. A hydraulic cutterhead (pipeline) dredge will be used to perform the proposed dredging project. This type of dredging uses a dredge with a cutter section head to produce a slurry of sediments and water, which is essentially vacuumed up and pumped to a disposal site via a temporary discharge pipe. Shortnose sturgeon may be killed from entrainment in the cutter suction head or burial in sediment during dredging and/or when sediment is deposited at the disposal site. Sturgeon are not likely to survive entrainment in the dredge.

In March 1996, three shortnose sturgeon were found in a dredge spoil near Newbold Island where a pipeline dredge was discharging material. A necropsy indicated that the sturgeon were likely alive and in good condition when they were entrained in the dredge. In January 1998, three shortnose sturgeon were found in a dredge spoil for that year's maintenance dredging of the Delaware River. Both dredge operations occurred in the Kinkora-Trenton range of the Delaware River where dense, sedentary aggregations of sturgeon occur in the winter months. Since these incidents, time of year restrictions have been implemented which prohibit dredging in this area of the river when overwintering sturgeon are present.

In the Kennebec River, five shortnose sturgeon were entrained in a hopper dredge in October 2003. Three of the sturgeon died and two were released alive. Approximately 10,000 cubic yards of material was removed from the deepwater navigation channel over the course of five days. These sturgeon were presumably completing their upstream migration to overwintering areas.

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. For example, dredging in the Bath Iron Works sinking basin in the Kennebec River prior to 2003 resulted in no interactions with shortnose sturgeon but one shortnose sturgeon was killed by a clamshell dredge in the last hour of the last day of dredging on April 30, 2003.

The number of interactions between dredge equipment and shortnose sturgeon seems to be best associated with the length of time dredging takes, with a greater number of interactions associated with 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 shortnose sturgeon are present in the action area) and the type of dredge plant used. Shortnose sturgeon seem better able to avoid a mechanical dredge than a hopper or pipeline dredge, likely due to the hydraulic suction associated with a hopper and pipeline dredge which makes avoidance more difficult. The likelihood of entrainment in a hopper dredge is likely to be greater than a pipeline dredge as hopper dredges have a larger opening and operate at higher suction levels. Shortnose sturgeon also seem better able to avoid dredges during the non-winter months when the fish are more active.

As noted above, the somewhat unpredictable nature of dredging interactions makes it difficult to determine an actual number of interactions that are likely to occur. The initial phase of dredging of the berthing area is expected to take approximately 100 days. This work will occur from August – December when juvenile and adult sturgeon are likely to be present in the area to be dredged.

Most shortnose sturgeon in the Marcus Hook area are expected to be in the channel and not in the berthing area. However, as shortnose sturgeon are known to occasionally use shallow water habitats, and the fish are expected to be highly mobile in this area and at this time of year, it is likely that some number of transient sturgeon will be present in the area to be dredged. As noted above, six shortnose sturgeon were killed during two separate dredging operations with cutterhead dredges operating in the Kinkora – Trenton range in the winters of 1996 and 1998. NMFS believes that the effects of the proposed dredging at the proposed berthing area will be less than the impacts of the 1996 and 1998 dredging as there are expected to be fewer shortnose sturgeon at the berthing area and the fish will be highly mobile and not concentrated. However, without more information on the likely number of sturgeon present in the overwintering areas in 1996 and 1998 and the numbers likely to occur at the berthing area in the August – December time frame, it is not possible to predict to what degree the effects will be different.

While dredging at Crown Landing will remove a greater volume of material and operate over a greater amount of time than the 1996 and 1998 dredging events, there are expected to be fewer shortnose sturgeon present in the area to be dredged and the sturgeon are expected to be more active and not in sedentary concentrations. Therefore, NMFS expects that the number of sturgeon directly affected by this dredging action will be no more than the number taken in 1996 or 1998. As such, during the proposed initial dredge cycle occurring, NMFS estimates that no more than 3 shortnose sturgeon are likely to be entrained in the dredge.

Maintenance Dredging

Maintenance dredging is expected to be required every year, with approximately 67-97,000 cy of material needing to be removed. These subsequent phases of dredging will also occur with a hydraulic pipeline dredge and occur during the August 1 – December 31 timeframe. The initial phase of dredging will destroy all sedentary benthic resources in the berthing area. Studies have suggested that it takes approximately one year for benthic communities to be re-established after dredging. As the area will be dredged every year and will also be subject to constant scouring from use by the LNG vessels, it is unlikely that a substantial benthic community will be re-established. As such, shortnose sturgeon are not likely to be feeding in the area to be dredged and any effects of the removal of any potential forage items during dredging operations will be insignificant. Shortnose sturgeon are known to seek out deeper waters during the summer months that serve as thermal refugia. The berthing area will be consistent with the depths sought by shortnose sturgeon; however, as there are other deep water resources in the immediate area it is more likely that shortnose sturgeon will choose refuge areas with less disturbance. Transient shortnose sturgeon are likely to be occasionally present in the berthing area as they move between foraging areas and the channel which is the preferred migration route.

