UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
http://sero.nmfs.noaa.gov

F/SER31: DMB
SER-2017-18675

NOV 21 2017

Eric Reusch
Chief, Wilmington Regulatory Field Office
Wilmington District Corps of Engineers
Department of the Army
69 Darlington Avenue
Wilmington, North Carolina 28403

Holly Pelt
Environmental and Historic Preservation Advisor, DR-4285-NC
Federal Emergency Management Agency, Region IV
Department of Homeland Security
3003 Chamblee-Tucker Road
Atlanta, Georgia 30341

Ref.: SAW-2017-00781, The Town of Oak Island, Yaupon Fishing Pier, Oak Island, Brunswick County, North Carolina

Dear Mr. Reusch and Ms. Pelt:

The enclosed Biological Opinion ("Opinion") was prepared by the National Marine Fisheries Service (NMFS) pursuant to Section 7(a)(2) of the Endangered Species Act (ESA). The Opinion considers the effects of a proposal by the Wilmington District of the U.S. Army Corps of Engineers (USACE) to authorize, and U.S. Department of Homeland Security Federal Emergency Management Agency (FEMA) to fund, the restoration and extension of a public fishing pier. We base this Opinion on project-specific information provided in the consultation package as well as NMFS's review of published literature. This Opinion analyzes the potential for the project to affect the following species: green sea turtle (North Atlantic and South Atlantic distinct population segments [DPSs]), Kemp's ridley sea turtle, loggerhead sea turtle (Northwest Atlantic DPS), leatherback sea turtle, hawksbill sea turtle, Atlantic sturgeon (Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs), shortnose sturgeon, and North Atlantic right whale. This Opinion also analyzes the potential for the project to have an effect on the following designated critical habitat: loggerhead sea turtle (Northwest Atlantic DPS) nearshore reproductive habitat (Unit N-05) and North Atlantic right whale (Unit 2).

We look forward to further cooperation with you on other USACE and FEMA projects to ensure the conservation and recovery of our threatened and endangered marine species. If you have any questions regarding this consultation, please contact Dana Bethea, Consultation Biologist, by phone at 727-209-5974, or by email at Dana.Bethea@noaa.gov.

Sincerely,

Roy E. Crabtree, Ph.D.
Regional Administrator

Enclosure

File: 1514-22.F.1

Endangered Species Act - Section 7 Consultation
Biological Opinion

Lead Action Agency: U.S. Army Corps of Engineers (USACE), Wilmington District

Co-Action Agency: U.S. Department of Homeland Security Federal Emergency Management Agency (FEMA), Region IV

Applicant: The Town of Oak Island

Activity: Yaupon Fishing Pier, Oak Island, Brunswick County, North Carolina

Consulting Agency: National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), Southeast Regional Office, Protected Resources Division, St. Petersburg, Florida

Consultation Number SER-2017-18675

Approved by: Nov. 21, 2017

Roy E. Crabtree, Ph.D., Regional Administrator
NMFS, Southeast Regional Office
St. Petersburg, Florida

CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

BMP	Best Management Practices
CFR	Code of Federal Regulations
CPUE	Catch per unit effort
cSEL	Cumulative Sound Exposure
DPS	Distinct Population Segment
DWH	*Deepwater Horizon*
DTRU	Dry Tortugas Recovery Unit
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FP	Fibropapillomatosis disease
FWRI	Fish and Wildlife Research Institute
GADNR	Georgia Department of Natural Resources
GCRU	Greater Caribbean Recovery Unit
ITS	Incidental Take Statement
NCDENR	North Carolina Department of Environmental and Natural Resources
NCWRC	North Carolina Wildlife Resources Commission
NGMRU	Northern Gulf of Mexico Recovery Unit
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Association
NPS	National Park Service
NRU	Northern Recovery Unit
NWA	Northwest Atlantic
PRM	Post-release mortality
RPMs	Reasonable and Prudent Measures
SCDNR	South Carolina Department of Natural Resources
SCL	Straight carapace length

SEFSC	Southeast Fisheries Science Center
STSSN	Sea Turtle and Stranding Network
TED	Turtle Exclusion Device
TEWG	Turtle Expert Working Group
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
YOY	Young-of-the-year

UNITS OF MEASURE

°C	Degrees Celsius
cm	Centimeter(s)
°F	Degrees Fahrenheit
ft	Feet
ft^2	Square feet
in	Inch(es)
kg	Kilograms
lb	Pound(s)
mi	Mile(s)
mi^2	Square miles

1. BACKGROUND

Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. §1531 et seq.), requires that each federal agency ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of those species. When the action of a federal agency may affect a protected species or its critical habitat, that agency is required to consult with either the National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (USFWS), depending upon the protected species that may be affected.

Consultations on most listed marine species and their designated critical habitat are conducted between the action agency and NMFS. Consultations are concluded after NMFS determines the action is not likely to adversely affect listed species or critical habitats, or issues a Biological Opinion ("Opinion") that determines whether a proposed action is likely to jeopardize the continued existence of a federally listed species, or destroy or adversely modify federally designated critical habitat. The Opinion also states the amount or extent of listed species incidental take that may occur and develops nondiscretionary measures that the action agency must take to reduce the effects of said anticipated/authorized take. The Opinion may also recommend discretionary conservation measures. No incidental destruction or adverse modification of critical habitat may be authorized. The issuance of an Opinion detailing NMFS's findings concludes ESA Section 7 consultation.

Based on our review associated with United States Army Corp of Engineers (USACE) Wilmington District's proposal to rebuild and enhance Yaupon Fishing Pier in Brunswick County, North Carolina (SAW-2017-00781), this Opinion analyzes the potential for the project to affect the following species: green sea turtle (North Atlantic and South Atlantic distinct population segments [DPSs]), Kemp's ridley sea turtle, loggerhead sea turtle (Northwest Atlantic DPS), leatherback sea turtle, hawksbill sea turtle, Atlantic sturgeon (Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs), shortnose sturgeon, and North Atlantic right whale the following designated critical habitat: loggerhead sea turtle (Northwest Atlantic DPS) nearshore reproductive habitat (Unit N-05) and North Atlantic right whale (Unit 2). Our determinations are based on information provided by USACE, National Oceanic and Atmospheric Association (NOAA) National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center (SEFSC) Sea Turtle and Stranding Network (STSSN), North Carolina Sea Turtle Project (http://www.seaturtle.org/groups/ncwrc/), and the published literature cited herein.

2. CONSULTATION HISTORY

The following is a documentation of the consultation history for this Opinion (SER-2017-18384 Yaupon Fishing Pier):

- NMFS received a request for an informal consultation through the Expedited Track (formerly National LOC Pilot Program) from the USACE Wilmington District on May 30, 2017.
- NMFS requested additional information from USACE via e-mail on May 31, 2017.

- Due to the potential for incidental sea turtle and sturgeon take, NMFS determined the project was not eligible for Expedited Track and would proceed as a formal consultation. We informed USACE of the change in consultation type on June 5, 2017.
- NMFS requested sea turtle nesting, stranding, and reported recreational hook-and-line capture data for Brunswick County and Oak Island, North Carolina, from the Sea Turtle and Stranding Network (STSSN) in North Carolina on June 5, 2017.
- NMFS was informed the U.S. Department of Homeland Security Federal Emergency Management Agency (FEMA) was funding the project and would be the co-action agency on June 6, 2017.
- NMFS received the requested sea turtle data from the STSSN in North Carolina on June 20, 2017.
- NMFS requested additional information from the STSSN in North Carolina on July 28, 2017, and received a final response on August 8, 2017.
- NMFS requested additional project information from USACE on June 6, June 22, August 2, and August 7, 2017. We received a final response from USACE on August 9, 2017, and initiated formal consultation that day.
- At the request of USACE, NMFS issued a draft Opinion for USACE and FEMA review on November 8, 2017.

3. DESCRIPTION OF THE PROPOSED ACTION

3.1 Proposed Action

Originally built in 1955, the Yaupon Fishing Pier was rebuilt twice, once in 1972 and again in 1992. Although it withstood Hurricane Floyd in 1999 and Hurricane Irene in 2011, 150 feet (ft) of the pier collapsed during Hurricane Matthew in October 2016 (Figure 1, red box). The pier has been closed since that time. The Town of Oak Island is proposing to restore and expand the Yaupon Fishing Pier. A total of 115,000 recreational fishers per year are expected to use the pier upon project completion.

The pier will be widened and restored, starting at the most landward section (i.e., the parking lot) and ending at terminal. To increase and improve handrail safety, the applicant proposes to widen the pier from 16 ft to 18 ft. Widening the pier to 18’ will keep the walking width the same, while allowing a more secure handrail attachment method and required spacing for ADA compliant handrails. The T-head platform at the middle of the pier and the T-head at the terminal end of the pier will remain consistent with the dimensions of the previously permitted pier (48-ft-long by 19-ft-wide and 48-ft-long by 29-ft-wide, respectively). The pier will be the same length as the previously permitted pier as it existed prior to being damaged by Hurricane Matthew (i.e., 914 ft).

Restoration and widening will require the installation of 98 wood piles waterward of mean low water (MLW). The piles will have a diameter of 16 inches (in) at the base. A top-down construction approach will be used to minimize impacts to species and habitat, keeping machinery out of the water and off the surface of the ocean. To reduce noise impacts, piles will be installed via vibratory hammer from a crane located on the deck of the pier, a maximum of 4 piles will be driven per day, and approximately half of the piles will be driven at low tide above the MLW line. Turbidity curtains are not proposed for use during pile installation.

Figure 1. Image showing the Yaupon Fishing Pier at Oak Island, North Carolina, the portion of the pier destroyed by Hurricane Matthew (red box) and the area in yellow extending 300 ft (100 yd) around the pier to be monitored for sea turtles (Image supplied by USACE Wilmington)

The construction timeline will be based on whether or not there are sea turtle nests within 0.25 mi of the pier. The applicant proposes the following schedule, which depends on the issuance of this Opinion:

- September 5-15 – Mobilization. Construction will mostly be on the parking lot side of the pier; however, crane mats will be installed on the beach to the west of the pier. It is possible that a crane will be staged on the mats by the end of this time period.
- September 15 to October 6 – Pier ramp demolition. Demolition will start from the parking lot side of the pier and extend 25 pier bents over the beach. The over-beach work should begin on or around September 25.
- October 7-18 – Approach ramp and pile installation to bent 25. Construction will begin from the parking lot side of the pier and proceed toward the ocean. Pile installation will occur when the water is at or near low tide.
- October 11-31 – Pier framing. Construction will be overhead work. Lumber will be stocked on the parking lot side of the pier. Large lumber will be held in place overhead with a crane for attachment to the piles.
- November 1 – Begin overwater work. The goal is to have at least 3 sections of pier complete by this date in order to lift a crane into place to begin top down construction over the water.
- April 30 – Project completion.

The applicant proposes the following best management practices (BMPs) during construction:

- Use of the existing parking lot for delivery and storage of the majority of construction material and equipment, which will minimize construction area on the beach and over the water.
- Except for the use of turbidity curtains, the applicant will follow the NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*, dated March 23, 2006,[1] which requires construction to cease immediately if a sea turtle is seen within a 50-ft radius of the equipment. Activities will not resume until the sea turtle species has departed the project area of its own volition.
- The applicant will perform early morning (i.e., sunrise to 9 am) monitoring for sea turtle nesting evidence before any construction occurring prior to November 15 using local sea turtle volunteer groups. The applicant will report any evidence of sea turtle nesting to the Oak Island Sea Turtle Protection Program (OISTPP) who is part of the STSSN in North Carolina, and, if a sea turtle nest is found within 0.25 mi of the pier, work will not begin until the proper mitigation measures have been put in place. Prior to construction resuming, the turtle nest will be properly marked and fenced off. Based on the nest location, OISTPP will make a determination of whether construction can safely resume or if restrictions and/or alterations to the construction activities need to be made. If the OISTPP is unsure of the safety of future construction, they will refer the matter to USFWS for a decision. Once the mitigating measure have been finalized, the engineer and contractor will meet with either

[1] NMFS. 2006. Sea Turtle and Smalltooth Sawfish Construction Conditions revised March 23, 2006. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, Protected Resources Division, Saint Petersburg, Florida. http://sero.nmfs.noaa.gov/protected_resources/section_7/guidance_docs/documents/sea_turtle_and_smalltooth_sawfish_construction_conditions_3-23-06.pdf, accessed June 2, 2017.

OISTPP or USFWS (as appropriate) to discuss the new construction procedures. The engineer will monitor for compliance or hire a third party consultant to monitor compliance.
- The water will be scanned for whales for twenty minutes prior to pile driving and during all pile driving activities. If a whale is observed within 500 yards (yd) of the pier before or during construction, pile driving will not begin or will discontinue until the whale species has departed the project area of its own volition.

The applicant proposes the following BMPs post-construction:

- Upon completion, the on-site bait shop will act as the pier attendant. The bait shop employees will be able to assist with sea turtle recreational hook-and-line captures using large dip-nets and de-hooking equipment kept onsite.
- The applicant will coordinate an agreement with the Karen Beasley Sea Turtle Rescue and Rehabilitation Center in Surf City, North Carolina, to assist as needed with the rehabilitation of recreational hook-and-line sea turtle captures. The Karen Beasley Sea Turtle Rescue and Rehabilitation Center is an ESA-permitted sea turtle rehabilitation center within the STSSN.
- Fishing cleaning stations will be clearly marked and have nearby trash receptacles with lids. The applicant will post signage that will ask anglers not to dispose of fish carcasses or debris in the water.
- Monofilament receptacles will be placed along the pier in order to prevent fishing lines from being disposed of in the ocean or on the beaches. Receptacles will be clearly marked and will be emptied regularly to ensure they do not overfill and that fishing lines are disposed of properly.
- Educational signage for hooked sea turtles already in place on the Yaupon Fishing Pier will remain. The applicant will also post updated signage to provide current information to the public on how to handle potential encounters with other protected resources and ESA-listed species. The applicant will post signs at the bait shop, at the T-head platform in the middle of the pier, and at the T-head at the terminal end of the pier. The applicant will post the "Save the Sea Turtle, Sawfish, and Dolphins," "Help Protect North Atlantic Right Whales," and "Report Sturgeon" signs, which are available for download at: http://sero.nmfs.noaa.gov/protected_resources/section_7/protected_species_educational_signs/index.html.
- The applicant will conduct in-water and out-of-water pier cleanup on an annual basis.
- The applicant will use sea turtle friendly pier lighting (i.e., long wavelength amber, orange, or red LED lighting, mounting such lights as low to the ground as possible, and adding shielding structures).

3.2 Action Area

The action area is defined by regulation as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action" (50 Code of Federal Regulations (CFR) 402.02). As such, the action area includes the areas in which construction will take place, as well as the immediately surrounding areas that may be affected by direct effects (e.g., noise, sedimentation) and indirect effects (e.g., recreational hook-and-line interactions) of the proposed action.

The Yaupon Fishing Pier is located on the Atlantic Ocean at 705 Ocean Drive in Oak Island, Brunswick County, North Carolina (33.902586°N, 78.082408°W, World Geodetic System 1984) approximately 4.5 miles west of the estuary of the Cape Fear River. The action area for this project includes the existing pier footprint, the proposed reconstructed pier footprint, the beach, and the surrounding waters that may be affected by the proposed action.

Based on our analysis of the project's noise effects below, we consider the action area to extend 1.3 miles (mi) (2,154.4 meters [m]) into the Atlantic Ocean surrounding the pier as this is the outer most anticipated extent of the area where behavioral noise impacts to the North Atlantic right whale may be felt (discussed in Section 4.1). Given this, the boundary of the action overlaps with the 6 m contour line that defines the inshore boundary of North Atlantic right whale designated critical habitat (Unit 2) (Figure 2).

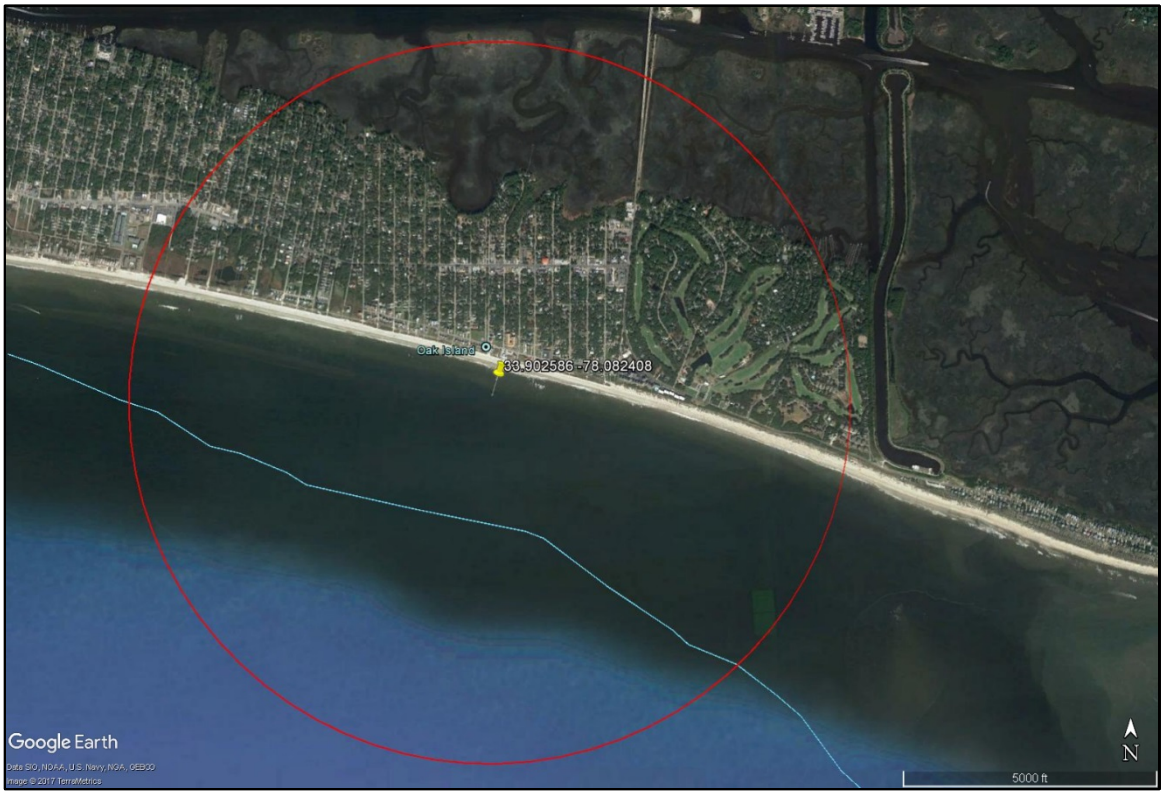

Figure 2. Image showing the Yaupon Fishing Pier at Oak Island, North Carolina (yellow pin), the anticipated extent of behavioral noise impacts to the North Atlantic right whale (red circle; i.e. the action area), and the 6 m contour line that defines North Atlantic right whale critical habitat (blue line) (2017 ©Google Earth)

Habitat within the action area is characterized as shallow open water and intertidal regions of the Atlantic Ocean and is comprised of sandy substrate. Depth at the end of proposed reconstructed pier is 15 ft (4.5 m) MLW. Submerged aquatic vegetation, hard bottom, mangroves, and corals are not present within the action area. Oak Island is a known nesting beach for green sea turtle (NA DPS) and loggerhead sea turtle (NWA DPS).

4. STATUS OF THE SPECIES AND CRITICAL HABITAT

Table 1 provides the effect determinations for ESA-listed species the USACE and NMFS believe may be affected by the proposed action.

Table 1. Effects Determinations for Species the Action Agency or NMFS Believes May Be Affected by the Proposed Action

Species	ESA Listing Status	Action Agency Effect Determination	NMFS Effect Determination
Sea Turtles			
Green (North Atlantic [NA] distinct population segment [DPS])	T	NLAA	LAA
Green (South Atlantic [SA] DPS)	T	NLAA	LAA
Kemp's ridley	E	NLAA	LAA
Leatherback	E	NLAA	NE
Loggerhead (Northwest Atlantic Ocean [NWA] DPS)	T	NLAA	LAA
Hawksbill	E	NLAA	NE
Fish			
Shortnose sturgeon	E	NLAA	NE
Atlantic sturgeon (Gulf of Maine DPS)	T	NLAA	LAA
Atlantic sturgeon (New York Bight DPS)	E	NLAA	LAA
Atlantic sturgeon (Chesapeake Bay DPS)	E	NLAA	LAA
Atlantic sturgeon (Carolina DPS)	E	NLAA	LAA
Atlantic sturgeon (SA DPS)	E	NLAA	LAA
Marine Mammals			
North Atlantic right whale	E	NLAA	NLAA
E = endangered; T = threatened; NLAA = may affect, not likely to adversely affect; LAA = likely to adversely affect; NE = no effect			

To determine which sea turtle species were most likely to occur within the action area, we reviewed nesting, stranding, and recreational hook-and-line data from seaturtle.org, a 501(c)3 tax-exempt research and conservation organization incorporated in the state of North Carolina (data provided directly to consulting biologist from M. Godfrey, Sea Turtle Program Coordinator, North Carolina Wildlife Resources Commission, on June 19 and 20, 2017) (Table 3). Based on this data, we believe green sea turtle (NA DPS), Kemp's ridley sea turtle, and loggerhead sea turtle (NWA DPS) occur within the action area. Further, until we have a genetic analysis with a larger sample size across more of the Atlantic Ocean by our SWFSC genetics lab, we assume that the individuals from the SA DPS of green sea turtle could also be in the action area.

We believe the project will have no effect on hawksbill sea turtle and leatherback sea turtle due to these species' very specific life history strategies, which are not supported at the project site.

Hawksbill sea turtles typically inhabit inshore reef and hard bottom areas where they forage primarily on encrusting sponges, and leatherback sea turtles have pelagic, deepwater life history, where they forage primarily on jellyfish. The absence of hawksbill sea turtle and leatherback sea turtle in the 3 datasets further supports our determination that the proposed action will have no effect on these species.

Table 2. Summary of Data for Sea Turtle Nesting (1989-2016), Stranding (1998-2016), and Reported Recreational Hook-and-Line Captures (1997-2016) in or near Oak Island, NC

Species	Nest Counts at Oak Island, NC	Stranding Data for Oak Island, NC	Reported Recreational Hook-and-Line Captures in Brunswick County, NC
Green sea turtle (NA DPS)	6	6	1
Kemp's ridley sea turtle	1	36	36
Leatherback sea turtle	0	0	0
Loggerhead sea turtle (NWA DPS)	1,585	11	11
Hawksbill sea turtle	0	0	0

We believe the project will have no effect on shortnose sturgeon due to its location on the Atlantic Ocean. Shortnose sturgeon inhabit rivers and estuaries, and, unlike other anadromous species, do not appear to make long distance offshore migrations. Because adult Atlantic sturgeon from all DPSs mix extensively in marine waters, we expect fish from all 5 DPSs listed in Table 1 (not just the Carolina DPS as proposed by USACE) to be found in the action area.

Table 3 provides the effects determinations for designated critical habitat occurring within the action area that the USACE and NMFS believe may be affected by the proposed action.

Table 3. Effects Determinations for Designated Critical Habitat the Action Agency or NMFS Believe May Be Affected by the Proposed Action

Species	Critical Habitat Unit	USACE Effect Determination	NMFS Effect Determination
Loggerhead sea turtle (NWA DPS)	Nearshore Reproductive, Unit N-05	LAA	NLAA
North Atlantic right whale	Unit 2	NLAA	NE
NLAA = may affect, not likely to adversely affect; NE = No effect			

The proposed action is located within the boundary of loggerhead sea turtle designated critical habitat (Nearshore Reproductive Habitat, Unit N-05). Nearshore Reproductive Habitat is the portion of the nearshore waters adjacent to nesting beaches used by hatchlings to egress to the open-water environment as well as by nesting females to transit between beach and open water during the nesting season. The following primary constituent elements (PCEs) support this habitat:

(i) Nearshore waters directly off the highest density nesting beaches and their adjacent beaches, as identified in 50 CFR 17.95(c), to 1.6 km offshore;
(ii) Waters sufficiently free of obstructions or artificial lighting to allow transit through the surf zone and outward toward open water; and
(iii) Waters with minimal manmade structures that could promote predators (i.e., nearshore predator concentration caused by submerged and emergent offshore structures), disrupt wave patterns necessary for orientation, and/or create excessive longshore currents.

We believe the proposed action will have no effect to PCE (iii) because the proposed action does not include submerged and emergent offshore structures that might promote predatory concentration nor will the project effect wave patterns or longshore currents. We believe only PCEs (i) and (ii) of loggerhead sea turtle designated critical habitat (Nearshore Reproductive Habitat, Unit N-05) may be affected, but are not likely to be adversely affected (NLAA), by the proposed action. This discussion is in Section 4.2.

The proposed action is located within the boundary of North Atlantic right whale designated critical habitat (Unit 2). The essential features (EFs) to the conservation of the North Atlantic right whale, which provide calving area functions in Unit 2, are:

(i) Sea surface conditions associated with Force 4 or less on the Beaufort Scale;
(ii) Sea surface temperatures of 7°C to 17°C; and
(iii) Water depths of 6 to 28 meters, where these features simultaneously co-occur over contiguous areas of at least 231 square nautical miles (nmi^2) of ocean waters during the months of November through April.

When these features are available, they are selected by North Atlantic right whale cows and calves in dynamic combinations that are suitable for calving, nursing, and rearing, and that vary, within the ranges specified, depending on factors such as weather and age of the calves. We believe the proposed action will have no effect on any of the EFs of North Atlantic right whale designated critical habitat in Unit 2 as the proposed action will not change sea surface conditions, sea surface temperature, water depth, or a combination of the 3 when they simultaneously co-occur over contiguous areas of at least 231 nmi^2 of ocean waters during the months of November through April.

4.1 Potential Routes of Effects Not Likely to Adversely Affect North Atlantic Right Whale, Green Sea Turtle (NA and SA DPS), Kemp's Ridley Sea Turtle, Loggerhead Sea Turtle (NWA DPS), and Atlantic Sturgeon (all 5 DPSs)

<u>Risk of Physical Injury from Construction Activities</u>

Effects to listed species include the risk of injury from construction activities, which will be discountable due to the species' likelihood to move away from the project site if disturbed. The applicant's implementation of NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions* will further reduce the risk by requiring all construction workers watch for sea turtles. The presence of environmental monitors, the applicant's agreement to stop work if a sea turtle is seen within 50 ft or a whale is spotted within 500 yd of the construction area, and the applicant's top-down construction approach will further reduce the likelihood of physical injury during construction.

Risk of Physical Injury from Discarded or Derelict Fishing Gear

The applicant has agreed to install and maintain monofilament receptacles, including trashcans with lids, to keep debris out of the water. Receptacles will be clearly marked and will be emptied regularly to ensure they do not overfill and that fishing lines are disposed of properly. The applicant will also allow, and aid as needed, volunteer groups to complete in-water and out-of-water pier cleanup on an annual/biennial basis. Therefore, the risk of injury to sea turtles and Atlantic sturgeon due to entanglement in improperly discarded fishing gear is highly unlikely and discountable.

Habitat Exclusion

Sea turtles may be affected by their temporary inability to access the in-water or nearshore portion of the project area for foraging, refuge, and nesting habitat due to their avoidance of construction activities and related noise. Given the action area's lack of seagrass, use of the area by sea turtle species for foraging and refuge is expected to be infrequent; however, Oak Island, North Carolina, is a known green sea turtle (NA DPS) and loggerhead sea turtle (NWA DPS) nesting beach. To reduce the risk to sea turtle nesting beaches, construction will take place to avoid sea turtle nesting season. The applicant, in coordination with local sea turtle volunteer groups, will monitor for sea turtle nesting evidence each morning before any construction occurring prior to November 15. Additionally, all new pier lighting will be sea turtle friendly so as not to disrupt adult, female turtles entering or hatchlings leaving the adjacent nesting beaches post-construction. Further, the pier's footprint during and after construction is not expected to obstruct access to the adjacent nesting beaches at Oak Island, North Carolina. Due to these measures, we anticipate any habitat exclusion effects to sea turtles will be so small as to be unmeasurable and, therefore, insignificant.

The project may affect sturgeon by reducing or displacing forage resources through benthic disturbance from the installation and placement of the piles. We expect construction effects to be temporary and anticipate benthic foraging resources surrounding the piles will return to pre-project conditions within a short time frame. Installation of the ninety-eight 16-in wooden piles will be a permanent loss of 136.76 square feet (ft^2) of habitat within the footprint of all piles combined ($Area = \pi r^2$ = $3.14 \times 8^2 = 200.96$ square inches per pile × 98 piles = 19,694.08 square inches for all piles = 136.76 ft^2) . Given the large expanses of similar habitat in the area nearby, the small project area, and the small footprint of the piles, we anticipate permanent habitat effects would be too small to detect. Further, the pier's footprint during and after construction is not expected to obstruct access to any potential foraging or migratory habitat. Therefore, we anticipate any habitat exclusion effects to Atlantic sturgeon (any of the 5 DPSs) to be insignificant.

The fall migration route of pregnant North Atlantic right whales hugs the U.S. Atlantic Ocean coastline from Nova Scotia, Canada, to northeastern Florida. As discussed above, the action area overlaps with the 6 m contour line that defines the inshore boundary of North Atlantic right whale critical habitat (Unit 2). To avoid sea turtle nesting season, pier construction will take place during North Atlantic right whale migration and calving season. The proposed action is not expected to disrupt calving, nursing, and rearing if an individual or individual with a calf chooses to use habitat within the action area during construction. The applicant will employ environmental monitors 20 minutes prior to the start of pile driving each day and during all pile driving activities to scan the water for whales. If a whale is observed within 500 yards (yd) of the pier before or during pile driving, pile driving will not begin or will discontinue until the whale species has departed the project area of its own volition. Additionally, only 4 pile will be installed per day and approximately half of the piles will be driven at low tide above the MLW line. Due to these measures, we anticipate any habitat exclusion effects to North Atlantic right whale will be so small as to be unmeasurable, and therefore insignificant.

Increased Turbidity

The process of installing piles into the substrate will increase turbidity during that aspect of the construction process. The applicant is not proposing to use turbidity curtains. However, because suspended sand particles will settle out within a short time frame, we anticipate any effects from increased turbidity on sea turtles, sturgeon, and North Atlantic right whale will be so small as to be unmeasurable, and therefore insignificant. Approximately half of the piles will be installed above MLW (i.e., in the dry) and only 4 piles will be installed per day, thereby further reducing the risk of any adverse effects from increased turbidity to these species.

Noise

Effects to listed species as a result of noise created by construction activities can physically injure animals in the affected areas or change animal behavior in the affected areas. Injurious effects can occur in 2 ways. First, immediate adverse effects can occur to listed species if a single noise event exceeds the threshold for direct physical injury. Second, effects can result from prolonged exposure to noise levels that exceed the daily cumulative exposure threshold for the animals, and these can constitute adverse effects if animals are exposed to the noise levels for sufficient periods. Behavioral effects can be adverse if such effects interfere with animals from migrating, feeding, resting, or reproducing, for example.

Our evaluation of effects to sea turtles and Atlantic sturgeon as a result of noise created by pile driving is based on the analysis prepared in support of the Opinion for SAJ-82.[2] Our evaluation of effects to North Atlantic right whale as a result of noise created by pile driving is based on the analysis prepared in support of NOAA Technical Memorandum NMFS-OPR-55.[3] The noise source level used in this Opinion is based on the vibratory installation of a 13-in steel pipe pile as a surrogate for the vibratory installation of the 16-in wood pile. This is a very conservative approach since the installation of a 13-in steel pipe pile would be considerably louder than a 16-in wood pile.

Based on our noise calculations, installation of 13-in steel piles by vibratory hammer will not result in any form of injurious noise effects to sea turtles or sturgeon. The installation method could result in injurious noise effects at radii of up to 14 ft (4.3 m) for North Atlantic right whale; however, pile driving will not begin or will discontinue if a whale is spotted within 500 yd (1,500 ft), well outside of the injurious noise radius, and pile driving will not resume until the

---

[2] NMFS. Biological Opinion on Regional General Permit SAJ-82 (SAJ-2007-01590), Florida Keys, Monroe County, Florida. June 10, 2014.

[3] National Marine Fisheries Service. 2016. Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept. of Commer., NOAA. NOAA Technical Memorandum NMFS-OPR-55, 178 p

species has departed of its own volition. Therefore, injurious noise effects to North Atlantic right whale are highly unlikely and discountable.

The installation of piles by vibratory hammer could result in behavioral effects at radii of up to 16 ft (5 m) for sea turtles, up to 72 ft (22 m) for Atlantic sturgeon, and up to 1.3 mi (2,154.4 m) for North Atlantic right whale. Given the mobility of these species, we expect them to move away from noise disturbances. Because there is similar habitat nearby, we believe this effect will be insignificant. If an individual chooses to remain within the behavioral response zone, it could be exposed to behavioral noise impacts during pile installation. However, any effect will be will be so small as to be unmeasurable and, therefore, insignificant because the project employs several attenuation factors:

(1) The use of wood piles (i.e., wood is more flexible, and sound-absorbing, than steel),
(2) Only 4 piles will be installed per day and installation of piles will occur during daylight hours only (i.e., species will be able to resume normal activities during quiet periods between pile installations and at night),
(3) Approximately half of the piles will be installed above MLW (i.e., in the dry),
(4) The sandy substrate will allow for easier seating of piles (i.e., less installation time per pile), and
(5) The shallow depth and wave/tidal action will increase the sound drop-off rate (i.e., potential for a smaller behavioral impact radius).

4.2 Potential Routes of Effects Not Likely to Adversely Affect Loggerhead Sea Turtle Nearshore Reproductive Habitat

PCE (i) of Loggerhead Sea Turtle Nearshore Reproductive Habitat (Unit N-05)

PCE (i) is nearshore waters directly off the highest density nesting beaches and their adjacent beaches, as identified in 50 CFR 17.95(c), to 1.6 km offshore. The nearshore waters and nesting beaches of Oak Island may be affected by the proposed action if construction were to take place during nesting season; however, construction will take place early-September to early-April to avoid the majority of sea turtle nesting season. The applicant has proposed 2 additional construction conditions to minimize any potential impacts to nearshore waters and nesting beaches:

1) Construction will be conducted in a top-down manner, and
2) The existing parking area will be used for delivery and storage of construction material and equipment.

These conditions will keep machinery out of the water and off the beach during the time period of late-emerging sea turtle nests (i.e., September through November). To further reduce the risk to late-emerging nests, early morning (i.e., sunrise to 9 am) monitoring for sea turtle nesting evidence will be conducted within 0.25 mi of the pier every morning before any construction occurring before November 15. Because the applicant will avoid nesting season and will implement construction conditions designed to minimize nearshore water and nesting beach impacts, effects to PCE (i) are highly unlikely and, therefore, discountable.

PCE (ii) of Loggerhead Sea Turtle Nearshore Reproductive Habitat (Unit N-05)

PCE(ii) is waters sufficiently free of obstructions or artificial lighting to allow transit through the surf zone and outward toward open water. Transit through the surf zone and outward toward open water may be affected by the proposed action if the waters around the pier were not sufficiently free of obstructions or artificial lightings. The pier's footprint during and after construction is not expected to obstruct access to the adjacent nesting beaches at Oak Island, North Carolina. The applicant is not using turbidity curtains which could obstruct access to the open ocean for nesting females or newly-hatched sea turtles. Additionally, all new pier lighting will be sea turtle friendly so as not to disrupt adult, female turtles entering or hatchlings leaving the adjacent nesting beaches. Given the overall small footprint of the action area in relation to the existing nesting beach and the implementation of construction conditions designed to reduce transit through the surf zone, effects to PCE (ii) will be so small as to be unmeasurable and, therefore, insignificant.

4.3 Potential Routes of Effects Likely to Adversely Affect Green Sea Turtle (NA and SA DPS), Kemp's Ridley Sea Turtle, Loggerhead Sea Turtle (NWA DPS), and Atlantic Sturgeon (all 5 DPSs)

Recreational Fishing

Hook-and-line gear commonly used by recreational anglers fishing from fishing piers can adversely affect sea turtles via entanglement, hooking, and trailing line. Sea turtles released alive may later succumb to injuries sustained at the time of capture or from exacerbated trauma from fishing hooks or lines that were ingested, entangled, or otherwise still attached when they were released. Of the sea turtles hooked or entangled that do not die from their wounds, some may suffer impaired swimming or foraging abilities, altered migratory behavior, and altered breeding or reproductive patterns. The applicant has agreed to install and maintain fishing cleaning stations, including trashcans with lids, to keep fish remains out of the water. Although there will still be some sea turtle hook-and-line captures, this will reduce the likelihood of sea turtles becoming habituated to a food source once the pier is open to the public for recreational fishing. A more in-depth discussion of the effects of hook-and-line capture to sea turtles is discussed in Section 6.1.

As stated above, educational signage for sea turtles already in place on the Yaupon Fishing Pier will remain and the applicant will post updated signage to provide current information to the public on how to handle and report encounters with sea turtles. Upon completion, the fishing pier will have an attendant onsite who be able to assist with sea turtle recreational hook-and-line captures using large dip-nets and de-hooking equipment. Further, the applicant has agreed to coordinate an agreement with the Karen Beasley Sea Turtle Rescue and Rehabilitation Center in Surf City, North Carolina, to assist as needed with the rehabilitation of recreational hook-and-line sea turtle captures. These measures will not reduce the potential risk of recreational hook-and-line interaction, but they will help reduce the severity of injury to incidentally captured sea turtles.

In general, information on sturgeon caught via recreational hook-and-line is sparse (J. Reuter, NOAA NMFS PRD SERO, pers. comm. to consulting biologist on July 6, 2017); therefore, we are unsure of recreational fishing effects to sturgeon via entanglement, hooking, and trailing line. Anecdotal evidence indicates sturgeon have been caught or snagged on recreational fishing line (A. Kaeser, USFWS, pers. comm. to J. Reuter, NOAA NMFS SERO on June 29, 2017; C.

