UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
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St. Petersburg, Florida 33701-5505
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F/SER31: PO

JAN 31 2017

Michael L. Piccirilli
Chief-Wildlife and Sport Fish Restoration
United States Fish and Wildlife Service
1875 Century Boulevard Suite 240
Atlanta, Georgia 30345

Dear Mr. Piccirilli:

The enclosed Biological Opinion ("Opinion") responds to your request for consultation with us, the National Marine Fisheries Service (NMFS), pursuant to Section 7 of the Endangered Species Act for the funding of the Georgia Department of Natural Resources (GA DNR) to collect, analyze and report biological and fisheries information to describe the conditions or health of recreationally important finfish (SER-2015-16739).

The Opinion considers the effects of the research that will be conducted by the GA DNR on the following listed species and/or critical habitat: blue whale, sei whale, sperm whale, fin whale, North Atlantic right whale (NARW), North Atlantic green sea turtle Distinct Population Segment (DPS), South Atlantic green sea turtle DPS, hawksbill sea turtle, leatherback sea turtle, Northwest Atlantic loggerhead sea turtle DPS, Kemp's ridley sea turtle, New York Bight Atlantic sturgeon DPS, Chesapeake Bay Atlantic sturgeon DPS, Carolina Atlantic sturgeon DPS, South Atlantic Atlantic sturgeon DPS, Gulf of Maine Atlantic sturgeon DPS, shortnose sturgeon, NARW critical habitat, and Northwest Atlantic loggerhead sea turtle DPS critical habitat. NMFS concludes that the proposed action is not likely to adversely affect the blue whale, sei whale, sperm whale, fin whale, NARW, leatherback sea turtle, hawksbill sea turtle, NARW critical habitat, and Northwest Atlantic loggerhead sea turtle DPS critical habitat. NMFS also concludes that the proposed action is not likely to jeopardize the continued existence of the North Atlantic green sea turtle DPS, South Atlantic green sea turtle DPS, Northwest Atlantic loggerhead sea turtle DPS, Kemp's ridley sea turtle, New York Bight Atlantic sturgeon DPS, Chesapeake Bay Atlantic sturgeon DPS, Carolina Atlantic sturgeon DPS, South Atlantic Atlantic sturgeon DPS, Gulf of Maine Atlantic sturgeon DPS, and shortnose sturgeon.

NMFS is providing an Incidental Take Statement with the Opinion. The Incidental Take Statement (ITS) describes reasonable and prudent measures NMFS considers necessary or appropriate to minimize the impact of incidental take associated with this action. The ITS also specifies nondiscretionary terms and conditions, including monitoring and reporting requirements with which the United States Fish and Wildlife Service and GA DNR must comply to carry out the reasonable and prudent measures.

We look forward to further cooperation with you on other projects to ensure the conservation of our threatened and endangered marine species and designated critical habitat. If you have any questions on this consultation, please contact Patrick Opay, Consultation Biologist, by phone at 727-551-5789, or by email at Patrick.Opay@noaa.gov.

Sincerely,

for Roy E. Crabtree, Ph.D.
Regional Administrator

Enclosure
File: SER-2015-16739

Endangered Species Act - Section 7 Consultation
Biological Opinion

Action Agency:	United States Fish and Wildlife Service
Activity:	Endangered Species Act (ESA) Section 7 Consultation on United States Fish and Wildlife Service (USFWS) Funding of Georgia Department of Natural Resources (GA DNR) to Collect, Analyze and Report Biological and Fisheries Information to Describe the Conditions or Health of Recreationally Important Finfish (SER-2015-16739)
Consulting Agency:	NOAA, NMFS, SERO, Protected Resources Division (F/SER3)

Date Issued: JAN 31 2017

Approved By: [signature] for

Roy E. Crabtree, Ph.D.
Regional Administrator

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List of Frequently Used Acronyms

CFLP	Coastal Fisheries Logbook Program
CPUE	Catch Per Unit Effort
DPS	Distinct Population Segment
DWH	Deepwater Horizon
EEZ	Exclusive Economic Zone
ESA	Endangered Species Act
F/SER1	NMFS - Southeast Regional Office - Operations, Management, and Information Services Division
F/SER3	NMFS - Southeast Regional Office - Protected Resources Division
FIM	Fisheries Independent Monitoring
FMP	Fishery Management Plan
FMU	Fishery Management Unit
GADNR	Georgia Department of Natural Resources
PRD	Protected Resources Division
HMS	Highly Migratory Species
ITS	Incidental Take Statement
MMPA	Marine Mammal Protection Act
NARW	North Atlantic Right Whale
NMFS	National Marine Fisheries Service
nmi	Nautical Mile
NOAA	National Oceanic and Atmospheric Administration
OST	Office of Science and Technology
RPMs	Reasonable and Prudent Measures
SEFSC	Southeast Fisheries Science Center
SERO	Southeast Regional Office
SRP	Scientific Research Permit
STSSN	Sea Turtle Stranding and Salvage Network
T/C	Terms and Conditions
TED	Turtle Excluder Device
TEWG	Turtle Expert Working Group
USFWS	United States Fish and Wildlife Service
YOY	Young-Of-The-Year

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Introduction

Section 7(a)(2) of the ESA of 1973, as amended (16 U.S.C. § 1531 et seq.), requires each federal agency to ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of any critical habitat of such species. To fulfill this obligation, Section 7(a)(2) requires federal agencies to consult with the appropriate Secretary on any action they propose that "may affect" listed species or designated critical habitat. NMFS and the U.S. Fish and Wildlife Service (USFWS) share responsibilities for administering the ESA.

Consultations on most listed marine species and their designated critical habitat are conducted between the action agency and NMFS. The consultation is concluded after NMFS concurs with an action agency that its action is not likely to adversely affect listed species or critical habitat or issues a Biological Opinion ("Opinion") that identifies whether a proposed action is likely to jeopardize the continued existence of a listed species, or destroy or adversely modify its critical habitat. If jeopardy or destruction or adverse modification is found to be likely, the Opinion identifies reasonable and prudent alternatives (RPAs) to the action as proposed, if any, that can avoid jeopardizing listed species or resulting in the destruction/adverse modification of critical habitat. The Opinion states the amount or extent of incidental take of the listed species that may occur, specifies reasonable and prudent measures (RPMs) that are required to minimize the impacts of incidental take and monitoring to validate the expected effects of the action, and recommends conservation measures to further conserve the species.

This document represents NMFS's Opinion on the effects of survey and sampling activities funded by the USFWS in the waters off the coast of Georgia on threatened and endangered species and designated critical habitat, in accordance with Section 7 of the ESA.

This Opinion has been prepared in accordance with Section 7 of the ESA and regulations promulgated to implement that section of the ESA. It is based on information provided in the biological evaluation (BE) submitted by the (USFWS 2015) subsequent emails with the USFWS and associated updates to the BE, as well as information provided in recovery plans, past research and monitoring data, and other relevant published and unpublished scientific and commercial data cited in the Literature Cited section of this document. During this consultation, we conducted electronic searches of the general scientific literature. We also contacted subject matter experts (e.g., NMFS science center staff) for informaton. These searches specifically tried to identify data or other information that supports a particular conclusion (for example, a study that suggests a species will respond to a stimulus in a certain way) as well as data that does not support our conclusion. When data are equivocal, or in the face of substantial uncertainty, our decisions are designed to avoid the risks of inaccurately concluding that an action would not have an adverse effect on listed species.

1.0 Consultation History

The USFWS submitted a request to reinitiate formal consultation with the NMFS Southeast Regional Office (SERO) on June 20, 2014 (NMFS Consultation Number SER-2011-5655). While the request used the word “reinitiation,” it was in fact a request for initiation, as the previous request for consultation under SER-2011-5655 was never completed. The formal consultation request was for the USFWS federal funding of the Georgia Department of Natural Resources Coastal Resources Division (GCRD) ongoing research project titled “*Georgia Marine Recreational Fisheries Surveys and Inventories (F-79).*” Money is provided through the Dingell-Johnson Sport Fish Restoration Act of 1950, 64 Stat. 430, as amended 16 U.S.C. 777-777n. In the USFWS June 20, 2014 letter, the USFWS acknowledged that the funding could result in the incidental take of several sea turtle species (i.e. Kemp’s ridley, green, and loggerhead) and the Atlantic sturgeon of the South Atlantic distinct population segment (DPS) of coastal Georgia.

On October 15, 2014, the USFWS and SERO had a conference call and SERO recommended combining all the GCRD Sport Fish Restoration Program funded activities (SER-2011-5655, SER- 2013-11107, and SER-2014-14909) under one Biological Opinion. Each of the previous uncompleted requests for consultation was subsequently withdrawn. On March 12, 2015, the USFWS requested “reinitiation” on funded GCRD Sport Fish Restoration Projects. However, since no consultations had been yet been completed, the request was for consultation on the program funded activities as discussed on the conference call. That request resulted in this consultation, SER-2015-16739.

Due to SERO staffing issues, consultation was delayed. In August of 2016, consultation resumed and it was determined that activities that were not associated with the Georgia Marine Recreational Fisheries Surveys did not require inclusion in this consultation request. These other activities (maintenance of offshore buoy systems and markers, artificial reef sites, oyster reef restoration sites, boating access sites, and fishing piers and docks) require U.S. Army Corps of Engineering (Corps) permitting. Maintenance activities on existing structures are covered under U.S. Army Corps of Engineers General Permits (GP) or Nationwide Permits (NWP), and the NMFS' programmatic Biological Opinion on the Corps' Nationwide Permits Program (November 24, 2014) has assessed the status of listed resources and the potential impacts these activities may have on NMFS listed species. USFWS will request separate consultation for any activities that are not covered by the programmatic Opinion. Therefore, this consultation and resulting biological opinion address only survey and inventorying activities that would be conducted from February 1, 2017 to January 31, 2022, as described in the proposed action section of this Opinion.