Approximately 1/10 the volume of the initial dredging will be removed during subsequent maintenance dredging. As noted above, the initial dredging and use of the site by LNG vessels will alter the habitat characteristics of the berthing area. While the dredged berthing area will be more consistent with the preferred depths of shortnose sturgeon it is unlikely that shortnose sturgeon will forage in the berthing area as it is not likely that it will support a significant benthic community. As such, NMFS assumes that similar to the pre-dredging scenario, the area will only experience limited use by transient shortnose sturgeon. Therefore, NMFS believes the effects of the maintenance dredging are likely to be similar to the effects of the initial phase of dredging. It is NMFS understanding that a 10 year maintenance dredging permit will be issued by the ACOE for this project. During the ten year duration of the maintenance dredging permit, NMFS believes that no more than 3 shortnose sturgeon are likely to be entrained and killed in the dredge.

Alteration of foraging habitat

Dredging destroys all benthic resources in an area and as such, destroys and degrades the habitat in the area. Since dredging involves removing the bottom material down to a specified depth, the benthic environment will be impacted by dredging operations. As noted above, transient adults and juveniles are likely to spend the majority of their times in deeper water areas, particularly the channel. A limited amount of suitable forage (i.e., *Corbicula*) currently exists in the proposed berthing area, shortnose sturgeon may use the site for foraging and some level of foraging by transient shortnose sturgeon may occur at the site.

Dredging can cause indirect effects on shortnose sturgeon by reducing prey species through the alteration of the existing biotic assemblages. While some areas of the Delaware River may be more desirable to certain sturgeon due to prey availability, there is no information to indicate that the proposed berthing area has more abundant prey or better foraging habitat than other areas of the river. Due to the level of disturbance in the berthing area and the availability of forage in other nearby areas, the assumption can be made that shortnose sturgeon are not likely to be more attracted to the berthing area than to other foraging areas in the river and should be able to find sufficient prey in alternate areas. Recolonization by benthic organisms is expected to occur within approximately 12 months, when the berthing area will be dredged again, thus as noted above, the berthing area is unlikely to be established as a suitable foraging site. However, as extensive areas of suitable foraging habitat occur elsewhere in the Delaware River and the berthing area is not known to be a preferred foraging area, NMFS anticipates that the dredging activities are not likely to disrupt normal feeding behaviors for shortnose sturgeon and are not likely to remove critical amounts of prey resources from the river. In addition, the dredging activities are not likely to alter the habitat in any way that prevents sturgeon from using the area as a migratory pathway.

Interactions with the Sediment Plume

Dredging operations cause sediment to be suspended in the water column. This results in a sediment plume in the river, 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. Dredging with a pipeline dredge minimizes the amount of material re-suspended in the water column as the material is essentially vacuumed up and transported to the disposal site in a pipe. The DEIS presents results from the DREDGE model used to estimate the extent of any sediment plume associated with the proposed dredging. The model results indicated that the concentration of suspended sediments resulting from hydraulic dredging would be highest close to the bottom and would decrease rapidly downstream and higher in the water column. Based on a conservative (i.e., low) TSS background concentration of 5mg/L, the modeling results indicated that elevated TSS concentrations (i.e., above background levels) would be present at the bottom 2 meters of the water column for a distance of approximately 1,150 feet.

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). The studies reviewed by Burton demonstrated lethal effects to fish at concentrations of 580mg/L to 700,000mg/L depending on species. Sublethal effects have been observed at substantially lower turbidity levels. For example, prey consumption was significantly lower for striped bass larvae tested at concentrations of 200 and 500 mg/L compared to larvae exposed to 0 and 75 mg/L (Breitburg 1988 in Burton 1993). Studies with striped bass adults showed that pre-spawners did not avoid concentrations of 954 to 1,920 mg/L to reach spawning sites (Summerfelt and Moiser 1976 and Combs 1979 in Burton 1993). While there have been no directed studies on the effects of TSS on shortnose sturgeon, shortnose sturgeon juveniles and adults are often documented in turbid water and Dadswell (1984) reports that shortnose sturgeon are more active under lowered light conditions, such as those in turbid waters. As such, shortnose sturgeon are assumed to be as least as tolerant to suspended sediment as other estuarine fish such as striped bass.

The life stages of shortnose sturgeon most vulnerable to increased sediment are eggs and larvae which are subject to burial and suffocation. As noted above, no eggs and/or larvae will be present in the action area. Juvenile and adult shortnose sturgeon are frequently found in turbid water and would be capable of avoiding any sediment plume by swimming higher in the water column.