Godwin, NC Department of Environmental and Natural Rersources, pers. comm. to J. Reuter, NOAA NMFDS SERO, on July 6, 2017); however, reported and validated incidences are rare (B. Howard, NOAA NMFS Habitat Conservation Division, pers. comm. to J. Rueter on August 3, 2017). The only known hook-and-line interaction of a sturgeon from a fishing pier is from January 2014. The Florida Fish and Wildlife Conservation Commission reported that a sturgeon was caught on hook-and-line from the Jacksonville Beach Pier, south of the mouth of the St. Johns River in Florida; it was identified from photos by experts as a subadult Atlantic sturgeon. Due to the fishing pier's proximity to the Cape Fear River, a known spawning river for Atlantic sturgeon, we believe Atlantic sturgeon could be migrating through the action area or foraging in the action area before and after spring spawning and are likely to be affected by recreational fishing that will occur at the Yaupon Fishing Pier. As stated above, the applicant has agreed to post educational signage to provide current information to the public on how to handle encounters with and report recreational hook-and-line captures of sturgeon. While signage will not reduce the potential risk of recreational hook-and-line interaction, it will encourage anglers to report interactions, thus providing valuable data to researchers and resource managers.

4.4 General Threats Faced by All Sea Turtles

Sea turtles face numerous natural and man-made threats that shape their status and affect their ability to recover. Many of the threats are either the same or similar in nature for all listed sea turtle species, those identified in this section are discussed in a general sense for all sea turtles. Threat information specific to a particular species is then discussed in the corresponding status of the species section where appropriate.

<u>Commercial Fisheries</u>

Incidental bycatch in commercial fisheries is identified as a major contributor to past declines, and a threat to future recovery, for all of the sea turtle species (NMFS and USFWS 1991a; NMFS and USFWS 1992; NMFS and USFWS 1993; NMFS and USFWS 2008a; NMFS et al. 2011a). Domestic fisheries often capture, injure, and kill sea turtles at various life stages. Sea turtles in the pelagic environment are exposed to U.S. Atlantic pelagic longline fisheries. Sea turtles in the benthic environment in waters off the coastal United States are exposed to a suite of other fisheries in federal and state waters. These fishing methods include trawls, gillnets, purse seines, hook-and-line gear (including bottom longlines and vertical lines [e.g., bandit gear, handlines, and rod-reel]), pound nets, and trap fisheries (refer to the Environmental Baseline section of this Opinion for more specific information regarding federal and state managed fisheries affecting sea turtles within the action area). The Southeast U.S. shrimp fisheries have historically been the largest fishery threat to benthic sea turtles in the southeastern United States, and continue to interact with and kill large numbers of sea turtles each year.

In addition to domestic fisheries, sea turtles are subject to direct as well as incidental capture in numerous foreign fisheries, further impeding the ability of sea turtles to survive and recover on a global scale. For example, pelagic stage sea turtles, especially loggerheads and leatherbacks, circumnavigating the Atlantic are susceptible to international longline fisheries including the Azorean, Spanish, and various other fleets (Aguilar et al. 1994; Bolten et al. 1994; Crouse 1999). Bottom longlines and gillnet fishing are known to occur in many foreign waters, including but not limited to the northwest Atlantic, western Mediterranean, South America, West Africa, Central America, and the Caribbean. Shrimp trawl fisheries are also occurring off the shores of numerous foreign countries and pose a significant threat to sea turtles similar to the impacts seen in U.S. waters. Many unreported takes or incomplete records by foreign fleets make it difficult to characterize the total impact that international fishing pressure is having on listed sea turtles. Nevertheless, international fisheries represent a continuing threat to sea turtle survival and recovery throughout their respective ranges.

Non-Fishery In-Water Activities
There are also many non-fishery activities affecting the status of sea turtle species, both in the ocean and on land. In nearshore waters of the United States, the construction and maintenance of federal navigation channels has been identified as a source of sea turtle mortality. Hopper dredges, which are frequently used in ocean bar channels and sometimes in harbor channels and offshore borrow areas, move relatively rapidly and can entrain and kill sea turtles (NMFS 1997). Sea turtles entering coastal or inshore areas have also been affected by entrainment in the cooling-water systems of electrical generating plants. Other nearshore threats include harassment and/or injury resulting from private and commercial vessel operations, military detonations and training exercises, in-water construction activities, and scientific research activities.

Coastal Development and Erosion Control
Coastal development can deter or interfere with nesting, affect nesting success, and degrade nesting habitats for sea turtles. Structural impacts to nesting habitat include the construction of buildings and pilings, beach armoring and renourishment, and sand extraction (Bouchard et al. 1998; Lutcavage et al. 1997). These factors may decrease the amount of nesting area available to females and change the natural behaviors of both adults and hatchlings, directly or indirectly, through loss of beach habitat or changing thermal profiles and increasing erosion, respectively. (Ackerman 1997; Witherington et al. 2003; Witherington et al. 2007). In addition, coastal development is usually accompanied by artificial lighting which can alter the behavior of nesting adults, confusing them on their approach to their native nesting beaches, and also subsequently drawing sea turtle hatchlings away from the water toward artificial lighting on shorefront properties (Witherington 1992) and is often fatal to emerging hatchlings that are drawn away from the water (Witherington and Bjorndal 1991). In-water erosion control structures such as breakwaters, groins, and jetties can impact nesting females and hatchling as they approach and leave the surf zone or head out to sea by creating physical blockage, concentrating predators, creating longshore currents, and disrupting wave patterns.

Environmental Contamination
Multiple municipal, industrial, and household sources, as well as atmospheric transport, introduce various pollutants such as pesticides, hydrocarbons, organochlorides (e.g., dichlorodiphenyltrichloroethane [DDT], polychlorinated biphenyls [PCB], and perfluorinated chemicals [PFC]), and others that may cause adverse health effects to sea turtles (Garrett 2004; Grant and Ross 2002; Hartwell 2004; Iwata et al. 1993). Acute exposure to hydrocarbons from petroleum products released into the environment via oil spills and other discharges may directly injure individuals through skin contact with oils (Geraci 1990), inhalation at the water's surface and ingesting compounds while feeding (Matkin and Saulitis 1997). Hydrocarbons also have the potential to impact prey populations, and therefore may affect listed species indirectly by reducing food availability in the action area.

The April 20, 2010, explosion of the DEEPWATER HORIZON (DWH) oil rig affected sea turtles in the Gulf of Mexico. An assessment has been completed on the injury to Gulf of Mexico marine life, including sea turtles, resulting from the spill (DWH Trustees 2015). Following the spill, juvenile Kemp's ridley, green, and loggerhead sea turtles were found in *Sargassum* algae mats in the convergence zones, where currents meet and oil collected. Sea turtles found in these areas were often coated in oil and/or had ingested oil. The spill resulted in the direct mortality of many sea turtles and may have had sublethal effects or caused environmental damage that will impact other sea turtles into the future. Information on the spill impacts to individual sea turtle species is presented in the Status of the Species sections for each species. A thorough assessment of the long-term effects of the spill on sea turtles has not yet been completed; however, the spill resulted in the direct mortality of many sea turtles and may have had sublethal effects or caused environmental damage that will impact other sea turtles into the future. The population level effects of the spill and associated response activity are likely to remain unknown for some period into the future.

Marine debris is a continuing problem for sea turtles. Sea turtles living in the pelagic environment commonly eat or become entangled in marine debris (e.g., tar balls, plastic bags/pellets, balloons, and ghost fishing gear) as they feed along oceanographic fronts where debris and their natural food items converge. This is especially problematic for sea turtles that spend all or significant portions of their life cycle in the pelagic environment (i.e., leatherbacks, juvenile loggerheads, and juvenile green turtles).

Climate Change

There is a large and growing body of literature on past, present, and future impacts of global climate change, exacerbated and accelerated by human activities. Some of the likely effects commonly mentioned are sea level rise, increased frequency of severe weather events, and change in air and water temperatures. NOAA's climate information portal provides basic background information on these and other measured or anticipated effects (see http://www.climate.gov).

Climate change impacts on sea turtles currently cannot be predicted with any degree of certainty; however, significant impacts to the hatchling sex ratios of sea turtles may result (NMFS and USFWS 2007b). In sea turtles, sex is determined by the ambient sand temperature (during the middle third of incubation) with female offspring produced at higher temperatures and males at lower temperatures within a thermal tolerance range of 25°-35°C (Ackerman 1997). Increases in global temperature could potentially skew future sex ratios toward higher numbers of females (NMFS and USFWS 2007b).

The effects from increased temperatures may be intensified on developed nesting beaches where shoreline armoring and construction have denuded vegetation. Erosion control structures could potentially result in the permanent loss of nesting beach habitat or deter nesting females (NRC 1990a). These impacts will be exacerbated by sea level rise. If females nest on the seaward side of the erosion control structures, nests may be exposed to repeated tidal overwash (NMFS and USFWS 2007c). Sea level rise from global climate change is also a potential problem for areas with low-lying beaches where sand depth is a limiting factor, as the sea may inundate nesting sites and decrease available nesting habitat (Baker et al. 2006; Daniels et al. 1993; Fish et al.

2005). The loss of habitat as a result of climate change could be accelerated due to a combination of other environmental and oceanographic changes such as an increase in the frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion (Antonelis et al. 2006; Baker et al. 2006).

Other changes in the marine ecosystem caused by global climate change (e.g., ocean acidification, salinity, oceanic currents, dissolved oxygen levels, nutrient distribution) could influence the distribution and abundance of lower trophic levels (e.g., phytoplankton, zooplankton, submerged aquatic vegetation, crustaceans, mollusks, forage fish) which could ultimately affect the primary foraging areas of sea turtles.

<u>Other Threats</u>

Predation by various land predators is a threat to developing nests and emerging hatchlings. The major natural predators of sea turtle nests are mammals, including raccoons, dogs, pigs, skunks, and badgers. Emergent hatchlings are preyed upon by these mammals as well as ghost crabs, laughing gulls, and the exotic South American fire ant (*Solenopsis invicta*). In addition to natural predation, direct harvest of eggs and adults from beaches in foreign countries continues to be a problem for various sea turtle species throughout their ranges (NMFS and USFWS 2008b). Diseases, toxic blooms from algae and other microorganisms, and cold stunning events are additional sources of mortality that can range from local and limited to wide-scale and impacting hundreds or thousands of animals.

4.5 Status of Green Sea Turtle – North Atlantic and South Atlantic DPSs

The green sea turtle was originally listed as threatened under the ESA on July 28, 1978, except for the Florida and Pacific coast of Mexico breeding populations, which were listed as endangered. On April 6, 2016, the original listing was replaced with the listing of 11 distinct population segments (DPSs) (81 FR 20057 2016). The Mediterranean, Central West Pacific, and Central South Pacific DPSs were listed as endangered. The North Atlantic, South Atlantic, Southwest Indian, North Indian, East Indian-West Pacific, Southwest Pacific, Central North Pacific, and East Pacific were listed as threatened. For the purposes of this consultation, only the South Atlantic DPS (SA DPS) and North Atlantic DPS (NA DPS) will be considered, as they are the only two DPSs with individuals occurring in the Atlantic and Gulf of Mexico waters of the United States.

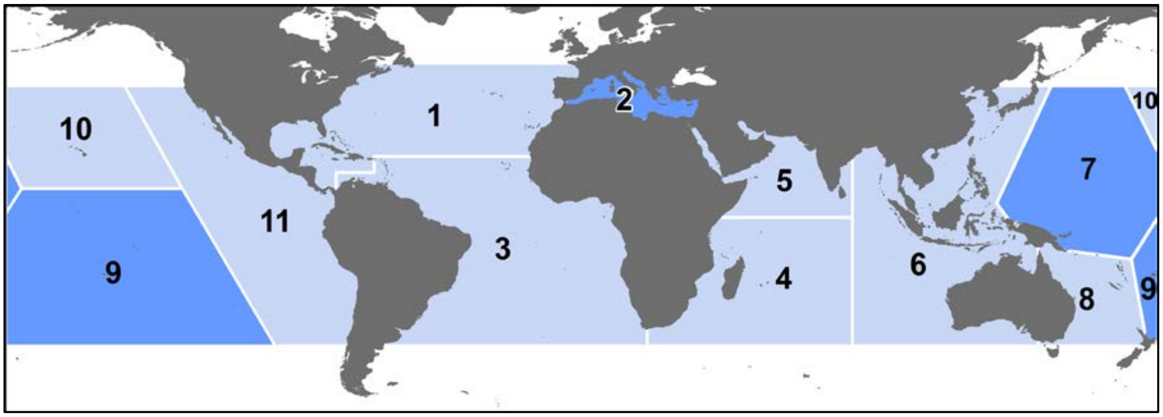

Figure 3. Threatened (light) and endangered (dark) green turtle DPSs: 1. North Atlantic, 2. Mediterranean, 3. South Atlantic, 4. Southwest Indian, 5. North Indian, 6. East Indian-West Pacific, 7. Central West Pacific, 8. Southwest Pacific, 9. Central South Pacific, 10. Central North Pacific, and 11. East Pacific.

Species Description and Distribution

The green sea turtle is the largest of the hardshell marine turtles, growing to a weight of 350 lb (159 kg) with a straight carapace length of greater than 3.3 ft (1 m). Green sea turtles have a smooth carapace with 4 pairs of lateral (or costal) scutes and a single pair of elongated prefrontal scales between the eyes. They typically have a black dorsal surface and a white ventral surface, although the carapace of green sea turtles in the Atlantic Ocean has been known to change in color from solid black to a variety of shades of grey, green, or brown and black in starburst or irregular patterns (Lagueux 2001).

With the exception of post-hatchlings, green sea turtles live in nearshore tropical and subtropical waters where they generally feed on marine algae and seagrasses. They have specific foraging grounds and may make large migrations between these forage sites and natal beaches for nesting (Hays et al. 2001). Green sea turtles nest on sandy beaches of mainland shores, barrier islands, coral islands, and volcanic islands in more than 80 countries worldwide (Hirth 1997). The 2 largest nesting populations are found at Tortuguero, on the Caribbean coast of Costa Rica (part of the NA DPS), and Raine Island, on the Pacific coast of Australia along the Great Barrier Reef.

Differences in mitochondrial DNA properties of green sea turtles from different nesting regions indicate there are genetic subpopulations (Bowen et al. 1992; FitzSimmons et al. 2006). Despite the genetic differences, sea turtles from separate nesting origins are commonly found mixed together on foraging grounds throughout the species' range. Within U.S. waters individuals from both the NA and SA DPSs can be found on foraging grounds. While there are currently no in-depth studies available to determine the percent of NA and SA DPS individuals in any given location, two small-scale studies provide an insight into the degree of mixing on the foraging grounds. An analysis of cold-stunned green turtles in St. Joseph Bay, Florida (northern Gulf of Mexico) found approximately 4% of individuals came from nesting stocks in the SA DPS (specifically Suriname, Aves Island, Brazil, Ascension Island, and Guinea Bissau) (Foley et al. 2007). On the Atlantic coast of Florida, a study on the foraging grounds off Hutchinson Island found that approximately 5% of the turtles sampled came from the Aves Island/Suriname nesting assemblage, which is part of the SA DPS (Bass and Witzell 2000). All of the individuals in both studies were benthic juveniles. Available information on green turtle migratory behavior indicates that long distance dispersal is only seen for juvenile turtles. This suggests that larger adult-sized turtles return to forage within the region of their natal rookeries, thereby limiting the potential for gene flow across larger scales (Monzón-Argüello et al. 2010). While all of the mainland U.S. nesting individuals are part of the NA DPS, the U.S. Caribbean nesting assemblages are split between the NA and SA DPS. Nesters in Puerto Rico are part of the NA DPS, while those in the U.S. Virgin Islands are part of the SA DPS. We do not currently have information on what percent of individuals on the U.S. Caribbean foraging grounds come from which DPS.

<u>North Atlantic DPS Distribution</u>
The NA DPS boundary is illustrated in Figure 3. Four regions support nesting concentrations of particular interest in the NA DPS: Costa Rica (Tortuguero), Mexico (Campeche, Yucatan, and Quintana Roo), U.S. (Florida), and Cuba. By far the most important nesting concentration for green turtles in this DPS is Tortuguero, Costa Rica. Nesting also occurs in the Bahamas, Belize, Cayman Islands, Dominican Republic, Haiti, Honduras, Jamaica, Nicaragua, Panama, Puerto Rico, Turks and Caicos Islands, and North Carolina, South Carolina, Georgia, and Texas, U.S.A. In the eastern North Atlantic, nesting has been reported in Mauritania (Fretey 2001).

The complete nesting range of NA DPS green sea turtles within the southeastern United States includes sandy beaches between Texas and North Carolina, as well as Puerto Rico (Dow et al. 2007; NMFS and USFWS 1991b). The vast majority of green sea turtle nesting within the southeastern United States occurs in Florida (Johnson and Ehrhart 1994; Meylan et al. 1995). Principal U.S. nesting areas for green sea turtles are in eastern Florida, predominantly Brevard south through Broward counties.

In U.S. Atlantic and Gulf of Mexico waters, green sea turtles are distributed throughout inshore and nearshore waters from Texas to Massachusetts. Principal benthic foraging areas in the southeastern United States include Aransas Bay, Matagorda Bay, Laguna Madre, and the Gulf inlets of Texas (Doughty 1984; Hildebrand 1982; Shaver 1994), the Gulf of Mexico off Florida from Yankeetown to Tarpon Springs (Caldwell and Carr 1957), Florida Bay and the Florida Keys (Schroeder and Foley 1995), the Indian River Lagoon system in Florida (Ehrhart 1983), and the Atlantic Ocean off Florida from Brevard through Broward Counties (Guseman and Ehrhart 1992; Wershoven and Wershoven 1992). The summer developmental habitat for green sea turtles also encompasses estuarine and coastal waters from North Carolina to as far north as Long Island Sound (Musick and Limpus 1997). Additional important foraging areas in the western Atlantic include the Culebra archipelago and other Puerto Rico coastal waters, the south coast of Cuba, the Mosquito Coast of Nicaragua, the Caribbean coast of Panama, scattered areas along Colombia and Brazil (Hirth 1971), and the northwestern coast of the Yucatán Peninsula.

<u>South Atlantic DPS Distribution</u>
The SA DPS boundary is shown in Figure 3, and includes the U.S. Virgin Islands in the Caribbean. The SA DPS nesting sites can be roughly divided into four regions: western Africa, Ascension Island, Brazil, and the South Atlantic Caribbean (including Colombia, the Guianas, and Aves Island in addition to the numerous small, island nesting sites).

The in-water range of the SA DPS is widespread. In the eastern South Atlantic, significant sea turtle habitats have been identified, including green turtle feeding grounds in Corisco Bay, Equatorial Guinea/Gabon (Formia 1999); Congo; Mussulo Bay, Angola (Carr and Carr 1991); as well as Principe Island. Juvenile and adult green turtles utilize foraging areas throughout the Caribbean areas of the South Atlantic, often resulting in interactions with fisheries occurring in those same waters (Dow et al. 2007). Juvenile green turtles from multiple rookeries also frequently utilize the nearshore waters off Brazil as foraging grounds as evidenced from the frequent captures by fisheries (Lima et al. 2010; López-Barrera et al. 2012; Marcovaldi et al. 2009). Genetic analysis of green turtles on the foraging grounds off Ubatuba and Almofala, Brazil show mixed stocks coming primarily from Ascension, Suriname and Trindade as a secondary source, but also Aves, and even sometimes Costa Rica (North Atlantic DPS)(Naro-Maciel et al. 2007; Naro-Maciel et al. 2012). While no nesting occurs as far south as Uruguay and Argentina, both have important foraging grounds for South Atlantic green turtles (Gonzalez Carman et al. 2011; Lezama 2009; López-Mendilaharsu et al. 2006; Prosdocimi et al. 2012; Rivas-Zinno 2012).

Life History Information

Green sea turtles reproduce sexually, and mating occurs in the waters off nesting beaches and along migratory routes. Mature females return to their natal beaches (i.e., the same beaches where they were born) to lay eggs (Balazs 1982; Frazer and Ehrhart 1985) every 2-4 years while males are known to reproduce every year (Balazs 1983). In the southeastern United States, females generally nest between June and September, and peak nesting occurs in June and July (Witherington and Ehrhart 1989b). During the nesting season, females nest at approximately 2-week intervals, laying an average of 3-4 clutches (Johnson and Ehrhart 1996). Clutch size often varies among subpopulations, but mean clutch size is approximately 110-115 eggs. In Florida, green sea turtle nests contain an average of 136 eggs (Witherington and Ehrhart 1989b). Eggs incubate for approximately 2 months before hatching. Hatchling green sea turtles are approximately 2 inches (5 cm) in length and weigh approximately 0.9 ounces (25 grams). Survivorship at any particular nesting site is greatly influenced by the level of man-made stressors, with the more pristine and less disturbed nesting sites (e.g., along the Great Barrier Reef in Australia) showing higher survivorship values than nesting sites known to be highly disturbed (e.g., Nicaragua) (Campell and Lagueux 2005; Chaloupka and Limpus 2005).

After emerging from the nest, hatchlings swim to offshore areas and go through a post-hatchling pelagic stage where they are believed to live for several years. During this life stage, green sea turtles feed close to the surface on a variety of marine algae and other life associated with drift lines and debris. This early oceanic phase remains one of the most poorly understood aspects of green sea turtle life history (NMFS and USFWS 2007a). Green sea turtles exhibit particularly slow growth rates of about 0.4-2 inches (1-5 cm) per year (Green 1993), which may be attributed to their largely herbivorous, low-net energy diet (Bjorndal 1982). At approximately 8-10 inches (20-25 cm) carapace length, juveniles leave the pelagic environment and enter nearshore developmental habitats such as protected lagoons and open coastal areas rich in sea grass and marine algae. Growth studies using skeletochronology indicate that green sea turtles in the western Atlantic shift from the oceanic phase to nearshore developmental habitats after approximately 5-6 years (Bresette et al. 2006; Zug and Glor 1998). Within the developmental habitats, juveniles begin the switch to a more herbivorous diet, and by adulthood feed almost exclusively on seagrasses and algae (Rebel 1974), although some populations are known to also feed heavily on invertebrates (Carballo et al. 2002). Green sea turtles mature slowly, requiring 20-50 years to reach sexual maturity (Chaloupka and Musick 1997a; Hirth 1997).

While in coastal habitats, green sea turtles exhibit site fidelity to specific foraging and nesting grounds, and it is clear they are capable of "homing in" on these sites if displaced (McMichael et al. 2003). Reproductive migrations of Florida green sea turtles have been identified through flipper tagging and/or satellite telemetry. Based on these studies, the majority of adult female Florida green sea turtles are believed to reside in nearshore foraging areas throughout the Florida Keys and in the waters southwest of Cape Sable, and some post-nesting turtles also reside in Bahamian waters as well (NMFS and USFWS 2007a).

Status and Population Dynamics
Accurate population estimates for marine turtles do not exist because of the difficulty in sampling turtles over their geographic ranges and within their marine environments. Nonetheless, researchers have used nesting data to study trends in reproducing sea turtles over time. A summary of nesting trends and nester abundance is provided in the most recent status review for the species (Seminoff et al. 2015), with information for each of the DPSs.

<u>North Atlantic DPS</u>
The NA DPS is the largest of the 11 green turtle DPSs, with an estimated nester abundance of over 167,000 adult females from 73 nesting sites. Overall this DPS is also the most data rich. Eight of the sites have high levels of abundance (i.e., <1000 nesters), located in Costa Rica, Cuba, Mexico, and Florida. All major nesting populations demonstrate long-term increases in abundance (Seminoff et al. 2015).

Tortuguero, Costa Rica is by far the predominant nesting site, accounting for an estimated 79% of nesting for the DPS (Seminoff et al. 2015). Nesting at Tortuguero appears to have been increasing since the 1970's, when monitoring began. For instance, from 1971-1975 there were approximately 41,250 average annual emergences documented and this number increased to an average of 72,200 emergences from 1992-1996 (Bjorndal et al. 1999). Troëng and Rankin (2005) collected nest counts from 1999-2003 and also reported increasing trends in the population consistent with the earlier studies, with nest count data suggesting 17,402-37,290 nesting females per year (NMFS and USFWS 2007a). Modeling by Chaloupka et al. (2008) using data sets of 25 years or more resulted in an estimate of the Tortuguero, Costa Rica population's growing at 4.9% annually.

In the continental United States, green sea turtle nesting occurs along the Atlantic coast, primarily along the central and southeast coast of Florida where an estimated 200-1,100 females nest each year (Meylan et al. 1994; Weishampel et al. 2003). Occasional nesting has also been documented along the Gulf Coast of Florida (Meylan et al. 1995). Green sea turtle nesting is documented annually on beaches of North Carolina, South Carolina, and Georgia, though nesting is found in low quantities (nesting databases maintained on www.seaturtle.org).

In Florida, index beaches were established to standardize data collection methods and effort on key nesting beaches. Since establishment of the index beaches in 1989, the pattern of green sea turtle nesting has generally shown biennial peaks in abundance with a positive trend during the

10 years of regular monitoring (Figure X). According to data collected from Florida's index nesting beach survey from 1989-2016, green sea turtle nest counts across Florida have increased approximately ten-fold from a low of 267 in the early 1990s to a high of 27,975 in 2015. Two consecutive years of nesting declines in 2008 and 2009 caused some concern, but this was followed by increases in 2010 and 2011, and a return to the trend of biennial peaks in abundance thereafter (Figure 4). Modeling by Chaloupka et al. (2008) using data sets of 25 years or more has resulted in an estimate of the Florida nesting stock at the Archie Carr National Wildlife Refuge growing at an annual rate of 13.9%.

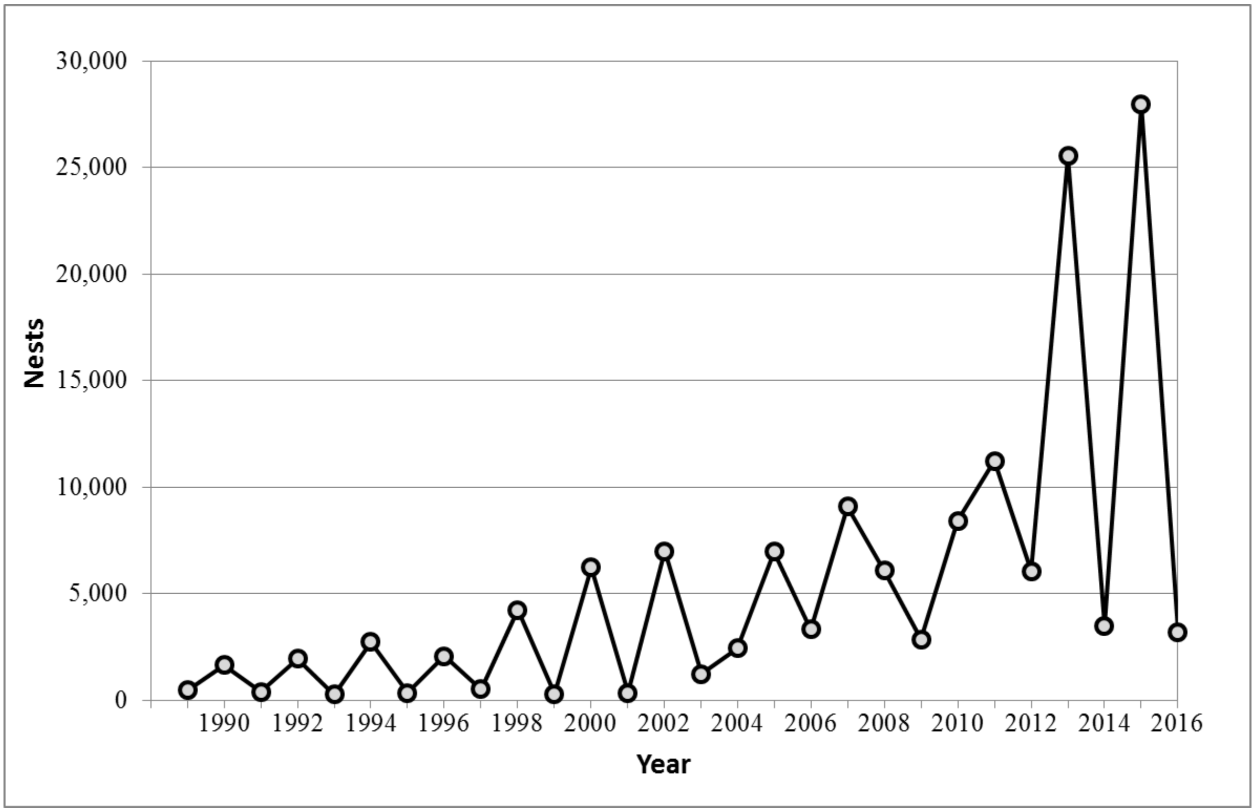

Figure 4. Green sea turtle nesting at Florida index beaches since 1989

Similar to the nesting trend found in Florida, in-water studies in Florida have also recorded increases in green turtle captures at the Indian River Lagoon site, with a 661 percent increase over 24 years (Ehrhart et al. 2007), and the St Lucie Power Plant site, with a significant increase in the annual rate of capture of immature green turtles (SCL<90 cm) from 1977 to 2002 or 26 years (3,557 green turtles total; M. Bressette, Inwater Research Group, unpubl. data; (Witherington et al. 2006).

<u>South Atlantic DPS</u>

The SA DPS is large, estimated at over 63,000 nesters, but data availability is poor. More than half of the 51 identified nesting sites (37) did not have sufficient data to estimate number of nesters or trends (Seminoff et al. 2015). This includes some sites, such as beaches in French Guiana, which are suspected to have large numbers of nesters. Therefore, while the estimated number of nesters may be substantially underestimated, we also do not know the population trends at those data-poor beaches. However, while the lack of data was a concern due to increased uncertainty, the overall trend of the SA DPS was not considered to be a major concern as some of the largest nesting beaches such as Ascension Island, Aves Island (Venezuela), and Galibi (Suriname) appear to be increasing. Others such as Trindade (Brazil), Atol das Rocas (Brazil), and Poilão and the rest of Guinea-Bissau seem to be stable or do not have sufficient data to make a determination. Bioko (Equatorial Guinea) appears to be in decline but has less nesting than the other primary sites (Seminoff et al. 2015).

In the U.S., nesting of SA DPS green turtles occurs on the beaches of the U.S. Virgin Islands, primarily on Buck Island. There is insufficient data to determine a trend for Buck Island nesting, and it is a smaller rookery, with approximately 63 total nesters utilizing the beach (Seminoff et al. 2015).

Threats

The principal cause of past declines and extirpations of green sea turtle assemblages has been the overexploitation of the species for food and other products. Although intentional take of green sea turtles and their eggs is not extensive within the southeastern United States, green sea turtles that nest and forage in the region may spend large portions of their life history outside the region and outside U.S. jurisdiction, where exploitation is still a threat. Green sea turtles also face many of the same threats as other sea turtle species, including destruction of nesting habitat from storm events, oceanic events such as cold-stunning, pollution (e.g., plastics, petroleum products, petrochemicals), ecosystem alterations (e.g., nesting beach development, beach nourishment and shoreline stabilization, vegetation changes), poaching, global climate change, fisheries interactions, natural predation, and disease. A discussion on general sea turtle threats can be found in Section 4.2.1.

In addition to general threats, green sea turtles are susceptible to natural mortality from Fibropapillomatosis (FP) disease. FP results in the growth of tumors on soft external tissues (flippers, neck, tail, etc.), the carapace, the eyes, the mouth, and internal organs (gastrointestinal tract, heart, lungs, etc.) of turtles (Aguirre et al. 2002; Herbst 1994; Jacobson et al. 1989). These tumors range in size from 0.04 inches (0.1 cm) to greater than 11.81 inches (30 cm) in diameter and may affect swimming, vision, feeding, and organ function (Aguirre et al. 2002; Herbst 1994; Jacobson et al. 1989). Presently, scientists are unsure of the exact mechanism causing this disease, though it is believed to be related to both an infectious agent, such as a virus (Herbst et al. 1995), and environmental conditions (e.g., habitat degradation, pollution, low wave energy, and shallow water (Foley et al. 2005). FP is cosmopolitan, but it has been found to affect large numbers of animals in specific areas, including Hawaii and Florida (Herbst 1994; Jacobson 1990; Jacobson et al. 1991).

Cold-stunning is another natural threat to green sea turtles. Although it is not considered a major source of mortality in most cases, as temperatures fall below 46.4°-50°F (8°-10°C) turtles may lose their ability to swim and dive, often floating to the surface. The rate of cooling that precipitates cold-stunning appears to be the primary threat, rather than the water temperature itself (Milton and Lutz 2003). Sea turtles that overwinter in inshore waters are most susceptible to cold-stunning because temperature changes are most rapid in shallow water (Witherington and Ehrhart 1989a). During January 2010, an unusually large cold-stunning event in the southeastern United States resulted in around 4,600 sea turtles, mostly greens, found cold-stunned, and hundreds found dead or dying. A large cold-stunning event occurred in the western Gulf of Mexico in February 2011, resulting in approximately 1,650 green sea turtles found cold-stunned in Texas. Of these, approximately 620 were found dead or died after stranding, while approximately 1,030 turtles were rehabilitated and released. During this same time frame, approximately 340 green sea turtles were found cold-stunned in Mexico, though approximately 300 of those were subsequently rehabilitated and released.

Whereas oil spill impacts are discussed generally for all species in Section 4.2.1, specific impacts of the DWH spill on green sea turtles are considered here. Impacts to green sea turtles occurred to offshore small juveniles only. A total of 154,000 small juvenile greens (36.6% of the total small juvenile sea turtle exposures to oil from the spill) were estimated to have been exposed to oil. A large number of small juveniles were removed from the population, as 57,300 small juveniles greens are estimated to have died as a result of the exposure. A total of 4 nests (580 eggs) were also translocated during response efforts, with 455 hatchlings released (the fate of which is unknown) (DWH Trustees 2015). Additional unquantified effects may have included inhalation of volatile compounds, disruption of foraging or migratory movements due to surface or subsurface oil, ingestion of prey species contaminated with oil and/or dispersants, and loss of foraging resources which could lead to compromised growth and/or reproductive potential. There is no information currently available to determine the extent of those impacts, if they occurred.

While green turtles regularly use the northern Gulf of Mexico, they have a widespread distribution throughout the entire Gulf of Mexico, Caribbean, and Atlantic, and the proportion of the population using the northern Gulf of Mexico at any given time is relatively low. Although it is known that adverse impacts occurred and numbers of animals in the Gulf of Mexico were reduced as a result of the Deepwater Horizon oil spill of 2010 (DWH), the relative proportion of the population that is expected to have been exposed to and directly impacted by the DWH event, as well as the impacts being primarily to smaller juveniles (lower reproductive value than adults and large juveniles), reduces the impact to the overall population. It is unclear what impact these losses may have caused on a population level, but it is not expected to have had a large impact on the population trajectory moving forward. However, recovery of green turtle numbers equivalent to what was lost in the northern Gulf of Mexico as a result of the spill will likely take decades of sustained efforts to reduce the existing threats and enhance survivorship of multiple life stages (DWH Trustees 2015).

4.6 Status of Kemp's Ridley Sea Turtle

The Kemp's ridley sea turtle was listed as endangered on December 2, 1970, under the Endangered Species Conservation Act of 1969, a precursor to the ESA. Internationally, the Kemp's ridley is considered the most endangered sea turtle (Groombridge 1982; TEWG 2000; Zwinenberg 1977).

Species Description and Distribution

The Kemp's ridley sea turtle is the smallest of all sea turtles. Adults generally weigh less than 100 lb (45 kg) and have a carapace length of around 2.1 ft (65 cm). Adult Kemp's ridley shells are almost as wide as they are long. Coloration changes significantly during development from the grey-black dorsum and plastron of hatchlings, a grey-black dorsum with a yellowish-white plastron as post-pelagic juveniles, and then to the lighter grey-olive carapace and cream-white or yellowish plastron of adults. There are 2 pairs of prefrontal scales on the head, 5 vertebral scutes, usually 5 pairs of costal scutes, and generally 12 pairs of marginal scutes on the carapace. In each bridge adjoining the plastron to the carapace, there are 4 scutes, each of which is perforated by a pore.

Kemp's ridley habitat largely consists of sandy and muddy areas in shallow, nearshore waters less than 120 ft (37 m) deep, although they can also be found in deeper offshore waters. These areas support the primary prey species of the Kemp's ridley sea turtle, which consist of swimming crabs, but may also include fish, jellyfish, and an array of mollusks.

The primary range of Kemp's ridley sea turtles is within the Gulf of Mexico basin, though they also occur in coastal and offshore waters of the U.S. Atlantic Ocean. Juvenile Kemp's ridley sea turtles, possibly carried by oceanic currents, have been recorded as far north as Nova Scotia. Historic records indicate a nesting range from Mustang Island, Texas, in the north to Veracruz, Mexico, in the south. Kemp's ridley sea turtles have recently been nesting along the Atlantic Coast of the United States, with nests recorded from beaches in Florida, Georgia, and the Carolinas. In 2012, the first Kemp's ridley sea turtle nest was recorded in Virginia. The Kemp's ridley nesting population had been exponentially increasing prior to the recent low nesting years, which may indicate that the population had been experiencing a similar increase. Additional nesting data in the coming years will be required to determine what the recent nesting decline means for the population trajectory.