2.0 Description of the Proposed Action

The USFWS proposes to fund the Georgia Department of Natural Resources (GADNR) Coastal Resources Division (GCRD) to collect, analyze and report biological and fisheries information to describe the conditions or health of recreationally important finfish populations and develop management recommendations that would maintain or restore the stocks in coastal Georgia. Each year, project biologists would consult with state and regional experts and stock assessment analysts to determine priority activities for each year's investigation, but the activities would be as described in this Opinion. Investigations would be intended to serve as the framework to collect the timely and pertinent data needed for proactive fishery management. Some investigations would be short-term and specifically targeted at a discrete fisheries data need. Others would be designed to provide for longer, systematic investigation of more complex issues such as changes in age-composition. Specifically, the project would conduct these surveys: 1) Ecological Monitoring Trawl Survey, 2) Juvenile Trawl Survey, 3) Marine Sport Fish Health Survey – Gill Net Survey, 4) Marine Sport Fish Health Survey – Trammel Net Survey, 5) Hook and Line Surveys/Sampling, and 6) Artificial Reef Monitoring.

2.1 Description of the Funded Research Program Activities

Ecological Monitoring Trawl Survey (EMTS)

Fish populations in six Georgia estuaries (Wassaw, Ossabaw, Sapelo, St. Simons, St. Andrew and Cumberland) and near offshore waters would be monitored monthly utilizing a trawl to gather data on relative abundance, size composition, temporal and spatial distributions of various marine species. Approximately six to ten pre-designated trawl stations would be sampled within each estuary (Figure 2.2).

Trawl times would be standardized to 15 minutes bottom time. The objective of this survey would be to provide a comprehensive, long-term fishery-independent monitoring program for finfish, invertebrates, and water quality.

Project personnel would sample estuaries on a monthly basis. These data collection efforts would provide fishery managers with occurrence, abundance, and distribution information on juvenile finfish and help define essential fish habitat for important recreational finfish. This sampling would complement established trammel and gill net studies targeting sub-adult and adult fish populations. Samples would be collected via a 12.2 m (40 ft) flat trawl net with elephant ears (no BRD/TED) with 1 7/8 in (47.6 mm) stretch mesh w/ #12 twine (body); 1 5/8 inch (41.3 mm) stretch w/ #36 twine (bag); 46.5 ft (14.1732 m) tickler chain; and 5 ft x 32 in (1.5 m x 0.813 m) wooden doors w/ 4 in (101.6 mm) irons/shoes towed from a 18.3 m (60 ft) shrimp vessel (R/V Anna). A total of 2,520 trawls, standard 15 minutes tow duration, would be performed at 42 sites (July – June) over a 5 year period. After deploying the net via a double-drum winch, the net would be stopped, or "dogged off", and the official tow time recorded. After towing the net for 15 minutes, the winch would be re-engaged and the net would be retrieved. The cod end of the net would be brought onboard the vessel and its contents released into a culling table for sorting. At each station, GPS coordinates (decimal deg.), tow duration (minutes), and depth (feet) would be recorded. Maximum trawl depth would not exceed 59.6 ft

(18.3 m). After the EMTS catch is processed, the boat and crew will travel to the next station and repeat the sampling procedure.

Actions to Reduce Impacts of Proposed Action
The parameters of the trawl and the deployment techniques would be selected in order to minimize the potential interaction with non-target species, while maintaining a viable sampling design that would meet project objectives. When feasible, sampling would occur at high tide or in locations with sufficient water depth to provide for greater distance between the propeller and the substrate to avoid effects to habitat. Trawl times would be limited to a maximum of 15 minutes to reduce trauma to collected species. All possible precautions would be implemented to reduce the possibility of incidental take of protected species. Short trawl times (15 minutes) at depths with good visibility and a relatively short trawl rope (60 ft) would reduce the possibility of an interaction. If a listed species is observed within 50 ft of operating or sampling activities, work would be stopped immediately in order to further reduce the risk of an interaction. If an interaction occurs, immediate steps would be taken to limit harm. Should any federally listed species be incidentally taken, GADNR staff would: (1) follow handling guidelines (Appendices A and C), (2) affirm that the listed species is alive, uninjured, and is in good condition and ready to return to the water; and, (3) release the listed species as expediently as possible. Any injured, entangled, or stranded marine mammals or sea turtles would be immediately reported to the National Marine Fisheries Service's Protected Resources Division and the local authorized stranding/rescue program.

Juvenile Trawl Survey (JTS)

The JTS is a small trawl survey designed to assess smaller bodies of water (creeks/rivers) and areas unable to be sampled by the EMTS. This survey would be conducted in two of Georgia's estuaries (Ossabaw, Altamaha) (Figure 2.3) year-round.

Five-minute trawls would be made monthly at six stations in each sound system (Ossabaw, Altamaha), with a total of 720 trawls conducted during July – June over a five year period (i.e., 12 sites per month x 12 months x 5 years = 720 trawls). The primary objective of this survey is to provide additional fishery-independent data on finfish, crustaceans, and other marine biota that fishery managers can use in helping better understand current population trends and subsequently make better informed management decisions. Monthly catch-per-unit-of-effort (CPUE) values, defined as the number per standard trawl, are compared with historical database averages to evaluate stock status and abundance and to prepare administrative fishery management recommendations for recreationally and/or commercially important species.

On arrival at a designated fixed sampling site, the 5.8 m (19 ft) Cape Horn boat and crew would deploy a single semi-balloon trawl net from a davit arm on the starboard side of the boat. When the JTS net begins to open in the water, the tow line would be taken off of the davit arm and the net deployed off of the stern of the boat. Ample scope (at least 3:1 ratio) would be provided for the net, based on the water depth at the sampling station. When the net is deployed, the tow line would be tied off to a stern cleat and the tow time officially begun. The net would be towed for a standardized 5 minutes. After 5 minutes the tow line would be untied from the stern cleat, officially ending the tow duration, and the net retrieved by hand. Maximum trawl depth would not exceed 29 ft (8.9 m). The entire net, beginning with the mouth and moving towards the cod end, would be brought aboard the boat.

Actions to Reduce Impacts of Proposed Action
The parameters of the trawl and the deployment techniques are selected in order to minimize the potential interaction with protected species, while maintaining a viable sampling design that would meet project objectives. When feasible, sampling would occur at high tide or in locations with sufficient water depth to provide for greater distance between the propeller and the substrate to avoid effects to habitat. Trawl times would be limited to a maximum of 5 minutes to reduce trauma to collected species. These short trawl times (5 minutes) at depths with good visibility reduces the possibility of an interaction. If a listed species is observed within 50 ft of operating or sampling activities work would be stopped immediately in order to further reduce the risk of an interaction. If an interaction occurs, immediate steps would be taken to limit harm. Should any federally listed species be incidentally taken, GADNR staff would: (1) follow handling guidelines (Appendices A and C), (2) immediately take measurements, (3) affirm that the listed species is alive, uninjured, and demonstrating that it is in good condition and ready to return to the water; and, (4) release the listed species as expediently as possible. Any injured, entangled, or stranded marine mammals or sea turtles would be immediately reported to the National Marine Fisheries Service's Protected Resources Division and the local authorized stranding/rescue program.

Marine Sport Fish Population Health Survey (MSPHS)

The survey area consists of two Georgia estuarine systems: Wassaw and Altamaha Sounds. Wassaw Sound, located in Chatham County, is bordered by the city of Savannah; the largest metropolitan area on the Georgia coast (Figures 2.4 and 2.5 in Section 2.2). Due to fresh water influence of the Altamaha River, salinity and water temperature are highly variable in the estuary. Altamaha Sound sampling is divided into three regions; Doboy Sound in the northern part of the sound, the Altamaha River proper along the main channel of the river, and the Hampton River in the southern part of the sound.

MSPHS Gill Net Survey. During June-August, young-of-the-year red drum in the Altamaha and Wassaw estuaries would be monitored utilizing gillnets in a random stratified sampling design to gather data on relative abundance and occurrence. Young red drum and other finfish collected would be measured and released.

Using Arc View 3.3, each sound (i.e. Wassaw, Altamaha, the southern portions of Doboy Sound and Hampton River) was over-laid with a geo-referenced ¼ square mile series of grids. GADNR personnel reviewed each grid to determine if there was a location which was conducive to deploying a trammel net, a gill net, or both gear types along an uninterrupted length of stream bank. An uninterrupted length of stream bank was defined as a 91 m (300 ft) continuous length of stream bank, which did not exceed a depth of 2.75 m (9 ft) and was not interrupted by a stream mouth. Personnel recorded substrate type (i.e. mud, sand, live oysters or dead oysters) for each site determined to be conducive to deploying and retrieving entanglement gear.

A sampling event would consist of a single net set. All sampling would occur during the last three hours of ebb tide during daylight hours. Survey gear would be a single panel gill net. The net would measure 91 m by 3 m (300 ft by 9 ft). The panel would have 64 mm (2.5 in) stretched mesh. The net would have a 12.7 mm (0.5 in) diameter float rope and a 34 kg (75 lb) lead line. An 11 kg (25 lb) anchor chain would be attached to each end of the lead line, and a large bullet float attached to each end of the float line. The net would be deployed in a semi-circle along the shore by boat. Net deployment would be done against the tidal current. Immediately after deployment, the net would be actively fished by making two to three passes with the boat in the area enclosed by the net. After the last pass is made, the net would be retrieved starting with the portion that was deployed first. Nets would be set no longer than 30 minutes. A total of 216 30-minute gillnet sets per year would be done equating to 1,080 samples over a 5 year period.