Laboratory studies (Niklitschek 2001 and Secor and Niklitschek 2001) have demonstrated shortnose sturgeon are able to actively avoid areas with unfavorable water quality conditions and that they will seek out more favorable conditions when available. While the increase in suspended sediments may cause shortnose sturgeon to alter their normal movements, any change in behavior is likely to be insignificant as it will only involve movement further up in the water column. Based on this information, any increase in suspended sediment is not likely to affect the movement of shortnose sturgeon between foraging areas and/or concentration areas during any phase of dredging or otherwise negatively affect shortnose sturgeon in the action area.

Release of Contaminated Sediments

Sediment cores taken from the project site and the surrounding Marcus Hook Channel and Berth area were analyzed for the presence of 126 EPA designated priority pollutants and 40 additional non-priority organic compounds. Results of this analysis indicate that the only contaminants present were the following eight metals: arsenic, cadmium, chromium, copper, lead, mercury, nickel, and zinc. The DREDGE model was used by the ACOE to estimate dissolved concentrations of various metal constituents in the water column suspended as a result of hydraulic dredging. This model was based on samples from the Marcus Hook area, not the project site specifically; however, as the sediment core results were comparable for the two areas, it is reasonable to assume that the impacts from dredging of either area would be comparable.

Based on the maximum metal concentrations observed in the Marcus Hook samples, only mercury and chromium concentrations were predicted to exceed EPA water quality criteria. Predicted mercury concentrations exceeded the chronic exposure criteria near the river bottom and up to 0.5m above the bottom for a distance of up to 1,148 feet downstream from the point of dredging. At 0.5m above the bottom, mercury concentrations exceeded chronic exposure levels fro a distance of 590 feet downstream. Mercury concentrations above 0.5m did not exceed water quality standards. Predicted chromium concentrations at the river bottom exceeded both acute and chronic exposure criteria up to 262 feet downstream of the point of dredging. Predicted chromium concentrations at 0.5m from the bottom and higher did not exceed water quality criteria.

Based on this analysis, shortnose sturgeon could potentially be exposed to high levels of mercury and cadmium if the fish swam through the sediment plume located near the bottom of the river. As shortnose sturgeon are benthic fish this is possible. However, any exposure to these increased levels of metals is likely to be temporary as shortnose sturgeon in this area are highly mobile. Additionally, as explained above, this area is not known to be a high use area for this species and shortnose sturgeon are unlikely to be using this area for foraging or resting. As such, any effects to shortnose sturgeon from the re-suspension of metals will be insignificant.

Impacts of pier/berthing area construction

The only in-water work associated with the construction of the pier and berthing area facilities will be pile driving. All other work will be done above the water line. For the construction of the berth, steel piles (100-120 feet long and 30-36” in diameter) will be driven. For the berth and mooring dolphins, 36” piles will be driven. All permits to be issued will prohibit pile driving from March 15 – August 1. The DEIS indicates that the piles will be installed with a Delmag D46-32 diesel impact hammer. Each pile will take approximately 5 hours to install with 25-30 minutes of actual driving time per pile. The entire pile driving operation is expected to take 6-8 months to complete.

Typically only one pile will be driven per day.

The driving of steel piles produces sound waves that may affect fish. The degree to which an individual fish exposed to sound waves would be affected is dependent upon several variables including the peak sound pressure level, the frequency of the sound and the size, species and condition of the fish. Generally, small fish are more prone to injury by intense sound waves than are larger fish. The best available information suggests that sound pressure levels greater than 190 decibels (dB) have the potential to physically injure fish (Hastings 2002). Sound pressure levels greater than 155dB often illicit avoidance behaviors and can stun small fish (NMFS 2003).

The DEIS provides information on the sound levels associated with driving tubular steel piles with an impact hammer in similar settings to the Crown Landing project. The information presented indicates that the use of an impact hammer during construction of the project could generate underwater sound levels of 190 dB (the maximum sound level expected) as far as 190 feet from a steel pile and sound levels of 155 dB as far as 1,860 feet from a steel pile.

While no studies have been conducted on the effects of pile driving on shortnose sturgeon, two studies have been conducted on the effects of blasting on this species. Both activities produce sound waves that would act similarly in the water column, making effects comparable. Moser (1999) studied the effects of rock blasting in Wilmington Harbor on caged hatchery reared shortnose sturgeon. In this study, blasts measured had a maximum sound level of 234dB. Fifty fish shortnose sturgeon were placed at locations 35’, 70’, 140’, 280’ and 560’ upstream and downstream from the blast. Additionally, a control group of 200 individuals were held 0.5 miles from the test blast area. A small number of sturgeon mortalities were recorded during this testing in the cages nearest to the blasts. This study indicated that among the species tested (which included mullet, cyprinodontids and striped bass), mortality rates were lowest for shortnose sturgeon. Injuries noted in fish caged closest to the blast included loss of equilibrium, distended swim bladder and hemorrhaging. Dead fish were generally negatively buoyant, indicating that they would not be noted in surface evaluations of fish mortality following a blast. A study done in the Cooper River, South Carolina, by Collins and Post (2001) tested the use of blasting caps to possibly repel shortnose sturgeon from a blasting site. Recorded sound levels were between 196-229 dB. Shortnose sturgeon located within 50 feet of the blast were temporarily stunned. No mortalities were reported. Both of these studies were conducted with sound wave levels higher than those expected to result from the driving of steel piles at the Crown Landing site.