Life History Information

Kemp's ridley sea turtles share a general life history pattern similar to other sea turtles. Females lay their eggs on coastal beaches where the eggs incubate in sandy nests. After 45-58 days of embryonic development, the hatchlings emerge and swim offshore into deeper, ocean water where they feed and grow until returning at a larger size. Hatchlings generally range from 1.65-1.89 in (42-48 mm) straight carapace length (SCL), 1.26-1.73 in (32-44 mm) in width, and 0.3-0.4 lb (15-20 g) in weight. Their return to nearshore coastal habitats typically occurs around 2 years of age (Ogren 1989a), although the time spent in the oceanic zone may vary from 1-4 years or perhaps more (TEWG 2000). Juvenile Kemp's ridley sea turtles use these nearshore coastal habitats from April through November, but they move towards more suitable overwintering habitat in deeper offshore waters (or more southern waters along the Atlantic coast) as water temperature drops.

The average rates of growth may vary by location, but generally fall within 2.2-2.9 ± 2.4 in per year (5.5-7.5 ± 6.2 cm/year) (Schmid and Barichivich 2006; Schmid and Woodhead 2000). Age to sexual maturity ranges greatly from 5-16 years, though NMFS et al. (2011b) determined the best estimate of age to maturity for Kemp's ridley sea turtles was 12 years. It is unlikely that most adults grow very much after maturity. While some sea turtles nest annually, the weighted mean remigration rate for Kemp's ridley sea turtles is approximately 2 years. Nesting generally occurs from April to July. Females lay approximately 2.5 nests per season with each nest containing approximately 100 eggs (Márquez M. 1994).

Population Dynamics

Of the 7 species of sea turtles in the world, the Kemp's ridley has declined to the lowest population level. Most of the population of adult females nest on the beaches of Rancho Nuevo, Mexico (Pritchard 1969). 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). By the mid-1980s, however, nesting numbers from Rancho Nuevo and adjacent Mexican beaches were below 1,000, with a low of 702 nests in 1985. Yet, nesting steadily increased through the 1990s, and then accelerated during the first decade of the twenty-first century (Figure 4), which indicates the species is recovering.

It is worth noting that when the Bi-National Kemp's Ridley Sea Turtle Population Restoration Project was initiated in 1978, only Rancho Nuevo nests were recorded. In 1988, nesting data from southern beaches at Playa Dos and Barra del Tordo were added. In 1989, data from the northern beaches of Barra Ostionales and Tepehuajes were added, and most recently in 1996, data from La Pesca and Altamira beaches were recorded. Currently, nesting at Rancho Nuevo accounts for just over 81% of all recorded Kemp's ridley nests in Mexico. Following a significant, unexplained 1-year decline in 2010, Kemp's ridley nests in Mexico reached a record high of 21,797 in 2012 (Gladys Porter Zoo 2013). From 2013 through 2014, there was a second significant decline, as only 16,385 and 11,279 nests were recorded, respectively. Recent data, however, indicates an increase in nesting. In 2015 there were 14,006 recorded nests, and in 2016 overall numbers increased to 18,354 recorded nests (Gladys Porter Zoo 2016). At this time, it is unclear if future nesting will steadily and continuously increase, similar to what occurred from 1990-2009, or if nesting will continue to exhibit sporadic declines and increases as recorded in the past 5 years.

A small nesting population is also emerging in the United States, primarily in Texas, rising from 6 nests in 1996 to 42 in 2004, to a record high of 209 nests in 2012 (National Park Service data, http://www.nps.gov/pais/naturescience/strp.htm, http://www.nps.gov/pais/naturescience/current-season.htm). It is worth noting that nesting in Texas has paralleled the trends observed in Mexico, with a significant decline in 2010 followed by a second decline in 2013-2014. Nesting rebounded in 2015, as 159 nests were documented along the Texas coast (D. Shaver, National Park Service, pers. comm. to M. Barnette, NMFS PRD, October 28, 2015).

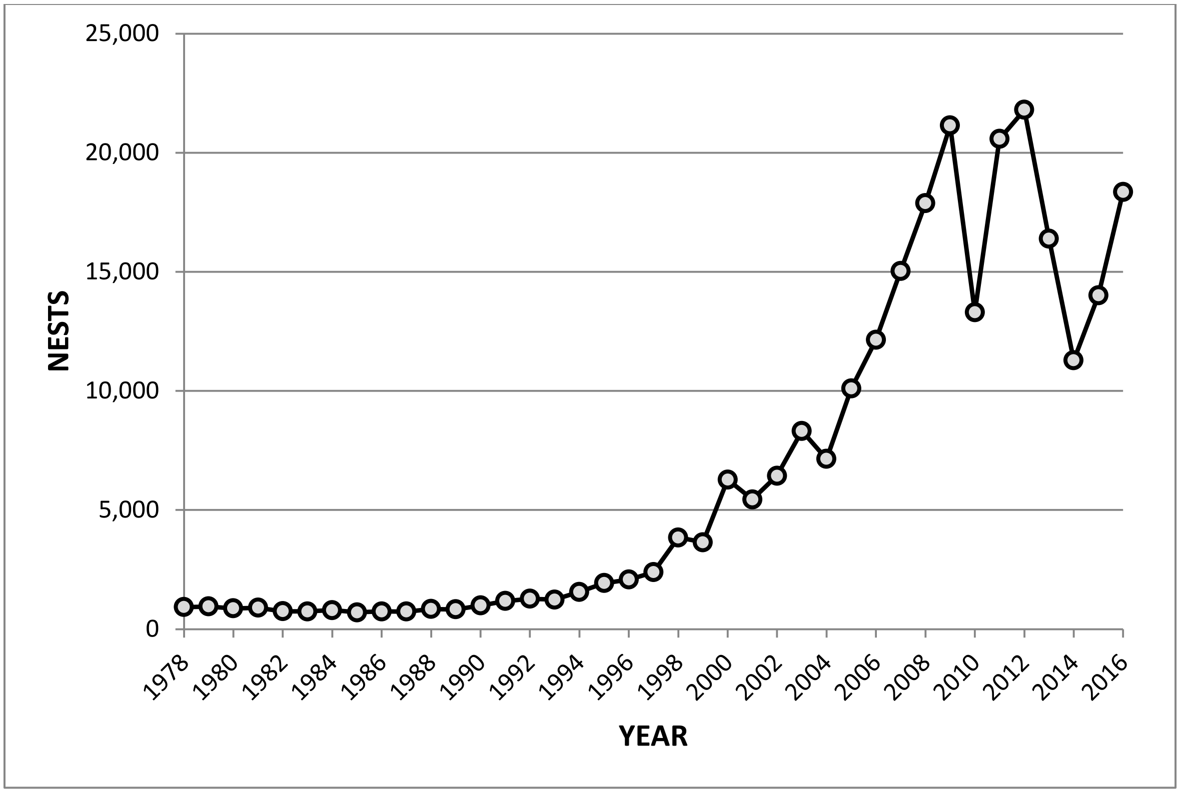

Figure 5. Kemp's ridley nest totals from Mexican beaches (Gladys Porter Zoo nesting database 2016)

Through modelling, Heppell et al. (2005) predicted the population is expected to increase at least 12-16% per year and could reach at least 10,000 females nesting on Mexico beaches by 2015. NMFS et al. (2011b) produced an updated model that predicted the population to increase 19% per year and to attain at least 10,000 females nesting on Mexico beaches by 2011. Approximately 25,000 nests would be needed for an estimate of 10,000 nesters on the beach, based on an average 2.5 nests/nesting female. While counts did not reach 25,000 nests by 2015, it is clear that the population has increased over the long term. The increases in Kemp's ridley sea turtle nesting over the last 2 decades is likely due to a combination of management measures including elimination of direct harvest, nest protection, the use of TEDs, reduced trawling effort in Mexico and the United States, and possibly other changes in vital rates (TEWG 1998a; TEWG 2000). While these results are encouraging, the species' limited range as well as low global abundance makes it particularly vulnerable to new sources of mortality as well as demographic and environmental randomness, all factors which are often difficult to predict with any certainty. Additionally, the significant nesting declines observed in 2010 and 2013-2014 potentially indicate a serious population-level impact, and there is cause for concern regarding the ongoing recovery trajectory.

Threats

Kemp's ridley sea turtles face many of the same threats as other sea turtle species, including destruction of nesting habitat from storm events, oceanic events such as cold-stunning, pollution (plastics, petroleum products, petrochemicals, etc.), ecosystem alterations (nesting beach development, beach nourishment and shoreline stabilization, vegetation changes, etc.), poaching, global climate change, fisheries interactions, natural predation, and disease. A discussion on general sea turtle threats can be found in Section 4.4; the remainder of this section will expand on a few of the aforementioned threats and how they may specifically impact Kemp's ridley sea turtles.

As Kemp's ridley sea turtles continue to recover and nesting arribadas[4] are increasingly established, bacterial and fungal pathogens in nests are also likely to increase. Bacterial and fungal pathogen impacts have been well documented in the large arribadas of the olive ridley at Nancite in Costa Rica (Mo 1988). In some years, and on some sections of the beach, the hatching success can be as low as 5% (Mo 1988). As the Kemp's ridley nest density at Rancho Nuevo and adjacent beaches continues to increase, appropriate monitoring of emergence success will be necessary to determine if there are any density-dependent effects.

Over the past 6 years, NMFS has documented (via the Sea Turtle Stranding and Salvage Network data, http://www.sefsc.noaa.gov/species/turtles/strandings.htm) elevated sea turtle strandings in the Northern Gulf of Mexico, particularly throughout the Mississippi Sound area. In the first 3 weeks of June 2010, over 120 sea turtle strandings were reported from Mississippi and Alabama waters, none of which exhibited any signs of external oiling to indicate effects associated with the DWH oil spill event. A total of 644 sea turtle strandings were reported in 2010 from Louisiana, Mississippi, and Alabama waters, 561 (87%) of which were Kemp's ridley sea turtles. During March through May of 2011, 267 sea turtle strandings were reported from Mississippi and Alabama waters alone. A total of 525 sea turtle strandings were reported in 2011 from Louisiana, Mississippi, and Alabama waters, with the majority (455) having occurred from March through July, 390 (86%) of which were Kemp's ridley sea turtles. During 2012, a total of 384 sea turtles were reported from Louisiana, Mississippi, and Alabama waters. Of these reported strandings, 343 (89%) were Kemp's ridley sea turtles. During 2014, a total of 285 sea turtles were reported from Louisiana, Mississippi, and Alabama waters, though the data is incomplete. Of these reported strandings, 229 (80%) were Kemp's ridley sea turtles. These stranding numbers are significantly greater than reported in past years; Louisiana, Mississippi, and Alabama waters reported 42 and 73 sea turtle strandings for 2008 and 2009, respectively. It should be noted that stranding coverage has increased considerably due to the DWH oil spill event.

Nonetheless, considering that strandings typically represent only a small fraction of actual mortality, these stranding events potentially represent a serious impact to the recovery and survival of the local sea turtle populations. While a definitive cause for these strandings has not been identified, necropsy results indicate a significant number of stranded turtles from these events likely perished due to forced submergence, which is commonly associated with fishery interactions (B. Stacy, NMFS, pers. comm. to M. Barnette, NMFS PRD, March 2012). Yet, available information indicates fishery effort was extremely limited during the stranding events. The fact that 80% or more of all Louisiana, Mississippi, and Alabama stranded sea turtles in the past 5 years were Kemp's ridleys is notable; however, this could simply be a function of the species' preference for shallow, inshore waters coupled with increased population abundance, as reflected in recent Kemp's ridley nesting increases.

---

[4] Arribada is the Spanish word for "arrival" and is the term used for massive synchronized nesting within the genus *Lepidochelys.*

In response to these strandings, and due to speculation that fishery interactions may be the cause, fishery observer effort was shifted to evaluate the inshore skimmer trawl fishery during the summer of 2012. During May-July of that year, observers reported 24 sea turtle interactions in the skimmer trawl fishery. All but a single sea turtle were identified as Kemp's ridleys (1 sea turtle was an unidentified hardshell turtle). Encountered sea turtles were all very small juvenile specimens, ranging from 7.6-19.0 in (19.4-48.3 cm) curved carapace length (CCL). All sea turtles were released alive. The small average size of encountered Kemp's ridleys introduces a potential conservation issue, as over 50% of these reported sea turtles could potentially pass through the maximum 4-in bar spacing of TEDs currently required in the shrimp fishery. Due to this issue, a proposed 2012 rule to require TEDs in the skimmer trawl fishery (77 FR 27411) was not implemented. Based on anecdotal information, these interactions were a relatively new issue for the inshore skimmer trawl fishery. Given the nesting trends and habitat utilization of Kemp's ridley sea turtles, it is likely that fishery interactions in the Northern Gulf of Mexico may continue to be an issue of concern for the species, and one that may potentially slow the rate of recovery for Kemp's ridley sea turtles.

While oil spill impacts are discussed generally for all species in Section 4.4, specific impacts of the DWH oil spill event on Kemp's ridley sea turtles are considered here. Kemp's ridleys experienced the greatest negative impact stemming from the DWH oil spill event of any sea turtle species. Impacts to Kemp's ridley sea turtles occurred to offshore small juveniles, as well as large juveniles and adults. Loss of hatchling production resulting from injury to adult turtles was also estimated for this species. Injuries to adult turtles of other species, such as loggerheads, certainly would have resulted in unrealized nests and hatchlings to those species as well. Yet, the calculation of unrealized nests and hatchlings was limited to Kemp's ridleys for several reasons. All Kemp's ridleys in the Gulf belong to the same population (NMFS et al. 2011b), so total population abundance could be calculated based on numbers of hatchlings because all individuals that enter the population could reasonably be expected to inhabit the northern Gulf of Mexico throughout their lives (DWH Trustees 2015).

A total of 217,000 small juvenile Kemp's ridleys (51.5% of the total small juvenile sea turtle exposures to oil from the spill) were estimated to have been exposed to oil. That means approximately half of all small juvenile Kemp's ridleys from the total population estimate of 430,000 oceanic small juveniles were exposed to oil. Furthermore, a large number of small juveniles were removed from the population, as up to 90,300 small juveniles Kemp's ridleys are estimated to have died as a direct result of the exposure. Therefore, as much as 20% of the small oceanic juveniles of this species were killed during that year. Impacts to large juveniles (>3 years old) and adults were also high. An estimated 21,990 such individuals were exposed to oil (about 22% of the total estimated population for those age classes); of those, 3,110 mortalities were estimated (or 3% of the population for those age classes). The loss of near-reproductive and reproductive-stage females would have contributed to some extent to the decline in total nesting abundance observed between 2011 and 2014. The estimated number of unrealized Kemp's ridley nests is between 1,300 and 2,000, which translates to between approximately 65,000 and 95,000 unrealized hatchlings (DWH Trustees 2015). This is a minimum estimate, however, because the sublethal effects of the DWH oil spill event on turtles, their prey, and their habitats might have delayed or reduced reproduction in subsequent years, which may have contributed substantially to additional nesting deficits observed following the DWH oil spill event. These sublethal effects could have slowed growth and maturation rates, increased remigration intervals, and decreased clutch frequency (number of nests per female per nesting season). The nature of the DWH oil spill event effect on reduced Kemp's ridley nesting abundance and associated hatchling production after 2010 requires further evaluation. It is clear that the DWH oil spill event resulted in large losses to the Kemp's ridley population across various age classes, and likely had an important population-level effect on the species. Still, we do not have a clear understanding of those impacts on the population trajectory for the species into the future.

4.7 Status of Loggerhead Sea Turtle – Northwest Atlantic (NWA) DPS

The loggerhead sea turtle was listed as a threatened species throughout its global range on July 28, 1978. NMFS and USFWS published a Final Rule which designated 9 DPSs for loggerhead sea turtles (76 FR 58868, September 22, 2011, and effective October 24, 2011). This rule listed the following DPSs: (1) Northwest Atlantic Ocean (threatened), (2) Northeast Atlantic Ocean (endangered), (3) South Atlantic Ocean (threatened), (4) Mediterranean Sea (endangered), (5) North Pacific Ocean (endangered), (6) South Pacific Ocean (endangered), (7) North Indian Ocean (endangered), (8) Southeast Indo-Pacific Ocean (endangered), and (9) Southwest Indian Ocean (threatened). The Northwest Atlantic (NWA) DPS is the only one that occurs within the action area, and therefore it is the only one considered in this Opinion.

Species Description and Distribution

Loggerheads are large sea turtles. Adults in the southeast United States average about 3 ft (92 cm) long, measured as a straight carapace length (SCL), and weigh approximately 255 lb (116 kg) (Ehrhart and Yoder 1978). Adult and subadult loggerhead sea turtles typically have a light yellow plastron and a reddish brown carapace covered by non-overlapping scutes that meet along seam lines. They typically have 11 or 12 pairs of marginal scutes, 5 pairs of costals, 5 vertebrals, and a nuchal (precentral) scute that is in contact with the first pair of costal scutes (Dodd Jr. 1988).

The loggerhead sea turtle inhabits continental shelf and estuarine environments throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans (Dodd Jr. 1988). Habitat uses within these areas vary by life stage. Juveniles are omnivorous and forage on crabs, mollusks, jellyfish, and vegetation at or near the surface (Dodd Jr. 1988). Subadult and adult loggerheads are primarily found in coastal waters and eat benthic invertebrates such as mollusks and decapod crustaceans in hard bottom habitats.

The majority of loggerhead nesting occurs at the western rims of the Atlantic and Indian Oceans concentrated in the north and south temperate zones and subtropics (NRC 1990b). For the NWA DPS, most nesting occurs along the coast of the United States, from southern Virginia to Alabama. Additional nesting beaches for this DPS are found along the northern and western Gulf of Mexico, eastern Yucatán Peninsula, at Cay Sal Bank in the eastern Bahamas (Addison 1997; Addison and Morford 1996), off the southwestern coast of Cuba (Moncada Gavilan 2001), and along the coasts of Central America, Colombia, Venezuela, and the eastern Caribbean Islands.

Non-nesting, adult female loggerheads are reported throughout the U.S. Atlantic, Gulf of Mexico, and Caribbean Sea. Little is known about the distribution of adult males who are seasonally abundant near nesting beaches. Aerial surveys suggest that loggerheads as a whole are distributed in U.S. waters as follows: 54% off the southeast U.S. coast, 29% off the northeast U.S. coast, 12% in the eastern Gulf of Mexico, and 5% in the western Gulf of Mexico (TEWG 1998a).

Within the NWA DPS, most loggerhead sea turtles nest from North Carolina to Florida and along the Gulf Coast of Florida. Previous Section 7 analyses have recognized at least 5 western Atlantic subpopulations, divided geographically as follows: (1) a Northern nesting subpopulation, occurring from North Carolina to northeast Florida at about 29ºN; (2) a South Florida nesting subpopulation, occurring from 29°N on the east coast of the state to Sarasota on the west coast; (3) a Florida Panhandle nesting subpopulation, occurring at Eglin Air Force Base and the beaches near Panama City, Florida; (4) a Yucatán nesting subpopulation, occurring on the eastern Yucatán Peninsula, Mexico (Márquez M. 1990; TEWG 2000); and (5) a Dry Tortugas nesting subpopulation, occurring in the islands of the Dry Tortugas, near Key West, Florida (NMFS 2001).

The recovery plan for the Northwest Atlantic population of loggerhead sea turtles concluded that there is no genetic distinction between loggerheads nesting on adjacent beaches along the Florida Peninsula. It also concluded that specific boundaries for subpopulations could not be designated based on genetic differences alone. Thus, the recovery plan uses a combination of geographic distribution of nesting densities, geographic separation, and geopolitical boundaries, in addition to genetic differences, to identify recovery units. The recovery units are as follows: (1) the Northern Recovery Unit (Florida/Georgia border north through southern Virginia), (2) the Peninsular Florida Recovery Unit (Florida/Georgia border through Pinellas County, Florida), (3) the Dry Tortugas Recovery Unit (islands located west of Key West, Florida), (4) the Northern Gulf of Mexico Recovery Unit (Franklin County, Florida, through Texas), and (5) the Greater Caribbean Recovery Unit (Mexico through French Guiana, the Bahamas, Lesser Antilles, and Greater Antilles) (NMFS and USFWS 2008b). The recovery plan concluded that all recovery units are essential to the recovery of the species. Although the recovery plan was written prior to the listing of the NWA DPS, the recovery units for what was then termed the Northwest Atlantic population apply to the NWA DPS.

Life History Information

The Northwest Atlantic Loggerhead Recovery Team defined the following 8 life stages for the loggerhead life cycle, which include the ecosystems those stages generally use: (1) egg (terrestrial zone), (2) hatchling stage (terrestrial zone), (3) hatchling swim frenzy and transitional stage (neritic zone[5]), (4) juvenile stage (oceanic zone), (5) juvenile stage (neritic zone), (6) adult stage (oceanic zone), (7) adult stage (neritic zone), and (8) nesting female (terrestrial zone) (NMFS and USFWS 2008b). Loggerheads are long-lived animals. They reach sexual maturity between 20-38 years of age, although age of maturity varies widely among populations (Frazer and Ehrhart 1985; NMFS 2001). The annual mating season occurs from late March to early June, and female turtles lay eggs throughout the summer months. Females deposit an average of 4.1 nests within a nesting season (Murphy and Hopkins 1984), but an individual female only nests every 3.7 years on average (Tucker 2010). Each nest contains an average of 100-126 eggs

[5] Neritic refers to the nearshore marine environment from the surface to the sea floor where water depths do not exceed 200 meters.

(Dodd Jr. 1988) which incubate for 42-75 days before hatching (NMFS and USFWS 2008b). Loggerhead hatchlings are 1.5-2 inches long and weigh about 0.7 oz (20 g).

As post-hatchlings, loggerheads hatched on U.S. beaches enter the "oceanic juvenile" life stage, migrating offshore and becoming associated with *Sargassum* habitats, driftlines, and other convergence zones (Carr 1986; Conant et al. 2009a; Witherington 2002). Oceanic juveniles grow at rates of 1-2 inches (2.9-5.4 cm) per year (Bjorndal et al. 2003; Snover 2002) over a period as long as 7-12 years (Bolten et al. 1998) before moving to more coastal habitats. Studies have suggested that not all loggerhead sea turtles follow the model of circumnavigating the North Atlantic Gyre as pelagic juveniles, followed by permanent settlement into benthic environments (Bolten and Witherington 2003; Laurent et al. 1998). These studies suggest some turtles may either remain in the oceanic habitat in the North Atlantic longer than hypothesized, or they move back and forth between oceanic and coastal habitats interchangeably (Witzell 2002). Stranding records indicate that when immature loggerheads reach 15-24 in (40-60 cm) SCL, they begin to reside in coastal inshore waters of the continental shelf throughout the U.S. Atlantic and Gulf of Mexico (Witzell 2002).

After departing the oceanic zone, neritic juvenile loggerheads in the Northwest Atlantic inhabit continental shelf waters from Cape Cod Bay, Massachusetts, south through Florida, The Bahamas, Cuba, and the Gulf of Mexico. Estuarine waters of the United States, including areas such as Long Island Sound, Chesapeake Bay, Pamlico and Core Sounds, Mosquito and Indian River Lagoons, Biscayne Bay, Florida Bay, as well as numerous embayments fringing the Gulf of Mexico, comprise important inshore habitat. Along the Atlantic and Gulf of Mexico shoreline, essentially all shelf waters are inhabited by loggerheads (Conant et al. 2009a).

Like juveniles, non-nesting adult loggerheads also use the neritic zone. However, these adult loggerheads do not use the relatively enclosed shallow-water estuarine habitats with limited ocean access as frequently as juveniles. Areas such as Pamlico Sound, North Carolina, and the Indian River Lagoon, Florida, are regularly used by juveniles but not by adult loggerheads. Adult loggerheads do tend to use estuarine areas with more open ocean access, such as the Chesapeake Bay in the U.S. mid-Atlantic. Shallow-water habitats with large expanses of open ocean access, such as Florida Bay, provide year-round resident foraging areas for significant numbers of male and female adult loggerheads (Conant et al. 2009a).

Offshore, adults primarily inhabit continental shelf waters, from New York south through Florida, The Bahamas, Cuba, and the Gulf of Mexico. Seasonal use of mid-Atlantic shelf waters, especially offshore New Jersey, Delaware, and Virginia during summer months, and offshore shelf waters, such as Onslow Bay (off the North Carolina coast), during winter months has also been documented (Hawkes et al. 2007); Georgia Department of Natural Resources, unpublished data; South Carolina Department of Natural Resources, unpublished data). Satellite telemetry has identified the shelf waters along the west Florida coast, The Bahamas, Cuba, and the Yucatán Peninsula as important resident areas for adult female loggerheads that nest in Florida (Foley et al. 2008; Girard et al. 2009; Hart et al. 2012). The southern edge of the Grand Bahama Bank is important habitat for loggerheads nesting on the Cay Sal Bank in The Bahamas, but nesting females are also resident in the bights of Eleuthera, Long Island, and Ragged Islands. They also reside in Florida Bay in the United States, and along the north coast of Cuba (A. Bolten and K.

Bjorndal, University of Florida, unpublished data). Moncada et al. (2010) report the recapture of 5 adult female loggerheads in Cuban waters originally flipper-tagged in Quintana Roo, Mexico, which indicates that Cuban shelf waters likely also provide foraging habitat for adult females that nest in Mexico.

Status and Population Dynamics
A number of stock assessments and similar reviews (Conant et al. 2009a; Heppell et al. 2003; NMFS-SEFSC 2009a; NMFS 2001; NMFS and USFWS 2008b; TEWG 1998a; TEWG 2000; TEWG 2009) have examined the stock status of loggerheads in the Atlantic Ocean, but none have been able to develop a reliable estimate of absolute population size.

Numbers of nests and nesting females can vary widely from year to year. Nesting beach surveys, though, can provide a reliable assessment of trends in the adult female population, due to the strong nest site fidelity of female loggerhead sea turtles, as long as such studies are sufficiently long and survey effort and methods are standardized (e.g., (NMFS and USFWS 2008b). NMFS and USFWS (2008b) concluded that the lack of change in 2 important demographic parameters of loggerheads, remigration interval and clutch frequency, indicate that time series on numbers of nests can provide reliable information on trends in the female population.

Peninsular Florida Recovery Unit
The Peninsular Florida Recovery Unit (PFRU) is the largest loggerhead nesting assemblage in the Northwest Atlantic. A near-complete nest census (all beaches including index nesting beaches) undertaken from 1989 to 2007 showed an average of 64,513 loggerhead nests per year, representing approximately 15,735 nesting females per year (NMFS and USFWS 2008b). The statewide estimated total for 2015 was 89,295 nests (FWRI nesting database).

In addition to the total nest count estimates, the Florida Fish and Wildlife Research Institute (FWRI) uses an index nesting beach survey method. The index survey uses standardized data-collection criteria to measure seasonal nesting and allow accurate comparisons between beaches and between years. This provides a better tool for understanding the nesting trends (Figure 6). FWRI performed a detailed analysis of the long-term loggerhead index nesting data (1989-2016; http://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead-trend/). Over that time period, 3 distinct trends were identified. From 1989-1998, there was a 24% increase that was followed by a sharp decline over the subsequent 9 years. A large increase in loggerhead nesting has occurred since, as indicated by the 71% increase in nesting over the 10-year period from 2007 and 2016. Nesting in 2016 also represents a new record for loggerheads on the core index beaches. FWRI examined the trend from the 1998 nesting high through 2016 and found that the decade-long post-1998 decline was replaced with a slight but nonsignificant increasing trend. Looking at the data from 1989 through 2016, FWRI concluded that there was an overall positive change in the nest counts although it was not statistically significant due to the wide variability between 2012-2016 resulting in widening confidence intervals (http://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead-trend/).

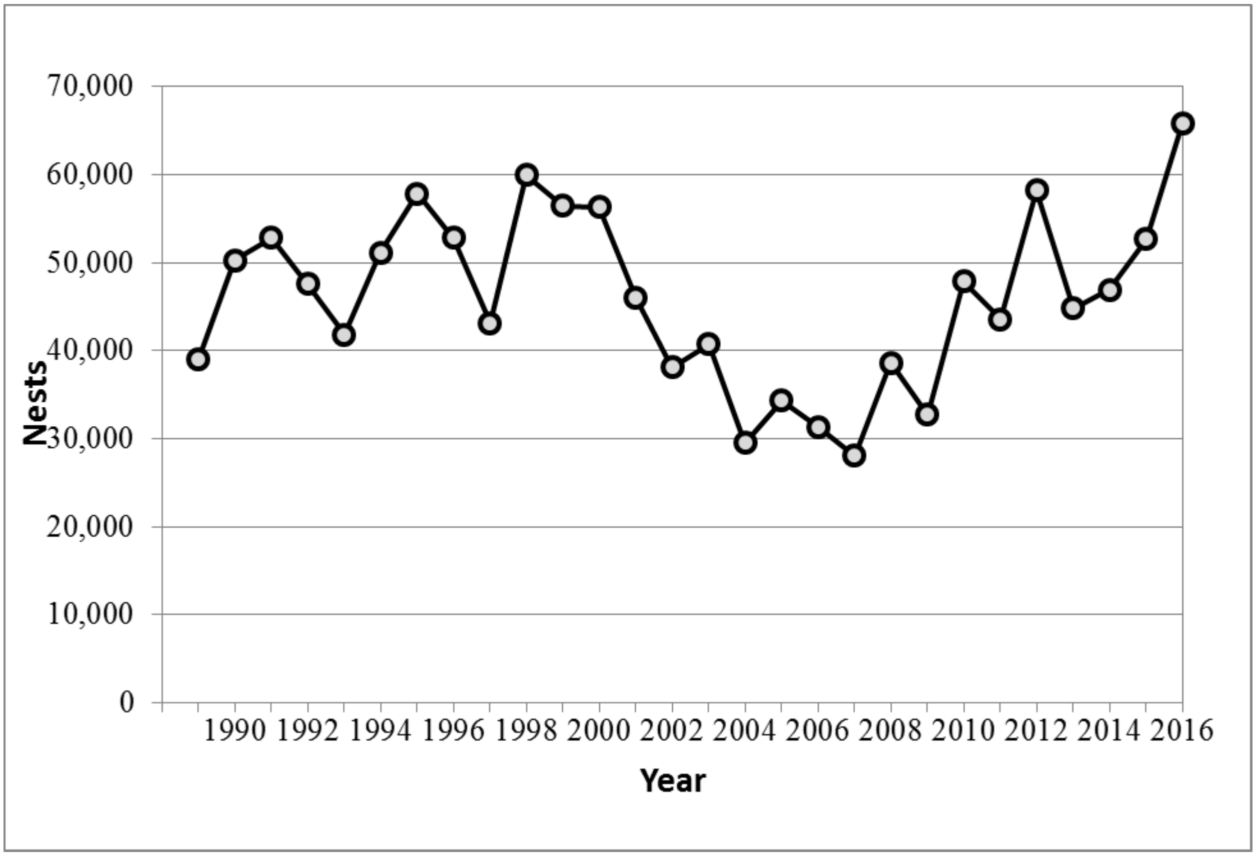

Figure 6. Loggerhead sea turtle nesting at Florida index beaches since 1989

Northern Recovery Unit

Annual nest totals from beaches within the Northern Recovery Unit (NRU) averaged 5,215 nests from 1989-2008, a period of near-complete surveys of NRU nesting beaches (Georgia Department of Natural Resources [GADNR] unpublished data, North Carolina Wildlife Resources Commission [NCWRC] unpublished data, South Carolina Department of Natural Resources [SCDNR] unpublished data), and represent approximately 1,272 nesting females per year, assuming 4.1 nests per female (Murphy and Hopkins 1984). The loggerhead nesting trend from daily beach surveys showed a significant decline of 1.3% annually from 1989-2008. Nest totals from aerial surveys conducted by SCDNR showed a 1.9% annual decline in nesting in South Carolina from 1980-2008. Overall, there are strong statistical data to suggest the NRU had experienced a long-term decline over that period of time.

Data since that analysis (Table 4) are showing improved nesting numbers and a departure from the declining trend. Georgia nesting has rebounded to show the first statistically significant increasing trend since comprehensive nesting surveys began in 1989 (Mark Dodd, GADNR press release, http://www.georgiawildlife.com/node/3139). South Carolina and North Carolina nesting have also begun to shift away from the past declining trend. Loggerhead nesting in Georgia, South Carolina, and North Carolina all broke records in 2015 and then topped those records again in 2016.

Table 4. Total Number of NRU Loggerhead Nests (GADNR, SCDNR, and NCWRC nesting datasets compiled at Seaturtle.org)

Nests Recorded	2008	2009	2010	2011	2012	2013	2014	2015	2016
Georgia	1,649	998	1,760	1,992	2,241	2,289	1,196	2,319	3,265
South Carolina	4,500	2,182	3,141	4,015	4,615	5,193	2,083	5,104	6,443
North Carolina	841	302	856	950	1,074	1,260	542	1,254	1,612
Total	**6,990**	**3,472**	**5,757**	**6,957**	**7,930**	**8,742**	**3,821**	**8,677**	**11,320**

South Carolina also conducts an index beach nesting survey similar to the one described for Florida. Although the survey only includes a subset of nesting, the standardized effort and locations allow for a better representation of the nesting trend over time. Increases in nesting were seen for the period from 2009-2013, with a subsequent steep drop in 2014. Nesting then rebounded in 2015 and 2016, setting new highs each of those years (Figure 7).

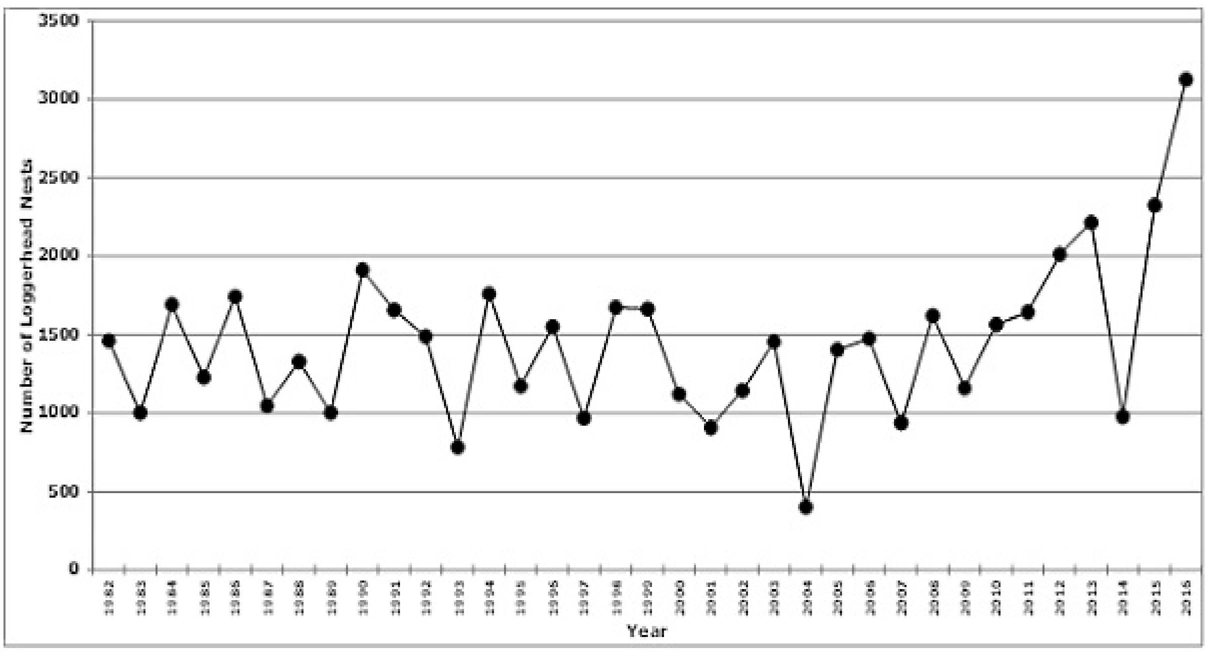

Figure 7. South Carolina index nesting beach counts for loggerhead sea turtles (from the SCDNR website: http://www.dnr.sc.gov/seaturtle/nest.htm)

<u>Other Northwest Atlantic DPS Recovery Units</u>

The remaining 3 recovery units—Dry Tortugas (DTRU), Northern Gulf of Mexico (NGMRU), and Greater Caribbean (GCRU)—are much smaller nesting assemblages, but they are still considered essential to the continued existence of the species. Nesting surveys for the DTRU are conducted as part of Florida's statewide survey program. Survey effort was relatively stable during the 9-year period from 1995-2004, although the 2002 year was missed. Nest counts ranged from 168-270, with a mean of 246, but there was no detectable trend during this period (NMFS and USFWS 2008b). Nest counts for the NGMRU are focused on index beaches rather than all beaches where nesting occurs. Analysis of the 12-year dataset (1997-2008) of index nesting beaches in the area shows a statistically significant declining trend of 4.7% annually. Nesting on the Florida Panhandle index beaches, which represents the majority of NGMRU nesting, had shown a large increase in 2008, but then declined again in 2009 and 2010 before rising back to a level similar to the 2003-2007 average in 2011. Nesting survey effort has been inconsistent among the GCRU nesting beaches, and no trend can be determined for this subpopulation (NMFS and USFWS 2008b). Zurita et al. (2003) found a statistically significant increase in the number of nests on 7 of the beaches on Quintana Roo, Mexico, from 1987-2001, where survey effort was consistent during the period. Nonetheless, nesting has declined since 2001, and the previously reported increasing trend appears to not have been sustained (NMFS and USFWS 2008b).