MSPHS Trammel Net Survey. The primary objective of the trammel netting survey is to gather data on spotted seatrout (*Cynoscion nebulosus*); however, as in the gill netting survey, all trammel netted finfish, rays, skates, and sharks collected during the sampling would be identified and measured. The data would be used to create long-term uninterrupted indices of abundance that are used to monitor population trends and to evaluate the efficacy of current fishery management practices.

The trammel netting area would be identical to the gill netting area. The survey area consists of two Georgia estuaries, Wassaw Sound and Altamaha River Sound (Figures 2.4 and 2.5). The survey would be conducted with random stratified sampling based on the estuary (Wassaw Sound or Altamaha River Sound), and quadrant (a specified area within the estuary). The stations would be selected randomly each month from a predefined allocation. To determine relative spotted seatrout abundance, monthly trammel net surveys would be conducted from September through November in the Altamaha River Sound and Wassaw Sound. A total of 750 sets would be conducted each month over a 5 year period.

The monofilament trammel net would be 91 m (300 ft) by 2.1 m (7 ft), consisting of two outer panels with 35.6 cm (14 in) stretch mesh, and an inner panel with 70 mm (2.75 in) stretch mesh. The net would have a 2.5 cm (1 in) diameter float rope and a 75 kg (165 lb) lead line. An 11 kg (25 lb) anchor chain would be attached to each end of the lead line, and a large bullet float attached to each end of the float line.

A sampling event would consist of a single net set. All trammel net sets would be made during the last three hours of ebb tide during daylight hours. The net would never be left unattended and the soak time would not exceed 30 minutes. The net would be deployed from the bow of an 18 ft (5.5 m) McKee Craft powered with a 115 hp outboard engine. The net would be deployed from the boat, in reverse gear, in a half circle along the shore. Net deployment would be done against the tidal current in water no deeper than 2.1 m (6.9 ft). After deployment, the net would be retrieved from the end that was deployed first.

Actions to Reduce Impacts of Proposed Action

The parameters of the gill and trammel nets and the deployment techniques were selected in order to minimize the potential interaction with non-targeted species, while still maintaining a viable sampling design that would meet project objectives. All possible precautions would be implemented to reduce the possibility of protected species incidental take. If a listed species is observed within 50 ft of operating or sampling activities work would be stopped immediately in order to further reduce the risk of an interaction. If an incidental take occurs, immediate steps would be taken to limit harm, and set and soak times would be modified to avoid periods when interactions are more likely to occur. Any injured, entangled, or stranded marine mammals or sea turtles will be immediately reported to the National Marine Fisheries Service's Protected Resources Division (727-824-5312) and the local authorized sea turtle stranding/rescue program.

Hook and Line Surveys/Sampling

Age and Growth, Contaminants Sampling, Tagging, and Broodfish Procurement
Hook-and-line sampling consists of two to four anglers fishing for a timed interval. Each discrete sample is taken dependent on project goals and objectives (i.e. Tagging studies, Contaminant Monitoring, Age and Growth, Cooperative Tagging, etc.). Multiple hook-and-line samples can be taken during any sampling day. Sampling gear includes medium/light action rods with unbalanced spinning reels. Each rod and reel contains 15 lb test monofilament and uses a 30 lb test and a 2 hook bottom rig. These rigs use #2 J style hooks and a common 1-3 ounce bank style sinker or other species specific tackle (i.e. circle hooks, artificial lures, etc.). Bait type (shrimp, menhaden, or squid), time fishing and the number of times the rigs would be re-baited would be recorded. This sampling will mainly be using bottom rigged tackle. Habitat data would be collected if required, environmental data, soak time, species, lengths, weights would also be recorded. Each site would be sampled dependent on target species, project goals, and objectives. Annual Hook and Line Sampling by GCRD would be approximately 10 days per year with a crew of two to four anglers fishing for a timed interval totaling a maximum of 1,200 hours of effort over a 5 year period (i.e. 4 anglers * 6 hours * 10 days = 240 hours/year). A maximum of 3-6 hours of sampling would be possible per event, with a maximum of four rods per sample. To date, hook-and-line sampling has not encountered any threatened or endangered species using this survey.

Hook and Line, Inshore Artificial Reefs
GADNR would perform hook-and-line sampling at the Inshore Artificial Reefs (IAR) sites (Figure 2.6) to determine baseline species diversity on reef areas following the GADNR Inshore Artificial Reef Monitoring Plan. Baseline biological information would be collected annually via hook and line surveys for each of the 15 IAR sites over a three-year period. A minimum of two staff would conduct one-hour hook and line surveys on an incoming or outgoing tide at all IAR sites. One angler would place his or her bait on the seafloor while the other uses a slip-float rig to hold bait over and/or near existing reef structures. All fish captured would be identified, measured, weighed, and, if needed, tissue samples would be collected for General Contaminant chemical assays. Select individual targeted game fish would receive a tag from the GADNR Cooperative Angler Tagging Project. To avoid additional staff time and expense, monitoring events would occur (May through August) in conjunction with annual side-scan sonar or other reef monitoring surveys. During all monitoring events environmental data would be collected to describe conditions at each site. Information would be collected on water temperature; water depth; current flow; water clarity; wind speed; wind direction; air temperature; cloud cover; bait type; gear type; general comments about each event; and the presence and estimated abundance of baitfish, dolphin, birds, and other animals. No more than 15 sampling events (30 angling hours) would occur annually, or 150 hours over a 5 year period.

Actions to Reduce Impacts of Proposed Action
The limited soak time and constant tending by the angler would allow for gear to be removed from the water if species are observed, and especially if observed in the immediate vicinity. Every precaution would be made to reduce the potential for protected species incidental take. Should take occur, the operator would be able to adjust their rate of retrieval to reduce stress on the individual and still bring the species to the surface for assessment. Any injured, entangled, or stranded marine mammals or sea turtles would be immediately reported to the National Marine Fisheries Service's Protected Resources Division and the local authorized sea turtle stranding/rescue organization.

<u>Artificial Reef Monitoring</u>

Artificial Reefs (Figure 2.6 and Figure 2.7) would be monitored to determine whether they are meeting the GADNR and the National Artificial Reef Plan goals of habitat enhancement beneficial to fisheries resources while not impeding navigation. Regular compliance surveys and mapping of Artificial Reef sites and materials will occur, and will help to identify and offset potential liabilities that may exist post-placement or develop over time as reef structures deteriorate. Annual on-site inspections will be conducted during summer. Artificial Reef monitoring techniques employed at each site will differ but may include side-scan sonar equipment, aerial surveys, and scuba visual surveys.

Two-dimensional, DownScan™, and side scan sonar images would be obtained from all IAR and at least seven offshore artificial reef sites annually to comply with State and Federal permits. A Klein System 3000 (model #3200) side scan sonar (Figure 2.1) with dual frequencies of 100/500 kHz would be towed behind the 45 foot GADNR research vessel R/V Marguerite at the offshore sites. DownScan™ and side scan images would be used to supplement aerial surveys and verify reef material placements and settlement. A small vessel outfitted with a relatively low cost commercially available Fishfinder/Chartplotter unit with a transom mounted transducer and operating frequencies of 455/800 kHz (DownScan Imaging™) and Med, High (CHIRP) with frequencies 83kHz/200kHz, would be used annually during summer to collect traditional and DownScan™ / side-scan sonar images of IAR materials at high tide. These images are very effective for assessing the condition and location of materials, subsidence, depth clearances, and structural changes but do not allow for an assessment of encrusting organism growth.

Figure 2.1. Klein System 3000 (model #3200) TM Side Scan Sonar transducer that is towed behind the 45 foot R/V Marguerite (from USFWS consultation initiation package).

A helicopter would be used to fly the inshore artificial reef sites (Figure 2.6) for the aerial surveys. These aerial surveys would occur approximately over two days (~2 hours per day) in August each year. GADNR would fly at low tide so the reef materials can be seen to inspect the marker pilings for wear/damage. GADNR would use a Bell 407 or Bell 206L-4 helicopter. Aerial surveys would fly at 500-800 ft and descend to approximately 200 ft at the site for the photograph/video.

A Phantom III UAV/UAS would also be used to fly the inshore artificial reef sites (Figure 2.6) over four to five days. The UAV/UAS is limited to flights under 400 feet and to remain in visual contact (without the use of binoculars) operated from a boat or shore. The Certificate of Authorization from the FAA allows GADNR to fly anywhere in the State as long as they fly within the approved unrestricted areas. They have the ability to fly points, areas, and can map up to 350 acres. The UAV is limited to daylight flights only and cannot fly if the winds exceed 20 mph.

Visual scuba diving assessments of artificial reef materials would be used to better describe the sessile organisms present at each site and to conduct visual fish surveys and collect samples by spearfishing.

Actions to Reduce Impacts of Proposed Action
The limited time and constant tending by the crew would allow for any towed sonar gear to be removed from the water if listed species are observed, and especially if observed in the immediate vicinity. Sonar frequencies between 83-800 kHz would be used for short duration to avoid any potential impacts to marine mammals. Every precaution would be made to reduce the potential for protected species incidental take. Additionally, activities would cease if survey activities are within 50 ft of listed species, until the animal has left the area of its own volition. Federal law prohibits approaching or remaining within 500 yd of a North Atlantic Right Whale (NARW). Any injured, entangled, or stranded marine mammals or sea turtles would be immediately reported to the National Marine Fisheries Service's Protected Resources Division and the local authorized sea turtle stranding/rescue organization.

Data Collection (related to all activities and species)

GADNR project staff has been trained to identify and measure all sea turtles and sturgeon and resuscitate sea turtles. They are also trained to check for and record external flipper tags and passive integrated transponder (PIT) tags. These activities would support monitoring the potential impacts of the proposed action to species incidentally taken, as well as collection of information useful to conservation management.