Based on these studies, shortnose sturgeon are not likely to be killed due to exposure to sound waves in the range likely to result from the pile driving required for this project (i.e., less than 190dB). This conclusion is based on the studies noted above which only noted mortality at levels of 234dB. Shortnose sturgeon may be temporarily stunned if they were close enough to the piles being driven. However, as noted, shortnose sturgeon are most likely to occur in the deep channel sections of the river. As this area is greater than 190 feet from the piles, it is likely that few shortnose sturgeon will be exposed to the 190dB sound waves. A greater number of shortnose sturgeon may be exposed to sound levels of 155dB. Injury and mortality are not likely due to exposure to sound waves associated with the pile driving (Moser 1999, Collins and Post 2001) as sound waves will be lower than 234dB. Shortnose sturgeon exposed to the sound waves greater than 155dB may experience temporary stunning or otherwise be temporarily diverted from normal behaviors, such as foraging or migrating past the project site. No effects are likely as the sound waves dissipate to levels below 155dB.

It is difficult to predict the number of shortnose sturgeon that will likely be exposed to sound waves greater than 155dB. As noted above, sound waves above the no effect threshold (i.e., 155dB) are likely to be experienced as far as 1,860 feet from a steel pile. Unlike the dredging operations which will operate on a more continuous basis, the driving of piles is intermittent, with only one pile driven per day. Actual pile driving will only occur for 25-30 minutes per day. The installation of all of the piles will take 6-8 months. For effects to be likely, a shortnose sturgeon would need to be within 1,860 feet of the pile during the particular 25-30 minutes that the pile will be driven. NMFS believes that the likelihood of a shortnose sturgeon being affected by the pile driving is discountable for the following reasons: the small amount of time during each day when piles will be driven creates a small window of opportunity for effects to occur; as all pile driving will be prohibited from March 15 – August 1 and shortnose sturgeon are only likely to be present in the area through November the potential for interaction is further reduced (4 months as opposed to the 6-8 months pile driving will occur); and, sound levels will dissipate to below 155dB when they reach the deep water channel where the majority of shortnose sturgeon will occur.

Potential for impingement/entrainment during hydrostatic testing
As described above, Crown Landing will conduct hydrostatic testing for each of the three proposed LNG storage tanks, which will require approximately 25 million gallons of water withdrawn from the Delaware water for each tank (total approximately 75 million gallons of water). This water will be pumped from the River through a 2mm slot wedge-wire screened intake at intake screen approach velocities below 0.5 feet per second. As noted above, the youngest life stage of shortnose sturgeon likely to occur in the berthing area are juveniles. Juvenile shortnose sturgeon are known to be able to readily avoid velocities of 1.0 feet per second or lower and are much larger than 2mm (Kynard, pers. comm. 2005). As such, shortnose sturgeon are not likely to be vulnerable to impingement or entrainment during hydrostatic testing. Based on this information, the hydrostatic testing to be conducted by Crown Landing is not likely to affect shortnose sturgeon.

Potential for spills of LNG
If an accident occurred and LNG were released from its cargo tank, LNG would vaporize and as it is a cryogenic liquid, FERC has concluded that the greatest threat to aquatic life from an LNG spill would be short term thermal stress due to exposure to extreme cold temperatures. However, operational controls imposed by the Coast Guard and local pilots are specifically designed to prevent the collision scenarios that could result in an LNG cargo tank breach. In addition, the double hulled construction of the LNG ships further reduces the likelihood of a tank breach. The DEIS states that since 1959 when LNG began being transported by ships, over 33,000 voyages have occurred with only 8 accidents reported, none of which resulted in spill out of a ship. As such, FERC has determined that an LNG spill, and the resultant environmental impacts, is highly unlikely to occur. Therefore, impacts to listed species from an accidental LNG spill are unlikely.

Effect of ballast water withdrawal
As LNG is offloaded from the ships, seawater ballast will be taken on in order for the ships to maintain a constant draft at the berth. LNG ships typically have several ballast water intakes, each

with ballast pumps. As explained in the description of the action, typically two pumps operate during ballasting with the third pump on stand-by. Ballast water intake velocity has been estimated at approximately 1.0 foot per second (fps). Crown Landing will implement restrictions stating that LNG carriers are to withdraw the minimum amount of ballast water (approximately 8 million gallons) needed for carrier stability while at berth and limiting ballast water intake velocities to approximately one foot per second.