In-water Trends

Nesting data are the best current indicator of sea turtle population trends, but in-water data also provide some insight. In-water research suggests the abundance of neritic juvenile loggerheads is steady or increasing. Although Ehrhart et al. (2007) found no significant regression-line trend in a long-term dataset, researchers have observed notable increases in catch per unit effort (CPUE) (Arendt et al. 2009; Ehrhart et al. 2007; Epperly et al. 2007). Researchers believe that this increase in CPUE is likely linked to an increase in juvenile abundance, although it is unclear whether this increase in abundance represents a true population increase among juveniles or merely a shift in spatial occurrence. Bjorndal et al. (2005), cited in NMFS and USFWS (2008b), caution about extrapolating localized in-water trends to the broader population and relating localized trends in neritic sites to population trends at nesting beaches. The apparent overall increase in the abundance of neritic loggerheads in the southeastern United States may be due to increased abundance of the largest oceanic/neritic juveniles (historically referred to as small benthic juveniles), which could indicate a relatively large number of individuals around the same age may mature in the near future (TEWG 2009). In-water studies throughout the eastern United States, however, indicate a substantial decrease in the abundance of the smallest oceanic/neritic juvenile loggerheads, a pattern corroborated by stranding data (TEWG 2009).

Population Estimate

The NMFS Southeast Fisheries Science Center developed a preliminary stage/age demographic model to help determine the estimated impacts of mortality reductions on loggerhead sea turtle population dynamics (NMFS-SEFSC 2009a). The model uses the range of published information for the various parameters including mortality by stage, stage duration (years in a stage), and fecundity parameters such as eggs per nest, nests per nesting female, hatchling emergence success, sex ratio, and remigration interval. Resulting trajectories of model runs for each individual recovery unit, and the western North Atlantic population as a whole, were found to be very similar. The model run estimates from the adult female population size for the western North Atlantic (from the 2004-2008 time frame), suggest the adult female population size is approximately 20,000-40,000 individuals, with a low likelihood of females' numbering up to 70,000 (NMFS-SEFSC 2009a). A less robust estimate for total benthic females in the western North Atlantic was also obtained, yielding approximately 30,000-300,000 individuals, up to less than 1 million (NMFS-SEFSC 2009a). A preliminary regional abundance survey of loggerheads within the northwestern Atlantic continental shelf for positively identified loggerhead in all strata estimated about 588,000 loggerheads (interquartile range of 382,000-817,000). When correcting for unidentified turtles in proportion to the ratio of identified turtles, the estimate increased to about 801,000 loggerheads (interquartile range of 521,000-1,111,000) (NMFS-NEFSC 2011).

Threats (Specific to Loggerhead Sea Turtles)
The threats faced by loggerhead sea turtles are well summarized in the general discussion of threats in Section 4.2.1. Yet the impact of fishery interactions is a point of further emphasis for this species. The joint NMFS and USFWS Loggerhead Biological Review Team determined that the greatest threats to the NWA DPS of loggerheads result from cumulative fishery bycatch in neritic and oceanic habitats (Conant et al. 2009a).

Regarding the impacts of pollution, loggerheads may be particularly affected by organochlorine contaminants; they have the highest organochlorine concentrations (Storelli et al. 2008a) and metal loads (D'Ilio et al. 2011) in sampled tissues among the sea turtle species. It is thought that dietary preferences were likely to be the main differentiating factor among sea turtle species. Storelli et al. (2008a) analyzed tissues from stranded loggerhead sea turtles and found that mercury accumulates in sea turtle livers while cadmium accumulates in their kidneys, as has been reported for other marine organisms like dolphins, seals, and porpoises (Law et al. 1991b).

While oil spill impacts are discussed generally for all species in Section 4.2.1, specific impacts of the DWH oil spill event on loggerhead sea turtles are considered here. Impacts to loggerhead sea turtles occurred to offshore small juveniles as well as large juveniles and adults. A total of 30,800 small juvenile loggerheads (7.3% of the total small juvenile sea turtle exposures to oil from the spill) were estimated to have been exposed to oil. Of those exposed, 10,700 small juveniles are estimated to have died as a result of the exposure. In contrast to small juveniles, loggerheads represented a large proportion of the adults and large juveniles exposed to and killed by the oil. There were 30,000 exposures (almost 52% of all exposures for those age/size classes) and 3,600 estimated mortalities. A total of 265 nests (27,618 eggs) were also translocated during response efforts, with 14,216 hatchlings released, the fate of which is unknown (DWH Trustees 2015). Additional unquantified effects may have included inhalation of volatile compounds, disruption of foraging or migratory movements due to surface or subsurface oil, ingestion of prey species contaminated with oil and/or dispersants, and loss of foraging resources which could lead to compromised growth and/or reproductive potential. There is no information currently available to determine the extent of those impacts, if they occurred.

Unlike Kemp's ridleys, the majority of nesting for the Northwest Atlantic Ocean loggerhead DPS occurs on the Atlantic coast, and thus loggerheads were impacted to a relatively lesser degree. However, it is likely that impacts to the NGMRU of the NWA loggerhead DPS would be proportionally much greater than the impacts occurring to other recovery units. Impacts to nesting and oiling effects on a large proportion of the NGMRU recovery unit, especially mating and nesting adults likely had an impact on the NGMRU. Based on the response injury evaluations for Florida Panhandle and Alabama nesting beaches (which fall under the NFMRU), the Trustees estimated that approximately 20,000 loggerhead hatchlings were lost due to DWH oil spill response activities on nesting beaches. Although the long-term effects remain unknown, the DWH oil spill event impacts to the Northern Gulf of Mexico Recovery Unit may result in some nesting declines in the future due to a large reduction of oceanic age classes during the DWH oil spill event. Although adverse impacts occurred to loggerheads, the proportion of the population that is expected to have been exposed to and directly impacted by the DWH oil spill event is relatively low. Thus we do not believe a population-level impact occurred due to the widespread distribution and nesting location outside of the Gulf of Mexico for this species.

Specific information regarding potential climate change impacts on loggerheads is also available. Modeling suggests an increase of 2°C in air temperature would result in a sex ratio of over 80% female offspring for loggerheads nesting near Southport, North Carolina. The same increase in air temperatures at nesting beaches in Cape Canaveral, Florida, would result in close to 100% female offspring. Such highly skewed sex ratios could undermine the reproductive capacity of the species. More ominously, an air temperature increase of 3°C is likely to exceed the thermal threshold of most nests, leading to egg mortality (Hawkes et al. 2007). Warmer sea surface temperatures have also been correlated with an earlier onset of loggerhead nesting in the spring (Hawkes et al. 2007; Weishampel et al. 2004), short inter-nesting intervals (Hays et al. 2002), and shorter nesting seasons (Pike et al. 2006).

4.8 Status of Atlantic Sturgeon – All DPSs

Five separate DPSs of Atlantic sturgeon were listed under the ESA by NMFS effective April 6, 2012 (77 FR 5880 and 5914, February 6, 2012). The New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs were listed as endangered. The Gulf of Maine DPS was listed as threatened.

Species Descriptions and Distributions

Atlantic sturgeon are long-lived, late-maturing, estuarine-dependent, anadromous fish distributed along the eastern coast of North America (Waldman and Wirgin 1998). Historically, sightings have been reported from Hamilton Inlet, Labrador, south to the St. Johns River, Florida (Murawski et al. 1977; Smith and Clugston 1997). Atlantic sturgeon may live up to 60 years, reach lengths up to 14 ft, and weigh over 800 lb (ASSRT 2007; Collette and Klein-MacPhee 2002). They are distinguished by armor-like plates (called scutes) and a long protruding snout that has 4 barbels (slender, whisker-like feelers extending from the head used for touch and taste). Atlantic sturgeon spend the majority of their lives in nearshore marine waters, returning to their natal rivers to spawn (Wirgin et al. 2002). Young sturgeon may spend the first few years of life in their natal river estuary before moving out to sea (Wirgin et al. 2002). Sturgeon are omnivorous benthic (bottom) feeders and filter quantities of mud along with their food. Adult sturgeon diets include mollusks, gastropods, amphipods, isopods, and small fishes, especially sand lances (*Ammodytes* sp.) (Scott and Crossman 1973). Juvenile sturgeon feed on aquatic insects and other invertebrates (Smith 1985).

Historically, Atlantic sturgeon were present in approximately 38 rivers in the United States from the St. Croix River, Maine to the St. Johns River, Florida, of which 35 rivers have been confirmed to have had a historical spawning population. Atlantic sturgeon are currently present in approximately 32 of these rivers, and spawning occurs in at least 20 of them. The marine range of Atlantic sturgeon extends from the Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. Because adult Atlantic sturgeon from all DPSs mix extensively in marine waters, we expect fish from all DPSs to be found in the action area.

Life History Information

Atlantic sturgeon populations show clinal variation, with a general trend of faster growth and earlier age at maturity in more southern systems. Atlantic sturgeon mature between the ages of 5-19 years in South Carolina (Smith et al. 1982), between 11-21 years in the Hudson River

(Young et al. 1988), and between 22-34 years in the St. Lawrence River (Scott and Crossman 1973). Most Atlantic sturgeon adults likely do not spawn every year. Multiple studies have shown that spawning intervals range from 1-5 years for males (Caron et al. 2002; Collins et al. 2000b; Smith 1985) and 2-5 years for females (Stevenson and Secor 1999; Van Eenennaam et al. 1996; Vladykov and Greely 1963). Fecundity of Atlantic sturgeon has been correlated with age and body size, with egg production ranging from 400,000 to 8,000,000 eggs per year (Dadswell 2006; Smith et al. 1982; Van Eenennaam and Doroshov 1998). The average age at which 50% of maximum lifetime egg production is achieved is estimated to be 29 years, approximately 3-10 times longer than for other bony fish species examined (Boreman 1997).

Spawning adult Atlantic sturgeon generally migrate upriver in spring/early summer, which occurs in February-March in southern systems, April-May in mid-Atlantic systems, and May-July in Canadian systems (Bain 1997; Caron et al. 2002; Murawski et al. 1977; Smith 1985; Smith and Clugston 1997). In some southern rivers, a fall spawning migration may also occur (Moser et al. 1998; Rogers and Weber 1995; Weber and Jennings 1996). In the fall, Hager et al. (2014) captured an Atlantic sturgeon identified as a spawned-out female due to her size and concave stomach and also noted capture of other fish showing signs of wear suggesting males had been engaging in spawning behavior. In Virginia's James River, Balazik et al. (2012) captured 1 fish identified as a female in the fall during the 3-year study with a concave condition of the abdomen consistent with female sturgeon that have spawned recently. In addition, postovulated eggs recovered from the urogenital opening were in an early degradation stage, suggesting the fish had spawned within days (Balazik et al. 2012). Further physiological support for fall spawning is provided by the 9 spermiating males captured along with the female and a grand total of 106 different spermiating males captured during August–October (Balazik et al. 2012). Randall and Sulak (2012) reported similar evidence for fall spawning of the closely related Gulf sturgeon, which included multiple captures of sturgeon in September–November that were ripe or exhibited just-spawned characteristics.

Atlantic sturgeon spawning occurs in fast-flowing water between the salt front and fall line of large rivers (Bain et al. 2000; Borodin 1925; Crance 1987; Leland 1968; Scott and Crossman 1973) over hard substrate, such as cobble, gravel, or boulders, to which the highly adhesive sturgeon eggs adhere (Gilbert 1989; Smith and Clugston 1997). Hatching occurs approximately 94-140 hours after egg deposition and larvae assume a demersal existence (Smith et al. 1980). The yolk sac larval stage is completed in about 8-12 days, during which time the larvae move downstream to rearing grounds (Kynard and Horgan 2002). During the first half of their migration downstream, movement is limited to night. During the day, larvae use benthic structure (e.g., gravel matrix) as refugia (Kynard and Horgan 2002). During the latter half of migration, when larvae are more fully developed, movement to rearing grounds occurs both day and night. Juvenile sturgeon continue to move further downstream into brackish waters, and eventually become residents in estuarine waters for months or years.

Juvenile and adult Atlantic sturgeon occupy upper estuarine habitat where they frequently congregate around the saltwater/freshwater interface. Estuarine habitats are important for juveniles, serving as nursery areas by providing abundant foraging opportunities, as well as thermal and salinity refuges, for facilitating rapid growth. Some juveniles will take up residency in non-natal rivers that lack active spawning sites (Bain 1997). Residency time of young

Atlantic sturgeon in estuarine areas varies between 1-6 years (Schueller and Peterson 2010; Smith 1985), after which Atlantic sturgeon start out-migration to the marine environment. Out-migration of adults from the estuaries to the sea is cued by water temperature and velocity. Adult Atlantic sturgeon will reside in the marine habitat during the non-spawning season and forage extensively. Coastal migrations by adult Atlantic sturgeon are extensive and are known to occur over sand and gravel substrate (Greene et al. 2009). Atlantic sturgeon remain in the marine habitat until the waters begin to warm, at which time ripening adults migrate back to their natal rivers to spawn.

Upstream migration to the spawning grounds is cued primarily by water temperature and velocity. Therefore, fish in the southern portion of the range migrate earlier than those to the north do (Kieffer and Kynard 1993; Smith 1985). In Georgia and South Carolina, migration begins in February or March (Collins et al. 2000a). Males commence upstream migration to the spawning sites when waters reach around 6°C (Dovel and Berggren 1983; Smith 1985; Smith et al. 1982), with females following a few weeks later when water temperatures are closer to 12° or 13°C (Collins et al. 2000a; Dovel and Berggren 1983; Smith 1985). In some rivers, predominantly in the south, a fall spawning migration may also occur (Moser et al. 1998; Rogers and Weber 1995), with running ripe males found August through October and post-spawning females captured in late September and October (Collins et al. 2000b).

Status and Population Dynamics

At the time Atlantic sturgeon were listed, the best available abundance information for each of the 5 DPSs was the estimated number of adult Atlantic sturgeon spawning in each of the rivers on an annual basis. The estimated number of annually spawning adults in each of the river populations is insufficient to quantify the total population numbers for each DPS of Atlantic sturgeon due to the lack of other necessary accompanying life history data. A recently Atlantic sturgeon population estimate was derived from the Northeast Area Monitoring and Assessment Program (NEAMAP). NEAMAP trawl surveys were conducted from Cape Cod, Massachusetts, to Cape Hatteras, North Carolina, in nearshore waters to depths of 60 ft from fall 2007 through spring 2012. The results of these surveys, assuming 50% gear efficiency (i.e., assumption that the gear will capture some, but not all, of the sturgeon in the water column along the tow path, and the survey area is only a portion of Atlantic sturgeon habitat), are presented in Table 6. It is important to note that the NEAMAP surveys were conducted primarily in the Northeast and may underestimate the actual population abundances of the Carolina and South Atlantic DPSs, which are likely more concentrated in the Southeast since they originated from and spawn there. However, the total ocean population abundance estimates listed in Table 5 currently represent the best available population abundance estimates for the 5 U.S. Atlantic sturgeon DPSs.

Table 5. Summary of Calculated Population Estimates of Atlantic Sturgeon based upon the NEAMAP Survey Swept Area, Assuming 50% Efficiency (NMFS 2013)

DPS	Estimated Ocean Population Abundance	Estimated Ocean Population of Adults	Estimated Ocean Population of Subadults (of size vulnerable to capture in fisheries)
South Atlantic	14,911	3,728	11,183
Carolina	1,356	339	1,017
Chesapeake Bay	8,811	2,203	6,608
New York Bight	34,566	8,642	25,925
Gulf of Maine	7,455	1,864	5,591

South Atlantic DPS

The South Atlantic DPS includes all Atlantic sturgeon that spawn or are spawned in the watersheds (including all rivers and tributaries) of the Ashepoo, Combahee, and Edisto River (ACE) Basins southward along the South Carolina, Georgia, and Florida coastal areas to the St. Johns River, Florida. Rivers known to have current spawning populations within the range of the South Atlantic DPS include the Combahee, Edisto, Savannah, Ogeechee, Altamaha, and Satilla Rivers. We determined spawning was occurring if young-of-the-year (YOY) were observed, or mature adults were present, in freshwater portions of a system. However, in some rivers, spawning by Atlantic sturgeon may not be contributing to population growth because of lack of suitable habitat and the presence of other stressors on juvenile survival and development.

Historically, both the Broad-Coosawatchie and St. Marys Rivers were documented to have spawning populations; there is also evidence that spawning may have occurred in the St. Johns River or one of its tributaries. The spawning population in the St. Marys River, as well as any historical spawning population in the St. Johns, are believed to be extirpated, and the status of the spawning population in the Broad-Coosawatchie is unknown. Both the St. Marys and St. Johns rivers are used as nursery habitat by young Atlantic sturgeon originating from other spawning populations. The use of the Broad-Coosawatchie by sturgeon from other spawning populations is unknown at this time. The presence of historical and current spawning populations in the Ashepoo River has not been documented; however, this river may currently be used for nursery habitat by young Atlantic sturgeon originating from other spawning populations. This represents our current knowledge of the river systems utilized by the South Atlantic DPS for specific life functions, such as spawning, nursery habitat, and foraging. Still, fish from the South Atlantic DPS likely use other river systems than those listed here for their specific life functions.

Prior to the collapse of the fishery in the late 1800s, the sturgeon fishery was the third largest fishery in Georgia. Secor (2002) estimated from U.S. Fish Commission landing reports that approximately 11,000 spawning females were likely present in Georgia and 8,000 adult females were present in South Carolina prior to 1890. The Altamaha River population of the South Atlantic DPS, with an estimated 343 adults spawning annually, is believed to be the largest remaining population in the Southeast, yet is estimated to be only 6% of its historical population size. The abundances of the remaining river populations within the South Atlantic DPS, each estimated to have fewer than 300 annually spawning adults, are estimated to be less than 1% of what they were historically (ASSRT 2007). The NEAMAP model estimates a minimum ocean population of 14,911 South Atlantic DPS Atlantic sturgeon, of which 3,728 are adults.

<u>Carolina DPS</u>

The Carolina DPS includes all Atlantic sturgeon that are spawned in the watersheds (including all rivers and tributaries) from the Albemarle Sound southward along the southern Virginia, North Carolina, and South Carolina coastal areas to Charleston Harbor. Rivers known to have current spawning populations within the range of the Carolina DPS include the Roanoke, Tar-Pamlico, Cape Fear, Waccamaw, and Yadkin-Pee Dee Rivers. We determined spawning was occurring if YOY were observed, or mature adults were present, in freshwater portions of a system. In some rivers, though, spawning by Atlantic sturgeon may not be contributing to population growth because of lack of suitable habitat and the presence of other stressors on juvenile survival and development. There may also be spawning populations in the Neuse, Santee, and Cooper Rivers, though it is uncertain.

Historically, both the Sampit and Ashley Rivers in South Carolina were documented to have spawning populations at one time, although the spawning population in the Sampit River is believed to be extirpated and the current status of the spawning population in the Ashley River is unknown. Both rivers may be used as nursery habitat by young Atlantic sturgeon originating from other spawning populations. This represents our current knowledge of the river systems utilized by the Carolina DPS for specific life functions, such as spawning, nursery habitat, and foraging. Still, fish from the Carolina DPS likely use other river systems than those listed here for their specific life functions.

Historical landings data indicate that between 7,000 and 10,500 adult female Atlantic sturgeon were present in North Carolina prior to 1890 (Armstrong and Hightower 2002; Secor 2002). Secor (2002) estimates that 8,000 adult females were present in South Carolina during that same time frame. The Atlantic sturgeon spawning population in at least 1 river system (the Sampit River) within the Carolina DPS has been extirpated, and the statuses of 4 additional spawning populations are uncertain. There are believed to be only 5 of 7-10 historical spawning populations remaining in the Carolina DPS. In some rivers, spawning by Atlantic sturgeon may not be contributing to population growth because of lack of suitable habitat and the presence of other stressors on juvenile survival and development. The abundances of the remaining river populations within the DPS, each estimated to have fewer than 300 spawning adults, are estimated to be less than 3% of what they were historically (ASSRT 2007). The NEAMAP model estimates a minimum ocean population of 1,356 Carolina DPS Atlantic sturgeon, of which 339 are adults.

<u>Chesapeake Bay DPS</u>

The Chesapeake Bay DPS includes all anadromous Atlantic sturgeons that are spawned in the watersheds that drain into the Chesapeake Bay and into coastal waters from the Delaware-Maryland border on Fenwick Island to Cape Henry, Virginia. Within this range, Atlantic sturgeon historically spawned in the Susquehanna, Potomac, James, York, Rappahannock, and Nottoway Rivers (ASSRT 2007). Spawning still occurs in the James River, and the presence of juvenile and adult sturgeon in the York River suggests that spawning may occur there as well (ASSRT 2007; Greene et al. 2009; Musick et al. 1994). However, conclusive evidence of current spawning is available for the James River, only. Atlantic sturgeon that are spawned elsewhere are known to use waters of the Chesapeake Bay for other life functions, such as foraging and as juvenile nursery habitat, before entering the marine system as subadults (ASSRT 2007; Grunwald et al. 2008; Vladykov and Greely 1963; Wirgin et al. 2007).

Historically, the Chesapeake Bay DPS likely supported more than 10,000 spawning adults (ASSRT 2007; KRRMP 1993; Secor 2002). Current estimates of the Chesapeake Bay DPS from the NEAMAP model (Table 6) indicate the current number of spawning adults is likely an order of magnitude lower than historical levels (ASSRT 2007; Kahnle et al. 2007). The NEAMAP model estimates a minimum ocean population of 8,811 Chesapeake Bay DPS Atlantic sturgeon, of which 2,319 are adults.

New York Bight DPS

The New York Bight DPS includes all anadromous Atlantic sturgeon that spawn in the watersheds that drain into coastal waters from Chatham, Massachusetts, to the Delaware-Maryland border on Fenwick Island. Within this range, Atlantic sturgeon historically spawned in the Connecticut, Delaware, Hudson, and Taunton Rivers (ASSRT 2007; Murawski et al. 1977; Secor 2002). Spawning still occurs in the Delaware and Hudson Rivers, but there is no recent evidence (within the last 15 years) of spawning in the Connecticut and Taunton Rivers (ASSRT 2007). Atlantic sturgeon that are spawned elsewhere continue to use habitats within the Connecticut and Taunton Rivers for other life functions (ASSRT 2007; Savoy 2007; Wirgin and King 2011).

Prior to the onset of expanded fisheries exploitation of sturgeon in the 1800s, a conservative historical estimate for the Hudson River Atlantic sturgeon population was 10,000 adult females (Secor 2002). Current population abundance is likely at least one order of magnitude smaller than historical levels (ASSRT 2007; Kahnle et al. 2007; Secor 2002). Based on data collected from 1985-1995, there are 870 spawning adults per year in the Hudson River (Kahnle et al. 2007). Kahnle (2007; 1998) also showed that the level of fishing mortality from the Hudson River Atlantic sturgeon fishery during the period of 1985-1995 exceeded the estimated sustainable level of fishing mortality for the riverine population, and may have led to reduced recruitment. All available data on abundance of juvenile Atlantic sturgeon in the Hudson River Estuary indicate a substantial drop in production of young since the mid-1970s (Kahnle et al. 1998). A decline appeared to occur in the mid- to late 1970s followed by a secondary drop in the late 1980s (ASMFC 2010; Kahnle et al. 1998; Sweka et al. 2007). Catch-per-unit-effort (CPUE) data suggest that recruitment has remained depressed relative to catches of juvenile Atlantic sturgeon in the estuary during the mid- to late 1980s (ASMFC 2010; Sweka et al. 2007). From 1985-2007, there were significant fluctuations in CPUE. The number of juveniles appears to have declined between the late 1980s and early 1990s. While the CPUE is generally higher in the 2000s as compared to the 1990s, significant annual fluctuations make it difficult to discern any trend. The CPUEs from 2000-2007 are generally higher than those from 1990-1999; however, they remain lower than the CPUEs observed in the late 1980s. There is currently not enough information regarding any life stage to establish a trend for the Hudson River population (ASMFC 2010; Sweka et al. 2007).

There is no abundance estimate for the Delaware River population of Atlantic sturgeon. Harvest records from the 1800s indicate that this was historically a large population, with an estimated 180,000 adult females prior to 1890 (Secor 2002; Secor and Waldman 1999). Fisher (2009) sampled the Delaware River in 2009 to target YOY Atlantic sturgeon. The effort captured 34 YOY. Brundage and O'Herron (2003) also collected 32 YOY Atlantic sturgeon from the Delaware River in a separate study. Fisher (2011) reports that genetics information collected from 33 of the 2009 year class YOY indicates that at least 3 females successfully contributed to the 2009 year class. The capture of YOY in 2009 shows that successful spawning is still occurring in the Delaware River, but the relatively low numbers suggest the existing riverine population is limited in size. Similar to the Hudson River, there is currently not enough information to determine a trend for the Delaware River population. The ASSRT (2007) suggested that there may be less than 300 spawning adults per year for the Delaware River portion of the New York Bight DPS. The NEAMAP model estimates a minimum ocean population of 34,566 Atlantic sturgeon, of which 8,642 are adults.

Gulf of Maine DPS

The Gulf of Maine DPS includes all anadromous Atlantic sturgeons that are spawned in the watersheds from the Maine/Canadian border and, extending southward, all watersheds draining into the Gulf of Maine as far south as Chatham, Massachusetts. Within this range, Atlantic sturgeon historically spawned in the Androscoggin, Kennebec, Merrimack, Penobscot, and Sheepscot Rivers (ASSRT 2007). Spawning still occurs in the Kennebec and Androscoggin Rivers, and may still occur in the Penobscot River. Atlantic sturgeon continue to be present in the Kennebec River; in addition, they are captured in directed research projects in the Penobscot River. They are also observed in the Saco, Presumpscot, and Charles rivers where they were unknown to occur before or had not been observed to occur for many years. These observations suggest that the abundance of the Gulf of Maine DPS of Atlantic sturgeon is large enough that recolonization to rivers historically suitable for spawning may be occurring.

Historically, the Gulf of Maine DPS likely supported more than 10,000 spawning adults (ASSRT 2007; KRRMP 1993; Secor 2002), suggesting the recent estimate of spawning adults within the DPS is 1-2 orders of magnitude smaller than historical levels (i.e., hundreds to low thousands) (ASSRT 2007; Kahnle et al. 2007). The CPUE of subadult Atlantic sturgeon in a multifilament gillnet survey conducted on the Kennebec River was considerably greater for the period of 1998-2000 (CPUE = 7.43) compared to the CPUE for the period 1977-1981 (CPUE = 0.30). The CPUE of adult Atlantic sturgeon showed a slight increase over the same time period (1977-1981 CPUE = 0.12 versus 1998-2000 CPUE = 0.21) (Squiers 2004). There is also new evidence of Atlantic sturgeon presence in rivers (e.g., the Saco River) where they have not been observed for many years. Still, there is not enough information to establish a trend for this DPS. The NEAMAP model estimates a minimum ocean population of 7,455 Atlantic sturgeon, of which 1,864 are adults.

Viability of Atlantic Sturgeon DPSs

The concept of a viable population able to adapt to changing environmental conditions is critical to Atlantic sturgeon, and the low population numbers of every river population in the 5 DPSs on the East Coast put them in danger of extinction throughout their range. None of the riverine spawning populations are large or stable enough to provide with any level of certainty for continued existence of any of the DPSs. Although the largest impact that caused the precipitous decline of the species has been prohibited (directed fishing), the Atlantic sturgeon population sizes within each DPS have remained relatively constant at greatly reduced levels for 100 years. The largest Atlantic sturgeon population in the United States, the Hudson River population within the New York Bight DPS, is estimated to have only 870 spawning adults each year. The Altamaha River population within the South Atlantic DPS is the largest Atlantic sturgeon population in the Southeast and only has an estimated 343 adults spawning annually. All other Atlantic sturgeon river populations in the U.S. are estimated to have less than 300 spawning adults annually.

Small numbers of individuals resulting from drastic reductions in populations, such as occurred with Atlantic sturgeon due to the commercial fishery, can remove the buffer against natural demographic and environmental variability provided by large populations (Berry 1971; Shaffer 1981; Soulé 1980). Recovery of depleted populations is an inherently slow process for a late-maturing species such as Atlantic sturgeon, and they continue to face a variety of other threats that contribute to their risk of extinction. Their late age at maturity provides more opportunities for individual Atlantic sturgeon to be removed from the population before reproducing. While a long life span allows multiple opportunities to contribute to future generations, it also increases the time frame over which exposure to the multitude of threats facing Atlantic sturgeon can occur.

The viability of the Atlantic sturgeon DPSs depends on having multiple self-sustaining riverine spawning populations and maintaining suitable habitat to support the various life functions (spawning, feeding, growth) of Atlantic sturgeon populations. Because a DPS is a group of populations, the stability, viability, and persistence of individual populations affects the persistence and viability of the larger DPS. The loss of any population within a DPS will result in: (1) a long-term gap in the range of the DPS that is unlikely to be recolonized; (2) loss of reproducing individuals; (3) loss of genetic biodiversity; (4) potential loss of unique haplotypes; (5) potential loss of adaptive traits; (6) reduction in total number; and (7) potential for loss of population source of recruits. The loss of a population will negatively impact the persistence and viability of the DPS as a whole, as fewer than 2 individuals per generation spawn outside their natal rivers (King et al. 2001; Waldman et al. 2002; Wirgin et al. 2000). The persistence of individual populations, and in turn the DPS, depends on successful spawning and rearing within the freshwater habitat, the immigration into marine habitats to grow, and then the return of adults to natal rivers to spawn.

Threats

Atlantic sturgeon were once numerous along the East Coast until fisheries for their meat and caviar reduced the populations by over 90% in the late 1800s. Fishing for Atlantic sturgeon became illegal in state waters in 1998 and in remaining U.S. waters in 1999. Dams, dredging, poor water quality, and accidental catch (bycatch) by fishers continue to threaten Atlantic sturgeon. Though Atlantic sturgeon populations appear to be increasing in some rivers, other river populations along the East Coast continue to struggle and some have been eliminated entirely. The 5 DPSs of Atlantic sturgeon were listed as threatened or endangered under the ESA primarily as a result of a combination of habitat restriction and modification, overutilization (i.e., being taken as bycatch) in commercial fisheries, and the inadequacy of regulatory mechanisms in ameliorating these impacts and threats.

Dams

Dams for hydropower generation, flood control, and navigation adversely affect Atlantic sturgeon by impeding access to spawning, developmental, and foraging habitat, modifying free-flowing rivers to reservoirs, physically damaging fish on upstream and downstream migrations, and altering water quality in the remaining downstream portions of spawning and nursery habitat (ASSRT 2007). Attempts to minimize the impacts of dams using measures such as fish passage have not proven beneficial to Atlantic sturgeon, as they do not regularly use existing fish passage devices, which are generally designed to pass pelagic fish (i.e., those living in the water column) rather than bottom-dwelling species, like sturgeon. Within the range occupied by the Carolina DPS, dams have restricted Atlantic sturgeon spawning and juvenile developmental habitat by blocking over 60% of the historical sturgeon habitat upstream of the dams in the Cape Fear and Santee-Cooper River systems. Water quality (velocity, temperature, and DO downstream of these dams, as well as on the Roanoke River, has been reduced, which modifies and restricts the extent of spawning and nursery habitat for the Carolina DPS.

Within the range of the New York Bight DPS, the Holyoke Dam on the Connecticut River blocks further upstream passage; however, the extent that Atlantic sturgeon historically would have used habitat upstream of Holyoke is unknown. Connectivity may be disrupted by the presence of dams on several smaller rivers in the New York Bight region. Connectivity is disrupted by the presence of dams on several rivers in the range of the Gulf of Maine DPS. Within the Gulf of Maine DPS, access to historical spawning habitat is most severely impacted in the Merrimack River (ASSRT 2007). Construction of the Essex Dam blocked the migration of Atlantic sturgeon to 58% of its historically available habitat (ASSRT 2007). The extent that Atlantic sturgeon are affected by operations of dams in the Gulf of Maine region is currently unknown, although Atlantic sturgeon larvae have been found downstream of the Brunswick Dam in the Androscoggin River. This suggests that Atlantic sturgeon spawning may be occurring in the vicinity of at least 1 hydroelectric project and may be affected by its operations.

Dredging

Riverine, nearshore, and offshore areas are often dredged to support commercial shipping and recreational boating, construction of infrastructure, and marine mining. Environmental impacts of dredging include the direct removal/burial of prey species; turbidity/siltation effects; contaminant resuspension; noise/disturbance; alterations to hydrodynamic regime and physical habitat; and actual loss of riparian habitat (Chytalo 1996; Winger et al. 2000). According to Smith and Clugston (1997), dredging and filling impact important habitat features of Atlantic sturgeon as they disturb benthic fauna, eliminate deep holes, and alter rock substrates.

In the South Atlantic DPS, maintenance dredging is currently modifying Atlantic sturgeon nursery habitat in the Savannah River. Modeling indicates that the proposed deepening of the navigation channel will result in reduced DO and upriver movement of the salt wedge, restricting spawning habitat. Dredging is also modifying nursery and foraging habitat in the St. Johns River. For the Carolina DPS, dredging in spawning and nursery grounds modifies the quality of the habitat and is further restricting the extent of available habitat in the Cape Fear and Cooper

Rivers, where Atlantic sturgeon habitat has already been modified and restricted by the presence of dams. Dredging for navigational purposes is suspected of having reduced available spawning habitat for the Chesapeake Bay DPS in the James River (ASSRT 2007; Bushnoe et al. 2005; Holton and Walsh 1995). Both the Hudson and Delaware rivers have navigation channels that are maintained by dredging. Dredging is also used to maintain channels in the nearshore marine environment. Many rivers in the range of the Gulf of Maine DPS also have navigation channels that are maintained by dredging. Dredging outside of federal channels and in-water construction occurs throughout the range of the New York Bight and Gulf of Maine DPSs.

Water Quality

Atlantic sturgeon rely on a variety of water quality parameters to successfully carry out their life functions. Low DO and the presence of contaminants modify the quality of Atlantic sturgeon habitat and in some cases, restrict the extent of suitable habitat for life functions. Secor (1995) noted a correlation between low abundances of sturgeon during this century and decreasing water quality caused by increased nutrient loading and increased spatial and temporal frequency of hypoxic (low oxygen) conditions. Of particular concern is the high occurrence of low DO coupled with high temperatures in the river systems throughout the range of the Carolina and South Atlantic DPSs in the Southeast. Sturgeon are more highly sensitive to low DO than other fish species (Niklitschek and Secor 2009a; Niklitschek and Secor 2009b) and low DO in combination with high temperature is particularly problematic for Atlantic sturgeon. Studies have shown that juvenile Atlantic sturgeon experience lethal and sublethal (metabolic, growth, feeding) effects as DO drops and temperatures rise (Niklitschek and Secor 2005; Niklitschek and Secor 2009a; Niklitschek and Secor 2009b; Secor and Gunderson 1998).

Reductions in water quality from terrestrial activities have modified habitat utilized by the South Atlantic DPS. Low DO is modifying sturgeon habitat in the Savannah due to dredging, and non-point source inputs are causing low DO in the Ogeechee River and in the St. Marys River, which completely eliminates juvenile nursery habitat in summer. Low DO has also been observed in the St. Johns River in the summer. In the Pamlico and Neuse systems occupied by the Carolina DPS, nutrient-loading and seasonal anoxia are occurring, associated in part with concentrated animal feeding operations (CAFOs). Heavy industrial development and CAFOs have degraded water quality in the Cape Fear River. Water quality in the Waccamaw and Yadkin-Pee Dee Rivers has been affected by industrialization and riverine sediment samples contain high levels of various toxins, including dioxins. Decreased water quality also threatens Atlantic sturgeon of the Chesapeake Bay DPS, especially since the Chesapeake Bay system is vulnerable to the effects of nutrient enrichment due to a relatively low tidal exchange and flushing rate, large surface-to-volume ratio, and strong stratification during the spring and summer months (ASMFC 1998; ASSRT 2007; Pyzik et al. 2004). These conditions contribute to reductions in DO levels throughout the bay. The availability of nursery habitat, in particular, may be limited given the recurrent hypoxia (low DO) conditions within the Bay (Niklitschek and Secor 2005; Niklitschek and Secor 2010). Both the Hudson and Delaware Rivers, as well as other rivers in the New York Bight region, were heavily polluted in the past from industrial and sewer discharges. In the past, many rivers in Maine, including the Androscoggin River, were heavily polluted from industrial discharges from pulp and paper mills. While water quality has improved and most discharges are limited through regulations, many pollutants persist in the benthic environment of the New York Bight and Gulf of Maine DPSs. It is particularly problematic if pollutants are present on spawning and nursery grounds, as developing eggs and larvae are particularly susceptible to exposure to contaminants.

Water Quantity

Water allocation issues are a growing threat in the Southeast and exacerbate existing water quality problems. Taking water from one basin and transferring it to another fundamentally and irreversibly alters natural water flows in both the originating and receiving basins, which can affect DO levels, temperature, and the ability of the basin of origin to assimilate pollutants (GWC 2006). Water quality within the river systems in the range of the South Atlantic and Carolina DPSs is negatively affected by large water withdrawals. Known water withdrawals of over 240 million gallons per day are permitted from the Savannah River for power generation and municipal uses. However, permits for users withdrawing less than 100,000 gallons per day are not required, so actual water withdrawals from the Savannah and other rivers within the range of the South Atlantic DPS are likely much higher. In the range of the Carolina DPS, 20 interbasin water transfers in existence prior to 1993, averaging 66.5 million gallons per day (mgd), were authorized at their maximum levels without being subjected to an evaluation for certification by the North Carolina Department of Environment and Natural Resources or other resource agencies. Since the 1993 legislation requiring certificates for transfers, almost 170 mgd of interbasin water withdrawals have been authorized, with an additional 60 mgd, pending certification. The removal of large amounts of water from these systems will alter flows, temperature, and DO. Water shortages and "water wars" are already occurring in the rivers occupied by the South Atlantic and Carolina DPSs and will likely be compounded in the future by population growth and potentially by climate change.