Staff would record date, time, location (latitude and longitude, when possible) of each turtle species taken, condition of the species (e.g. dead or alive, the presence or absence of injuries, a thorough description of all anomalies, condition of carcasses), species sex (if determinable), measurements, and final disposition. Live sea turtles would be tagged and released in cooperation with the Cooperative Marine Turtle Tagging Program (CMTTP), GADNR turtle program, and the NMFS Southeast Fisheries Science Center.

Staff would collect date, time, location (latitude and longitude, when possible) of each Atlantic and/or shortnose sturgeon taken. Information would be collected on all pertinent biological information (i.e. fork length, total length, weight, condition). Fin clips would also be taken for genetic analysis. Sturgeon may be PIT tagged and released in cooperation with ongoing NMFS, USFWS, and University of Georgia (UGA) studies. Details on these procedures can be found in Appendix C.

Handling and Resuscitation Requirements (all activities)

Any specimens taken incidentally during the course of research activities would be handled with due care to prevent injury, observed for activity, and returned to the water as soon as possible according to the procedures found in Appendix A and Appendix C. These procedures would help minimize the potential effects to protected species by requiring the GADNR researchers to understand how to handle, disentangle, resuscitate (if necessary), and release protected species that are incidentally captured during their activities.

Vessel Operations (all activities)

GADNR project leads will instruct all personnel associated with the project of the potential presence of protected species and the need to avoid collisions, and staff will observe water-related activities for the presence of protected species to avoid interaction with them. Additionally, activities will cease if survey activities are within 50 ft of listed species until the animal has left the area of its own volition. Federal law prohibits approaching or remaining within 500 yd of a NARW.

2.2 Action Area

The proposed action would occur in offshore, nearshore, and inshore waters of the coast of Georgia and would include sampling at the locations shown on the following maps, as well as transit to and from them.

Based on the maximum range of the sonar equipment that would be part of the research, the outer most edge of the action area would be expected to be 500 m from the edge of artificial reefs surveyed (please refer to Figure 2.7). However, due to the nature of the research and proposed use of the equipment (researchers would emit a very focused beam directed at the survey area) it is expected that the maximum the beam width would extend past the reef surveyed would typically not exceed 100 m (in order to achieve the more refined resolution desired by the researchers). Beam energy would dissipate rapidly after reaching the reef, with insignificant sound reflection. Thus the maximum outer limit of area affected by the sonar would not extend significantly past the reef areas surveyed.

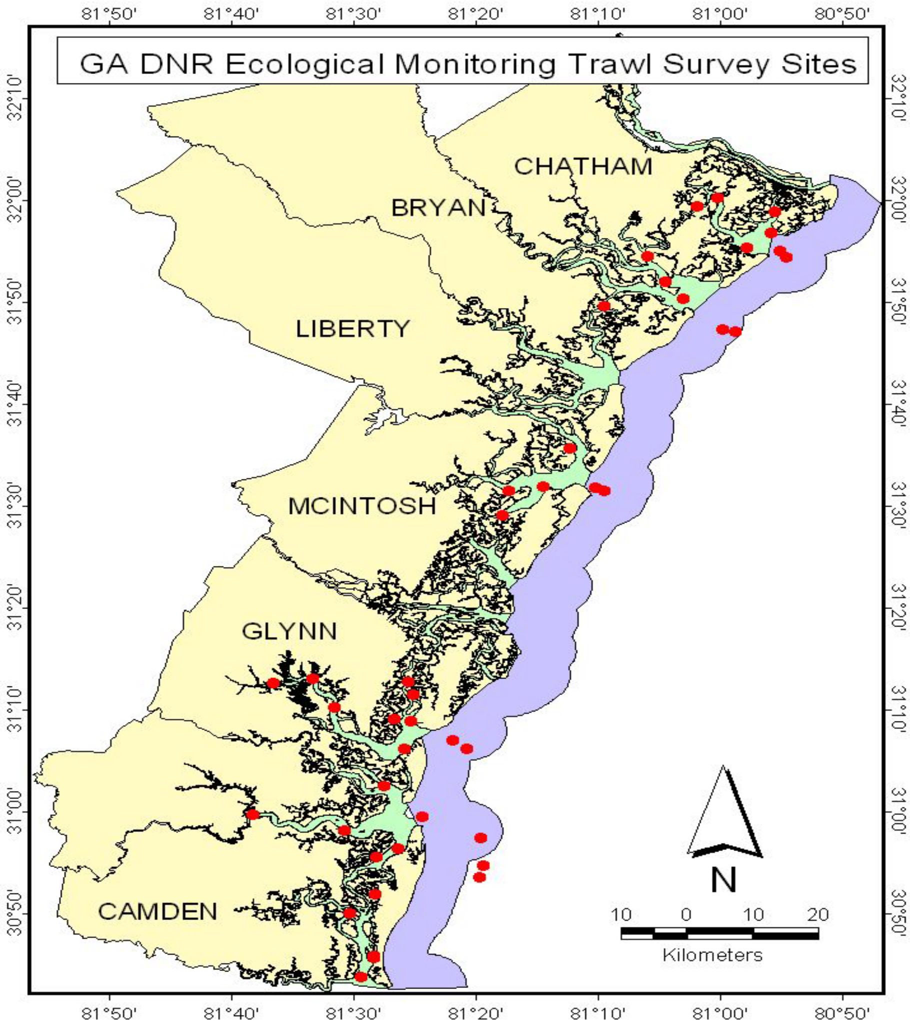

Figure 2.2. Site locations from the Ecological Monitoring Trawl Survey, from USFWS Section 7 initiation package.

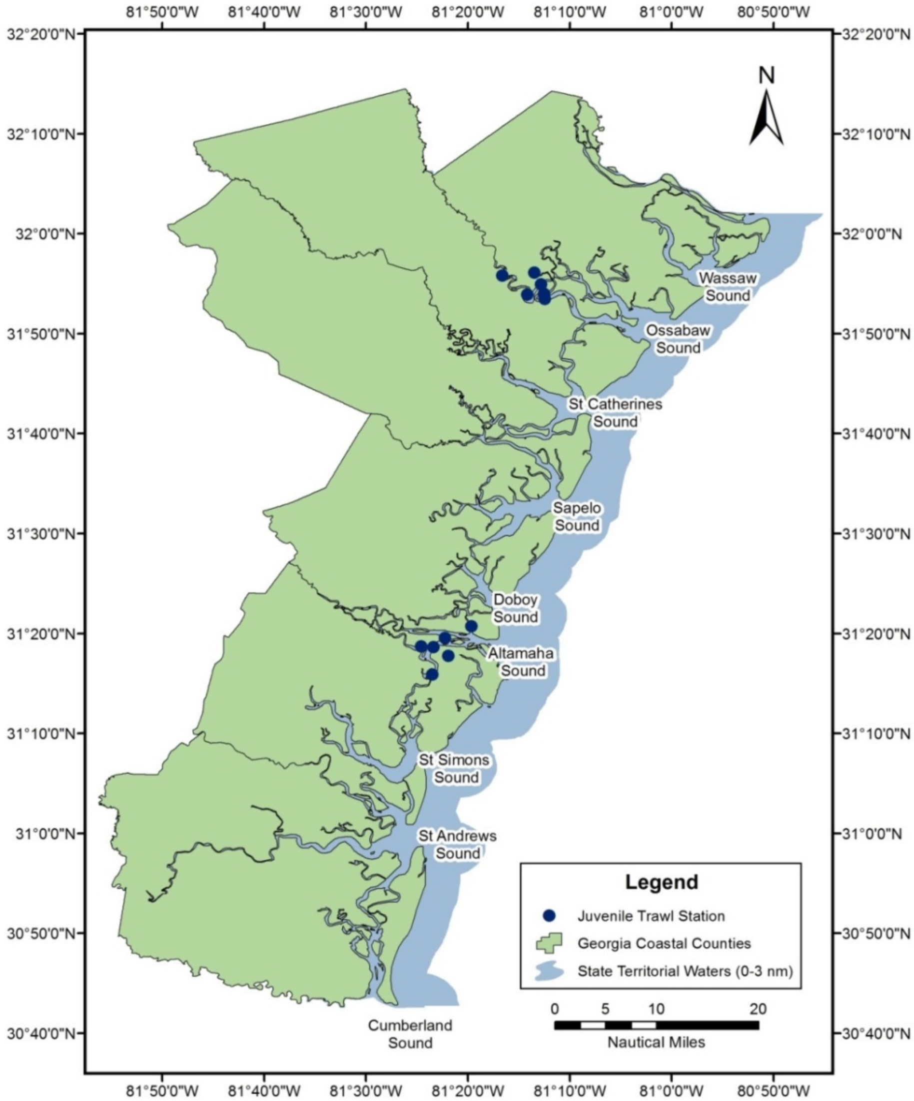

Figure 2.3. Juvenile Trawl Sampling Sites, from USFWS Section 7 initiation package.