The ballast water intake openings are screened to prevent the intake of debris and aquatic life. The largest intake opening is approximately 1 inch. As noted above, juveniles are the youngest life stage of shortnose sturgeon likely to occur in the area of the Delaware River from which ballast water will be withdrawn. Juvenile shortnose sturgeon are capable of readily avoiding velocities of 1.0 fps and are larger than 1 inch. Therefore, shortnose sturgeon will not be vulnerable to impingement or entrainment at the ballast water intakes and the withdrawal of ballast water by LNG ships is not likely to affect shortnose sturgeon.

Interactions between listed species and LNG ships

The construction and operation of the Crown Landing facility will result in an increase in the number of LNG ships entering Delaware Bay and transiting the Delaware River shipping channels. As shortnose sturgeon are benthic animals and spend the majority of their time within the bottom meter of the water column, typically out of the range of ship hulls and propellers. Shortnose sturgeon are not known to be vulnerable to ship strikes. Based on this analysis, an interaction between an LNG vessel and a shortnose sturgeon is extremely unlikely to occur.

Sea turtles are likely to occur in lower Delaware Bay and the area of the Atlantic Ocean where LNG ships will be transiting on their way to and from the Crown Landing terminal. While sea turtles have been reported with injuries consistent with propeller wounds, these interactions are likely from with small, fast moving vessels, such as recreational boats. Based on the best available information, sea turtles are thought to be able to avoid large LNG vessels or to be pushed out of the impact zone by prop wash or bow wake and the likelihood of an interaction between a sea turtle and an LNG vessel is discountable.

Large whales, particularly Northern right whales, are vulnerable to injury and mortality from ship strikes. There have been no documented interactions between LNG tankers and whales; however, other large, deep draft vessels such as container ships and oil tankers are known to strike and kill whales. Jensen and Silber (2003) report eight documented ship strikes in the vicinity of the Delaware Bay entrance from 1975-2002. Since 2002, there have been five additional confirmed or suspected ship strikes reported in the vicinity of the Delaware Bay entrance (NMFS unpublished data). However, some of these reported locations represent where carcasses were found, and not necessarily where the whales were actually struck. Two of these documented ship strikes involved right whales; the remainder included fin, humpback, and one minke whale. It should be noted that these numbers represent a minimum number of whales struck by vessels, as many ship strikes go undetected or unreported, and many whale carcasses are never recovered. Although fin whales are the species most often reported struck, the low abundance of right whales suggests that right whales are struck proportionally more often than any other species of large whale (Jensen and Silber 2003).

To address the occurrence of ship strikes of endangered Northern right whales along the US east coast, NMFS is considering implementing measures to regulate speed in the approaches to major port entrances in the mid-Atlantic, including the approaches to Delaware Bay (69 FR 30857). However, the rulemaking process is still ongoing, and there are no regulations currently in place to restrict vessel activity in the vicinity of right whales. As such, Crown Landing agreed to implement an interim 12-knot speed restriction between November and April every year for all BP LNG vessels within a 30 nm radius of the Delaware Bay entrance, in accordance with the Advance Notice of Proposed Rulemaking (ANPR) for right whale ship strike reduction. Because right whales have been sighted year-round in the Delaware Bay region, Crown Landing also agreed to provide NMFS with email contact information to which recent right whale sighting information can be sent to alert LNG vessels entering the Crown Landing terminal to the presence of whales in the area. In addition, Crown Landing will provide the LNG vessel operators with outreach materials (produced by NMFS) so that they will be informed of appropriate precautionary measures to take when whales are seen or reported near the vessel's path. These measures will not preclude or replace any ship strike reduction regulations that are promulgated prior to receipt of shipments at the Crown Landing terminal (currently scheduled to begin in 2011). If regulations are put into effect, Crown Landing will be bound by them to the same extent as other carriers are required to comply.

Limited data are available on whale behavior in the vicinity of an approaching vessel and the hydrodynamics of whale/vessel interactions. However, the measures proposed by Crown Landing above are in accordance with measures outlined in NMFS Ship Strike Reduction Strategy as the best available means of reducing ship strikes of right whales. Most ship strikes have occurred at vessel speeds of 13-15 knots or greater (Jensen and Silber 2003; Laist et al. 2001). Peak abundance of right whales in the Delaware Bay region is generally from November through April of every year, and the majority of sightings in the area (90%) have been within 30 nm of the coast (Merrick memo to Silber). Although these measures have been developed specifically with right whales in mind, the speed reduction is likely to provide protection for fin and humpback whales as well, as these species are generally faster swimmers and are more likely to be able to avoid oncoming vessels. As such, based on the implementation of the proposed ship strike reduction measures and the limited number of ship strikes that have been documented in the Delaware Bay region (13 in 30 years), the likelihood of an LNG tanker associated with the Crown Landing terminal colliding with a whale is likely to be insignificant.