Climate Change

The Intergovernmental Panel on Climate Change (IPCC) projects with high confidence that higher water temperatures and changes in extremes, including floods and droughts, will affect water quality and exacerbate many forms of water pollution—from sediments, nutrients, dissolved organic carbon, pathogens, pesticides, and salt, as well as thermal pollution—with possible negative impacts on ecosystems (IPCC 2008). In addition, sea level rise is projected to extend areas of salinization of groundwater and estuaries, resulting in a decrease of freshwater availability for humans and ecosystems in coastal areas. Some of the most heavily populated areas are low-lying, and the threat of salt water entering into its aquifers with projected sea level rise is a concern (USGRG 2004). Existing water allocation issues would be exacerbated, leading to an increase in reliance on interbasin water transfers to meet municipal water needs, further stressing water quality.

Dams, dredging, and poor water quality have already modified and restricted the extent of suitable habitat for Atlantic sturgeon spawning and nursery habitat. Changes in water availability (depth and velocities) and water quality (temperature, salinity, DO, contaminants, etc.) in rivers and coastal waters inhabited by Atlantic sturgeon resulting from climate change will further modify and restrict the extent of suitable habitat for Atlantic sturgeon. Effects could be especially harmful since these populations have already been reduced to low numbers, potentially limiting their capacity for adaptation to changing environmental conditions (Belovsky 1987; Salwasser et al. 1984; Soulé 1987; Thomas 1990).

The effects of changes in water quality (temperature, salinity, DO, contaminants, etc.) in rivers and coastal waters inhabited by Atlantic sturgeon are expected to be more severe for those populations that occur at the southern extreme of the Atlantic sturgeon's range, and in areas that are already subject to poor water quality as a result of eutrophication. The South Atlantic and Carolina DPSs are within a region the IPCC predicts will experience overall climatic drying (IPCC 2008). Atlantic sturgeon from these DPSs are already susceptible to reduced water quality resulting from various factors: inputs of nutrients; contaminants from industrial activities and non-point sources; and interbasin transfers of water. In a simulation of the effects of water temperature on available Atlantic sturgeon habitat in Chesapeake Bay, Niklitschek and Secor (2005) found that a 1°C increase of water temperature in the bay would reduce available sturgeon habitat by 65%.

Vessel Strikes

Vessel strikes are a threat to the Chesapeake Bay and New York Bight DPSs. Eleven Atlantic sturgeon were reported to have been struck by vessels on the James River from 2005 through 2007. Several of these were mature individuals. From 2004-2008, 29 mortalities believed to be the result of vessel strikes were documented in the Delaware River; at least 13 of these fish were large adults. The time of year when these events occurred (predominantly May through July, with 2 in August), indicate the animals were likely adults migrating through the river to the spawning grounds. Because we do not know the percent of total vessel strikes that these observed mortalities represent, we are not able to quantify the number of individuals likely killed as a result of vessel strikes in the Chesapeake and New York Bight DPSs.

Bycatch Mortality

Overutilization of Atlantic sturgeon from directed fishing caused initial severe declines in Atlantic sturgeon populations, from which they have never rebounded. Further, continued overutilization of Atlantic sturgeon as bycatch in commercial fisheries is an ongoing impact to Atlantic sturgeon in all 5 DPSs. Atlantic sturgeon are more sensitive to bycatch mortality because they are a long-lived species, have an older age at maturity, have lower maximum reproductive rates, and a large percentage of egg production occurs later in life. Based on these life history traits, Boreman (1997) calculated that Atlantic sturgeon can only withstand the annual loss of up to 5% of their population to bycatch mortality without suffering population declines. Mortality rates of Atlantic sturgeon taken as bycatch in various types of fishing gear range between 0% and 51%, with the greatest mortality occurring in sturgeon caught by sink gillnets. Currently, there are estimates of the number of Atlantic sturgeon captured and killed in sink gillnet and otter trawl fisheries authorized by Fishery Management Plans (FMPs) in the Northeast Region (Miller and Shepherd 2011). Those estimates indicate from 2006-2010, on average there were 1,548 and 1,569 encounters per year in observed gillnet and trawl fisheries, respectively, with an average of 3,118 encounters combined annually. Mortality rates in gillnet gear were approximately 20%, while mortality rates in otter trawl gear are generally lower, at approximately 5%. Atlantic sturgeon are particularly vulnerable to being caught in sink gillnets; therefore, fisheries using this type of gear account for a high percentage of Atlantic sturgeon bycatch. Atlantic sturgeon are incidentally captured in state and federal fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (ASMFC 2007; Stein et al. 2004). Little data exists on bycatch in the Southeast and high levels of bycatch underreporting are suspected. However, fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may access multiple river systems, they are subject to being caught in multiple fisheries throughout their range. In addition, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins and low DO). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality.

5. ENVIRONMENTAL BASELINE

This section describes the effects of past and ongoing human and natural factors contributing to the current status of the species, its habitat (including designated critical habitat), and ecosystem within the action area, without the additional effects of the proposed action. In the case of ongoing actions, this section includes the effects that may contribute to the projected future status of the species, its habitat, and ecosystem. The environmental baseline describes a species' and habitat's health based on information available at the time of this consultation.

By regulation (50 CFR 402.02), environmental baselines for Biological Opinions include the past and present impacts of all state, federal, or private actions and other human activities or natural phenomena in, or having effects in, the action area. We identify the anticipated impacts of all proposed federal projects in the specific action area of the consultation at issue that have already undergone formal or early Section 7 consultation (as defined in 50 CFR 402.11), as well as the impact of state or private actions, or the impacts of natural phenomena, which are concurrent with the consultation in process (50 CFR 402.02).

Focusing on the impacts of the activities in the action area specifically allows us to assess the prior experience and state (or condition) of the endangered and threatened individuals. This consideration is important because in some states or life history stages, or areas of their ranges, listed individuals will commonly exhibit, or be more susceptible to, adverse responses to stressors than they would be in other states, stages, or areas within their distributions. These localized stress responses or stressed baseline conditions may increase the severity of the adverse effects expected from the proposed action.

5.1 Status of Sea Turtles within the Action Area

The Town of Oak Island is responsible for monitoring all sea turtle nesting activity within the town limits of Oak Island, North Carolina. Employees and volunteers with the town's Parks and Recreation Department conduct daily patrols of the nesting beach, marking all nests and protecting them during incubation. The monitoring program began in 1989. As discussed above, based on nesting, stranding, and recreational hook-and-line data from seaturtle.org (Table 2), green sea turtle (NA and SA DPSs), Kemp's ridley sea turtle, and loggerhead sea turtle (NWA DPS) may be located in the action area and may be affected by the proposed action. All of these sea turtle species are migratory, traveling for forage grounds or reproduction purposes. The nearshore waters of Oak Island, North Carolina, are likely used by these species of sea turtle for post-hatchling developmental habitat or foraging habitat. NMFS believes that no individual sea turtle is likely to be a permanent resident of the nearshore waters of this area, although some individuals may be present at any given time. These same individuals will migrate into offshore waters, as well as the Gulf of Mexico, Caribbean Sea, and other areas of the North Atlantic

Ocean at certain times of the year, and thus may be affected by activities occurring there; therefore, the status of the sea turtles species in the action area, as well as the threats to these sea turtles in the action area are considered to be the same as those discussed in Section 4.4-4.7.

5.2 Factors Affecting Sea Turtles within the Action Area

Federal Actions

ESA Section 7 Consultations

While NMFS has consulted on many other federal actions along the North Carolina coast, a search of NMFS records by the consulting biologist on June 22, 2017, found no projects in the action area that have undergone previous Section 7 consultation.

ESA Section 10 Permits

The ESA allows the issuance of permits to take ESA-listed species for the purposes of scientific research or enhancement (Section 10(a)(1)(A)). In addition, the ESA allows for NMFS to enter into cooperative agreements with states, developed under Section 6 of the ESA, to assist in recovery actions of listed species. Prior to issuance of these authorizations, the proposal must be reviewed for compliance with Section 7 of the ESA.

There are 4 active Section 10(a)(1)(A) scientific research permits applicable to the action area in this Opinion as per a search NOAA Fisheries Authorizations and Permits for Protected Species (APPS) database by the consulting biologist on October 30, 2017. Authorized activities range from photographing, weighing, and tagging sea turtles, to blood sampling, tissue sampling (biopsy), and performing laparoscopy. The number of authorized takes varies widely depending on the research and species involved but may involve the taking of hundreds of sea turtles annually. Most takes authorized under these permits are expected to be non-lethal; however, Permit Nos. 16556 and 17225 authorize 1lethal take of a sea turtle due to accidental death during research activities over the course of the permit. Permits are issued for 5 years.

Critical Habitat Designation

NMFS published the final critical habitat designation for the NWA DPS of loggerhead sea turtle on July 10, 2014 (79 FR 39856). As stated above, the action area occurs within the boundary of loggerhead sea turtle designated critical habitat (Nearshore Reproductive Habitat, Unit N-05).

State or Private Actions

Recreational Fishing

Recreational fishing as regulated by the State of North Carolina can affect protected species or their habitats within the action area. Pressure from recreational fishing in and adjacent to the action area is likely to continue and will increase with the restoration, extension, and operation of the proposed fishing pier. Recreational fishing from private vessels may also occur in the action area. Observations of state recreational fisheries have shown that loggerhead sea turtles are known to bite baited hooks and frequently ingest the hooks. Hooked turtles have been reported by the public fishing from boats, piers, and beach, banks, and jetties and from commercial anglers fishing for reef fish and for sharks with both single rigs and bottom longlines. Additionally, lost fishing gear such as line cut after snagging on rocks, or discarded hooks and line, can also pose an entanglement threat to sea turtles in the area. A detailed summary of the known impacts of hook-and-line incidental captures to loggerhead sea turtles can be found in the SEFSC Turtle Expert Working Group (TEWG) reports (TEWG 1998a; TEWG 2000).

Coastal Development
Beachfront development, lighting, and beach erosion control all are ongoing activities along the North Carolina coastline, including within the action area. These activities potentially reduce or degrade sea turtle nesting habitats or interfere with hatchling movement to sea. Nocturnal human activities along nesting beaches may also discourage sea turtles from nesting sites. The extent to which these activities reduce sea turtle nesting and hatchling production is unknown. Still, more and more coastal counties are adopting stringent protective measures to protect hatchling sea turtles from the disorienting effects of beach lighting.

Stochastic events
Stochastic (i.e., random) events, such as hurricanes, occur in North Carolina and can affect the action area. These events are by nature unpredictable, and their effect on the recovery of a species is unknown; yet, they have the potential to directly impede recovery if animals die as a result or indirectly if important habitats are damaged. Other stochastic events, such as a cold snap, can injure or kill sea turtles.

Marine Pollution and Environmental Contamination
Coastal runoff, marina and dock construction, dredging, aquaculture, oil and gas exploration and extraction, increased under water noise, and boat traffic can degrade marine habitats used by sea turtles (Colburn et al. 1996) and negatively impact nearshore habitats, including the action area. Fueling facilities at marinas can sometimes discharge oil, gas, and sewage into sensitive estuarine and coastal habitats. Although these contaminant concentrations are unknown in the action area, the sea turtles analyzed in this Biological Opinion travel within near shore and offshore habitats and may be exposed to and accumulate these contaminants during their life cycles.

Some sources of marine pollution that indirectly affect sea turtles in the action area are difficult to attribute to a specific federal, state, local or private action. Sources of pollutants include atmospheric loading of pollutants such as PCBs and storm water runoff from coastal towns and cities into rivers and canals emptying into bays and the ocean. There are studies on organic contaminants and trace metal accumulation in green, leatherback, and loggerhead sea turtles (Aguirre et al. 1994; Caurant et al. 1999; Corsolini et al. 2000). McKenzie et al. (1999) measured concentrations of chlorobiphenyls and organochlorine pesticides in sea turtles tissues collected from the Mediterranean (Cyprus, Greece) and European Atlantic waters (Scotland) between 1994 and 1996. Omnivorous loggerhead turtles had the highest organochlorine contaminant concentrations in all the tissues sampled, including those from green and leatherback turtles (Storelli et al. 2008b). It is thought that dietary preferences were likely to be the main differentiating factor among species. Decreasing lipid contaminant burdens with sea turtle size were observed in green turtles, most likely attributable to a change in diet with age. (Sakai et al. 1995) documented the presence of metal residues occurring in loggerhead sea turtle organs and eggs. Storelli et al. (1998) analyzed tissues from 12 loggerhead sea turtles stranded along the Adriatic Sea (Italy) and found that characteristically, mercury accumulates in sea turtle livers while cadmium accumulates in their kidneys, as has been reported for other marine organisms like dolphins, seals, and porpoises (Law et al. 1991a). No information on detrimental threshold concentrations is available and little is known about the consequences of exposure of organochlorine compounds to sea turtles. Research is needed into how chlorobiphenyl, organochlorine, and heavy-metal accumulation effect the short- and long-term health of sea turtles and what effect those chemicals have on the number of eggs laid by females. More information is needed to understand the potential impacts of marine pollution on sturgeon in the action area.

Nutrient loading from land-based sources, such as coastal communities, stimulate plankton blooms in closed or semi-closed estuarine systems. For example, oxygen depletion, referred to as hypoxia, can negatively impact sea turtle habitat, prey availability, and survival and reproductive fitness.

Climate Change

As discussed earlier in this Opinion, there is a large and growing body of literature on past, present, and future impacts of global climate change. Potential effects commonly mentioned include changes in sea temperatures and salinity (due to melting ice and increased rainfall), ocean currents, storm frequency and weather patterns, and ocean acidification. These changes have the potential to affect species behavior and ecology including migration, foraging, reproduction (e.g., success), and distribution. For example, sea turtles currently range from temperate to tropical waters. A change in water temperature could result in a shift or modification of range. Climate change may also affect marine forage species, either negatively or positively (the exact effects for the marine food web upon which sea turtles or sturgeon rely is unclear, and may vary between species). It may also affect migratory behavior (e.g., timing, length of stay at certain locations). These types of changes could have implications for sea turtle recovery.

Additional discussion of climate change can be found in the Status of the Species sections (sections 4.4-4.7). However, to summarize with regards to the action area, global climate change may affect the timing and extent of population movements and their range, distribution, species composition of prey, and the range and abundance of competitors and predators. Changes in distribution including displacement from ideal habitats, decline in fitness of individuals, population size due to the potential loss of foraging opportunities, abundance, migration, community structure, susceptibility to disease and contaminants, and reproductive success are all possible impacts that may occur as the result of climate change. Still, more information is needed to better determine the full and entire suite of impacts of climate change on sea turtles and sturgeon and specific predictions regarding impacts in the action area are not currently possible.

Conservation and Recovery Actions Shaping the Environmental Baseline

NMFS and cooperating states have established an extensive network of STSSN participants along the Atlantic and Gulf of Mexico coasts that collect data on dead sea turtles and rescue and rehabilitate live stranded sea turtles.

NMFS has implemented a series of regulations aimed at reducing potential for incidental mortality of sea turtles from commercial fisheries near the action area. These include sea turtle release gear requirements for the South Atlantic snapper-grouper fishery and TED requirements for the Southeast shrimp trawl fisheries. In addition to regulations, outreach programs have been established and data on sea turtle interactions with recreational fisheries has been collected through the Marine Recreational Fishery Statistical Survey/Marine Recreational Information Program.

NMFS published a Final Rule (66 FR 67495, December 31, 2001) detailing handling and resuscitation techniques for sea turtles that are incidentally caught during scientific research or fishing activities. Persons participating in fishing activities or scientific research are required to handle and resuscitate (as necessary) sea turtles as prescribed in the Final Rule. These measures help to prevent mortality of hardshell turtles caught in fishing or scientific research gear.

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

5.3 Status of Atlantic Sturgeon within the Action Area

Once completed and open to the public, the Yaupon Pier will be located on the Atlantic Ocean approximately 4.5 miles west of the estuary of the Cape Fear River. The Cape Fear River is contains a current spawning population of Atlantic sturgeon within the range of the Carolina DPS. When not spawning, coastal migrations by adult Atlantic sturgeon are extensive and are known to occur over sand substrate (Greene et al. 2009). When adult Atlantic sturgeon reside in the marine habitat, they forage extensively on mollusks, gastropods, amphipods, isopods, and small fishes, especially sand lances (*Ammodytes* sp.) (Scott and Crossman 1973). Further, Atlantic sturgeon remain in the marine habitat until the waters begin to warm, at which time ripening adults migrate back to their natal rivers to spawn. NMFS believes that no individual sturgeon is likely to be a permanent resident of the nearshore waters of Oak Island, North Carolina, although some individuals may be present in the action area at any given time and may be affected by recreational fishing upon completion of pier. Based on their foraging and spawning habitat preferences, Atlantic sturgeon may be affected by activities occurring both in the marine environment and in spawning rivers and, therefore, the status of the 5 Atlantic sturgeon DPSs in the action area, as well as the threats to these DPSs, are considered to be the same as those discussed in Section 4.8.

5.4 Factors Affecting Atlantic Sturgeon within the Action Area

<u>Federal Actions</u>

ESA Section 7 Consultations

While NMFS has consulted on many other federal actions along the North Carolina coast, a search of NMFS records by the consulting biologist on June 22, 2017, found no projects in the action area that have undergone previous Section 7 consultation.

ESA Section 10 Permits

The ESA allows the issuance of permits to take listed species for the purposes of scientific research and enhancement (Section 10(a)(1)(A)). In addition, the ESA allows for NMFS to enter into cooperative agreements with states, developed under Section 6 of the ESA, to assist in recovery actions of listed species. Prior to issuance of these authorizations, the proposal must be reviewed for compliance with Section 7 of the ESA.

There is one active Section 10(a)(1)(A) scientific research permit applicable to the action area in this Opinion as per a search NOAA Fisheries Authorizations and Permits for Protected Species (APPS) database by the consulting biologist on October 30, 2017. NMFS issued an ESA Section 10(a)(1)(A) permit (Permit No. 17273) authorizing named federal and state agency personnel to collect, necropsy, sample and/or salvage dead Atlantic sturgeon found beached, sunken, or floating. U.S. facilities authorized to hold captive bred sturgeon are also authorized to collect, necropsy, and sample under this permit should a captive Atlantic sturgeon need to be euthanized. Opportunistic research such as this may be useful for scientific and educational purposes.

Critical Habitat Designation
NMFS published the final critical habitat designation for the Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs of Atlantic sturgeon on August 17, 2017 (82 FR 39160). The action area does not occur within the boundary of Atlantic sturgeon designated critical habitat.

<u>State or Private Actions</u>
Fisheries
Recreational fishing as regulated by the State of North Carolina can affect protected species or their habitats within the action area. Pressure from recreational fishing in and adjacent to the action area is likely to continue and will increase with the restoration and operation of the proposed fishing pier. Recreational fishing from private vessels may also occur in the action area. As stated above, information on sturgeon caught via recreational hook-and-line is sparse and we are unsure of recreational fishing effects to sturgeon via entanglement, hooking, and trailing line.

While the ESA prohibits the direct harvest of Atlantic sturgeon, the species is taken incidentally in state fisheries that deploy nets. Entanglement of sturgeon in gillnets or trawls can result in injury and mortality, reduced fecundity, and delayed or aborted spawning migrations (Collins et al. 2000a; Moser 2000; Moser and Ross 1993; Moser and Ross 1995; Weber 1996). Mandatory reporting of sturgeon bycatch was initiated in 2000 by the Atlantic States Marine Fisheries Commission. According to their data, between 2000 and 2009 the average annual bycatch of Atlantic sturgeon reported by the commercial shad fishery was 84.7 Atlantic sturgeon.

Poaching is likely another fishing threat and may be more prevalent where legal markets for sturgeon exist from imports, commercial harvest, or commercial culture; impacts from poaching to individual population segments are unknown.

<u>Marine Pollution and Environmental Contamination</u>
Marine debris, marina and dock construction, dredging, aquaculture, oil and gas exploration and extraction, increased under water noise, and boat traffic can degrade marine habitats used by sturgeon (Colburn et al. 1996) and negatively impact nearshore habitats, including the action area. Although contaminant concentrations are unknown in the action area, the Atlantic

sturgeon analyzed in this Biological Opinion travel within near shore and offshore habitats and may be exposed to and accumulate contaminants during their life cycles. Coastal runoff and nutrient loading from land-based sources, such as coastal communities, can stimulate plankton blooms. Oxygen depletion, referred to as hypoxia, can lead to mortality and/or negatively impact sturgeon habitat, prey availability, and reproductive fitness.

Stochastic events

Stochastic (i.e., random) events, such as hurricanes, occur in North Carolina and can affect the action area. These events are by nature unpredictable, and their effect on the recovery of Atlantic sturgeon is unknown; yet, they have the potential to directly impede recovery if animals die as a result or indirectly if important habitats are damaged. Other stochastic events, such as a cold snap, can injure or kill sturgeon.

Climate Change

Additional discussion of climate change can be found in the Status of the Species section (section 4.8). To summarize with regards to the action area, the effects of climate change to water quality (temperature, salinity, DO, contaminants, etc.) in rivers and coastal waters inhabited by Atlantic sturgeon are expected to be more severe for those populations that occur at the southern extreme of the species range, and in areas that are already subject to poor water quality as a result of eutrophication. The South Atlantic and Carolina DPSs are within a region the IPCC predicts will experience overall climatic drying (IPCC 2008). Atlantic sturgeon from these DPSs are already susceptible to reduced water quality resulting from various factors: inputs of nutrients; contaminants from industrial activities and non-point sources; and interbasin transfers of water. Still, more information is needed to better determine the full and entire suite of impacts of climate change on sturgeon and specific predictions regarding impacts in the action area are not currently possible.

6. EFFECTS OF THE ACTION

Effects of the action include direct and indirect effects of the action under consultation. Indirect effects are those that result from the proposed action, occur later in time (i.e., after the proposed action is complete), but are still reasonably certain to occur (40 CFR 402.02).

6.1 Effects of Hook-and-Line Captures to Sea Turtles

First, we will discuss general effects of the action and types of injuries that can occur to sea turtles via hook-and-line capture. Then, we will estimate the number of sea turtles anticipated to be captured at the Yaupon Fishing Pier, based on the available data regarding the number of sea turtles that have been reported captured via recreational hook-and-line in the surrounding area and the estimated number of un-reported recreational hook-and-line captures in the surrounding area. We will then estimate the survival rate of sea turtles post capture (i.e., post-release mortality) based on data from rehabilitation facilities and the severity of the injury during capture. Finally, we will use the available data to estimate the numbers of captures at the Yaupon Fishing Pier by species.

Hook-and-line gear commonly used by recreational anglers fishing from fishing piers can adversely affect sea turtles via entanglement, hooking, and trailing line. Sea turtles released alive may later succumb to injuries sustained at the time of capture or from exacerbated trauma from fishing hooks or lines that were ingested, entangled, or otherwise still attached when they were released. Of the sea turtles hooked or entangled that do not die from their wounds, some may suffer impaired swimming or foraging abilities, altered migratory behavior, and altered breeding or reproductive patterns.

The current understanding of the effects of hook-and-line gear on sea turtles relates primarily to the effects observed in association with commercial fisheries (particularly longline fisheries); few data exist on the effects of recreational fishing on sea turtles. Dead sea turtles found stranded with hooks in their digestive tract have been reported, though it is assumed that most sea turtles hooked by recreational fishers are released alive (Thompson 1991). Little information exists on the frequency of recreational fishing captures and the status of the sea turtles after they are caught. Regardless, the types of effects that sea turtles are likely to experience as a result of interactions with commercial fisheries (i.e., entanglement, hooking, and trailing line) are expected to be the same as those that might occur in recreational hook-and-line gear. The following discussion summarizes in greater detail the available information on how individual sea turtles may be affected by interactions with hook-and-line gear.

Entanglement

Sea turtles are particularly prone to entanglement as a result of their body configuration and behavior. Records of stranded or entangled sea turtles reveal that hook-and-line gear can wrap around the neck, flipper, or body of a sea turtle and severely restrict swimming or feeding. If the sea turtle is entangled when young, the fishing line becomes tighter and more constricting as the sea turtle grows, cutting off blood flow and causing deep gashes, some severe enough to remove an appendage. Sea turtles have been found entangled in many different types of hook-and-line gear. Entangling gear can interfere with a sea turtle's ability to swim or impair its feeding, breeding, or migration. Entanglement may even prevent surfacing and cause drowning.

Hooking

Sea turtles are also injured and killed by being hooked. Hooking can occur as a result of a variety of scenarios, some depend on the foraging strategies and diving and swimming behavior of the various species of sea turtles. Sea turtles are either hooked externally in the flippers, head, shoulders, armpits, or beak, or internally inside the mouth or when the animal has swallowed the bait (Balazs et al. 1995). Swallowed hooks are of the greatest concern. A sea turtle's esophagus (throat) is lined with strong conical papillae directed towards the stomach (White 1994). The presence of these papillae in combination with an S-shaped bend in the esophagus make it difficult to see hooks when looking through a sea turtle's mouth, especially if the hooks have been deeply ingested. Because of a sea turtle's digestive structure, deeply ingested hooks are also very difficult to remove without seriously injuring the turtle. A sea turtle's esophagus is also firmly attached to underlying tissue; thus, if a sea turtle swallows a hook and tries to free itself or is hauled on board a vessel, the hook can pierce the sea turtle's esophagus or stomach and can pull organs from its connective tissue. These injuries can cause the sea turtle to bleed internally or can result in infections, both of which can kill the sea turtle.

If a hook does not lodge into, or pierce, a sea turtle's digestive organs, it can pass through the digestive system entirely (Aguilar et al. 1995; Balazs et al. 1995) with little damage (Work 2000). For example, a study of loggerheads deeply hooked by the Spanish Mediterranean pelagic longline fleet found ingested hooks could be expelled after 53 to 285 days (average 118 days) (Aguilar et al. 1995). If a hook passes through a sea turtle's digestive tract without getting lodged, the hook probably has not harmed the turtle.

Trailing Line

Trailing line (i.e., line left on a sea turtle after it has been captured and released) poses a serious risk to sea turtles. Line trailing from a swallowed hook is also likely to be swallowed, which may irritate the lining of the digestive system. The line may cause the intestine to twist upon itself until it twists closed, creating a blockage ("torsion"), or may cause a part of the intestine to slide into another part of intestine like a telescopic rod ("intussusception") which also leads to blockage. In both cases, death is a likely outcome (Watson et al. 2005). The line may also prevent or hamper foraging, eventually leading to death. Trailing line may also become snagged on a floating or fixed object, further entangling a turtle and potentially slicing its appendages and affecting its ability to swim, feed, avoid predators, or reproduce. Sea turtles have been found trailing gear that has been snagged on the sea floor, or has the potential to snag, thus anchoring them in place (Balazs 1985). Long lengths of trailing gear are likely to entangle the sea turtle, eventually leading to impaired movement, constriction wounds, and potentially death.

6.2 Captures of Sea Turtles at the Yaupon Fishing Pier

6.2.1 Estimating Reported Captures

The 20-year dataset of recreational hook-and-line captures of sea turtles for all of North Carolina (1997-2016), there have been 3 reported captures at the Yaupon Fishing Pier, 4 at Oak Island Pier, 4 at Holden Beach Pier, 3 at Ocean Isle Beach Pier, and 7 at Sunset Beach Pier (n=21). Based on similarity of pier location and habitat type (i.e., Atlantic Ocean-facing beach with sandy substrate), we believe the best available data to estimate the number of expected reported captures of sea turtles at the Yaupon Fishing Pier is an average of the reported sea turtle captures at these 5 fishing piers.

To calculate the expected number of reported hook-and-line captures at the Yaupon Fishing Pier in 20 years, we use the following equation:

$$Expected\ Captures\ (Reported)\ for\ Yaupon\ Pier\ in\ 20\ years$$
$$= Sum\ of\ the\ \ Captures\ (Reported)\ in\ 20\ Years\ from\ Yaupon\ Pier\ plus\ the\ 4\ Closest\ Piers$$
$$\div\ 5$$
$$Expected\ Captures\ (Reported)\ for\ Yaupon\ Pier\ in\ 20\ years\ = (3 + 4 + 4 + 3 + 7) \div 5$$
$$Expected\ Captures\ (Reported)\ for\ Yaupon\ Pier\ in\ 20\ years\ = 21\ \div 5$$
$$Expected\ Captures\ (Reported)\ for\ Yaupon\ Pier\ in\ 20\ years\ = 4.2$$

To calculate the estimated expected annual number of reported recreational hook-and-line captures of sea turtles at the Yaupon Fishing Pier, we use the following equation:

$$Expected\ Annual\ Captures\ (Reported)\ at\ Yaupon\ Pier$$
$$= Average\ Annual\ Reported\ Captures \div 20\ years$$

$$Expected\ Annual\ Captures\ (Reported)\ at\ Yaupon\ Pier = 4.2 \div 20$$
$$Expected\ Annual\ Captures\ (Reported) at\ Yaupon\ Pier = 0.2100\ (Table\ 6, Line\ 1)$$

6.2.2 Estimating Un-reported Captures

While we believe the best available information for estimating future captures at a fishing pier are the reported captures at public piers in the surrounding area, we also recognize the need to account for un-reported captures. In the following section, we use the best available data to estimate the number of un-reported recreational hook-and-line-captures from the same five fishing piers as in Section 6.2.1. To the best of our knowledge, only two fishing pier surveys aimed at collecting data regarding un-reported recreational hook-and-line captures of listed species have been conducted in the Southeast. One is from Charlotte Harbor, Florida (Gulf of Mexico-side of Florida), and the other is from the State of Mississippi.

The fishing pier survey in Charlotte Harbor, Florida, was conducted at 26 fishing piers in smalltooth sawfish critical habitat (Hill 2013). During the survey, 93 anglers were asked a series of open-ended questions regarding captures of sea turtles, smalltooth sawfish, and dolphins, including whether or not they knew these encounters were required to be reported and if they did report encounters. The interviewer also noted conditions about the pier including if educational signs regarding reporting of hook-and-line captures were present at the pier. Regardless of whether educational signs were present, Hill (2013) found that only 8% of anglers would have reported a sea turtle hook-and-line capture (i.e., 92% of anglers would not have reported a sea turtle capture).

NMFS conducted a fishing pier survey in Mississippi that interviewed 382 anglers (Cook et al. 2014). This survey indicated that approximately 60% of anglers who incidentally captured a sea turtle on hook-and-line reported it (i.e., 40% of anglers would not have reported a sea turtle capture) (Cook et al. 2014). It is important to note that in 2012 educational signs were installed at all fishing piers in Mississippi, alerting anglers to report accidental hook-and-line captures of sea turtles. After the signs were installed, there was a dramatic increase in the number of reported sea turtle hook-and-line captures. Though this increase in reported captures may not solely be related to outreach efforts, it does highlight the importance of educational signs on fishing piers. The STSSN in Mississippi indicated that inconsistency in reporting of captures may also be due to anglers' concerns over their personal liability, public perception at the time of the capture, or other consequences from turtle captures (M. Cook, STSSN, pers. comm. to N. Bonine, NMFS Protected Resources Division, April 17, 2015). Since it may be illegal to take an ESA-listed species, anglers are often afraid to admit the incidental capture. Similarly, a study of smalltooth sawfish noted that some anglers were apprehensive to continue to report smalltooth sawfish encounters once the species was listed on the ESA, fearing their favorite fishing hole would be closed or restricted due to the known presence of an endangered species (Wiley and Simpfendorfer 2010).

No studies have been conducted near the action area to determine the rate of underreporting. Like Mississippi, the North Carolina Division of Marine Fisheries (NC DMF) has placed education signs at most fishing piers, instructing the public on how to handle encounters with sea turtles (i.e., call the STSSN Hotline). However, the politics involved with hook-and-line interactions on and off fishing piers has greatly affected the ability to work with local pier owners and fishers (M. Godfrey, NC Wildlife Resources Commission, pers. comm. to consulting biologist, on June 8, 2017). Due to this anecdotal evidence, we believe it is reasonable and conservative to the species to use the higher un-reported rate in the (Hill 2013) fishing pier study to estimate the un-reported captures at the Yaupon Fishing Pier. We will address un-reported captures by assuming that the expected annual reported captures of 0.2100 sea turtles per year at the Yaupon Fishing Pier represent only 8% of the actual captures and 92% of sea turtle captures will be un-reported. To calculate the annual number of un-reported recreational hook-and-line captures of sea turtles at the Yaupon Fishing Pier, we use the equation:

$$Expected\ Annual\ Captures\ at\ Yaupon\ Pier\ (Un-Reported) \div 92\%$$
$$= Expected\ Annual\ Captures\ (Reported)\ at\ Yaupon\ Pier\ [From\ Section\ 6.2.1] \div 8\%$$
$$Expected\ Annual\ Captures\ at\ Yaupon\ Pier\ (Un-Reported) \div 0.92 = 0.2100 \div 0.08$$
$$Expected\ Annual\ Captures\ at\ Yaupon\ Pier\ (Un-Reported) = (0.2100 \div 0.08) \times 0.92$$
$$Expected\ Annual\ Captures\ at\ Yaupon\ Pier\ (Un-Reported) = 2.4150\ (Table\ 6, Line\ 2)$$

6.2.3 Calculating Total Captures

The number of captures in any given year can be influenced by sea temperatures, species abundances, fluctuating salinity levels in estuarine habitats where piers may be located, and other factors that cannot be predicted. For these reasons, we believe basing our future capture estimate on a 1-year estimated capture is largely impractical. Using our experience monitoring other fisheries, a 3-year time period is appropriate for meaningful monitoring. The triennial takes are set as 3-year running sums (i.e., 2017-2019, 2018-2020, 2019-2021 and so on) and not for static 3-year periods (i.e., 2017-2019, 2020-2022, 2023-2025 and so on). This approach reduces the likelihood of re-initiation of ESA consultation process because of inherent variability captures, while still allowing for an accurate assessment of how the proposed action is performing versus our expectations. Table 6 calculates the total sea turtle captures for any 3-year period based on the expected annual reported and un-reported captures at the Yaupon Fishing Pier.

Table 6. Summary of Expected Reported and Un-Reported Captures at the Yaupon Fishing Pier

		Total
1.	Expected Annual Reported Captures	0.2100
2.	Expected Annual Un-reported Captures	2.4150
	Annual Total	2.6250
	Triennial (3-year) Total	7.8750

6.3 Post Release Mortality

6.3.1 Estimating Post Release Mortality for Reported Captures

Sea turtles that are captured, landed, and reported to the STSSN in North Carolina are most often evaluated by a trained professional (e.g, veterinarian, STSSN volunteer, etc.) to determine if they can be immediately released alive after the hook is removed or require more extensive care at a rehabilitation center. (M. Godfrey, NC Wildlife Resources Commission, pers. comm. to D. Bethea, NOAA NMFS SERO PRD, on June 30, 2017). We believe the 20-year North Carolina STSSN dataset of reported recreational hook-and-line sea turtle captures in North Carolina (1997-2016) is a more accurate representation of post-release mortality for sea turtles than a smaller subset of data from a specific pier (e.g., Sunset Beach Pier), a specific nesting beach (e.g., Oak Island), or a larger set of data from another Atlantic-coast state (e.g., east coast of Florida). We believe this dataset is large enough to account for inter-annual variability while also pertaining specifically to the coastline in North Carolina where the proposed action is occurring. Table 7 provides a breakdown of final disposition of the 176 sea turtles that were reported captured by recreational hook-and-line fishes in North Carolina and also received professional evaluation. The dataset contains information on another 83 sea turtles that were captured and released alive immediately, but did not receive professional evaluation prior to release (e.g., the fishing line broke prior to landing). We cannot be sure of the final disposition of these 83 sea turtles; therefore, they are not included in Table 7.

Table 7. Final Disposition of Sea Turtles Evaluated by a Trained Professional from Reported Recreational Hook-and-Line Captures in North Carolina, 1997-2016 (n=176)

	Died Onsite	Evaluated, Released Alive Immediately	Taken to Rehab, Released Alive Later	Taken to Rehab, Kept in Rehab	Taken to Rehab, Died in Rehab
Number of Records	24	56	91	1	4
Percentage	13.64	31.82	51.70	0.57	2.27

Of these 176 sea turtles, 16.48% were removed from the wild population either through death or being unable to be released from the rehabilitation facility (i.e., lethal captures, 16.48 = 13.64 + 0.57 + 2.27) and 83.52% were released alive back into the wild population either immediately or after rehabilitation (i.e., non-lethal captures, 83.52 = 31.82 + 51.70). We assume the 31.82% of sea turtles evaluated and released alive into the wild population immediately do not suffer any post release mortality due to the on-site evaluation by a trained professional prior to release (i.e., all gear removed from the animals and the animal's health assessed prior to release). To calculate the annual estimated lethal captures of reported sea turtles at the Yaupon Fishing Pier, we use the following equation:

$$Annual\ Lethal\ Captures\ (Reported)\ at\ Yaupon\ Pier$$
$$= Expected\ Annual\ Reported\ Captures\ at\ Yaupon\ Pier\ [Section\ 6.2.1;\ Table\ 6, Line\ 1]$$
$$\times\ 16.48\%\ [calculated\ from\ Table\ 7]$$
$$Annual\ Lethal\ Captures\ (Reported)\ at\ Yaupon\ Pier = 0.2100 \times 0.1648$$
$$Annual\ Lethal\ Captures\ (Reported)\ at\ Yaupon\ Pier = 0.0346\ (Table\ 11, Line\ 1A)$$

To calculate the estimated annual non-lethal captures of reported sea turtles at the Yaupon Fishing Pier, we use the following equation:

$$Annual\ Non-lethal\ Captures\ (Reported)\ at\ Yaupon\ Pier$$
$$= Expected\ Annual\ Reported\ Captures\ at\ Yaupon\ Pier\ [Section\ 6.2.1;\ Table\ 6, Line\ 1]$$
$$\times\ 83.52\%\ [calculated\ from\ Table\ 7]$$
$$Annual\ Non-lethal\ Captures\ (Reported)\ at\ Yaupon\ Pier = 0.2100 \times 0.8352$$
$$Annual\ Non-lethal\ Captures\ (Reported)\ at\ Yaupon\ Pier = 0.1754\ (Table\ 11, Line\ 1B)$$

6.3.2 Estimating Post Release Mortality for Un-reported Captures

Sea turtles that are captured and not reported to the STSSN may be released alive and subsequently suffer post-release mortality. The risk of post-release mortality to sea turtles from hook-and-line captures will depend on numerous factors including how deeply the hook is embedded, whether or not the hook was swallowed, whether the sea turtle was released with trailing line, how soon and how effectively the hooked sea turtle was de-hooked or otherwise cut loose and released, and other factors which are discussed in more detail below. While the preferred method to release a hooked sea turtle safely is to bring it ashore and de-hook/disentangle it there and release it immediately, that cannot always be accomplished. The next preferred technique is to cut the line as close as possible to the sea turtle's mouth or hooking site rather than attempt to pull the sea turtle up to the pier. Some incidentally captured sea turtles are likely to break free on their own and escape with embedded/ingested hooks and/or trailing line. Because of considerations such as the tide, weather, and the weight and size of the captured sea turtle, some will not be able to be de-hooked (when applicable), and will be cut free by anglers and intentionally released. These sea turtles will escape with embedded or swallowed hooks, or trailing varying amounts of monofilament fishing line which may cause post-release injury or death.