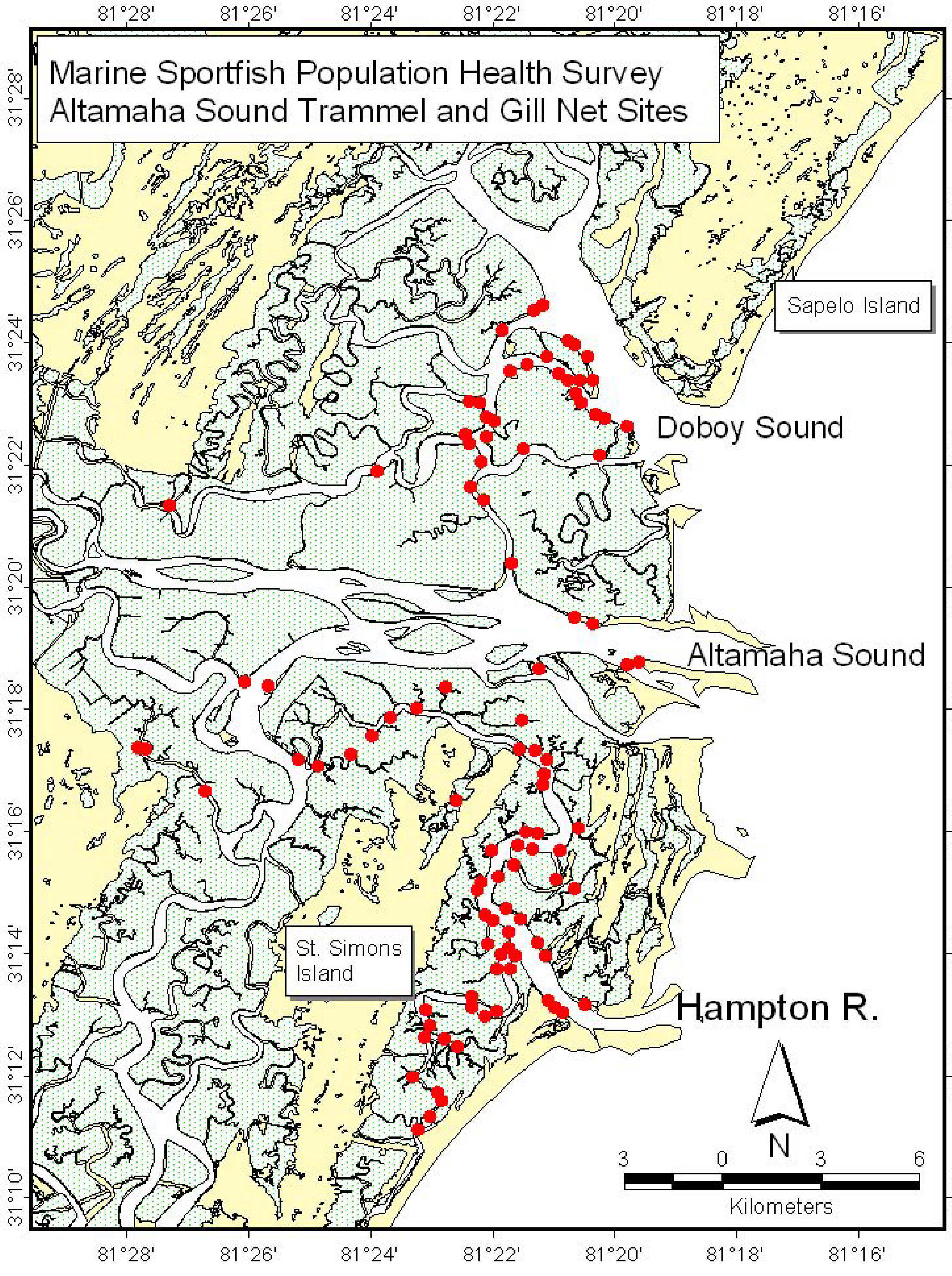

Figure 2.4. Sites for the Marine Sportfish Population Health Survey in Altamaha Sound using gill nets (June-August) and trammel nets (September – November) from USFWS Section 7 initiation package.

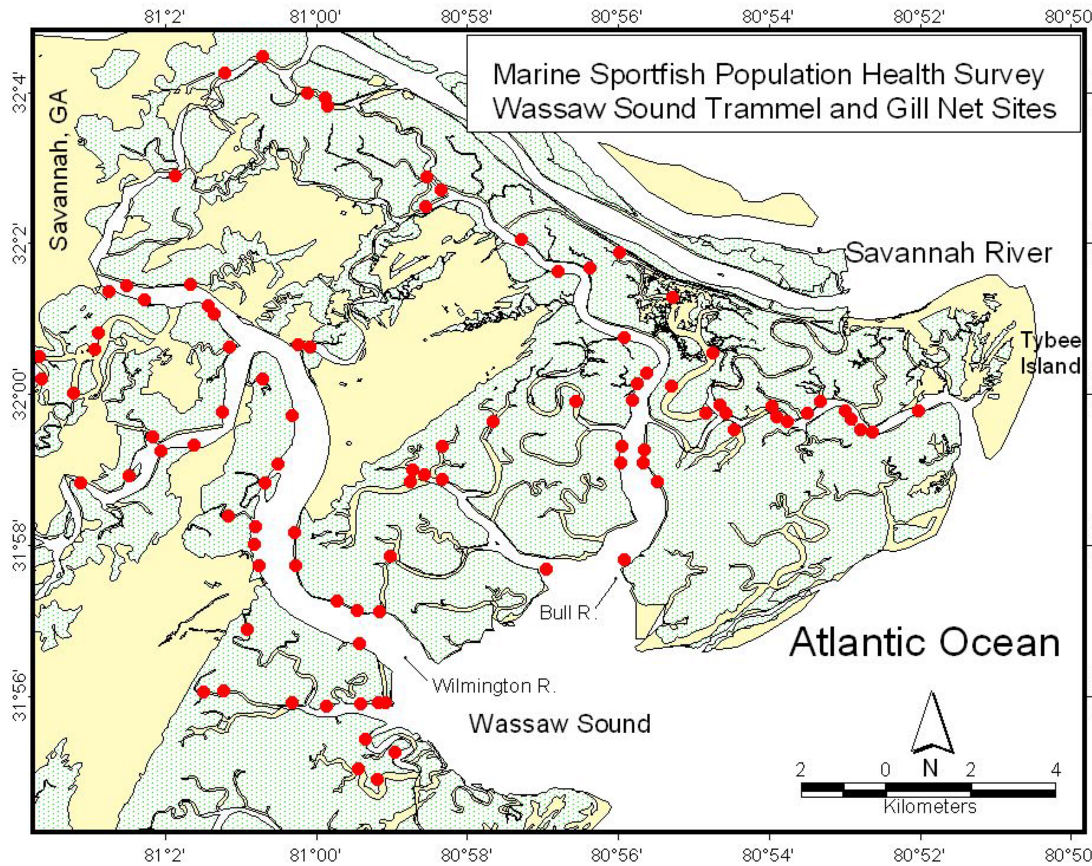

Figure 2.5. Sites for the Marine Sportfish Population Health Survey in Wassaw Sound using gill nets (June-August) and trammel nets (September – November), from USFWS Section 7 initiation package.

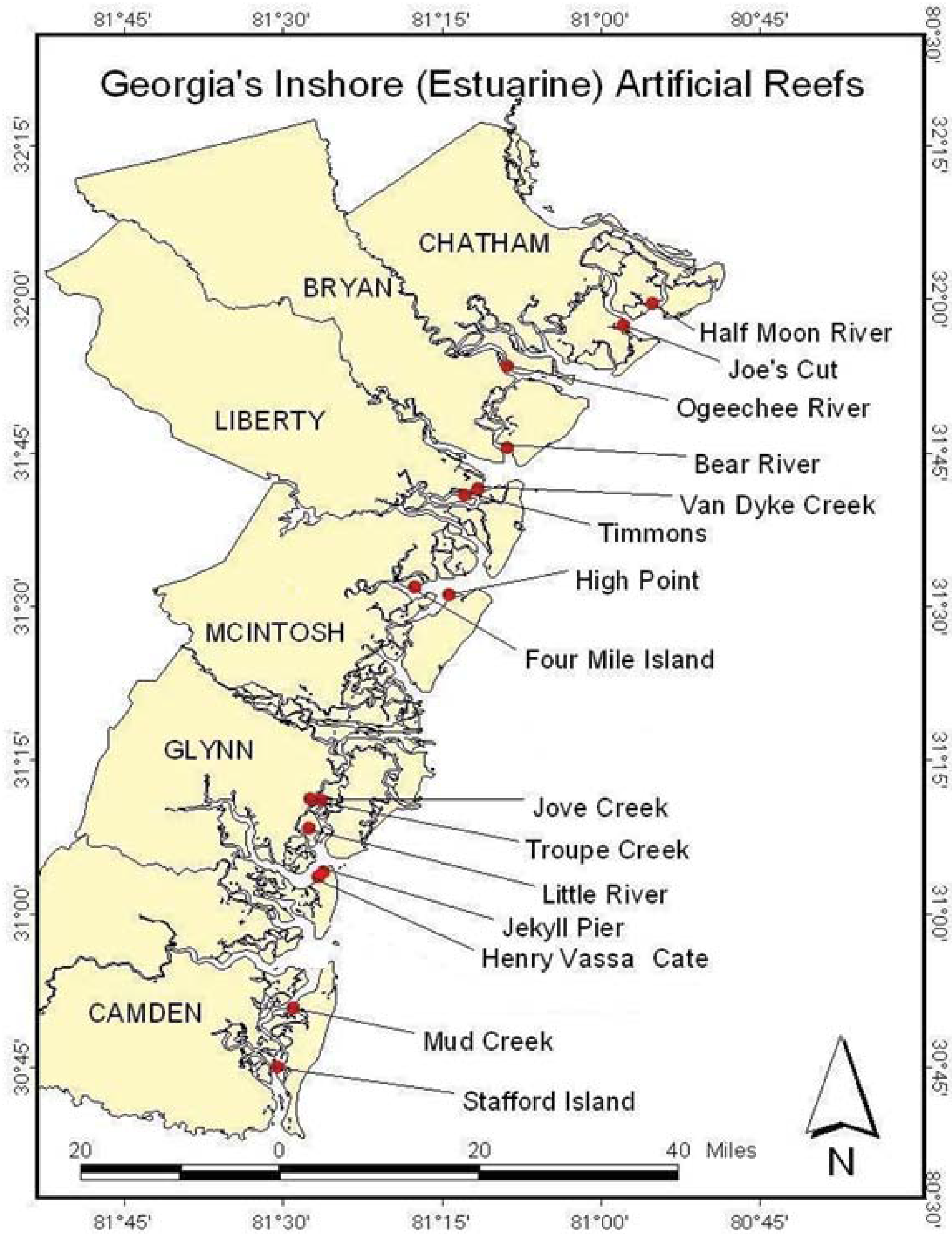

Figure 2.6. Inshore Artificial Reefs (hook and line sampling) from USFWS Section 7 initiation package.