CUMULATIVE EFFECTS

Cumulative effects are defined in 50 CFR §402.02 as 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.

Several features of the shortnose sturgeon's natural history, including delayed maturation, non-annual spawning (Dadswell et al. 1984; Boreman 1997), and long life-span, affect the rate at which recovery can proceed. The effects of future state and private activities in the action area that are reasonably certain to occur during the dredging operations are recreational and commercial fisheries, pollutants, and development and/or construction activities resulting in excessive water turbidity and habitat degradation.

Impacts to shortnose sturgeon from non-federal activities are largely unknown in this river. It is possible that occasional recreational and commercial fishing for anadromous fish species may result in incidental takes of shortnose sturgeon. However, positive identification and distinction between Atlantic sturgeon and shortnose sturgeon are difficult and therefore, historically, takes have not been quantified. Pollution from point and non-point sources has been a major problem in this river system, which continues to receive discharges from sewer treatment facilities and paper production facilities (metals, dioxin, dissolved solids, phenols, and hydrocarbons). Contaminants introduced into the water column or through the food chain, eventually become associated with the benthos where bottom dwelling species like shortnose sturgeon are particularly vulnerable.

Natural mortality of sea turtles and whales, including disease (parasites) and predation, occurs in the action area. 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, and for sea turtles, dredging operations.

Dredging

The Delaware River is an essential waterway that links the city of Philadelphia with ports all over the world. In 2003, over 3000 ships traveled in and out of Philadelphia, making it one of the busiest ports in the US Atlantic (website of The Port of Philadelphia and Camden). With a 1997 estimated population growth rate of 0.89%, increasing demands of global markets, and a deeper channel resulting from the Delaware River Deepening Project, it is predicted that the number and size of ships traveling in and out of Philadelphia will continue to grow (website of City of Philadelphia). As a result, it is evident that continued dredging of the Delaware River will be necessary to maintain channel depths for the movement of a greater number and larger ships to and from Philadelphia.

Continued dredging of the Delaware River would mean further removal of bottom material, which would have significant impacts on the benthic environment. Shortnose sturgeon are benthic omnivores, thus, benthic disruption directly impacts their foraging and/or distribution. In addition to habitat disruption, shortnose sturgeon are particularly susceptible to entrainment, especially in hopper dredges. Entrainment occurs when the faster moving draghead overtakes the slower moving sturgeon. Usually upon entrainment, shortnose sturgeon are then sucked into the draghead, pumped through the intake pipe and ultimately killed as they travel through the centrifugal pump and into the hopper. Hydraulic pipeline dredges may also cause sturgeon mortality or injury. If dredging of the Delaware River continues in the future, takes of shortnose sturgeon may occur and their foraging and/or distribution may be affected. As noted in the environmental baseline, sea turtles have also been affected by dredging in Delaware Bay and future dredging activities in Delaware Bay have the potential to continue to affect sea turtles.

Scientific Studies

It is likely that additional scientific studies will be conducted on shortnose sturgeon in the action area. Continued capturing, handling, tagging, and tracking of shortnose sturgeon may affect their migration, reproduction, foraging, and survival.

Contaminants and Water Quality

Contaminants associated with the action area are directly linked to industrial development along the waterfront. PCB’s, heavy metals, and waste associated with point source discharges and refineries are likely to be present in the future due to continued operation of industrial facilities. In addition many contaminants such as PCB's remain present in the environment for prolonged periods of time and thus would not disappear even if contaminant input were to decrease. It is likely that shortnose sturgeon will continue to be affected by contaminants in the action area in the future.

Industrialized waterfront development will continue to impact the water quality in and around the action area. Refineries, sewage treatment facilities, manufacturing plants, and generating facilities present in the action area are likely to continue to operate. Excessive water turbidity, water temperature variations and increased shipping traffic are likely with continued future operation of these facilities. As a result, shortnose sturgeon foraging and/or distribution in the action area may be adversely affected.

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 ecosystem of the action area are expected to continue in the future.

Fisheries

Incidental take of shortnose sturgeon is likely with the continued operation of hook and line and commercial fisheries in the Delaware River. There have been no documented takes in the action area, however, there is always the potential for this to occur when fisheries are known to operate in the presence of shortnose sturgeon. Thus, the operation of these hook and line fisheries and commercial fisheries could result in future shortnose sturgeon mortality and/or injury.

Impacts to shortnose sturgeon from non-federal activities are unknown in this river. It is possible that occasional recreational and commercial fishing for anadromous fish species may result in incidental takes of shortnose sturgeon. However, positive identification and distinction between Atlantic sturgeon and shortnose sturgeon are difficult and therefore, historically, takes have not been quantified. Pollution from point and non-point sources has been a major problem in this river system, which continues to receive discharges from sewer treatment facilities and industrial facilities. Contaminants introduced into the water column or through the food chain, eventually become associated with the benthos where bottom dwelling species like shortnose sturgeon are particularly vulnerable.