In January 2004, NMFS convened a workshop of experts to develop criteria for estimating post-release mortality (PRM) of sea turtles caught in the pelagic longline fishery based on the severity of injury. In 2006, those criteria were revised and finalized (Ryder et al. 2006). In February 2012, the Southeast Fisheries Science Center (SEFSC) updated the criteria again by adding 3 additional hooking scenarios, bringing the total to 6 categories of injury (NMFS and SEFSC 2012). Table 8 describes injury categories for hardshell sea turtles captured on hook-and-line and the associated post-released mortality estimates for sea turtles released with hook and tailing line greater than or equal to half the length of the carapace (i.e., Release Condition B as defined in (NMFS and SEFSC 2012).

Table 8. Estimated Post Release Mortality Based on Injury Category for Hardshell Sea Turtles Captured via Hook-and-Line and Released in Release Condition B (NMFS and SEFSC 2012).

Injury Category	Description	Post-release Mortality
I	Hooked externally with or without entanglement	20%
II	Hooked in upper or lower jaw with or without entanglement—includes ramphotheca (i.e., beak), but not any other jaw/mouth tissue parts	30%
III	Hooked in cervical esophagus, glottis, jaw joint, soft palate, tongue, and/or other jaw/mouth tissue parts not categorized elsewhere, with or without entanglement—includes all events where the insertion point of the hook is visible when viewed through the mouth.	45%
IV	Hooked in esophagus at or below level of the heart with or without entanglement—includes all events where the insertion point of the hook is not visible when viewed through the mouth	60%
V	Entangled only, no hook involved	50%*

*There is no post-release mortality estimate of Release Condition B for Injury Category V or VI. For Injury Category V we believe it is prudent to use the post-release mortality for Release Condition A (Released Entangled) because we know the sea turtle was released entangled without a hook, but we do not know how much line was remaining. For Injury Category VI we believe it is prudent to use the post-release mortality Release Condition D (Released with All Gear Removed) because we believe that if a fisher took the time to resuscitate the sea turtle, then it is likely the fisher also took the time to completely disentangle the animal before releasing it back into the wild.

Post-release mortality varies based on the initial injury the animal sustained and the amount of gear left on the animal at the time of release. Again, we will rely on the 20-year North Carolina STSSN dataset of reported recreational hook-and-line sea turtle captures in North Carolina (1997-2016) because this data includes the hooking location (i.e., where on the animal it was physically hooked/entangled). Unlike Table 7, Table 9 includes information on all 256 sea turtles that were captured and released alive immediately.

Table 9. Category of Injury of Sea Turtles from Reported Recreational Hook-and-Line Captures along the North Carolina Coast, 1997-2016 (n=259)

Injury Category	I	II	III	IV	V
Number	49	103	63	36	8
Percentage	18.92	39.77	24.32	13.90	3.09

To estimate the fate of the 92% of sea turtles expected to go un-reported, and therefore un-evaluated or rehabilitated, we use the injury category percentages in Table 9 along with the post-release mortality estimates in Table 8 to calculate the weighted mortality rate expected for each injury category. We then sum the weighted mortality rates across all injury categories to determine the overall post-release mortality for these turtles. This overall rate helps us account for the varying severity of future injuries and varying post-release mortality associated with these injuries. Based on the assumptions we have made about the percentage of sea turtles that will be released alive without rehabilitation, the likely hooking location, and the amount of fishing gear likely to remain on an animal released immediately at the pier, we estimate an total weighted post-release mortality of 36.54% for 92% of the sea turtles captured, un-reported, and released immediately at the Yaupon Fishing Pier (Table 10).

Table 10. Estimated Weighted and Overall Post Release Mortality for Sea Turtles Released Immediately from the Yaupon Fishing Pier

Injury Category	% Captures [from Table 9]	% Post-release Mortality [from Table 8]	% Weighted Post-release Mortality*
I	18.92	20	3.78
II	39.77	30	11.93
III	24.32	45	10.94
IV	13.90	60	8.34
V	3.09	50	1.55
**Total Weighted Post-release Mortality			36.54

*Weighted Mortality Rate = Percent of Total Captures in Each Injury Category x PRM Rate per Category
**Overall Weighted Post-Release Mortality Rate = Sum of Weighted Mortality Rates

To calculate the estimated annual lethal captures of un-reported sea turtles, we use the following equation:

$$Annual\ Lethal\ Captures\ (Un-reported)\ at\ Yaupon\ Pier$$
$$= Annual\ Captures\ at\ Yaupon\ Pier\ (Un-Reported)[Section\ 6.2.2]$$
$$\times Total\ Weighted\ Post-release\ Mortality\ [Table\ 10]$$
$$Annual\ Lethal\ Captures\ (Un-reported)\ at\ Yaupon\ Pier = 2.4150\ \times 36.54\%$$
$$Annual\ Lethal\ Captures\ (Un-reported)\ at\ Yaupon\ Pier = 2.4150\ \times 0.3654$$
$$Annual\ Lethal\ Captures\ (Un-reported)\ at\ Yaupon\ Pier = 0.8824\ (Table\ 11, Line\ 2A)$$

If the equation for calculating annual lethal captures of un-reported sea turtles multiplies the annual un-reported captures at Yaupon Pier by the total weighted post-release mortality of 36.54%, then the equation for calculating annual non-lethal captures of un-reported sea turtles would multiply the annual un-reported captures by 63.46% (100% – 36.54% = 63.46%). Therefore, to calculate the estimated annual non-lethal captures of un-reported sea turtles, we use the following equation:

$$Annual\ Non-lethal\ Captures\ (Un-reported)\ at\ Yaupon\ Pier$$
$$= Annual\ Captures\ at\ Quintana\ Pier\ (Un-Reported)[Section\ 6.2.2]$$
$$\times 63.46\%$$
$$Annual\ Non-lethal\ Captures\ (Un-reported)\ at\ Yaupon\ Pier = 2.4150 \times 0.6346$$
$$Annual\ Non-lethal\ Captures\ (Un-reported)\ at\ Yaupon\ Pier$$
$$= 1.5326\ (Table\ 11, Line\ 2B)$$

Table 11. Summary of Post Release Mortality at the Yaupon Fishing Pier

		A. Lethal	B. Non-lethal
1.	Annual Reported Captures	0.0346	0.1754
2.	Annual Un-reported Captures	0.8824	1.5326
	Annual Total	0.9170	1.7080
	Triennial (3-year) Total	2.7511	5.1239

6.4 Estimating Hook-and-Line Captures at the Yaupon Fishing Pier by Species of Sea Turtle

Of the 48 sea turtles identified to species in the 20-year dataset of recreational hook-and-line captures for all of Brunswick County (1997-2016; Table 2), 2.1% were green, 75.0% were Kemp's ridley, and 22.9% were loggerhead sea turtles. We will assume approximately the same species composition for future captures at the Yaupon Fishing Pier: 2% for green sea turtles (inclusive of the NA and SA DPSs), 75% for Kemp's ridley sea turtles, and 23% for loggerhead sea turtles (NWA DPS). Table 12 estimates the number of lethal and non-lethal captures by species for any 3-year period at the Yaupon Fishing Pier.

Table 12. Estimated Captures of Sea Turtle Species at the Yaupon Fishing Pier for Any 3-Year Period

Species	Lethal*	Non-lethal*	Total*
Green sea turtle**	1 (0.02 x 2.7511 = 0.0550)	1 (0.02 x 5.1239 = 0.1025)	2
Kemp's ridley sea turtle	3 (0.75 x 2.7511 = 2.0634)	4 (0.75 x 5.1239 = 3.8426)	7
Loggerhead sea turtle	1 (0.23 x 2.7511 = 0.6328)	2 (0.23 x 5.1239 = 1.1785)	3
*To be conservative to the species, numbers of captures are rounded up to the nearest whole number. **Inclusive of both the North Atlantic and South Atlantic DPSs.			

6.5 Estimating Hook-and-Line Captures at the Yaupon Pier for Atlantic Sturgeon

Data regarding sturgeon caught via recreational hook-and-line is sparse and we are unsure of recreational fishing effects to sturgeon via entanglement, hooking, and trailing line. However, in January 2014, the Florida Fish and Wildlife Conservation Commission reported that a sturgeon was caught on hook-and-line gear from the Jacksonville Beach Pier, south of the mouth of the St. Johns River in Florida; it was identified from photos by experts as a subadult Atlantic sturgeon. We do not know if this animal was released alive or died. Therefore, to be conservative in our effects determination for the species, we will assume the proposed action may result in the take of 2 Atlantic sturgeon (1 lethal, 1 non-lethal) from any DPS over any consecutive 3-year period (Table 13).

Table 13. Estimated Captures of Atlantic Sturgeon at the Yaupon Fishing Pier for Any 3-Year Period

Species	Lethal	Non-lethal	Total
Atlantic sturgeon***	1	1	2
****Any DPS.*			

7. CUMULATIVE EFFECTS

ESA Section 7 regulations require NMFS to consider cumulative effects in formulating their Biological Opinions (50 CFR 402.14). Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Opinion. At this time, we are not aware of any other non-federal actions being planned or under development in the action area. Within the action area, major future changes are not anticipated in the ongoing human activities described in the environmental baseline. The present, major human uses of the action area are expected to continue at the present levels of intensity in the near future.

8. JEOPARDY ANALYSIS

The analyses conducted in the previous sections of this Opinion serve to provide a basis to determine whether the proposed action is likely to jeopardize the continued existence of green, kemps ridley, or loggerhead sea turtles. In the effect of the action section, we outlined how the proposed action would affect these species at the individual level and the extent of those effects in terms of the number of associated interactions, captures, and mortalities of each species to the extent possible with the best available data. Now we assess each of these species' response to this impact, in terms of overall population effects, and whether those effects of the proposed action, when considered in the context of the status of the species, the environmental baseline, and the cumulative effects, are likely to jeopardize their continued existence in the wild.

To "jeopardize the continued existence of" means to "engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and the recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Thus, in making this determination for each species, we must look at whether the proposed action directly or indirectly reduces the reproduction, numbers, or distribution of a listed species. Then if there is a reduction in 1 or more of these elements, we evaluate whether it would be expected to cause an appreciable reduction in the likelihood of both the survival and the recovery of the species.

The NMFS and USFWS's ESA Section 7 Handbook (USFWS and NMFS 1998) defines survival and recovery, as they apply to the ESA's jeopardy standard. Survival means "the species' persistence . . . beyond the conditions leading to its endangerment, with sufficient resilience to allow recovery from endangerment." Survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a sufficiently large population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter. Recovery means "improvement in the status of a listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the Act." Recovery is the process by which species' ecosystems are restored and/or threats to the species are removed so self-sustaining and self-regulating populations of listed species can be supported as persistent members of native biotic communities.

The status of each listed species likely to be adversely affected by the proposed action is reviewed in the status of the species section. For any species listed globally, our jeopardy determination must find the proposed action will appreciably reduce the likelihood of survival and recovery at the global species range. For any species listed as DPSs, a jeopardy determination must find the proposed action will appreciably reduce the likelihood of survival and recovery of that DPS. Only DPSs are considered in this Opinion.

8.1 Green Sea Turtles (NA and SA DPSs)

As discussed in the effects of the action section, within U.S. waters individuals from both the NA and SA DPSs can be found on foraging grounds. While there are currently no in-depth studies available to determine the percent of NA and SA DPS individuals in any given location, an analysis of green sea turtles on the foraging grounds off Hutchinson Island, Florida (Atlantic Ocean-side), found approximately 95% of the turtles sampled came from the NA DPS. While is it highly likely green sea turtles found in or near the action area will be from the NA DPE, we cannot rule out that they may also be from the SA DPS. Therefore, to analyze effects in a precautionary manner, we will conduct 2 jeopardy analyses, one for each DPS (i.e., assuming lethal take could come from either DPS).

8.1.1 NA DPS of Green Sea Turtle

The proposed action may result in the take of 2 green sea turtles (1 lethal, 1 non-lethal) from the NA DPS over any consecutive 3-year period. The potential non-lethal capture of a green sea turtle from the NA DPS is not expected to have any measurable impact on the reproduction, numbers, or distribution of these species. The individuals suffering non-lethal injuries or stresses are expected to fully recover such that no reductions in reproduction or numbers of green sea turtles are anticipated. The captures may occur anywhere in the action area, which encompasses only a tiny portion of green sea turtles' overall range/distribution within the NA DPS. Any incidentally caught animal would be released within the general area where caught and no change in the distribution of NA DPS green sea turtles would be anticipated.

The potential lethal take of 1 NA DPS green sea turtle every 3-year period would reduce the number of NA DPS green sea turtles, compared to their numbers in the absence of the proposed action, assuming all other variables remained the same. A lethal interaction would also result in a potential reduction in future reproduction, assuming the individual would be females and would have survived otherwise to reproduce. For example, as discussed in this Opinion, an adult green sea turtle can lay up to 7 clutches (usually 3-4) of eggs every 2-4 years, with up to an average of 136 eggs/nest, of which a small percentage is expected to survive to sexual maturity. The anticipated lethal take is expected to occur in a small, discrete action area and green sea turtles in the NA DPS generally have large ranges; thus, no reduction in the distribution is expected from the take of these individuals.

Whether the reductions in numbers and reproduction of this species would appreciably reduce its likelihood of survival depends on the probable effect the changes in numbers and reproduction would have relative to current population sizes and trends. In the Status of Species of this Opinion, we presented the status of the DPS, outlined threats, and discussed information on estimates of the number of nesting females and nesting trends at primary nesting beaches. In the Environmental Baseline, this Opinion outlined the past and present impacts of all state, federal, or private actions and other human activities in or having effects in the action area that have impacted and continue to impact this DPS. The Cumulative Effects section of this Opinion discussed the effects of future state, tribal, local, or private actions that are reasonably certain to occur within the action area.

Seminoff et al. (2015) estimated that there are greater than 167,000 nesting females in the NA DPS. The nesting at Tortuguero, Costa Rica, accounts for approximately 79% of that estimate (approximately 131,000 nesters), with Quintana Roo, Mexico, (approximately 18,250 nesters; 11%), and Florida, USA (approximately 8,400 nesters; 5%), also accounting for a large portion of the overall nesting (Seminoff et al. 2015). At Tortuguero, Costa Rica, the number of nests laid per year from 1999 to 2010 increased, despite substantial human impacts to the population at the nesting beach and at foraging areas (Campell and Lagueux 2005; Troëng 1998; Troëng and Rankin 2005). Nesting locations in Mexico along the Yucatan Peninsula also indicate the number of nests laid each year has deposited, but by 2000 this increased to over 1,500 nests/year (NMFS and USFWS 2007a)(NMFS and USFWS 2007a). By 2012, more than 26,000 nests were counted in Quintana Roo (J. Zurita, CIQROO, unpubl. data, 2013, in Seminoff et al. 2015). In Florida, most nesting occurs along the Atlantic coast of eastern central Florida, where a mean of 5,055 nests were deposited each year from 2001 to 2005 (Meylan et al. 2006) and 10,377 each year from 2008 to 2012 (B. Witherington, Florida Fish and Wildlife Conservation Commission, pers. comm., 2013). As described in the Section 4.5, nesting has increased substantially over the last 20 years and peaked in 2015 with 27,975 nests statewide. Green sea turtles nesting in Brunswick County, North Carolina, is infrequent (57 nests in the last 21 years); nesting at in or near the action area on Oak Island ranks third (9 nests in the last 21 years) after Bald Head Island (28 nests in 21 years) and Ocean Isle Island (17 nests in 21 years) (Data provided directly to consulting biologist from M. Godfrey, Sea Turtle Program Coordinator, North Carolina Wildlife Resources Commission, on June 19 and 20, 2017).

In summary, nesting at the primary nesting beaches has been increasing over the course of the decades, against the background of the past and ongoing human and natural factors (i.e., the environmental baseline) that have contributed to the current status of the species. We believe these nesting trends are indicative of a species with a high number of sexually mature individuals. Since the abundance trend information for NA DPS green sea turtles is clearly increasing, we believe the potential lethal take of 1 green sea turtle from the NA DPS over any 3-year period attributed to the proposed action will not have any measurable effect on that trend. After analyzing the magnitude of the effects of the proposed action, in combination with the past, present, and future expected impacts to the DPS discussed in this Opinion, we believe the proposed action is not reasonably expected to cause an appreciable reduction in the likelihood of survival of the green sea turtle NA DPS in the wild.

Recovery

The NA DPS of green sea turtles does not have a separate recovery plan at this time. However, an Atlantic Recovery Plan for the population of Atlantic green sea turtles (NMFS and USFWS 1991b) does exist. Since the animals within the NA DPS all occur in the Atlantic Ocean and would have been subject to the recovery actions described in that plan, we believe it is appropriate to continue using that Recovery Plan as a guide until a new plan, specific to the NA DPS, is developed. The Atlantic Recovery Plan lists the following relevant recovery objectives over a period of 25 continuous years:

Objective: The level of nesting in Florida has increased to an average of 5,000 nests per year for at least 6 years.

Objective: A reduction in stage class mortality is reflected in higher counts of individuals on foraging grounds.

According to data collected from Florida's index nesting beach survey from 1989-2015, green sea turtle nest counts across Florida have increased approximately ten-fold from a low of 267 in the early 1990s to a high of 27,975 in 2015 (http://myfwc.com/research/wildlife/sea-turtles/nesting/green-turtle/; reviewed by consulting biologist on June 28, 2017). There are currently no estimates available specifically addressing changes in abundance of individuals on foraging grounds. Given the clear increases in nesting, however, it is likely that numbers on foraging grounds have increased.

The potential lethal take of up to 1 green sea turtle from the NA DPS over any 3-year period will result in a reduction in numbers when a capture occurs, but it is unlikely to have any detectable influence on the recovery objectives and trends noted above, even when considered in the context of the of the Status of the Species, the Environmental Baseline, and Cumulative Effects discussed in this Opinion. Non-lethal captures of these sea turtles would not affect the adult female nesting population or number of nests per nesting season. Thus, the proposed action will not impede achieving the recovery objectives above and will not result in an appreciable reduction in the likelihood of NA DPS green sea turtles' recovery in the wild.

<u>Conclusion</u>

The lethal and non-lethal take of green sea turtles from the NA DPS associated with the proposed action are not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the NA DPS of green sea turtle in the wild.

8.1.2 SA DPS of Green Sea Turtle

The proposed action may result in the take of 2 green sea turtles (1 lethal, 1 non-lethal) from the SA DPS over any consecutive 3-year period. The potential non-lethal capture of a green sea turtle from the SA DPS is not expected to have any measurable impact on the reproduction, numbers, or distribution of these species. The individuals suffering non-lethal injuries or stresses are expected to fully recover such that no reductions in reproduction or numbers of green sea turtles are anticipated. The captures may occur anywhere in the action area, which encompasses only a tiny portion of green sea turtles' overall range/distribution within the SA DPS. Any incidentally caught animal would be released within the general area where caught and no change in the distribution of SA DPS green sea turtles would be anticipated.

The potential lethal take of 1 SA DPS green sea turtle every 3-year period would reduce the number of green sea turtles, compared to their numbers in the absence of the proposed action, assuming all other variables remained the same. Lethal interactions would also result in a potential reduction in future reproduction, assuming the individual would be female and would have survived otherwise to reproduce. For example, as discussed in this Opinion, an adult green sea turtle can lay up to 7 clutches (usually 3-4) of eggs every 2-4 years, with up to an average of

136 eggs/nest, of which a small percentage is expected to survive to sexual maturity. The anticipated lethal take is expected to occur in a small, discrete action area and green sea turtles in the SA DPS generally have large ranges; thus, no reduction in the distribution is expected from the take of these individuals.

Whether the reductions in numbers and reproduction of this species would appreciably reduce its likelihood of survival depends on the probable effect the changes in numbers and reproduction would have relative to current population sizes and trends. In the Status of Species of this Opinion, we presented the status of the DPS, outlined threats, and discussed information on estimates of the number of nesting females and nesting trends at primary nesting beaches. In the Environmental Baseline, this Opinion considered the past and present impacts of all state, federal, or private actions and other human activities in or having effects in, the action area that have impacted and continue to impact this DPS. The Cumulative Effects section of this Opinion considered the effects of future state, tribal, local, or private actions that are reasonably certain to occur within the action area.

In Section 4.5, we summarized available information on number of nesters and nesting trends at SA DPS beaches. Seminoff et al. (2015) estimated that there are greater than 63,000 nesting females in the SA DPS, though they noted the adult female nesting abundance from 37 beaches could not be quantified. The nesting at Poilão, Guinea-Bissau, accounted for approximately 46% of that estimate (approximately 30,000 nesters), with Ascension Island, United Kingdom, (approximately 13,400 nesters; 21%), and the Galibi Reserve, Suriname (approximately 9,400 nesters; 15%) also accounting for a large portion of the overall nesting (Seminoff et al. 2015).

Seminoff et al. (2015) reported that while trends cannot be estimated for many nesting populations due to the lack of data, they could discuss possible trends at some of the primary nesting sites. Seminoff et al. (2015) indicated that the nesting concentration at Ascension Island (United Kingdom) is one of the largest in the SA DPS and the population has increased substantially over the last 3 decades (Broderick et al. 2006; Glen et al. 2006). Mortimer and Carr (1987) counted 5,257 nests in 1977 (about 1,500 females), and 10,764 nests in 1978 (about 3,000 females) whereas from 1999–2004, a total of about 3,500 females nested each year (Broderick et al. 2006). Since 1977, numbers of nests on 1 of the 2 major nesting beaches, Long Beach, have increased exponentially from around 1,000 to almost 10,000 (Seminoff et al. 2015). From 2010 to 2012, an average of 23,000 nests per year was laid on Ascension (Seminoff et al. 2015). Seminoff et al. (2015), caution that while these data are suggestive of an increase, historic data from additional years are needed to fully substantiate this possibility.

Seminoff et al. (2015) reported that the nesting concentration at Galibi Reserve and Matapica in Suriname was stable from the 1970s through the 1980s. From 1975–1979, 1,657 females were counted (Schulz 1982), a number that increased to a mean of 1,740 females from 1983–1987 (Ogren 1989b), and to 1,803 females in 1995 (Weijerman et al. 1998). Since 2000, there appears to be a rapid increase in nest numbers (Seminoff et al. 2015).

In the Bijagos Archipelago (Poilão, Guinea-Bissau), Parris and Agardy (1993 as cited in Fretey 2001) reported approximately 2,000 nesting females per season from 1990 to 1992, and Catry et al. (2002) reported approximately 2,500 females nesting during the 2000 season. Given the typical large annual variability in green sea turtle nesting, Catry et al. (2009) suggested it was premature to consider there to be a positive trend in Poilão nesting, though others have made such a conclusion (Broderick et al. 2006). Despite the seeming increase in nesting, interviews along the coastal areas of Guinea-Bissau generally resulted in the view that sea turtles overall have decreased noticeably in numbers over the past two decades (Catry et al. 2009). In 2011, a record estimated 50,000 green sea turtle clutches were laid throughout the Bijagos Archipelago (Seminoff et al. 2015).

In summary, nesting at the primary nesting beaches has been increasing over the course of the decades, against the background of the past and ongoing human and natural factors (environmental baseline) that have contributed to the current status of the species. We believe these nesting trends are indicative of a species with a high number of sexually mature individuals. Since the abundance trend information for green sea turtles is clearly increasing, we believe the potential lethal take of 1 green sea turtle from the SA DPS every 3-year period attributed to the proposed action will not have any measurable effect on that trend. After analyzing the magnitude of the effects of the proposed action, in combination with the past, present, and future expected impacts to the DPS discussed in this Opinion, we believe the proposed action is not reasonably expected to cause an appreciable reduction in the likelihood of survival of the green sea turtle SA DPS in the wild.

<u>*Recovery*</u>

Like the NA DPS, the SA DPS of green sea turtles does not have a separate recovery plan in place at this time. However, an Atlantic Recovery Plan for the population of Atlantic green sea turtles (NMFS and USFWS 1991b) does exist. Since the animals within the SA DPS all occur in the Atlantic Ocean and would have been subject to the recovery actions described in that plan, we believe it is appropriate to continue using that Recovery Plan as a guide until a new plan, specific to the SA DPS, is developed. In our analysis for the NA DPS, we stated that the Atlantic Recovery Plan lists the following relevant recovery objectives over a period of 25 continuous years:

Objective: The level of nesting in Florida has increased to an average of 5,000 nests per year for at least 6 years.

Objective: A reduction in stage class mortality is reflected in higher counts of individuals on foraging grounds.

The nesting recovery objective is specific to the NA DPS, but demonstrates the importance of increases in nesting to recovery. As previously stated, nesting at the primary SA DPS nesting beaches has been increasing over the course of the decades. There are currently no estimates available specifically addressing changes in abundance of individuals on foraging grounds. Given the clear increases in nesting and in-water abundance, however, it is likely that numbers on foraging grounds have increased.

The potential lethal take of up to 1 SA DPS green sea turtle every 3-year period will result in a reduction in numbers when capture occurs, but it is unlikely to have any detectable influence on the trends noted above, even when considered in context with the Status of the Species, the Environmental Baseline, and Cumulative Effects discussed in this Opinion. Non-lethal capture of a sea turtle would not affect the adult female nesting population or number of nests per nesting season. Thus, the proposed action will not impede achieving the recovery objectives above and will not result in an appreciable reduction in the likelihood of the SA DPS of green sea turtles' recovery in the wild.

Conclusion

The lethal and non-lethal captures of green sea turtles associated with the proposed action are not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the SA DPS of green sea turtle in the wild.

8.2 Kemp's Ridley Sea Turtle

The proposed action is anticipated to result in the capture of up to 7 Kemp's ridley sea turtles (3 lethal, 4 non-lethal) during any consecutive 3-year period. The potential non-lethal capture of Kemp's ridley sea turtles is not expected to have any measurable impact on the reproduction, numbers, or distribution of these species. The individuals suffering non-lethal injuries or stresses are expected to fully recover such that no reductions in reproduction or numbers of green sea turtles are anticipated. The captures may occur anywhere in the action area, which encompasses only a tiny portion of Kemp's ridley sea turtles' overall range/distribution. Any incidentally caught animal would be released within the general area where caught and no change in the distribution of Kemp's ridley sea turtles would be anticipated.

The potential lethal take of 3 Kemp's ridley sea turtle during any consecutive 3-year period would reduce the species' population compared to the number that would have been present in the absence of the proposed action, assuming all other variables remained the same. The Turtle Expert Working Group (TEWG 1998b) estimates age at maturity from 7-15 years. Females return to their nesting beach about every 2 years (TEWG 1998b). The mean clutch size for Kemp's ridley sea turtle is 100 eggs/nest, with an average of 2.5 nests/female/season. Lethal takes could also result in a potential reduction in future reproduction, assuming at least one of these individuals would be female and would have survived to reproduce in the future. The loss of 1 Kemp's ridley sea turtle could preclude the production of thousands of eggs and hatchlings, of which a fractional percentage would be expected to survive to sexual maturity. Thus, the death of any females would eliminate their contribution to future generations, and result in a reduction in sea turtle reproduction. The anticipated lethal takes are expected to occur in a small, discrete action area and Kemp's ridley sea turtle generally have large ranges; thus, no reduction in the distribution is expected from the take of these individuals.

In the absence of any total population estimates for Kemp's ridley sea turtle, nesting trends are the best proxy for estimating population changes. Following a significant, unexplained 1-year decline in 2010, Kemp's ridley sea turtle nests in Mexico reached a record high of 21,797 in 2012 (Gladys Porter Zoo nesting database 2013). In 2013 through 2014, there was a second significant decline in Mexico nests, with only 16,385 and 11,279 nests recorded, respectively. In 2015, nesting in Mexico improved to 14,006 recorded nests , and in 2016 overall numbers increased to 18,354 recorded nests (Gladys Porter Zoo 2016).

A small nesting population is also emerging in the United States, primarily in Texas, rising from 6 nests in 1996 to 42 in 2004, to a record high of 209 nests in 2012 (National Park Service data, http://www.nps.gov/pais/naturescience/strp.htm, http://www.nps.gov/pais/naturescience/current-season.htm). Nesting numbers from 2013 indicate they decreased in 2013 to 153 nests in Texas (Gladys Porter Zoo nesting database 2013). Nesting rebounded somewhat in 2015, with 159 nests documented along the Texas coast (D. Shaver, NPS Padre Island National Seashore Division of Sea Turtle Science and Recovery, pers. comm. to M. Barnette, NMFS, October 28, 2015). There have been no recorded Kemp's ridley sea turtles nests in Brunswick County, North Carolina, 1996-2016 (Data provided directly to consulting biologist from M. Godfrey, Sea Turtle Program Coordinator, North Carolina Wildlife Resources Commission, on June 19 and 20, 2017).

It is important to remember that with significant inter-annual variation in nesting data, sea turtle population trends necessarily are measured over decades and the long-term trend line better reflects the population increase in Kemp's ridleys. With the recent increase in nesting data (2015-16) and recent declining numbers of nesting females (2013-14), it is too early to tell whether the long-term trend line is affected. Nonetheless, long-term data from 1990 to present continue to support that Kemp's ridley sea turtle is increasing in population size.

We believe this long-term increasing trend in nesting is evidence of an increasing population, as well as a population that is maintaining (and potentially increasing) its genetic diversity. We believe these nesting trends are indicative of a species with a high number of sexually mature individuals. Since the abundance trend information is clearly increasing, we believe the potential lethal take of 3 Kemp's ridley sea turtles every 3-year period attributed to the proposed action will not have any measurable effect on that trend. After analyzing the magnitude of the effects of the proposed action, in combination with the past, present, and future expected impacts to the DPS discussed in this Opinion, we believe the proposed action is not reasonably expected to cause an appreciable reduction in the likelihood of survival of Kemp's ridley sea turtles in the wild.

Recovery

As to whether the proposed action will appreciably reduce the species' likelihood of recovery, the recovery plan for the Kemp's ridley sea turtle (NMFS et al. 2011a) lists the following relevant recovery objective:

- A population of at least 10,000 nesting females in a season (as measured by clutch frequency/female/season) distributed at the primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) in Mexico is attained. Methodology and capacity to implement and ensure accurate nesting female counts have been developed.

The recovery plan states the average number of nests per female is 2.5; it sets a recovery goal of 10,000 nesting females associated with 25,000 nests. The 2012 nesting season recorded approximately 22,000 nests. Yet, in 2013 through 2014, there was a second significant decline, with only 16,385 and 11,279 nests recorded, respectively, which would equate to 6,554 nesting females in 2013 (16,385 / 2.5) and 4,512 in 2014 (11,279 / 2.5). Nest counts increased in the last two years, but they did not reach 25,000 by 2016; however, it is clear that the population has increased over the last 2 decades. The increase in Kemp's ridley sea turtle nesting is likely due to a combination of management measures including elimination of direct harvest, nest protection, the use of TEDs, reduced trawling effort in Mexico and the United States, and possibly other changes in vital rates (TEWG 1998a; TEWG 2000).

The lethal take of up to 3 Kemp's ridley sea turtle during any consecutive 3-year period by the proposed action will result in a reduction in numbers and reproduction, but it is unlikely to have any detectable influence on the nesting trends noted above. Given a nesting population in the thousands, the projected loss is not expected to have any discernable impact to the species. Non-lethal takes of sea turtles would not affect the adult female nesting population or number of nests per nesting season.

Conclusion
The lethal and non-lethal captures of Kemp's ridley sea turtles associated with the proposed action are not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of Kemp's ridley sea turtle in the wild.

8.3 NWA DPS of Loggerhead Sea Turtle
The proposed action may result in the take of 3 loggerhead sea turtles (1 lethal, 2 non-lethal) from the NWA DPS over any consecutive 3-year period. The potential non-lethal capture of a loggerhead sea turtle from the NWA DPS is not expected to have any measurable impact on the reproduction, numbers, or distribution of these species. The individuals suffering non-lethal injuries or stresses are expected to fully recover such that no reductions in reproduction or numbers of green sea turtles are anticipated. The captures may occur anywhere in the action area, which encompasses only a tiny portion of green sea turtles' overall range/distribution within the NA DPS. Any incidentally caught animal would be released within the general area where caught and no change in the distribution of NA DPS green sea turtles would be anticipated.

The lethal take of 1 loggerhead sea turtle every 3-year period associated with the proposed action represents a reduction in numbers. A lethal take could also result in a potential reduction in future reproduction, assuming the individual would be female and would have survived to reproduce in the future. For example, an adult female loggerhead sea turtle can lay 3 or 4 clutches of eggs every 2-4 years, with 100-130 eggs per clutch. Thus, the loss of 1 adult female could preclude the production of thousands of eggs and hatchlings of which a small percentage would be expected to survive to sexual maturity. A reduction in the distribution of loggerhead sea turtles is not expected from lethal takes attributed to the proposed action. The anticipated lethal take is expected to occur in a small, discrete action area and loggerhead sea turtles in the NWA DPS generally have large ranges; thus, no reduction in the distribution is expected from the take of these individuals.

Whether or not the reductions in loggerhead sea turtle numbers and reproduction attributed to the proposed action would appreciably reduce the likelihood of survival for loggerheads depends on what effect these reductions in numbers and reproduction would have on overall population sizes and trends, i.e., whether the estimated reductions, when viewed within the context of the environmental baseline, status of the species, and cumulative effects are of such an extent that adverse effects on population dynamics are appreciable. In the Status of Species of this Opinion, we considered the status of the DPS, outlined threats, and discussed information on estimates of the number of nesting females and nesting trends at primary nesting beaches. In the

Environmental Baseline, this Opinion considered the past and present impacts of all state, federal, or private actions and other human activities in or having effects in, the action area that have impacted and continue to impact this DPS. The Cumulative Effects section of this Opinion considered the effects of future state, tribal, local, or private actions that are reasonably certain to occur within the action area.

Loggerhead sea turtle is a slow growing, late-maturing species. Because of its longevity, the loggerhead sea turtle requires high survival rates throughout its life to maintain a population. In other words, late-maturing species cannot tolerate much anthropogenic mortality without going into decline. Conant et al. (2009b) concluded because natural growth rates are low for loggerhead sea turtle, natural survival needs to be high, and even low- to moderate mortality can drive the population into decline. Because recruitment to the adult population is slow, population-modeling studies suggest even small increases in mortality rates in adults and subadults could substantially impact population numbers and viability (Chaloupka and Musick 1997b; Crouse et al. 1987; Crowder et al. 1994; Heppell et al. 1995).

NMFS-SEFSC (2009b) estimated the minimum adult female population size for the NW Atlantic DPS in the 2004-2008 timeframe to likely be between approximately 20,000-40,000 individuals (median 30,050), with a low likelihood of being as many as 70,000 individuals. Another estimate for the entire western North Atlantic population was a mean of 38,334 adult females using data from 2001-2010 (Richards et al. 2011). A much less robust estimate for total benthic females in the western North Atlantic was also obtained, with a likely range of approximately 30,000-300,000 individuals, up to less than 1 million.

NMFS-NEFSC (2011) preliminarily estimated the loggerhead population in the Northwestern Atlantic Ocean along the continental shelf of the Eastern Seaboard during the summer of 2010 at 588,439 individuals (estimate ranged from 381,941 to 817,023) based on positively identified individuals. The NMFS-NEFSC's point estimate increased to approximately 801,000 individuals when including data on unidentified sea turtles that were likely loggerheads. The NMFS-NEFSC (2011) underestimates the total population of loggerheads since it did not include Florida's east coast south of Cape Canaveral or the Gulf of Mexico, which are areas where large numbers of loggerheads are also expected. In other words, it provides an estimate of a subset of the entire population.

Florida accounts for more than 90% of U.S. loggerhead nesting. The Florida Fish and Wildlife Conservation Commission conducted a detailed analysis of Florida's long-term loggerhead nesting data (1989-2016) (Figure 5). They indicated that following a 24% increase in nesting between 1989 and 1998, nest counts declined sharply from 1999 to 2007. However, annual nest counts showed a strong increase (71%) from 2008 to 2016. Examining only the period between the high-count nesting season in 1998 and the most recent nesting season (2016), researchers found a slight but nonsignificant increase, indicating a reversal of the post-1998 decline. The overall change in counts from 1989 to 2016 was significantly positive; however, it should be noted that wide confidence intervals are associated with this complex data set (http://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead-trends/).

Loggerhead nesting is frequent along North Carolina beaches and in 2016 there was a record number of loggerhead nests laid (1,621) (Data obtained from seaturtle.org by consulting biologist on June 30, 2017). Brunswick County accounted for 20% of the state-wide loggerhead sea turtle nesting in 2016. More specifically, Oak Island was number 1 out of the 6 nesting beaches in the county for loggerhead sea turtle nests laid (115) (Data provided directly to consulting biologist from M. Godfrey, Sea Turtle Program Coordinator, North Carolina Wildlife Resources Commission, on June 19 and 20, 2017).