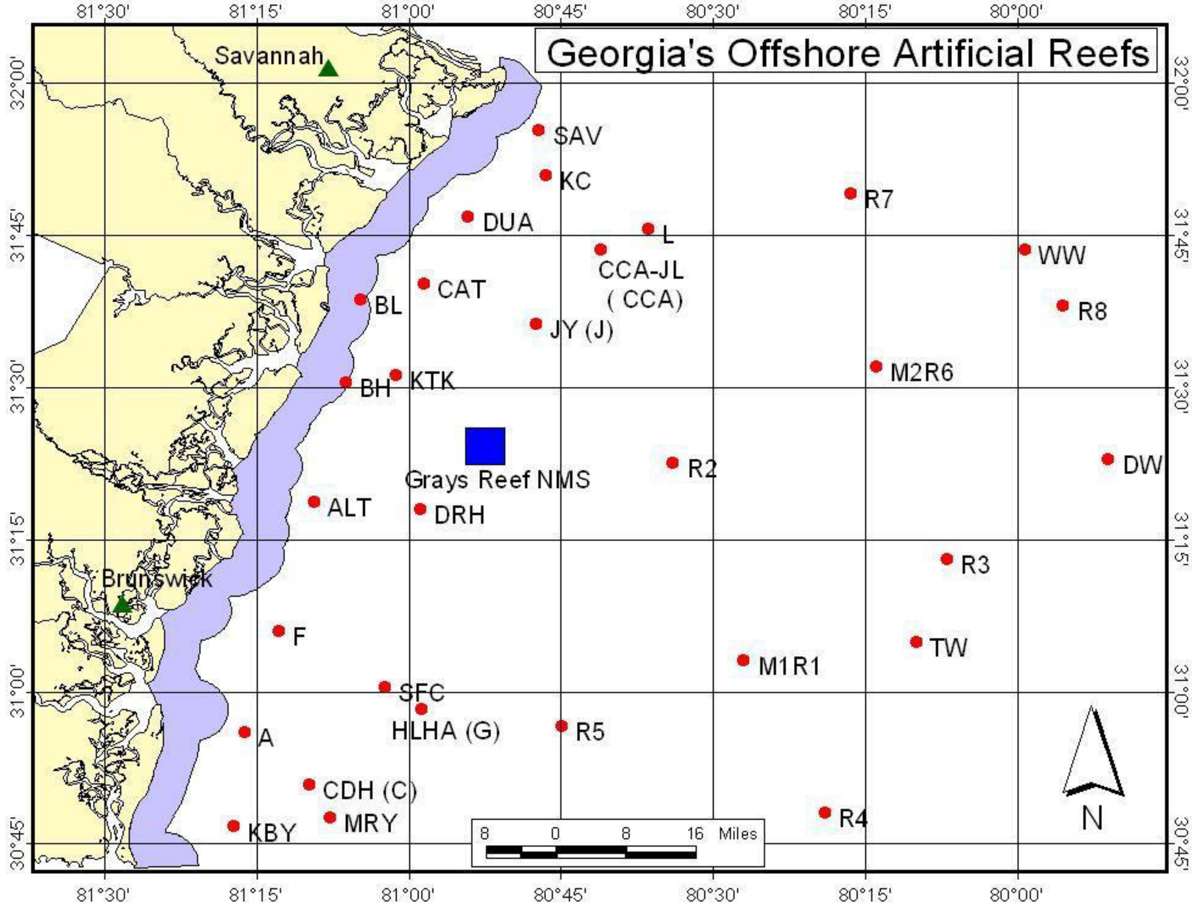

Figure 2.7. Offshore Artificial Reefs (Side scan sonar and scuba spearfishing and visual surveys) from USFWS Section 7 initiation package.

3.0 Status of Listed Species and Critical Habitat

Table 3.1. ESA-Listed Species Under NMFS's Purview in the South Atlantic and Assessed in this Consultation		
Marine mammals	Scientific Name	Status
Blue whale	*Balaenoptera musculus*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
NA right whale	*Eubalaena glacialis*	Endangered
Sea Turtles	Scientific Name	Status
Green sea turtle	*Chelonia mydas*	Threatened*
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Loggerhead sea turtle	*Caretta caretta*	Threatened**
Kemp's ridley sea turtle	*Lepidochelys kempii*	Threatened
Fish	Scientific Name	Status
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	Endangered/Threatened ***
Shortnose sturgeon	*Acipenser brevirostrum*	Endangered
Critical Habitat		
NARW critical habitat		
Northwest Atlantic DPS of loggerhead sea turtle critical habitat		
*The North Atlantic and South Atlantic DPS.		
**The Northwest Atlantic DPS.		
***The New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs are listed as endangered; the Gulf of Maine DPS is listed as threatened.		

3.1 Analysis of Species and Critical Habitat Not Likely to be Adversely Affected

We have determined that the proposed action being considered in this Opinion is not likely to adversely affect the following listed species or critical habitat under the ESA: blue whale, sei whale, sperm whale, fin whale, NARW and NARW critical habitat, NWA loggerhead DPS critical habitat, hawksbill sea turtle, and leatherback sea turtle**.** These species and critical habitats are therefore excluded from further analysis and consideration in this Opinion. The following discussion summarizes our rationale for these determinations.

3.1.1 Marine Mammals and Marine Mammal Critical Habitat

Blue, Sei, Sperm and Fin Whales

In the southeast U.S. Atlantic region, blue, sei, and sperm whales are predominantly found seaward of the continental shelf in deeper waters (CETAP 1982; NMFS 2011b; Waring et al. 2010; Waring et al. 2013; Wenzel et al. 1988). NMFS's annual marine mammal stock assessment reports (SAR) on blue whales in 2010 stated "[t]he blue whale is best considered as an occasional visitor in U.S. Atlantic EEZ waters, which may represent the current southern limit of its feeding range (CETAP 1982; Wenzel et al. 1988). Sightings of sperm whales are almost exclusively in the continental shelf edge and continental slope areas (Scott and Sadove 1997). Most sperm whales are found in very deep waters (> 1,000 m). Sei and blue whales also typically occur in deeper waters, and neither is commonly observed in the east coast U.S. waters (CETAP 1982; Waring and Palka 1998; Waring et al. 2002; Wenzel et al. 1988). Fin whales are generally found along the 100 m isobath with sightings also spread over deeper water including canyons along the shelf break and are found north of Cape Hatteras, North Carolina (Waring et al. 2012). The depth and expected locations at which these species are found greatly reduces the likelihood of any overlap between these whales and the GADNR activities (maximum depth of survey activities is 59.6 ft (18.17 m)). Gillnet, trammel net, most hook and line (except a small level of opportunistic effort), aerial surveys, and approximately 70% of trawl sampling would occur in riverine, estuary, or inshore bay environments where the species do not occur. Approximately 30% of trawl sampling would occur just off shore, but where these whales are very unlikely to be found. Outer reef scuba monitoring activities would occur in a focused manner on the reefs, GANDR has great control over their impacts, and any exposure to or interaction with the proposed action and these whale species is also very unlikely. There have been no reported interactions between offshore or coastal large whales and trawls in the Atlantic or Gulf of Mexico (76 FR 73912). There have been no interactions between these species and the activities of the proposed action since they were initiated. Based on the location of the proposed action activities, the very low expected occurrence of the species, best management practices, and past history, the probability of these species interacting with the proposed action is extremely unlikely and effects from the proposed action are considered discountable.

As just discussed, any effect from the proposed action on these whale species is considered discountable. However, given the increasing concerns regarding the effects of noise in the ocean environment on protected species, we provide additional information and analysis regarding the potential effects of the artificial reef monitoring side-scan sonar equipment and our determination. The sonar equipment used by the GADNR researchers would emit frequencies between 83-800 kHz. Baleen whales' upper hearing range limit is 35 kHz (NMFS 2016c). We do not expect the whales to interact with the proposed action, however, even if they were in the vicinity of the sonar, blue, sei and fin whale species would not hear the sound emitted by the sonar used by GADNR and it would have no effect on these species. Toothed whales (e.g., sperm) can hear up to 160 kHz (NMFS 2016c). While the sonar frequency of the equipment that would be used by the proposed action would overlap with the hearing range of the sperm whale, as discussed earlier, given the very unlikely presence of this species in the action area, as well as the focused beam and insignificant level of spreading of the sonar signal beyond the reefs sampled, the probability of any effects from this equipment on sperm whales is extremely unlikely and considered discountable.

For the reasons discussed in this section, we believe that it is extremely unlikely and therefore discountable that these species will be adversely affected by the proposed action.

North Atlantic Right Whale

The sonar equipment used by the GADNR researchers would utilize frequencies between 83-800 kHz. Baleen whales (including North Atlantic right whales) hear up to 35 kHz (NMFS 2016c). Therefore, this whale would not hear the sound emitted by the sonar used by GADNR and it would have no effect on this species.