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

As noted in the Environmental Baseline section, private 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.

As noted above, impacts to listed species from all of these activities are largely unknown. However, NMFS has no information to suggest that the effects of future activities in the action area will be any different from effects of activities that have occurred in the past.

INTEGRATION AND SYNTHESIS OF EFFECTS

Shortnose sturgeon

Shortnose sturgeon are endangered throughout their entire range. This species exists as nineteen separate populations that show no evidence of interbreeding. The shortnose sturgeon residing in the Delaware River form one of these nineteen populations.

NMFS has estimated that the proposed action, the issuance of an Order by FERC to Crown Landing LLC for the siting, construction and operation of a LNG terminal on the banks of the Delaware River and the issuance of a permit by the ACOE for associated dredging and construction, will result in the mortality of up to 3 shortnose sturgeon during the initial dredging needed to create the berthing area and the death of up to an additional 3 shortnose sturgeon over the first ten years of maintenance dredging permitted by the ACOE. As explained in the “Effects of the Action” section, only transient shortnose sturgeon are likely to occur in the project area and all other effects on shortnose sturgeon and their habitat are likely to be insignificant or discountable. Furthermore, the project is not likely to alter the Delaware River in a way that would make the action area unsuitable for use as a migratory pathway for any life stage of shortnose sturgeon.

NMFS believes that the authorization of the proposed action would not reduce the reproduction or distribution of shortnose sturgeon in the Delaware River. This action is not likely to reduce reproduction because it is not likely to affect spawning activity and the action will not affect suitable spawning habitat or prevent shortnose sturgeon from attempting or completing spawning. It is not likely to reduce distribution because the action will not impede shortnose sturgeon from accessing foraging, overwintering or spawning grounds in the Delaware River. Nor is it expected that the action would reduce the river by river distribution of shortnose sturgeon. While the dredging is likely to kill up to 6 shortnose sturgeon over a ten year period, this number represents a very small percentage of the shortnose sturgeon population in the Delaware River, which is believed to be increasing, and an even smaller percentage of the total population of shortnose sturgeon rangewide. The best available population estimates indicate that there are between 6,000 - 14,000 adult shortnose sturgeon in the Delaware River and an unknown number of juveniles. While the loss of six juvenile or adult will have a small effect on the number of shortnose sturgeon in the Delaware River over the 10 year period, it is not likely that this effect will be detectable at a population level; therefore, the loss of 6 shortnose sturgeon will not have a detectable effect on the species as a whole.

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, in general 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 shortnose sturgeon in the Delaware because: the species is widely geographically distributed, it is not known to have low levels of genetic diversity, and in the case of the Delaware River population, there are thousands of spawning adults.

For these reasons, NMFS believes that there is not likely to be any reduction in reproduction and distribution and only a small and likely undetectable decrease in the numbers of shortnose sturgeon in the Delaware River population. As such, there is not likely to be an appreciable reduction in the likelihood of survival and recovery in the wild of the Delaware River population or the species as a whole.

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

As noted in sections above, interactions with sea turtles, while possible, are unlikely to occur during the transit of LNG vessels to and from the Crown Landing facility. Additionally, no sea turtles are likely to occur at the project site where construction and dredging will occur. As such, this action is not likely to adversely affect listed sea turtles in the action area.

Sperm, right, humpback and fin whales

As noted in sections above, interactions with whales, while possible, are unlikely to occur during the transit of LNG vessels to and from the Crown Landing facility. The applicant has proposed several mitigation measures that will reduce the likelihood of interactions between whales and LNG vessels. All of these measures have been incorporated into the project design. Additionally, no whales are likely to occur at the project site where construction and dredging will occur. As such, this action is not likely to adversely affect listed whales in the action area.

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 shortnose sturgeon and is not likely to adversely affect loggerhead, Kemp's ridley, green or leatherback sea turtles or right, humpback, sperm or fin whales. Because no critical habitat is designated in the action area, none will be affected by the proposed action.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA 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. NMFS interprets the term "harm" as an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering (50 CFR §222.102). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

Amount or Extent of Incidental Take

The proposed dredging project has the potential to directly affect shortnose sturgeon by causing sturgeon to become entrained in the dredge. These interactions are likely to cause mortality to the affected shortnose sturgeon. Based on the known seasonal distribution of shortnose sturgeon in the Delaware River and information available on historic interactions between shortnose sturgeon and dredging operations, NMFS anticipates that no more than 6 shortnose sturgeon are likely to be directly affected by this action. As outlined in the "Effects of the Action" section of the accompanying Opinion, the initial dredging is likely to result in the take of up to 3 shortnose sturgeon, and maintenance dredging proposed to occur annually is likely to result in the take of no more than 3 shortnose sturgeon over the ten year life of the permit.