Abundance estimates accounting for only a subset of the entire loggerhead sea turtle population in the western North Atlantic indicate the population is large (i.e., several hundred thousand individuals). Nesting trends have been significantly increasing over several years against the background of the past and ongoing human and natural factors (environmental baseline) that have contributed to the current status of the species. Additionally, our estimate of future captures is not a new source of impacts on the species. The same or a similar level of captures has occurred in the past, yet we have still seen positive trends in the status of this species.

The proposed action could lethally take up to 1 individual every 3-year period. While the loss of 1 individual every 3-year period is an impact to the population, in the context of the overall population’s size and current trend, we do not expect this loss to result in a detectable change to the population numbers or increasing trend. After analyzing the magnitude of the effects of the proposed action, in combination with the past, present, and future expected impacts to the DPS discussed in this Opinion, we believe the proposed action is not reasonably expected to cause an appreciable reduction in the likelihood of survival of the loggerhead sea turtle DPS in the wild.

Recovery

The loggerhead recovery plan defines the recovery goal as “…ensur[ing] that each recovery unit meets its Recovery Criteria alleviating threats to the species so that protection under the ESA is no longer necessary” (NMFS and USFWS 2008b). The plan then identifies 13 recovery objectives needed to achieve that goal. We do not believe the proposed action impedes the progress of the recovery program or achieving the overall recovery strategy.

The recovery plan for the Northwest Atlantic population of loggerhead sea turtles (NMFS and USFWS 2009) lists the following recovery objectives that are relevant to the effects of the proposed action:

Objective: Ensure that the number of nests in each recovery unit is increasing and that this increase corresponds to an increase in the number of nesting females

Objective: Ensure the in-water abundance of juveniles in both neritic and oceanic habitats is increasing and is increasing at a greater rate than strandings of similar age classes

Recovery is the process of removing threats so self-sustaining populations persist in the wild. The proposed action would not impede progress on carrying out any aspect of the recovery program or achieving the overall recovery strategy. The recovery plan estimates that the population will reach recovery in 50-150 years following implementation of recovery actions. The minimum end of the range assumes a rapid reversal of the current declining trends; the higher end assumes that additional time will be needed for recovery actions to bring about population growth.

Nesting trends have been significantly increasing over several years. As noted previously, we believe the future takes predicted will be similar to the levels of take that has occurred in the past and those past takes did not impede the positive trends we are currently seeing in nesting during that time. We also indicated that the lethal take of 1 loggerhead sea turtle every 3-year period is so small in relation to the overall population, that it would be hardly detectable, even when considered in the context of the Status of the Species, the Environmental Baseline, and Cumulative Effects discussed in this Opinion. We believe this is true for both nesting and juvenile in-water populations. For these reasons, we do not believe the proposed action will impede achieving the recovery objectives or overall recovery strategy.

Conclusion
The lethal and nonlethal take of loggerhead sea turtles associated with the proposed action are not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the NWA DPS of the loggerhead sea turtle in the wild.

8.4 Atlantic Sturgeon (All DPSs)

Five DPSs of Atlantic sturgeon are listed, 4 as endangered and 1 as threatened. Because Atlantic sturgeon mix extensively in the marine range, individuals from all 5 DPSs could occur in the action area. The proposed action may result in the take of 2 Atlantic sturgeon (1 lethal, 1 non-lethal) from any DPS over any consecutive 3-year period. The non-lethal take of 1 Atlantic sturgeon by recreational hook-and-line during any 3-year consecutive period is not expected to have any measurable impact on the reproduction, numbers, or distribution of animals from any of the 5 DPSs because the individuals captured and released are expected to fully recover.

The expected lethal capture of 1 Atlantic sturgeon by recreational hook-and-line during any 3-year consecutive period from any of the 5 DPSs would result in a very small reduction in numbers within any DPS, ranging from 0.0029% to 0.0737% (Table 14). Therefore, we do not believe the potential lethal take of 1 Atlantic sturgeon from any of the 5 DPSs will appreciably reduce the likelihood that any of the 5 DPSs will survive in the wild. For this same reason, we also do not believe the potential lethal take of 1 Atlantic sturgeon from any of the 5 DPSs would affect the distribution of any of the 5 DPS.

Table 14. Percentage of Lethal Take of the Total Population of Atlantic Sturgeon

DPS	Lethal Take for Yaupon Pier	Estimated Ocean Population Abundance (from Table 5)	Take of Total Population (%)
South Atlantic	1	14,911	0.0067
Carolina	1	1,356	0.0737
Chesapeake Bay	1	8,811	0.0113
New York Bight	1	34,566	0.0029
Gulf of Maine	1	7,455	0.0134

For each of the 5 DPSs to remain stable over generations, a certain amount of spawning must occur to offset the deaths within the population. We measure spawning potential in two ways: spawning stock biomass per recruit (SSB/R) and eggs per recruit (EPR). EPR_{max} refers to the maximum number of eggs produced by a female Atlantic sturgeon over the course of its lifetime assuming no fishing mortality. Similarly, SSB/R_{max} is the expected contribution a female Atlantic sturgeon would make during its lifetime to the total weight of the fish in a stock that is old enough to spawn, assuming no fishing mortality. In both cases, as fishing mortality increases, the expected lifetime production of a female decreases from the theoretical maximum (i.e., SSB/R_{max} or EPR_{max}) due to an increased probability the animal will be caught and therefore unable to achieve its maximum potential (Boreman 1997).

Since the EPR_{max} or SSB/R_{max} for each individual within a population is the same, it is appropriate to talk about these parameters not only for individuals but for populations as well. Goodyear (1993) suggests that maintaining a SSB/R of at least 20% of SSB/R_{max} would allow a population to remain stable (i.e., retain the capacity for survival). Boreman (1997) indicates that since stock biomass and egg production are typically linearly correlated (i.e., larger individuals generally produce more eggs than smaller individuals) it is appropriate to apply the 20% (Goodyear 1993) threshold directly to EPR estimates. Boreman (1997) reported adult female Atlantic sturgeon in the Hudson River could have likely sustained a fishing mortality rate of 14% and still retained enough spawners for the population to remain stable (i.e., maintain an EPR of at least 20% of EPR_{max}). We believe evaluating the potential effects of the proposed action against the fishing mortality associated with maintaining an EPR of at least 20% of EPR_{max} (i.e., F=0.14) is appropriate for evaluating the potential impacts of the proposed action on the likelihood any of the DPSs will survive in the wild.

The expected lethal capture of 1 adult Atlantic sturgeon by recreational hook-and-line from any of the 5 DPSs would result in in a very small reduction in numbers of adults within any DPS, ranging from 0.0116% to 0.2950% (Table 15). All of these values are far below the estimated 14% fishing mortality rate we believe the population could likely withstand and still maintain an EPR of at least 20% of EPR_{max}. Therefore, although the potential lethal take of 1 Atlantic sturgeon during any 3-year consecutive period will cause a reduction in numbers of reproducing adults, we do not believe this reduction will appreciably reduce the likelihood that any of the 5 DPSs will survive in the wild.

Table 15. Percentage of Lethal Take of the Adult Population of Atlantic Sturgeon

DPS	Lethal Take for Yaupon Pier	Estimated Ocean Population of Adults (from Table 5)	Take of Adult Population (%)
South Atlantic	1	3,728	0.0268
Carolina	1	339	0.2950
Chesapeake Bay	1	2,203	0.0454
New York Bight	1	8,642	0.0116
Gulf of Maine	1	1,864	0.0536

Recovery
Because of the recent listing of the 5 DPSs of Atlantic sturgeon, a recovery plan for the species has not yet been developed; however, the first step in recovering a species is to reduce identified threats; only by alleviating threats can lasting recovery be achieved. An increase in the population to a size that maintains a steady recruitment of individuals representing all life stages would provide population stability and enable the population to sustain itself even in the event of unforeseen and unavoidable impacts. The major threats affecting the 5 Atlantic sturgeon DPSs were summarized in the final listing rules and include: dams, dredging, water quality, climate change, and overutilization for commercial purposes. We do not believe the proposed action will exacerbate any of these major threats. The potential mortality of 1 Atlantic sturgeon during any 3-year period attributed to the proposed action is not likely to reduce population numbers over time due to current population sizes and expected recruitment. We therefore conclude the proposed action will not appreciably diminish the likelihood of recovery for any of the 5 DPSs of Atlantic sturgeon.

Conclusion
The lethal and nonlethal take of Atlantic sturgeon associated with the proposed action is not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of Atlantic sturgeon in the wild.

9. CONCLUSION

After reviewing the current statuses of the species, the environmental baseline, the effects of the proposed action, and cumulative effects using the best available data, it is NMFS's biological opinion that the proposed action is not likely to jeopardize the continued existence of the NA or SA DPSs of green sea turtle, Kemp's ridley sea turtle, the NWA DPS of loggerhead sea turtle, or any of the 5 DPSs of Atlantic sturgeon.

10. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and protective regulations issued pursuant to Section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption.

Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. *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 would otherwise be considered prohibited under Section 9 or Section 4(d), but which is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA, provided that such taking is in compliance with the reasonable and prudent measures and the terms and conditions of the incidental take statement (ITS) of the Opinion.

10.1 Anticipated Amount or Extent of Incidental Take
Based on the above information and analyses, NMFS believes that the proposed action is likely to adversely affect green sea turtles (NA or SA DPS), Kemp's ridley sea turtles, loggerhead sea

turtles (NWA DPS), and any of the 5 DPSs of Atlantic sturgeon. These effects will result from capture on hook-and-line and entanglement in fishing line or debris. NMFS anticipates the following incidental take may occur in the future as a result of the proposed action. We anticipate the take will occur over any consecutive 3-calendar-year periods (i.e., 2017-2019, 2018-2020, 2019-2021, etc.). The take estimates by species and DPS are shown in Table 16.

Table 16. Estimated Take at the Yaupon Fishing Pier by Species and Distinct Population Segment (DPS) for Any 3-Year Period

Species (DPS)	Estimated Total Take	Estimated Lethal Take	Estimated Non-lethal Take
Green (NA or SA DPS)	2	1	1
Kemp's ridley	7	3	4
Loggerhead (NWA DPS)	3	1	2
Atlantic sturgeon (Any DPS)	2	1	1

10.2 Effect of Take

NMFS has determined the anticipated incidental take is not likely to jeopardize the continued existence of the green sea turtle (NA or SA DPS), the Kemp's ridley sea turtle, loggerhead sea turtle (NWA DPS), or any of the 5 DPSs of Atlantic sturgeon.

10.3 Reasonable and Prudent Measures (RPMs)

Section 7(b)(4) of the ESA requires NMFS to issue a statement specifying the impact of any incidental take on listed species, which results from an agency action otherwise found to comply with Section 7(a)(2) of the ESA. It also states that the RPMs necessary to minimize the impacts of take and the terms and conditions to implement those measures must be provided and must be followed to minimize those impacts. Only incidental taking by the federal agency or applicant that complies with the specified terms and conditions is authorized.

The RPMs and terms and conditions are specified as required by 50 CFR 402.14 (i)(1)(ii) and (iv) to document the incidental take by the proposed action and to minimize the impact of that take on sea turtles. These measures and terms and conditions are nondiscretionary, and must be implemented by the USACE in order for the protection of Section 7(o)(2) to apply. If the applicant fails to adhere to the terms and conditions of this Incidental Take Statement (ITS) through enforceable terms, and/or fail to retain oversight to ensure compliance with these terms and conditions, the protective coverage of Section 7(o)(2) may lapse. To monitor the impact of the incidental take, the applicant must report the progress of the action and its impact on the species to NMFS as specified in this ITS [50 CFR 402.14(i)(3)].

NMFS has determined that the following RPMs and associated terms and conditions are necessary and appropriate to minimize impacts of the incidental take of sea turtles related to the proposed action:

1. The USACE must ensure that the applicant provides take reports regarding all interactions with ESA-listed species at this fishing pier.
2. The USACE must ensure that the applicant minimizes the likelihood of injury or mortality to ESA-listed species resulting from hook-and-line capture or entanglement by activities at this fishing pier.

3. The USACE must ensure that the applicant reduces the impacts to incidentally captured ESA-listed species.
4. The USACE must ensure that the applicant coordinates periodic fishing line removal (i.e., cleanup) events with non-governmental or other local organizations.

10.4 Terms and Conditions (T&Cs)
The following T&Cs implement the above RPMs:

1. To implement RPM No. 1 and No. 3, USACE must make it a condition of their permit that the applicant reports all hook-and-line captures of ESA-listed species and any other takes of ESA-listed species at the Yaupon Fishing Pier to the NMFS's Southeast Regional Office.
    a. Within 24 hours of any capture, entanglement, stranding, or other take, the applicant must notify NMFS's Southeast Regional Office by email (takereport.nmfsser@noaa.gov).
        i. Emails must reference this Opinion by the NMFS PRD number for this Opinion (SER-2017-18384 Yaupon Fishing Pier) and date of issuance.
        ii. The email must state the species, date and time of the incident, general location and activity resulting in capture (i.e., fishing from the Yaupon Pier by hook-and-line), condition of the species (i.e., alive, dead, sent to rehabilitation), size of the individual, behavior, identifying features (i.e., presence of tags, scars, or distinguishing marks), and any photos that may have been taken.
    b. Every three years, a summary report of capture, entanglement, stranding, or other take of ESA-listed species must be submitted to NMFS's Southeast Regional Office by email (takereport.nmfsser@noaa.gov):
        i. The email and report must reference this Opinion by the NMFS PRD number for this Opinion (SER-2017-18384 Yaupon Fishing Pier) and date of issuance.
        ii. The report will contain the following information: the total number of ESA-listed species captures, entanglements, strandings, or other take that occurred at or adjacent to the pier included in this Opinion.
        iii. The report will contain all information for any sea turtles taken to a rehabilitation facility holding an appropriate U.S. Fish and Wildlife Native Endangered and Threatened Species Recovery permit.
        iv. The first report will be submitted by January 31, 2020, and cover the period of time from pier opening to December 31, 2019. Thereafter, reports will be prepared every other year, emailed no later than January 31 of any year, and include information for the previous two calendar years.
        v. Reports will include current photographs of signs and bins required in T&Cs No. 2 and 3 below.

2. To implement RPM No. 2, USACE must make it a condition of their permit that the applicant must:
    a. Install and maintain the following 3 NMFS Protected Species Educational Signs: "Save the Sea Turtle, Sawfish, and Dolphins," "Help Protect North Atlantic Right Whales," and "Report Sturgeon."

i. Signs will be posted at the entrance to the pier and at terminal end of each side of the T-head.
ii. Signs will be installed prior to opening the pier for public use.
iii. Photographs of the installed signs will be emailed to NMFS's Southeast Regional Office by email (takereport.nmfsser@noaa.gov) with the NMFS PRD number for this Opinion (SER-2017-18384 Yaupon Fishing Pier) and date of issuance.
iv. Sign designs and installation methods are provided at the following website: http://sero.nmfs.noaa.gov/protected_resources/section_7/protected_species_educational_signs/index.html.
v. Additionally, current photographs of the signs will be included in each report required by T&C No. 1, above.

b. Install and maintain monofilament recycling bins and trash receptacles at the piers to reduce the probability of trash and debris entering the water.
i. Monofilament recycling bins and trash receptacles will be installed prior to opening the pier for public use.
ii. Photographs of the installed bins will be emailed to NMFS's Southeast Regional Office by email (takereport.nmfsser@noaa.gov) with the NMFS PRD number for this Opinion (SER-2017-18384 Yaupon Fishing Pier) and date of issuance.
iii. The applicant must regularly empty the bins and trash receptacles and make sure they are functional and upright.
iv. Additionally, current photographs of the bins will be included in each report required by T&C No. 1, above.

3. To implement RPM No. 4, USACE will make it a condition of their permit that the applicant must:
   a. Conduct an annual in-water and out-of-water cleanup to remove derelict fishing line and associated gear from the pier structure. A volunteer group may be contacted. NMFS recommends contacting the following volunteer groups: NC Coastal Federation, Wrightsville Beach Turtle Project, and/or Ocean Conservancy.
   b. Submit a record of each cleaning event to NMFS's Southeast Regional Office by email (takereport.nmfsser@noaa.gov) with the NMFS PRD number for this Opinion (SER-2017-18384 Yaupon Fishing Pier) and date of issuance.

11. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to use 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 designed to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

NMFS believes the following conservation recommendations further the conservation of the listed species that will be affected by the USACE's proposed action. NMFS strongly recommends that these measures be considered and implemented by USACE:

1. USACE encourages the North Carolina sea turtle rehabilitation centers to work with other southeastern U.S. sea turtle rehabilitation facilities on the best handling techniques, data collection and reporting, and public outreach.
2. USACE encourages research to develop deterrents to discourage turtles from using fishing piers as a habitualized food source.

In order for NMFS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, NMFS requests notification of the implementation of any conservation recommendations.

12. REINITIATION OF CONSULTATION

As provided in 50 CFR Section 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 ITS is exceeded, (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered, (3) the identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in the Biological Opinion, or (4) a new species is listed or critical habitat designated that may be affected by the identified action.

13. LITERATURE CITED

81 FR 20057. 2016. Endangered and Threatened Wildlife and Plants; Final Rule To List Eleven Distinct Population Segments of the Green Sea Turtle (*Chelonia mydas*) as Endangered or Threatened and Revision of Current Listings Under the Endangered Species Act. Final Rule. Federal Register 81(66):20057 -20090.

Ackerman, R. A. 1997. The nest environment and the embryonic development of sea turtles. Pages 83-106 *in* P. L. Lutz, and J. A. Musick, editors. The Biology of Sea Turtles. CRC Press, Boca Raton, Florida.

Addison, D. 1997. Sea turtle nesting on Cay Sal, Bahamas, recorded June 2-4, 1996. Bahamas Journal of Science 5(1):34-35.

Addison, D., and B. Morford. 1996. Sea turtle nesting activity on the Cay Sal Bank, Bahamas. Bahamas Journal of Science 3(3):31-36.

Aguilar, R., J. Mas, and X. Pastor. 1994. Impact of Spanish swordfish longline fisheries on the loggerhead sea turtle *Caretta caretta* population in the western Mediterranean. Pages 91-96 *in* J. I. Richardson, and T. H. Richardson, editors. Proceedings of the 12th Annual Workshop on Sea Turtle Biology and Conservation. U.S. Department of Commerce, Jekyll Island, Georgia.

Aguilar, R., J. Mas, and X. Pastor. 1995. Impact of Spanish swordfish longline fisheries on the loggerhead sea turtle, Caretta caretta, population in the western Mediterranean. Pages 1 *in* 12th Annual Workshop on Sea Turtle Biology and Conservation, Jekyll Island, Georgia.

Aguirre, A., G. Balazs, T. Spraker, S. K. K. Murakawa, and B. Zimmerman. 2002. Pathology of oropharyngeal fibropapillomatosis in green turtles *Chelonia mydas*. Journal of Aquatic Animal Health 14:298-304.

Aguirre, A. A., G. H. Balazs, B. Zimmerman, and F. D. Galey. 1994. Organic Contaminants and Trace Metals in the Tissues of Green Turtles (*Chelonia mydas*) Afflicted with Fibropapillomas in the Hawaiian Islands. Marine Pollution Bulletin 28(2):109-114.

Antonelis, G. A., J. D. Baker, T. C. Johanos, R. C. Braun, and A. L. Harting. 2006. Hawaiian monk seal (*Monachus schauinslandi*): status and conservation issues. Atoll Research Bulletin 543:75-101.

Arendt, M., and coauthors. 2009. Examination of local movement and migratory behavior of sea turtles during spring and summer along the Atlantic coast off the southeastern United States. South Carolina Department of Natural Resources, Marine Resources Division.

Armstrong, J. L., and J. E. Hightower. 2002. Potential for restoration of the Roanoke River population of Atlantic sturgeon. Journal of Applied Ichthyology 18(4-6):475-480

ASMFC. 1998. American shad and Atlantic sturgeon stock assessment peer review: Terms of reference and advisory report. Atlantic States Marine Fisheries Commission, Washington, D. C.

ASMFC. 2007. Special Report to the Atlantic Sturgeon Management Board: Estimation of Atlantic sturgeon bycatch in coastal Atlantic commercial fisheries of New England and the Mid-Atlantic.

ASMFC. 2010. Atlantic States Marine Fisheries Commission Annual Report.

ASSRT. 2007. Status review of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*). National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Regional Office, Atlantic Sturgeon Status Review Team.

Bain, M., N. Haley, D. Peterson, J. R. Waldman, and K. Arend. 2000. Harvest and habitats of Atlantic sturgeon *Acipenser oxyrinchus* Mitchill, 1815 in the Hudson River estuary: Lessons for sturgeon conservation. Boletín. Instituto Español de Oceanografía 16:43-53.

Bain, M. B. 1997. Atlantic and shortnose sturgeons of the Hudson River: common and divergent life history attributes. Environmental Biology of Fishes 48(1):347-358.

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

Balazik, M. T., G. C. Garman, J. P. Van Eenennaam, J. Mohler, and L. C. Woods. 2012. Empirical Evidence of Fall Spawning by Atlantic Sturgeon in the James River, Virginia. Transactions of the American Fisheries Society 141(6):1465-1471.

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

Balazs, G. H. 1983. Recovery records of adult green turtles observed or originally tagged at French Frigate Shoals, Northwestern Hawaiian Islands. National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, NOAA-TM-NMFS-SWFC-36.

Balazs, G. H. 1985. Impact of ocean debris on marine turtles: entanglement and ingestion. R. S. Shomura, and H. O. Yoshida, editors. Proceedings of the workshop on the fate and impact of marine debris. NOAA-NMFS, Honolulu, HI.

Balazs, G. H., S. G. Pooley, and S. K. Murakawa. 1995. Guidelines for handling marine turtles hooked or entangled in the Hawaii longline fishery: Results of an expert workshop held in Honolulu, Hawaii March 15-17,1995. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, Honolulu.

Bass, A. L., and W. N. Witzell. 2000. Demographic composition of immature green turtles (*Chelonia mydas*) from the east central Florida coast: Evidence from mtDNA markers. Herpetologica 56(3):357-367.

Belovsky, G. E. 1987. Extinction models and mammalian persistence. Chapter 3 *In*: Soulé, M.E. (ed), Viable Populations for Conservation. Cambridge University Press, pp.35-57.

Berry, R. J. 1971. Conservation aspects of the genetical constitution of populations. Pages 177-206 *in* E. D. Duffey, and A. S. Watt, editors. The Scientific Management of Animal and Plant Communities for Conservation, Blackwell, Oxford.

Bjorndal, K. A. 1982. The consequences of herbivory for life history pattern of the Caribbean green turtle, *Chelonia mydas*. Pages 111-116 *in* Biology and Conservation of Sea Turtles. Smithsonian Institution, Washington, D. C.

Bjorndal, K. A., A. B. Bolten, and M. Y. Chaloupka. 2005. Evaluating trends in abundance of immature green turtles, *Chelonia mydas*, in the greater Caribbean. Ecological Applications 15(1):304-314.

Bjorndal, K. A., A. B. Bolten, T. Dellinger, C. Delgado, and H. R. Martins. 2003. Compensatory growth in oceanic loggerhead sea turtles: Response to a stochastic environment. Ecology 84(5):1237-1249.

Bjorndal, K. A., J. A. Wetherall, A. B. Bolten, and J. A. Mortimer. 1999. Twenty-six years of green turtle nesting at Tortuguero, Costa-Rica: An encouraging trend. Conservation Biology 13(1):126-134.

Bolten, A., and B. Witherington. 2003. Loggerhead Sea Turtles. Smithsonian Books, Washington, D. C.

Bolten, A. B., K. A. Bjorndal, and H. R. Martins. 1994. Life history model for the loggerhead sea turtle (Caretta caretta) populations in the Atlantic: Potential impacts of a longline fishery. U.S. Department of Commerce.

Bolten, A. B., and coauthors. 1998. Transatlantic developmental migrations of loggerhead sea turtles demonstrated by mtDNA sequence analysis. Ecological Applications 8(1):1-7.

Boreman, J. 1997. Sensitivity of North American sturgeons and paddlefish to fishing mortality. Environmental Biology of Fishes 48(1):399-405.

Borodin, N. 1925. Biological Observations on the Atlantic Sturgeon (Acipenser sturio). Transactions of the American Fisheries Society 55(1):184-190.

Bouchard, S., and coauthors. 1998. Effects of Exposed Pilings on Sea Turtle Nesting Activity at Melbourne Beach, Florida. Journal of Coastal Research 14:1343-1347.

Bowen, B. W., and coauthors. 1992. Global population structure and natural history of the green turtle (*Chelonia mydas*) in terms of matriarchal phylogeny. Evolution 46(4):865-881.

Bresette, M., R. A. Scarpino, D. A. Singewald, and E. P. de Maye. 2006. Recruitment of post-pelagic green turtles (*Chelonia mydas*) to nearshore reefs on Florida's southeast coast. Pages 288 *in* M. Frick, A. Panagopoulou, A. F. Rees, and K. Williams, editors. Twenty-Sixth Annual Symposium on Sea Turtle Biology and Conservation. International Sea Turtle Society, Athens, Greece.

Broderick, A. C., and coauthors. 2006. Are green turtles globally endangered? Global Ecology and Biogeography 15(1):21-26.

Brundage, H. M., and J. C. O. Herron. 2003. Population estimate for shortnose sturgeon in the Delaware River. Presented at the 2003 Shortnose Sturgeon Conference, 7-9 July 2003.

Bushnoe, T., J. Musick, and D. Ha. 2005. Essential spawning and nursery habitat of Atlantic sturgeon (*Acipenser oxyrinchus*) in Virginia. Virginia Institute of Marine Science, Gloucester Point, Virigina.

Caldwell, D. K., and A. Carr. 1957. Status of the sea turtle fishery in Florida. Pages 457-463 *in* J. B. Trefethen, editor Twenty-Second North American Wildlife Conference. Wildlife Management Institute, Statler Hotel, Washington, D. C.

Campell, C. L., and C. J. Lagueux. 2005. Survival probability estimates for large juvenile and adult green turtles (*Chelonia mydas*) exposed to an artisanal marine turtle fishery in the western Caribbean. Herpetologica 61(2):91-103.

Carballo, J. L., C. Olabarria, and T. G. Osuna. 2002. Analysis of four macroalgal assemblages along the Pacific Mexican coast during and after the 1997-98 El Niño. Ecosystems 5(8):749-760.

Caron, F., D. Hatin, and R. Fortin. 2002. Biological characteristics of adult Atlantic sturgeon (*Acipenser oxyrinchus*) in the St Lawrence River estuary and the effectiveness of management rules. Journal of Applied Ichthyology 18(4-6):580-585.

Carr, A. F. 1986. New perspectives on the pelagic stage of sea turtle development. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center.

Carr, T., and N. Carr. 1991. Surveys of the sea turtles of Angola. Biological Conservation 58(1):19-29.

Catry, P., and coauthors. 2002. First census of the green turtle at Poilifilo, Bijagos Archipelago, Guinea-Bissau: The most important nesting colony on the Atlantic coast of Africa. Oryx 36(4):400-403.

Catry, P., and coauthors. 2009. Status, ecology, and conservation of sea turtles in Guinea-Bissau. Chelonian Conservation and Biology 8(2):150-160.

Caurant, F., P. Bustamante, M. Bordes, and P. Miramand. 1999. Bioaccumulation of cadmium, copper and zinc in some tissues of three species of marine turtles stranded along the French Atlantic coasts. Marine Pollution Bulletin 38(12):1085-1091.

Chaloupka, M., and C. Limpus. 2005. Estimates of sex- and age-class-specific survival probabilities for a southern Great Barrier Reef green sea turtle population. Marine Biology 146(6):1251-1261.

Chaloupka, M., T. M. Work, G. H. Balazs, S. K. K. Murakawa, and R. Morris. 2008. Cause-specific temporal and spatial trends in green sea turtle strandings in the Hawaiian Archipelago (1982-2003). Marine Biology 154(5):887-898.

Chaloupka, M. Y., and J. A. Musick. 1997a. Age growth and population dynamics. Pages 233-276 *in* P. L. Lutz, and J. A. Musick, editors. The Biology of Sea Turtles. CRC Press, Boca Raton, Florida.

Chaloupka, M. Y., and J. A. Musick. 1997b. Age, growth, and population dynamics. Pages 233-276 *in* P. L. Lutz, and J. A. Musick, editors. The Biology of Sea Turtles. CRC Press, Boca Raton.

Chytalo, K. 1996. Summary of Long Island Sound dredging windows strategy workshop. Management of Atlantic Coastal Marine Fish Habitat: Proceedings of a workshop for habitat managers. ASMFC Habitat Management Series #2.

Colburn, T., D. Dumanoski, and J. P. Myers. 1996. Our stolen future. Dutton/ Penguin Books, New York.

Collette, B., and G. Klein-MacPhee. 2002. Fishes of the Gulf of Maine, 3rd edition. Smithsonian Institution Press.

Collins, M. R., S. G. Rogers, T. I. J. Smith, and M. L. Moser. 2000a. Primary factors affecting sturgeon populations in the southeastern United States: fishing mortality and degradation of essential habitats. Bulletin of Marine Science 66(3):917-928.

Collins, M. R., T. I. J. Smith, W. C. Post, and O. Pashuk. 2000b. Habitat Utilization and Biological Characteristics of Adult Atlantic Sturgeon in Two South Carolina Rivers. Transactions of the American Fisheries Society 129(4):982-988.

Conant, T. A., and coauthors. 2009a. Loggerhead sea turtle (*Caretta caretta*) 2009 status review under the U.S. Endangered Species Act. National Oceanic and Atmospheric Administration, National Marine Fisheries Service.

Conant, T. A., and coauthors. 2009b. Loggerhead sea turtle (Caretta caretta) 2009 status review under the U.S. Endangered Species Act. Report of the Loggerhead Biological Review Team to the National Marine Fisheries Service.

Cook, M. C., and coauthors. 2014. Hooked on Kemp's - Preliminary Results of Mississippi's Angler Survey. International Sea Turtle Symposium-2014, New Orleans, LA.

Corsolini, S., S. Aurigi, and S. Focardi. 2000. Presence of polychlorobiphenyls (PCBs) and coplanar congeners in the tissues of the Mediterranean loggerhead turtle *Caretta caretta*. Marine Pollution Bulletin 40(11):952-960.

Crance, J. H. 1987. Habitat suitability index curves for anadromous fishes. In: Common strategies of anadromous and catadromous fishes: proceedings of an International Symposium held in Boston, Massachusetts, USA, March 9-13, 1986. Pages 554 *in* M. J. Dadswell, editor. American Fisheries Society, Bethesda, Maryland.

Crouse, D. T. 1999. Population Modeling and Implications for Caribbean Hawksbill Sea Turtle Management Chelonian Conservation and Biology 3(2):185-188.

Crouse, D. T., L. B. Crowder, and H. Caswell. 1987. A Stage-Based Population Model for Loggerhead Sea Turtles and Implications for Conservation. Ecology 68(5):1412-1423.

Crowder, L. B., D. T. Crouse, S. S. Heppell, and T. H. Martin. 1994. Predicting the Impact of Turtle Excluder Devices on Loggerhead Sea Turtle Populations. Ecological Applications 4(3):437-445.

D'Ilio, S., D. Mattei, M. F. Blasi, A. Alimonti, and S. Bogialli. 2011. The occurrence of chemical elements and POPs in loggerhead turtles (*Caretta caretta*): An overview. Marine Pollution Bulletin 62(8):1606-1615.

Dadswell, M. J. 2006. A review of the status of Atlantic sturgeon in Canada, with comparisons to populations in the United States and Europe. Fisheries 31(5):218-229.

Daniels, R., T. White, and K. Chapman. 1993. Sea-level rise: Destruction of threatened and endangered species habitat in South Carolina. Environmental Management 17(3):373-385.

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

Doughty, R. W. 1984. Sea turtles in Texas: A forgotten commerce. Southwestern Historical Quarterly 88:43-70.

Dovel, W. L., and T. J. Berggren. 1983. Atlantic sturgeon of the Hudson River estuary, New York. New York. Fish and Game Journal 30:140-172.

Dow, W., K. Eckert, M. Palmer, and P. Kramer. 2007. An atlas of sea turtle nesting habitat for the wider Caribbean region. The Wider Caribbean Sea Turtle Conservation Network and The Nature Conservancy, Beaufort, North Carolina.

DWH Trustees. 2015. DWH Trustees (Deepwater Horizon Natural Resource Damage Assessment Trustees). 2015. Deepwater Horizon Oil Spill: Draft Programmatic Damage Assessment and Restoration Plan and Draft Programmatic Environmental Impact Statement. Retrieved from http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan/.

Ehrhart, L. M. 1983. Marine turtles of the Indian River Lagoon System. Florida Scientist 46(3/4):337-346.

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

Ehrhart, L. M., and R. G. Yoder. 1978. Marine turtles of Merritt Island National Wildlife Refuge, Kennedy Space Centre, Florida. Florida Marine Research Publications 33:25-30.

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

Fish, M. R., and coauthors. 2005. Predicting the Impact of Sea-Level Rise on Caribbean Sea Turtle Nesting Habitat. Conservation Biology 19(2):482-491.

Fisher, M. 2009. Atlantic Sturgeon Progress Report. Delaware State Wildlife Grant, Project T 4-1. December 16, 2008 to December 15, 2009.

Fisher, M. 2011. Atlantic Sturgeon Progress Report. Delaware State Wildlife Grant, Project T 4-1, October 1, 2006 to October 15, 2010.

FitzSimmons, N. N., L. W. Farrington, M. J. McCann, C. J. Limpus, and C. Moritz. 2006. Green turtle populations in the Indo-Pacific: A (genetic) view from microsatellites. Pages 111 *in* N. Pilcher, editor Twenty-Third Annual Symposium on Sea Turtle Biology and Conservation.

Foley, A. M., B. A. Schroeder, and S. L. MacPherson. 2008. Post-nesting migrations and resident areas of Florida loggerheads (Caretta caretta). Pages 75-76 *in* H. J. Kalb, A. S. Rhode, K. Gayheart, and K. Shanker, editors. Twenty-Fifth Annual Symposium on Sea Turtle Biology and Conservation. U.S. Department of Commerce, Savannah, Georgia.

Foley, A. M., B. A. Schroeder, A. E. Redlow, K. J. Fick-Child, and W. G. Teas. 2005. Fibropapillomatosis in stranded green turtles (*Chelonia mydas*) from the eastern United States (1980-98): Trends and associations with environmental factors. Journal of Wildlife Diseases 41(1):29-41.

Foley, A. M., and coauthors. 2007. Characteristics of a green turtle (*Chelonia mydas*) assemblage in northwestern Florida determined during a hypothermic stunning event. Gulf of Mexico Science 25(2):131-143.

Formia, A. 1999. Les tortues marines de la Baie de Corisco. Canopee 14: i-ii.

Frazer, N. B., and L. M. Ehrhart. 1985. Preliminary growth models for green, (*Chelonia mydas*) and loggerhead, (*Caretta caretta*), turtles in the wild. Copeia 1985(1):73-79.

Fretey, J. 2001. Biogeography and conservation of marine turtles of the Atlantic Coast of Africa, UNebraskaP/CMississippi Secretariat.

Garrett, C. 2004. Priority Substances of Interest in the Georgia Basin - Profiles and background information on current toxics issues. Technical Supporting Document.

Geraci, J. R. 1990. Physiologic and toxic effects on cetaceans. Sea Mammals and Oil: Confronting the Risks. J. R. Geraci & D. J. St. Aubin (eds.). p.167-197. Academic Press, San Diego. ISBN 0-12-280600-X.

Gilbert, C. R. 1989. Species profiles : life histories and environmental requirements of coastal fishes and invertebrates (Mid-Atlantic Bight) : Atlantic and shortnose sturgeons. Coastal Ecology Group, Waterways Experiment Station, U.S. Dept. of the Interior, Fish and Wildlife Service, Research and Development, National Wetlands Research Center, Vicksburg, MS, Washington, DC.

Girard, C., A. D. Tucker, and B. Calmettes. 2009. Post-nesting migrations of loggerhead sea turtles in the Gulf of Mexico: Dispersal in highly dynamic conditions. Marine Biology 156(9):1827-1839.

Gladys Porter Zoo. 2013. Gladys Porter Zoo's Preliminary Annual Report on the Mexico/United States of America Population Restoration Project for the Kemp’s Ridley Sea Turtle, *Lepidochelys kempii*, on the Coasts of Tamaulipas, Mexico 2013.

Glen, F., A. C. Broderick, B. J. Godley, and G. C. Hays. 2006. Thermal control of hatchling emergence patterns in marine turtles. Journal of Experimental Marine Biology and Ecology 334(1):31-42.

Gonzalez Carman, V., and coauthors. 2011. Argentinian coastal waters: A temperate habitat for three species of threatened sea turtles. Marine Biology Research 7:500-508.

Grant, S. C. H., and P. S. Ross. 2002. Southern resident killer whales at risk: Toxic chemicals in the British Columbia and Washington environment. Fisheries and Oceans Canada, Institute of Ocean Sciences, Sidney, British Columbia, Canada.

Green, D. 1993. Growth rates of wild immature green turtles in the Galápagos Islands, Ecuador. Journal of Herpetology 27(3):338-341.

Greene, K. E., J. L. Zimmerman, R. W. Laney, and J. C. Thomas-Blate. 2009. Atlantic coast diadromous fish habitat: A review of utilization, threats, recommendations for conservation, and research needs. Atlantic States Marine Fisheries Commission Washington, D.C.