The gillnet, trammel net, the majority of hook and line sampling, approximately 70% of trawl sampling, and aerial surveys will not affect North Atlantic right whales because they would occur in riverine, estuary, or inshore bay environments where the species do not occur. The opportunistic hook and line sampling, and the 30% of the trawl sampling that does not occur inshore occurs close (approximately 1-9 km (0.54-4.86 nmi)) to shore where North Atlantic right whales could potentially occur. The potential route of effect from the proposed action activities on this whale is via vessel collisions, entanglement in research gear (trawls or hook and line), or disturbance. There have been no reported interactions, injuries, or mortalities between NARW and trawls in the Atlantic (B. Zoodsma, NMFS SERO, pers. comm. to P. Opay, NMFS SERO, September 9, 2016); 76 FR 73912). Amendments to the MMPA in 1994 required NMFS to annually prepare SAR for each stock of marine mammals that occurs in U.S. waters. Each SAR is required to include a description of the commercial fisheries that interact with a stock, including the level of incidental mortality and serious injury of the stock by each, among other things. Since 1995, NMFS has been monitoring the status NARW and reporting interactions between the species and commercial fisheries in its annual SAR. Those reports indicate that based on information going back as far as 1975, there has never been a known interaction between bottom trawl gear (the category of gear that the proposed action would use) and North Atlantic right whales anywhere along the East Coast (Blaylock et al. 1995; Waring et al. 2006; Waring et al. 2010; Waring et al. 2014; Waring et al. 2003; Waring et al. 1999; Waring et al. 1997; Waring et al. 2001). Because some unknown number of interactions between North Atlantic right whales and commercial fisheries likely occur but go unaccounted for, the SARs represent a minimum accounting of all the known interactions. Some species of whale may be more likely to interact with bottom trawl gear because they could be attracted to trawling activities that make their prey species easier to catch (Fertl and Leatherwood 1997). However, NARW only feed on krill, which is not a species that can be fished by the types of bottom trawls used during GADNR-related activities. Therefore NARW would not be attracted to the trawling like some other whale species, further reducing the probability of NARW interacting with trawl gear. Available information suggests that interactions with NARW are extremely unlikely to occur.

Hook and line sampling effort is very low (10 days a year, the majority occurring inshore with some limited opportunistic sampling occasionally occurring offshore), which greatly decreases the probability of a potential interaction. Additionally, this type of sampling does not use any bait that would attract NAWR. Interaction with this gear would be extremely unlikely.

Scuba activities would occur along artificial reefs. Outer reef scuba monitoring activities would occur in a focused manner on the reefs, and adhere to best management practices to avoid NAWR. GANDR has great control over how the scuba surveying is implemented, its impacts, and any exposure to or interaction with the proposed action and this whale species is extremely unlikely.

Additionally, in the rare (and unexpected) event that NARW is in the same vicinity of sampling or surveying activities, associated vessels, scuba divers, or other survey staff would move slowly and cautiously, <u>and by law cannot approach closer than 500 yards</u>. Research vessel captains and crew would watch for protected species (including NARW) while underway and take necessary actions to avoid them. This would give a vessel time to avoid a collision, entanglement, or disturbance. Additionally, information regarding the location of NARW is reported via the Right Whale Early Warning System. NARW sightings are reported in near real time from aerial surveys, shipboard surveys, whale watch vessels, and opportunistic sources (USCG, commercial ships, fishing vessels, and the general public) and the information is disseminated to mariners within a half hour of a sighting. This reduces the likelihood of collisions or interaction between vessels/gear/surveying and NARW by alerting GADNR to the presence of the whales in near real time. There have been no NARW interactions with the GADNR sampling since it started in 1987 (R. Martin, USFWS, pers. comm. to P. Opay, NMFS SERO, September 9, 2016).

For the reasons expressed in this section, we believe sonar monitoring will not affect this species and any adverse effects from the other components of the proposed action on NARW are extremely unlikely to occur and are therefore discountable.

North Atlantic Right Whale Critical Habitat
NMFS originally designated critical habitat for NARW in the North Atlantic Ocean when they were recognized as a single species (59 FR 28793, July 5, 1994). On January 27, 2016, NMFS published a Final Rule expanding the critical habitat designation for the NARW (81 FR 4838). The new boundaries of the calving critical habitat that is within the action area include the marine waters from Cape Fear, North Carolina, southward to 28°N latitude (approximately 31 miles south of Cape Canaveral, Florida) (Figure 3.1). The revision identifies the physical features of right whale calving habitat that are essential to the conservation of the NARW to be: (1) calm sea surface conditions of Force 4 or less on the Beaufort Wind Scale; (2) sea surface temperatures from a minimum of 7°C, and never more than 17°C; and (3) water depths of 6-28 m, where these features simultaneously co-occur over contiguous areas of at least 231 km^2 of ocean waters during the months of November through April. None of the gear types/techniques or vessel activities associated with the proposed action would affect these essential features; these activities have no ability to alter sea state, sea surface temperature, or water depth, individually or when they co-occur.

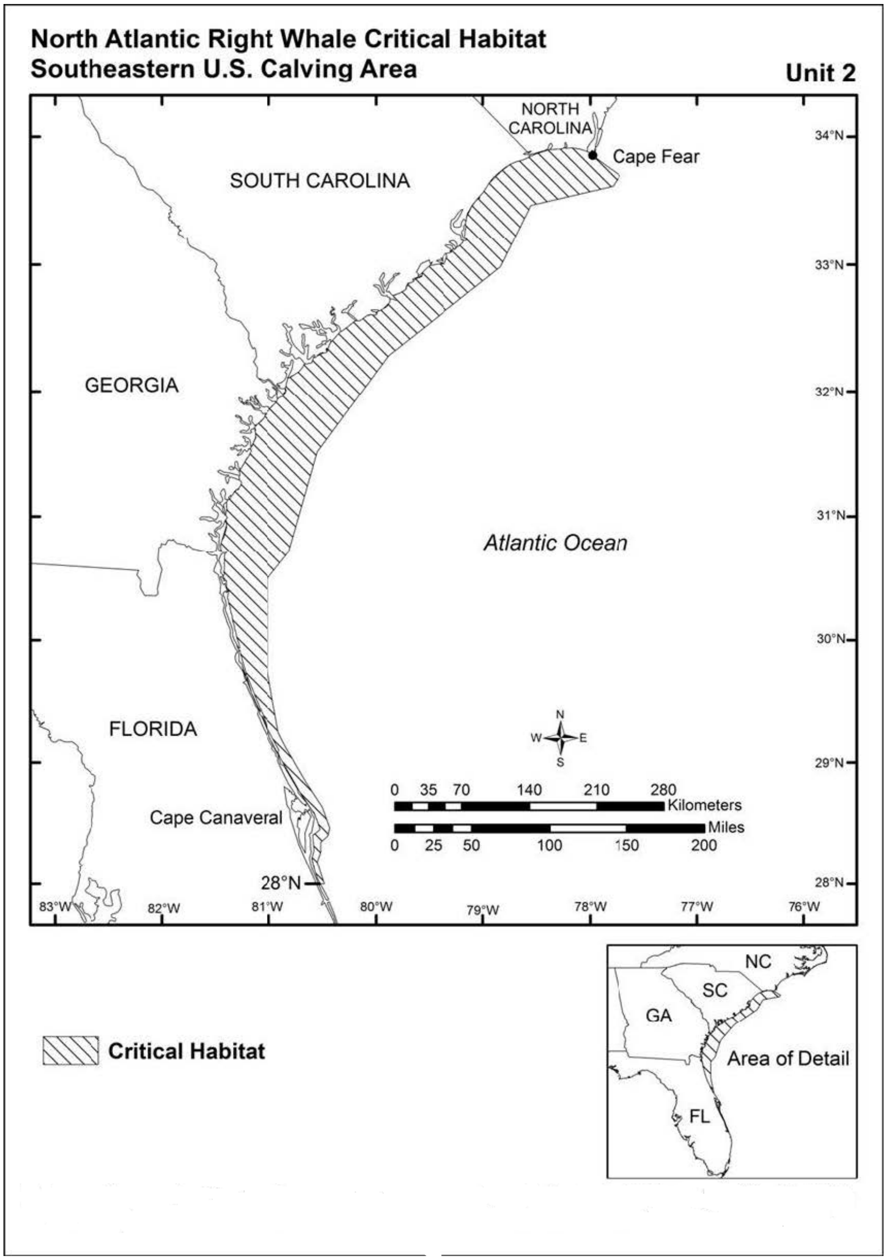

Figure 3.1. North Atlantic right whale critical habitat in the action area (Source: 81 FR4838, January 27, 2016)

3.1.2 Sea Turtles and Sea Turtle Critical Habitat

Leatherback and Hawksbill Sea Turtles

Net sampling, the majority of hook and line sampling, and approximately 70% of trawling would occur in sounds or inland rivers up to several miles upstream. Only a small portion of the hook and line surveying (opportunistic offshore sampling) and approximately 30% of the EMTS trawl sites occur along the coast off shore (not in a sound or river). Artificial Reef monitoring techniques employed may include side-scan sonar equipment, aerial surveys, and scuba visual surveys. Hawksbill nesting occurs in tropical and subtropical locations (NMFS 2013b) and is not expected on the coast of Georgia. Thus, no breeding activity and associated animals would be expected to co-occur with the activities of the proposed action. While the species is recorded in waters in the continental United States from all the Gulf of Mexico states and from along the eastern seaboard as far north as Massachusetts, sightings north of Florida are rare (NMFS and USFWS 1993a). A review of the last 10 years of inshore (the area that matches the proposed action area) stranding data showed no strandings of hawksbill sea turtles (http://www.sefsc.noaa.gov/stssnrep/). While this is only one measure and not the definitive documentation of possible presence of these species, it further suggests their rarity in the action area. Based on the subtropical to tropical nature of the species (i.e., no expected foraging or nesting to occur in the action area), the expected rarity of hawksbills in the action area, and the fact that there have been no interactions with this species since inception of the research project survey activities in 1976, NMFS expects that interactions with this species would be extremely unlikely to occur and therefore discountable.