NMFS believes this level of incidental take is reasonable given the seasonal distribution and abundance of adult shortnose sturgeon in the action area, the level of take historically in the Delaware River, and the level of take of shortnose sturgeon at other dredging projects. In the accompanying biological opinion, NMFS determined that this level of anticipated take is not likely to result in jeopardy to the species.

Reasonable and prudent measures

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize and monitor impacts of incidental take of the Delaware River population of shortnose sturgeon:

1. NMFS must be contacted before dredging commences and again upon completion of the dredging activity. This applies to the initial phase of dredging and all subsequent maintenance dredging activities.
2. A NMFS-approved observer must be present at the disposal site for the duration of the project. This applies to the initial phase of dredging and all subsequent maintenance dredging activities.

3. All interactions with shortnose sturgeon must be promptly reported to NMFS.

Terms and conditions
In order to be exempt from prohibitions of section 9 of the ESA, FERC and Crown Landing 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, the ACOE must require Crown Landing must contact NMFS (Julie Crocker: by email (julie.crocker@noaa.gov) or phone (978) 281- 9300 ext.6530) within 24-hours of the commencement of dredging and again within 24-hours of the completion of dredging activity.

2. To implement RPM #2, the ACOE must require that observer coverage is sufficient for 100% monitoring of disposal operations. All biological material disposed of at the disposal site must be documented by a NMFS-approved observer as outlined in Appendix B.

3. To implement RPM #2, the ACOE shall ensure that the disposal site is equipped and operated in a manner that provides the NMFS-approved endangered species observer with a reasonable opportunity for detecting interactions with listed species and that provides for handling and collection of shortnose sturgeon during project activity.

4. To implement RPM #3, the ACOE must require that the disposal site must be inspected daily by a NMFS-approved observer to look for evidence of entrained shortnose sturgeon.

5. To implement RPM #3, the ACOE must require Crown Landing to contact NMFS within 24 hours of any interactions with shortnose sturgeon, including non-lethal and lethal takes (Julie Crocker: by email (julie.crocker@noaa.gov) or phone (978) 281- 9328 ext.6530 or the Endangered Species Coordinator by phone (978)281-9208 or fax 978-281-9394).

6. To implement RPM #3, the ACOE must require Crown Landing to photograph and measure any shortnose sturgeon observed during project operations (including whole sturgeon or body parts observed at the disposal location) and the corresponding form (Appendix C) must be completed and submitted to NMFS **within 24 hours** by fax (978-281-9394).

7. To implement RPM #3, the ACOE must require Crown Landing that in the event of any lethal takes, 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 C must be completed and submitted to NMFS as noted above.

8. To implement RPM #3, the ACOE must require Crown Landing to submit a final report summarizing the results of dredging and any takes of listed species to NMFS within 30 working days of project completion by mail (to the attention of the Endangered Species Coordinator, NMFS Protected Resources Division, One Blackburn Drive, Gloucester, MA 01930). This report must be submitted at the close of initial dredging operations as well as each time maintenance dredging is required.

9. To implement RPM #3, the ACOE must require of Crown Landing that if any lethal take occurs, the NMFS-approved observer must take fin clips (according to the procedure outlined in Appendix D) to be returned to NMFS for ongoing analysis of the genetic composition of the Delaware River shortnose sturgeon population.

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. If, during the course of the action, the level of incidental take is exceeded, reinitiation of consultation and review of the reasonable and prudent measures are required. ACOE must immediately provide an explanation of the causes of the taking and review with NMFS the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. NMFS has determined that the proposed action is not likely to jeopardize the continued existence of endangered shortnose sturgeon located in the action area. To further reduce the adverse effects of the dredging on listed species, NMFS recommends that FERC and ACOE implement the following conservation recommendations.

(1) Population information on certain life stages of shortnose sturgeon is still sparse for this river system. FERC and the ACOE should continue to support studies to evaluate habitat and the use of the river, in general, by juveniles as well as use of the area below Philadelphia by all life stages.

(2) If any lethal take occurs, FERC and the ACOE should require or encourage Crown Landing to arrange for contaminant analysis of the specimen. If this recommendation is to be implemented, the fish should be immediately frozen and NMFS should be contacted within 24 hours to provide instructions on shipping and preparation

REINITIATION OF CONSULTATION

This concludes formal consultation on the issuance of an Order by FERC to Crown Landing LLC for the siting, construction and operation of a LNG terminal on the Delaware River and the issuance of permits by the ACOE for associated dredging and construction. 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 taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may not have been previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species; or (4) a new species is listed or critical habitat designated that may be affected by the identified action. In instances where the amount or extent of incidental take is exceeded, Section 7 consultation must be reinitiated immediately.

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