Groombridge, B. 1982. Kemp's ridley or Atlantic ridley, *Lepidochelys kempii* (Garman 1980). The IUCN Amphibia, Reptilia Red Data Book:201-208.

Grunwald, C., L. Maceda, J. Waldman, J. Stabile, and I. Wirgin. 2008. Conservation of Atlantic sturgeon *Acipenser oxyrinchus oxyrinchus*: Delineation of stock structure and distinct population segments. Conservation Genetics 9(5):1111-1124.

Guseman, J. L., and L. M. Ehrhart. 1992. Ecological geography of western Atlantic loggerheads and green turtles: Evidence from remote tag recoveries. Pages 50 *in* M. Salmon, and J. Wyneken, editors. Eleventh Annual Workshop on Sea Turtle Biology and Conservation. U.S. Department of Commerce, Jekyll Island, Georgia.

GWC. 2006. Georgia Water Coalition. Interbasin Transfer Fact Sheet. http://www.garivers.org/gawater/pdf%20files/IBT%20fact%20sheet02-06.pdf.

Hager, C., J. Kahn, C. Watterson, J. Russo, and K. Hartman. 2014. Evidence of Atlantic Sturgeon Spawning in the York River System. Transactions of the American Fisheries Society 143(5):1217-1219.

Hart, K. M., M. M. Lamont, I. Fujisaki, A. D. Tucker, and R. R. Carthy. 2012. Common coastal foraging areas for loggerheads in the Gulf of Mexico: Opportunities for marine conservation. Biological Conservation 145:185-194.

Hartwell, S. I. 2004. Distribution of DDT in sediments off the central California coast. Marine Pollution Bulletin 49:299-305.

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

Hays, G. C., and coauthors. 2001. The diving behavior of green turtles undertaking oceanic migration to and from Ascension Island: Dive durations, dive profiles, and depth distribution. Journal of Experimental Biology 204:4093-4098.

Hays, G. C., and coauthors. 2002. Water temperature and internesting intervals for loggerhead (*Caretta caretta*) and green (*Chelonia mydas*) sea turtles. Journal of Thermal Biology 27(5):429-432.

Heppell, S. S., and coauthors. 2005. A population model to estimate recovery time, population size, and management impacts on Kemp's ridley sea turtles. Chelonian Conservation and Biology 4(4):767-773.

Heppell, S. S., L. B. Crowder, D. T. Crouse, S. P. Epperly, and N. B. Frazer. 2003. Population models for Atlantic loggerheads: Past, present, and future. Pages 255-273 *in* A. Bolten, and B. Witherington, editors. Loggerhead Sea Turtles. Smithsonian Books, Washington, D. C.

Heppell, S. S., L. B. Crowder, and J. Priddy. 1995. Evaluation of a fisheries model for hawksbill sea turtle (Eretmochelys imbricata) harvest in Cuba. NOAA Tech. Memor. NMFS-OPR-5.

Herbst, L. H. 1994. Fibropapillomatosis of marine turtles. Annual Review of Fish Diseases 4:389-425.

Herbst, L. H., and coauthors. 1995. An infectious etiology for green turtle fibropapillomatosis. Proceedings of the American Association for Cancer Research Annual Meeting 36:117.

Hildebrand, H. H. 1963. Hallazgo del area de anidacion de la tortuga marina "lora", *Lepidochelys kempi* (Garman), en la costa occidental del Golfo de Mexico (Rept., Chel.). Ciencia, Mexico 22:105-112.

Hildebrand, H. H. 1982. A historical review of the status of sea turtle populations in the western Gulf of Mexico. Pages 447-453 *in* K. A. Bjorndal, editor. Biology and Conservation of Sea Turtles. Smithsonian Institution Press, Washington, D. C.

Hill, A. 2013. Rough Draft of Fishing Piers and Protected Species: An Asesment of the Presence and Effectiveness of Conservation Measures in Charlotte and Lee County, Florida. Pages 50 *in*. University of Miami, Rosenstiel School of Marine and Atmospheric Science.

Hirth, H. F. 1971. Synopsis of biological data on the green turtle *Chelonia mydas* (Linnaeus) 1758. Food and Agriculture Organization.

Hirth, H. F. 1997. Synopsis of the biological data on the green turtle *Chelonia mydas* (Linnaeus 1758). Biological Report 91(1):120.

Holton, J. W. J., and J. B. Walsh. 1995. Long-term dredged material management plan for the upper James River, Virginia. Waterway Surveys and Engineering, Ltd, Virginia Beach, VA.

IPCC. 2008. Climate Change and Water, Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, 210 pp.

Iwata, H., S. Tanabe, N. Sakai, and R. Tatsukawa. 1993. Distribution of persistent organochlorines in the oceanic air and surface seawater and the role of ocean on their global transport and fate Environmental Science and Technology 27:1080- 1098.

Jacobson, E. R. 1990. An update on green turtle fibropapilloma. Marine Turtle Newsletter 49:7-8.

Jacobson, E. R., and coauthors. 1989. Cutaneous fibropapillomas of green turtles (*Chelonia mydas*). Journal Comparative Pathology 101:39-52.

Jacobson, E. R., S. B. Simpson Jr., and J. P. Sundberg. 1991. Fibropapillomas in green turtles. Pages 99-100 *in* G. H. Balazs, and S. G. Pooley, editors. Research Plan for Marine Turtle Fibropapilloma, volume NOAA-TM-NMFS-SWFSC-156.

Johnson, S. A., and L. M. Ehrhart. 1994. Nest-site fidelity of the Florida green turtle. Pages 83 *in* B. A. Schroeder, and B. E. Witherington, editors. Thirteenth Annual Symposium on Sea Turtle Biology and Conservation.

Johnson, S. A., and L. M. Ehrhart. 1996. Reproductive ecology of the Florida green turtle: Clutch frequency. Journal of Herpetology 30(3):407-410.

Kahnle, A. W., K. A. Hattala, and K. A. McKown. 2007. Status of Atlantic sturgeon of the Hudson River Estuary, New York, USA. American Fisheries Society Symposium 56:347-363.

Kahnle, A. W., and coauthors. 1998. Stock Status of Atlantic sturgeon of Atlantic Coast Estuaries. Atlantic States Marine Fisheries Comission.

Kieffer, M. C., and B. Kynard. 1993. Annual Movements of Shortnose and Atlantic Sturgeons in the Merrimack River, Massachusetts. Transactions of the American Fisheries Society 122(6):1088-1103.

King, T. L., B. A. Lubinski, and A. P. Spidle. 2001. Microsatellite DNA variation in Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) and cross-species amplification in the Acipenseridae. Conservation Genetics 2(2):103-119.

KRRMP. 1993. Kennebec River Resource Management Plan: Balancing Hydropower Generation and Other Uses. Final Report to the Maine State Planning Office, Augusta, ME.

Kynard, B., and M. Horgan. 2002. Ontogenetic behavior and migration of Atlantic sturgeon, Acipenser oxyrinchus oxyrinchus, and shortnose sturgeon, A. brevirostrum, with notes on social behavior. Environmental Behavior of Fishes 63:137-150.

Lagueux, C. J. 2001. Status and distribution of the green turtle, *Chelonia mydas*, in the wider Caribbean region. Pages 32-35 *in* K. L. Eckert, and F. A. Abreu Grobois, editors. Marine Turtle Conservation in the Wider Caribbean Region - A Dialogue for Effective Regional Management, Santo Domingo, Dominican Republic.

Laurent, L., and coauthors. 1998. Molecular resolution of marine turtle stock composition in fishery by-catch: A case study in the Mediterranean. Molecular Ecology 7:1529-1542.

Law, R. J., and coauthors. 1991a. Concentrations of Trace-Metals in the Livers of Marine Mammals (Seals, Porpoises and Dolphins) from Waters around the British-Isles. Marine Pollution Bulletin 22(4):183-191.

Law, R. J., and coauthors. 1991b. Concentrations of trace metals in the livers of marine mammals (seals, porpoises and dolphins) from waters around the British Isles. Marine Pollution Bulletin 22(4):183-191.

Leland, J. G. 1968. A survey of the sturgeon fishery of South Carolina. Bears Bluff Laboratories, Wadmalaw Island, S.C.

Lezama, C. 2009. impacto de la pesqueria artesanal sobre la tortoga verde (*Chelonia mydas*) en las costas del Rio de la Plata exterior. Universidad de la República.

Lima, E. H. S. M., M. T. D. Melo, and P. C. R. Barata. 2010. Incidental capture of sea turtles by the lobster fishery off the Ceará Coast, Brazil. Marine Turtle Newsletter 128:16-19.

López-Barrera, E. A., G. O. Longo, and E. L. A. Monteiro-Filho. 2012. Incidental capture of green turtle (*Chelonia mydas*) in gillnets of small-scale fisheries in the Paranaguá Bay, Southern Brazil. Ocean and Coastal Management 60:11-18.

López-Mendilaharsu, M., A. Estrades, M. A. C. Caraccio, V., M. Hernández, and V. Quirici. 2006. Biología, ecología yetología de las tortugas marinas en la zona costera uru-guaya, Montevideo, Uruguay: Vida Silvestre, Uruguay.

Lutcavage, M. E., P. Plotkin, B. Witherington, and P. L. Lutz. 1997. Human impacts on sea turtle survival. Pages 432 *in* P. L. Lutz, and J. A. Musick, editors. The Biology of Sea Turtles. CRC Press.

Marcovaldi, N., B. B. Gifforni, H. Becker, F. N. Fiedler, and G. Sales. 2009. Sea Turtle Interactions in Coastal Net Fisheries in Brazil. U.S. National Marine Fisheries Service, Southeast Fisheries Science Center: Honolulu, Gland, Switze, Honolulu, Hawaii, USA.

Márquez M., R. 1990. Sea turtles of the world. An annotated and illustrated catalogue of sea turtle species known to date, Rome.

Márquez M., R. 1994. Synopsis of biological data on the Kemp's ridley sea turtle, *Lepidochelys kempii* (Garman, 1880). National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Center.

Matkin, C. O., and E. Saulitis. 1997. Restoration notebook: killer whale (Orcinus orca). Exxon Valdez Oil Spill Trustee Council, Anchorage, Alaska.

McKenzie, C., B. J. Godley, R. W. Furness, and D. E. Wells. 1999. Concentrations and patterns of organochlorine contaminants in marine turtles from Mediterranean and Atlantic waters. Marine Environmental Research 47:117-135.

McMichael, E., R. R. Carthy, and J. A. Seminoff. 2003. Evidence of homing behavior in juvenile green turtles in the northeastern Gulf of Mexico. Pages 223-224 *in* J. A. Seminoff, editor Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation.

Meylan, A., B. Schroeder, and A. Mosier. 1994. Marine turtle nesting activity in the State of Florida, 1979-1992. Pages 83 *in* K. A. Bjorndal, A. B. Bolten, D. A. Johnson, and P. J. Eliazar, editors. Fourteenth Annual Symposium on Sea Turtle Biology and Conservation.

Meylan, A. B., B. A. Schroeder, and A. Mosier. 1995. Sea turtle nesting activity in the State of Florida 1979-1992. Florida Department of Environmental Protection (52):63.

Meylan, A. B., B. E. Witherington, B. Brost, R. Rivero, and P. S. Kubilis. 2006. Sea turtle nesting in Florida, USA: Assessments of abundance and trends for regionally significant populations of *Caretta*, *Chelonia*, and **Dermochelys**. Pages 306-307 *in* M. Frick, A. Panagopoulou, A. F. Rees, and K. Williams, editors. Twenty-Sixth Annual Symposium on Sea Turtle Biology and Conservation. International Sea Turtle Society, Athens, Greece.

Miller, T., and G. Shepherd. 2011. Summary of Discard Estimates for Atlantic Sturgeon. Population Dynamics Branch, Northeast Fisheries Science Center.

Milton, S. L., and P. L. Lutz. 2003. Physiological and genetic responses to environmental stress. Pages 163-197 *in* P. L. Lutz, J. A. Musick, and J. Wyneken, editors. The Biology of Sea Turtles, volume II. CRC Press, Boca Raton, Florida.

Mo, C. L. 1988. Effect of bacterial and fungal infection on hatching success of Olive Ridley sea turtle eggs. World Wildlife Fund-U.S.

Moncada, F., and coauthors. 2010. Movement patterns of loggerhead turtles *Caretta caretta* in Cuban waters inferred from flipper tag recaptures. Endangered Species Research 11(1):61-68.

Moncada Gavilan, F. 2001. Status and distribution of the loggerhead turtle, *Caretta caretta*, in the wider Caribbean region. Pages 36-40 *in* K. L. Eckert, and F. A. Abreu Grobois, editors. Marine Turtle Conservation in the Wider Caribbean Region - A Dialogue for Effective Regional Management, Santo Domingo, Dominican Republic.

Monzón-Argüello, C., and coauthors. 2010. Evidence from genetic and Lagrangian drifter data for transatlantic transport of small juvenile green turtles. Journal of Biogeography 37(9):1752-1766.

Mortimer, J. A., and A. Carr. 1987. Reproduction and migrations of the Ascension Island green turtle (*Chelonia mydas*). Copeia 1987(1):103-113.

Moser, M. L. 2000. A protocol for use of shortnose and Atlantic sturgeons. Pages 1 online resource (18 p.) *in* NOAA technical memorandum NMFS-OPR ; 18. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, [Silver Spring, Md.].

Moser, M. L., J. B. Bichy, and S. B. Roberts. 1998. Sturgeon Distibution in North Carolina. Center for Marine Science Research, Wilmington, North Carolina.

Moser, M. L., and S. W. Ross. 1993. Distribution and movements of shortnose sturgeon (Acipenser brevirostrum) and other anadromous fishes of the lower Cape Fear River, North Carolina. Final Report to the U.S. Army Corps of Engineers, Wilmington, North Carolina.

Moser, M. L., and S. W. Ross. 1995. Habitat Use and Movements of Shortnose and Atlantic Sturgeons in the Lower Cape Fear River, North Carolina. Transactions of the American Fisheries Society 124(2):225-234.

Murawski, S. A., A. L. Pacheco, and United States. National Marine Fisheries Service. 1977. Biological and fisheries data on Atlantic sturgeon, Acipenser oxyrhynchus (Mitchill). Sandy Hook Laboratory, Northeast Fisheries Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Dept. of Commerce, Highlands, N.J.

Murphy, T. M., and S. R. Hopkins. 1984. Aerial and ground surveys of marine turtle nesting beaches in the southeast region. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center.

Musick, J. A., R. E. Jenkins, and N. B. Burkhead. 1994. Sturgeons, Family Acipenseridae. R. E. Jenkins, and N. B. Burkhead, editors. Freshwater Fishes of Virginia. American Fisheries Society, Bethesda, MD.

Musick, J. A., and C. J. Limpus. 1997. Habitat utilization and migration in juvenile sea turtles. Pages 137-163 *in* P. L. Lutz, and J. A. Musick, editors. The Biology of Sea Turtles. CRC Press, New York, New York.

Naro-Maciel, E., J. H. Becker, E. H. S. M. Lima, M. A. Marcovaldi, and R. DeSalle. 2007. Testing dispersal hypotheses in foraging green sea turtles (*Chelonia mydas*) of Brazil. Journal of Heredity 98(1):29-39.

Naro-Maciel, E., and coauthors. 2012. The interplay of homing and dispersal in green turtles: A focus on the southwestern atlantic. Journal of Heredity 103(6):792-805.

Niklitschek, E. J., and D. H. Secor. 2005. Modeling spatial and temporal variation of suitable nursery habitats for Atlantic sturgeon in the Chesapeake Bay. Estuarine, Coastal and Shelf Science 64(1):135-148.

Niklitschek, E. J., and D. H. Secor. 2009a. Dissolved oxygen, temperature and salinity effects on the ecophysiology and survival of juvenile Atlantic sturgeon in estuarine waters: I. Laboratory results. Journal of Experimental Marine Biology and Ecology 381(Supplement 1):S150-S160.

Niklitschek, E. J., and D. H. Secor. 2009b. Dissolved oxygen, temperature and salinity effects on the ecophysiology and survival of juvenile Atlantic sturgeon in estuarine waters: II. Model development and testing. Journal of Experimental Marine Biology and Ecology 381(Supplement 1):S161-S172.

Niklitschek, E. J., and D. H. Secor. 2010. Experimental and field evidence of behavioural habitat selection by juvenile Atlantic Acipenser oxyrinchus oxyrinchus and shortnose Acipenser brevirostrum sturgeons. Journal of Fish Biology 77(6):1293-1308.

NMFS-NEFSC. 2011. Preliminary summer 2010 regional abundance estimate of loggerhead turtles (*Caretta caretta*) in northwestern Atlantic Ocean continental shelf waters. U.S. Department of Commerce, Northeast Fisheries Science Center, Reference Document 11-03.

NMFS-SEFSC. 2009a. An assessment of loggerhead sea turtles to estimate impacts of mortality on population dynamics. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, PRD-08/09-14.

NMFS-SEFSC. 2009b. An assessment of loggerhead sea turtles to estimate impacts of mortality reductions on population dynamics. NMFS Southeast Fisheries Science Center.

NMFS. 1997. ESA Section 7 consultation on Navy activities off the southeastern United States along the Atlantic Coast. Biological Opinion.

NMFS. 2001. Stock assessments of loggerhead and leatherback sea turtles and an assessment of the impact of the pelagic longline fishery on the loggerhead and leatherback sea turtles of the western North Atlantic. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center.

NMFS, and SEFSC. 2012. Protocols for Categorizing Sea Turtles for Post-release Mortality Estimates. August 2001, revised February 2012. PRD Contribution: #PRD-2011-07.

NMFS, and USFWS. 1991a. Recovery plan for U.S. population of Atlantic green turtle (Chelonia mydas).

NMFS, and USFWS. 1991b. Recovery plan for U.S. population of the Atlantic green turtle (*Chelonia mydas*). National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, Washington, D. C.

NMFS, and USFWS. 1992. Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*). Pages 47 *in* U.S. Department of Interior, and U.S. Department of Commerce, editors. U.S. Fish and Wildlife Service, National Marine Fisheries Service.

NMFS, and USFWS. 1993. Recovery plan for hawksbill turtles in the U.S. Caribbean Sea, Atlantic Ocean, and Gulf of Mexico (Eretmochelys imbricata). U.S. Dept. of Commerce, National Oceanic and Atmopsheric Administration U.S. Dept. of the Interior, U.S. Fish and Wildlife Service, [Washington, D.C].

NMFS, and USFWS. 2007a. Green Sea Turtle (*Chelonia mydas*) 5-year review: Summary and Evaluation. National Marine Fisheries Service, Silver Spring, Maryland.

NMFS, and USFWS. 2007b. Kemp's ridley sea turtle (*Lepidochelys kempii*) 5-year review: summary and evaluation. National Marine Fisheries Service and U.S. Fish and Wildlife Service, Silver Spring, Maryland.

NMFS, and USFWS. 2007c. Kemp’s ridley Sea Turtle (*Lepidochelys kempii*) 5-year review: Summary and Evaluation. National Marine Fisheries Service, Silver Spring, MD.

NMFS, and USFWS. 2008a. Draft recovery plan for the northwest Atlantic population of the loggerhead sea turtle (*Caretta caretta*): Second revision. National Marine Fisheries Service and U.S. Fish and Wildlife Service, Silver Spring, Maryland.

NMFS, and USFWS. 2008b. Recovery plan for the northwest Atlantic population of the loggerhead sea turtle (*Caretta caretta*), second revision. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, Silver Spring, Maryland.

NMFS, and USFWS. 2009. Recovery plan for the northwest Atlantic population of the loggerhead sea turtle (*Caretta caretta)*. National Marine Fisheries Service and U.S. Fish and Wildlife Service, Silver Spring, Maryland.

NMFS, USFWS, and SEMARNAT. 2011a. Bi-National Recovery Plan for the Kemp’s Ridley Sea Turtle (*Lepidochelys kempii*), Second Revision. National Marine Fisheries Service, Silver Spring, Maryland.

NMFS, USFWS, and SEMARNAT. 2011b. Bi-National Recovery Plan for the Kemp’s Ridley Sea Turtle (*Lepidochelys kempii*), Second Revision. Pages 156 *in*. National Marine Fisheries Service, Silver Spring, Maryland.

NRC. 1990a. Decline of the Sea Turtles: Causes and Prevention. National Academy Press, 030904247X, Washington, D.C.

NRC. 1990b. Decline of the sea turtles: Causes and prevention. National Research Council, Washington, D. C.

Ogren, L. H. 1989a. Distribution of juvenile and subadult Kemp's ridley sea turtles: Preliminary results from 1984-1987 surveys. Pages 116-123 *in* C. W. Caillouet Jr., and A. M. Landry

Jr., editors. First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation and Management. Texas A&M University, Sea Grant College, Galveston, Texas.

Ogren, L. H. 1989b. Status report of the green turtle. Pages 89-94 *in* L. Ogren, and coeditors, editors. Second Western Atlantic Turtle Symposium.

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

Pritchard, P. C. H. 1969. The survival status of ridley sea-turtles in America. Biological Conservation 2(1):13-17.

Prosdocimi, L., V. González Carman, D. A. Albareda, and M. I. Remis. 2012. Genetic composition of green turtle feeding grounds in coastal waters of Argentina based on mitochondrial DNA. Journal of Experimental Marine Biology and Ecology 412:37-45.

Pyzik, L., J. Caddick, and P. Marx. 2004. Chesapeake Bay: Introduction to an ecosystem. EPA 903-R-04-003, CBP/TRS 232100.

.

Randall, M. T., and K. J. Sulak. 2012. Evidence of autumn spawning in Suwannee River gulf sturgeon, *Acipenser oxyrinchus desotoi* (Vladykov, 1955). Journal of Applied Ichthyology 28(4):489-495.

Rebel, T. P. 1974. Sea Turtles and the Turtle Industry of the West Indies, Florida and the Gulf of Mexico. University of Miami Press, Coral Gables, Florida.

Richards, P. M., and coauthors. 2011. Sea turtle population estimates incorporating uncertainty: A new approach applied to western North Atlantic loggerheads *Caretta caretta*. Endangered Species Research 15(2):151-158.

Rivas-Zinno, F. 2012. Captura incidental de tortugas marinas en Bajos del Solis, Uruguay. Universidad de la Republica Uruguay, Departamento de Ecologia y Evolucion.

Rogers, S. G., and W. Weber. 1995. Status and restoration of Atlantic and shortnose sturgeons in Georgia, Final Report. National Marine Fisheries Service, Southeast Regional Office, St. Petersburg, Florida.

Ryder, C. E., T. A. Conant, and B. A. Schroeder. 2006. Report of the Workshop on Marine Turtle Longline Post-Interaction Mortality. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources.

Sakai, H., H. Ichihashi, H. Suganuma, and R. Tatsukawa. 1995. Heavy metal monitoring in sea turtles using eggs. Marine Pollution Bulletin 30:347-353.

Salwasser, H., S. P. Mealey, and K. Johnson. 1984. Wildlife population viability: a question of risk. Pages 421-439 *in* Transactions of the North American Wildlife and Natural Resources Conference.

Savoy, T. 2007. Prey eaten by Atlantic sturgeon in Connecticut waters. American Fisheries Society Symposium 56:157.

Schmid, J. R., and J. A. Barichivich. 2006. *Lepidochelys kempii*–Kemp's ridley. Pages 128-141 *in* P. A. Meylan, editor. Biology and conservation of Florida turtles. Chelonian Research Monographs, volume 3.

Schmid, J. R., and A. Woodhead. 2000. Von Bertalanffy growth models for wild Kemp's ridley turtles: analysis of the NMFS Miami Laboratory tagging database. U. S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, Florida.

Schroeder, B. A., and A. M. Foley. 1995. Population studies of marine turtles in Florida Bay. J. I. Richardson, and T. H. Richardson, editors. Twelfth Annual Workshop on Sea Turtle Biology and Conservation.

Schueller, P., and D. L. Peterson. 2010. Abundance and recruitment of juvenile Atlantic sturgeon in the Altamaha River, Georgia. Transactions of the American Fisheries Society 139(5):1526-1535.

Schulz, J. P. 1982. Status of sea turtle populations nesting in Surinam with notes on sea turtles nesting in Guyana and French Guiana. Pages 435-438 *in* K. A. Bjorndal, editor. Biology and Conservation of Sea Turtles. Smithsonian Institution Press, Washington, D. C.

Scott, W. B., and E. J. Crossman. 1973. Freshwater fishes of Canada., Fisheries Research Board of Canada Bulletin.

Secor, D. 1995. Chesapeake Bay Atlantic sturgeon: current status and future recovery. Summary of findings and recommendations from a workshop convened 8 November 1994 at Chesapeake Biological Laboratory. Chesapeake Bay Biological Laboratory, Center for Estuarine and Environmental Studies, University of Maryland System, Solomons, MD.

Secor, D. H. 2002. Atlantic sturgeon fisheries and stock abundances during the late nineteenth century. Pages 89-98 *in* American Fisheries Society Symposium.

Secor, D. H., and T. E. Gunderson. 1998. Effects of hypoxia and temperature on survival, growth, and respiration of juvenile Atlantic sturgeon (*Acipenser oxyrinchus*). Fishery Bulletin U.S. 96:603-613.

Secor, D. H., and J. R. Waldman. 1999. Historical Abundance of Delaware Bay Atlantic Sturgeon and Potential Rate of Recovery. Pages 203-216 *in* American Fisheries Society Symposium.

Seminoff, J. A., and coauthors. 2015. Status review of the green turtle (*Chelonia Mydas*) under the endangered species act. NOAA Technical Memorandum, NMFS-SWFSC-539.

Shaffer, M. L. 1981. Minimum Population Sizes for Species Conservation. BioScience 31(2):131-134.

Shaver, D. J. 1994. Relative abundance, temporal patterns, and growth of sea turtles at the Mansfield Channel, Texas. Journal of Herpetology 28(4):491-497.

Smith, T. 1985. The fishery, biology, and management of Atlantic sturgeon, Acipenser oxyrhynchus, in North America. Environmental Biology of Fishes 14(1):61-72.

Smith, T. I. J., and J. P. Clugston. 1997. Status and management of Atlantic sturgeon, *Acipenser oxyrinchus*, in North America. Environmental Biology of Fishes 48(1-4):335-346.

Smith, T. I. J., E. K. Dingley, and E. E. Marchette. 1980. Induced spawning and culture of Atlantic sturgeon Progressive Fish Culturist 42:147-151.

Smith, T. I. J., D. E. Marchette, and R. A. Smiley. 1982. Life history, ecology, culture and management of Atlantic sturgeon, Acipenser oxyrhynchus, Mitchill, in South Carolina. Final Report to U.S. Fish and Wildlife Service Resources Department.

Snover, M. L. 2002. Growth and ontogeny of sea turtles using skeletochronology: Methods, validation and application to conservation. Duke University.

Soulé, M. E. 1980. Thresholds for survival: maintaining fitness and evolutionary potential. Pages 151-170 *in* M. E. Soulé, and B. A. Wilcox, editors. Conservation Biology: An Evolutionary-Ecological Perspective. Sinauer Associates, Sunderland, MA.

Soulé, M. E. 1987. Where do we go from here? Chapter 10 *In*: Soulé, M.E. (ed), Viable Populations for Conservation. Cambridge University Press, pp.175-183.

Squiers, T. 2004. State of Maine 2004 Atlantic sturgeon compliance report to the Atlantic States Marine Fisheries Commission. Report submitted to Atlantic States Marine Fisheries Commission, December 22, 2004, Washington, D.C.

Stein, A. B., K. D. Friedland, and M. Sutherland. 2004. Atlantic sturgeon marine bycatch and mortality on the continental shelf of the Northeast United States. North American Journal of Fisheries Management 24(1):171-183.

Stevenson, J. C., and D. H. Secor. 1999. Age determination and growth of Hudson River Atlantic sturgeon (*Acipenser oxyrinchus*). Fishery Bulletin 97:153-166.

Storelli, M. M., G. Barone, A. Storelli, and G. O. Marcotrigiano. 2008a. Total and subcellular distribution of trace elements (Cd, Cu and Zn) in the liver and kidney of green turtles (*Chelonia mydas*) from the Mediterranean Sea. Chemosphere 70(5):908-913.

Storelli, M. M., G. Barone, A. Storelli, and G. O. Marcotrigiano. 2008b. Total and subcellular distribution of trace elements (Cd, Cu and Zn) in the liver and kidney of green turtles (Chelonia mydas) from the Mediterranean Sea. Chemosphere 70:908-913.

Storelli, M. M., E. Ceci, and G. O. Marcotrigiano. 1998. Distribution of heavy metal residues in some tissues of *Caretta caretta* (Linnaeus) specimen beached along the Adriatic Sea (Italy). Bulletin of Environmental Contamination and Toxiocology 60:546-552.

Sweka, J., and coauthors. 2007. Juvenile Atlantic sturgeon habitat use in Newburgh and Haverstraw Bays of the Hudson River: Implications for Population Monitoring. North American Journal of Fisheries Management 27:1058-1067.

TEWG. 1998a. An assessment of the Kemp's ridley (*Lepidochelys kempii*) and loggerhead (*Caretta caretta*) sea turtle populations in the Western North Atlantic. Department of Commerce, Turtle Expert Working Group.

TEWG. 1998b. An assessment of the Kemp’s ridley (*Lepidochelys kempii*) and loggerhead (*Caretta caretta*) sea turtle populations in the western North Atlantic. U. S. Dept. Commerce.

TEWG. 2000. Assessment update for the Kemp's ridley and loggerhead sea turtle populations in the western North Atlantic. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, Turtle Expert Working Group.

TEWG. 2009. An assessment of the loggerhead turtle population in the western North Atlantic ocean. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Turtle Expert Working Group, NMFS-SEFSC-575.

Thomas, C. D. 1990. What Do Real Population Dynamics Tell Us About Minimum Viable Population Sizes? Conservation Biology 4(3):324-327.

Thompson, N. 1991. Preliminary Information on Turtle Captures Incidental to Fishing in Southeastern U.S. Waters. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, NOAA Technical Memorandum NMFS-SEFSC-285, Miami, FL.

Troëng, S. 1998. Poaching threatens the green turtle rookery at Tortuguero, Costa Rica. Marine Turtle Newsletter 80(11-12).

Troëng, S., and E. Rankin. 2005. Long-term conservation efforts contribute to positive green turtle *Chelonia mydas* nesting trend at Tortuguero, Costa Rica. Biological Conservation 121:111-116.

Tucker, A. D. 2010. Nest site fidelity and clutch frequency of loggerhead turtles are better elucidated by satellite telemetry than by nocturnal tagging efforts: Implications for stock estimation. Journal of Experimental Marine Biology and Ecology 383(1):48-55.

USFWS, and NMFS. 1998. Endangered Species Act consultation handbook. Procedures for Conducting Section 7 Consultations and Conferences. U.S. Fish and Wildlife, National Marine Fisheries Service.

USGRG. 2004. U.S. National Assessment of the Potential Consequences of Climate Variability and Change, Regional Paper: The Southeast. U.S. Global Research Group. Washington, D.C., August 20, 2004.

Van Eenennaam, J. P., and S. I. Doroshov. 1998. Effects of age and body size on gonadal development of Atlantic sturgeon. Journal of Fish Biology 53(3):624-637.

Van Eenennaam, J. P., and coauthors. 1996. Reproductive Conditions of the Atlantic Sturgeon (Acipenser oxyrinchus) in the Hudson River. Estuaries 19(4):769-777.

Vladykov, V. D., and J. R. Greely. 1963. Order Acipenseroidei. Pages 1630 pp *in* Fishes of Western North Atlantic, Sears Foundation. Marine Research, Yale University.

Waldman, J. R., C. Grunwald, J. Stabile, and I. Wirgin. 2002. Impacts of life history and biogeography on the genetic stock structure of Atlantic sturgeon Acipenser oxyrinchus oxyrinchus, Gulf sturgeon A-oxyrinchus desotoi, and shortnose sturgeon A-brevirostrum. Journal of Applied Ichthyology 18(4-6):509-518.

Waldman, J. R., and I. I. Wirgin. 1998. Status and Restoration Options for Atlantic Sturgeon in North America. Conservation Biology 12(3):631-638.

Watson, J. W., S. P. Epperly, A. K. Shah, and D. G. Foster. 2005. Fishing methods to reduce sea turtle mortality associated with pelagic longlines. Canadian Journal of Fisheries and Aquatic Sciences 62(5):965-981.

Weber, W. 1996. Population size and habitat use of shortnose sturgeon, Acipenser brevirostrum, in the Ogeechee River system, Georgia. University of Georgia, Athens, Georgia.

Weber, W., and C. A. Jennings. 1996. Endangered species management plan for the shortnose sturgeon, *Acipenser brevirostrum*. Final Report to Port Stewart Military Reservation, Fort Stewart, GA.

Weijerman, M. L., H. G. V. Tienen, A. D. Schouten, and W. E. J. Hoekert. 1998. Sea turtles of Galibi, Suriname. Pages 142-144 *in* R. Byles, and Y. Fernandez, editors. Sixteenth Annual Symposium on Sea Turtle Biology and Conservation.

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

Weishampel, J. F., D. A. Bagley, L. M. Ehrhart, and B. L. Rodenbeck. 2003. Spatiotemporal patterns of annual sea turtle nesting behaviors along an East Central Florida beach. Biological Conservation 110(2):295-303.

Wershoven, J. L., and R. W. Wershoven. 1992. Juvenile green turtles in their nearshore habitat of Broward County, Florida: A five year review. Pages 121-123 *in* M. Salmon, and J. Wyneken, editors. Eleventh Annual Workshop on Sea Turtle Biology and Conservation.

White, F. N. 1994. Swallowing dynamics of sea turtles. Pages 89-95 *in* G. H. Balazs, and S. G. Pooley, editors. Research Plan to Assess Marine Turtle Hooking Mortality. National Oceanic and Atmospheric Administration, Honolulu, Hawaii.

Wiley, T. R., and C. A. Simpfendorfer. 2010. Using public encounter data to direct recovery efforts for the endangered smalltooth sawfish, Pristis pectinata. Endangered Species Research 12:179-191.

Winger, P. V., P. J. Lasier, D. H. White, and J. T. Seginak. 2000. Effects of Contaminants in Dredge Material from the Lower Savannah River. Archives of Environmental Contamination and Toxicology 38(1):128-136.

Wirgin, I., C. Grunwald, J. Stabile, and J. Waldman. 2007. Genetic evidence for relict Atlantic sturgeon stocks along the mid-Atlantic coast of the USA. North American Journal of Fisheries Management 27(4):1214-1229.

Wirgin, I., and T. King. 2011. Mixed stock analysis of Atlantic sturgeon from coastal locales and a non-spawning river. NMFS Sturgeon Workshop, Alexandria, VA.

Wirgin, I., J. Waldman, J. Stabile, B. Lubinski, and T. King. 2002. Comparison of mitochondrial DNA control region sequence and microsatellite DNA analyses in estimating population structure and gene flow rates in Atlantic sturgeon Acipenser oxyrinchus. Journal of Applied Ichthyology 18(4-6):313-319.

Wirgin, I., and coauthors. 2000. Genetic structure of Atlantic sturgeon populations based on mitochondrial DNA control region sequences. Transactions of the American Fisheries Society 129(2):476-486.

Witherington, B., M. Bresette, and R. Herren. 2006. *Chelonia mydas* - Green turtle. Chelonian Research Monographs 3:90-104.

Witherington, B., S. Hirama, and A. Mosier. 2003. Effects of beach armoring structures on marine turtle nesting. Florida Fish and Wildlife Conservation Commission.

Witherington, B., S. Hirama, and A. Mosier. 2007. Changes to armoring and other barriers to sea turtle nesting following severe hurricanes striking Florida beaches. Florida Fish and Wildlife Conservation Commission.

Witherington, B. E. 1992. Behavioral responses of nesting sea turtles to artificial lighting. Herpetologica 48(1):31-39.

Witherington, B. E. 2002. Ecology of neonate loggerhead turtles inhabiting lines of downwelling near a Gulf Stream front. Marine Biology 140(4):843-853.

Witherington, B. E., and K. A. Bjorndal. 1991. Influences of artificial lighting on the seaward orientation of hatchling loggerhead turtles, Caretta caretta. Biological Conservation 55(2):139-149.

Witherington, B. E., and L. M. Ehrhart. 1989a. Hypothermic stunning and mortality of marine turtles in the Indian River Lagoon System, Florida. Copeia 1989(3):696-703.

Witherington, B. E., and L. M. Ehrhart. 1989b. Status, and reproductive characteristics of green turtles (*Chelonia mydas*) nesting in Florida. Pages 351-352 *in* L. Ogren, and coeditors, editors. Second Western Atlantic Turtle Symposium. .

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

Work, T. M. 2000. Synopsis of necropsy findings of sea turtles caught by the Hawaii-based pelagic longline fishery.

Young, J. R., T. B. Hoff, W. P. Dey, and J. G. Hoff. 1988. Management recommendations for a Hudson River Atlantic sturgeon fishery based on an age-structured population model. Fisheries Research in the Hudson River. State of University of New York Press, Albany, New York.

Zug, G. R., and R. E. Glor. 1998. Estimates of age and growth in a population of green sea turtles (*Chelonia mydas*) from the Indian River lagoon system, Florida: A skeletochronological analysis. Canadian Journal of Zoology 76(8):1497-1506.

Zurita, J. C., and coauthors. 2003. Nesting loggerhead and green sea turtles in Quintana Roo, Mexico. Pages 25-127 *in* J. A. Seminoff, editor Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation, Miami, Florida.

Zwinenberg, A. J. 1977. Kemp's ridley, *Lepidochelys kempii* (Garman, 1880), undoubtedly the most endangered marine turtle today (with notes on the current status of *Lepidochelys olivacea*). Bulletin Maryland Herpetological Society 13(3):170-192.