Leatherback sea turtles commonly occupy pelagic habitat more than riverine or nearshore environments. However, they can potentially move to inshore habitat in pursuit of jellyfish food resources. As previously discussed, all net sampling would occur in sounds and riverine habitat, and most of the hook and line and trawling sampling would occur inshore also. The remaining hook and line and trawling would occur at specific, limited nearshore locations (please refer to the maps in the action area discussion in Section 2). Artificial Reef monitoring techniques employed may include side-scan sonar equipment, aerial surveys, and scuba visual surveys. A review of the last 10 years of Georgia inshore (matching the area of the proposed action) stranding data showed no strandings of leatherback sea turtles (http://www.sefsc.noaa.gov/stssnrep/). The sampling protocol of the proposed action includes observation for, and avoidance of, all protected species to the extent possible. While it is possible the leatherback movements could overlap with proposed action, the limited survey effort for some gear (e.g., 4 anglers for 6 hours, 10 days a year for hook and line), the precautionary survey protocol, the uncommon occurrence of this species where sampling would occur, combined with the fact that this species has never been caught since surveys were started in 1976, make the likelihood of interactions extremely unlike to occur and therefore discountable.

Northwest Atlantic Loggerhead DPS Critical Habitat
Critical habitat for the NWA DPS of loggerhead sea turtles in the South Atlantic is defined by 5 specific habitat types: nearshore reproductive, winter concentration, concentrated breeding, constricted migratory, and *Sargassum*. Specifics of these habitats, including the primary constituent elements (PCEs) supporting each, can be found in Table 3.2.

The only habitat type that the proposed action could potentially affect is nearshore reproductive habitat located off the Georgia coast. The vast majority (approximately 97%) of sampling locations would not occur within critical habitat. None of the survey and sampling activities that could occur within critical habitat would result in any measurable effects on that habitat's physical and biological features or primary constituent elements. The proposed research sampling methods and gear types would not create manmade structures that could promote predators (i.e., nearshore predator concentration caused by submerged and emergent offshore structures), significantly disrupt wave patterns necessary for orientation, and/or create excessive longshore currents. The portion of the research that is offshore could potentially affect passage conditions, however because any sampling activities in these areas would be temporary for very short periods, as well as occur in a small area of the open ocean, we do not expect these activities to alter the passage conditions that allow hatchlings to egress to the open-water environment, or nesting females to transit between beach and open water during the nesting season. Therefore, any effects on the critical habitat would be insignificant.

Table 3.2. Details Regarding the PCEs of Critical Habitat for NWA DPS of Loggerhead Sea Turtles

Habitat Type	Units	State	Physical And Biological Features	Primary Constituent Elements
Nearshore Reproductive Habitat	LOGG-N-3, N-4, N-5, N-6	NC	Portion of nearshore waters adjacent to nesting beaches that hatchlings use as egress to the open-water environment. Also used by nesting females to transit between beach and open water during the nesting season.	1) Nearshore waters with direct proximity to nesting beaches that support critical aggregations of nesting turtles (e.g., highest density nesting beaches) to 1.6 kilometer (1 mile) offshore 2) Waters sufficiently free of obstructions or artificial lighting to allow transit through the surf zone and outward toward open water 3) 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
	LOGG-N-7, N-8, N-9, N-10, N-11	SC		
	LOGG-N-12, N-13	GA		
	LOGG-N-14, N-15, N-16, N-17, N-18, N-19, N-20, N-21, N-22, N-23, N-24, N-25, N-26, N-27, N-28, N-29, N-30, N-31, N-32	FL		
	LOGG-N-34, N-35, N-36	AL & MS		
Winter Concentration Habitat	LOGG-N-1, N-2	NC	Warm water habitat south of Cape Hatteras, near the western edge of the Gulf Stream, which supports meaningful aggregations of juveniles and adults during the winter months	1) Water temperatures above 10°C during the colder months of November through April 2) Continental shelf waters in proximity to the western boundary of the Gulf Stream 3) Water depths between 20-100 meters (m)
Concentrated Breeding Habitat	LOGG-N-17, N-19	FL	Sites that support meaningful aggregations of both male and female adult individuals during the breeding season	1) Meaningful concentrations of reproductive male and female loggerheads 2) Proximity to primary Florida migratory corridor 3) Proximity to Florida nesting grounds
Constricted Migratory Corridor Habitat	LOGG-N-1	NC	High-use migratory corridors that are constricted (limited in width) by land on 1 side and the edge of the continental shelf and Gulf Stream on the other side	1) Constricted continental shelf area relative to nearby continental shelf waters that concentrate migratory pathways 2) Passage conditions to allow for migration to and from nesting, breeding, and/or foraging areas
	LOGG-N-17, N-18, N-19	FL		
Sargassum Habitat	LOGG-S-1, S-2	Atlantic Ocean & Gulf of Mexico	Developmental and foraging habitat for young loggerheads where surface waters form accumulations of floating material, especially *Sargassum*	1) Convergence zones, surface-water downwelling areas, and other locations where there are concentrated components of the *Sargassum* community in water temperatures suitable for optimal growth of *Sargassum* and inhabitance of loggerheads 2) *Sargassum* in concentrations that support adequate prey abundance and cover 3) Available prey and other material associated with *Sargassum* habitat such as, but not limited to, plants and cyanobacteria and animals endemic to the *Sargassum* community such as hydroids and copepods 4) Sufficient water depth and proximity to available currents to ensure offshore transport, and foraging and cover requirements by Sargassum for post-hatchling loggerheads (i.e., >10 m depth to ensure not in surf zone)

3.1.3 Proposed Action Activities that will not affect or are Not Likely to Adversely Affect Loggerhead Sea Turtles, Kemp's Ridley Sea Turtles, Green Sea Turtles, Atlantic Sturgeon, or Shortnose Sturgeon

The previous sections discussed the species that are NLAA by the proposed action. While loggerhead, Kemp's ridley, and green sea turtles, as well as Atlantic and shortnose sturgeon are likely to be adversely affected (LAA) by the proposed action and could not be included in the NLAA determinations, there is one component of the proposed action that will not affect these species and four components of the proposed action that are NLAA these species. They are discussed here. Section 3.2 and the remainder of this Opinion will then focus on those aspects of the proposed action that are LAA these species.

Sonar Scanning
The sonar equipment used by the GADNR researchers would utilize frequencies between 83-800 kHz. Sea turtles' hearing range upper limit is approximately 2 kHz. The upper limit for most fish is 5 kHz, and for sturgeon it is approximately 2 kHz (Bartol and Ketten 2006; Fay and Popper 2000; Lenhardt et al. 1996; Lenhardt et al. 1994; Lovell et al. 2005; McCauley et al. 2000a; McCauley et al. 2000b; Meyer and Popper 2002; Moein et al. 1994; O'Hara and Wilcox 1990; Scholik-Schlomer 2015). Therefore neither sea turtles nor sturgeon would hear the sound emitted by the sonar used by GADNR and it would have no effect on these species.

Scuba Monitoring
Artificial Reef monitoring techniques employed at each site may include scuba visual surveys. Visual scuba diving assessments of artificial reef materials will be used to better describe the sessile organisms present at each site and to conduct visual fish surveys and collect samples by spearfishing. Scuba divers would not pursue or harass any protected species and have great control over their impacts. If any sea turtles or sturgeon are encountered researchers would take precautionary actions to avoid these species and minimize any impacts on their behavior (e.g., feeding). Any effects from this monitoring are unlikely, and if they would occur would not result in any measurable effect on the animals' behavior. Therefore, the proposed action would have insignificant effects on these species.

Aerial Monitoring
Sea turtles or sturgeon may or may not respond to an aircraft passing overhead depending upon the altitude of the plane, the proximity to the trackline, and the individual animal itself. If they react, animals' behavior (most probably those at the surface) could include diving as the aircraft is approaching or diving as the aircraft passes directly overhead. These aerial surveys would occur during limited periods, approximately over two days (~2 hours per day) only in August each year, so survey effort at any given location would be a very small fraction of a day each year. Animals could move to similar habitat in nearby areas, and could resume previous behavior in the surveyed area after the aircraft leaves. Thus, the monitoring would have insignificant effects on these species.

Hook-and-Line Gear
Hook-and-line gear could affect sturgeon, as well as sea turtles. However, no sturgeon or sea turtle captures have ever been documented during hook-and-line sampling conducted under the proposed action. The lack of interaction is likely due to low hook-and-line survey effort (e.g., as

described in the section 2. 1, sampling is 10 days per year with a crew of two to four anglers), combined with low species occurrence in relation to sampling activities. With regards to sturgeon, because of their diet and feeding mechanism, they are not likely to feed on baited hooks. While interactions between proposed action hook-and-line gear and Atlantic and shortnose sturgeon, as well as loggerhead, Kemp's ridley, and green sea turtles are possible, because the proposed projects effectively have had 100% observer coverage and no interactions with these species have ever been documented since sampling was started 1987, NMFS believes that none have occurred. The lack of any previous interactions and the low amount of effort leads us to believe interactions between proposed action hook-and-line sampling and Atlantic and shortnose sturgeon, and loggerhead, Kemp's ridley, and green sea turtles are extremely unlikely to occur and are discountable.

Vessel Operations

The vessel operations of the proposed action are not likely to adversely affect Atlantic or shortnose sturgeon, or loggerhead, Kemp's ridley, or loggerhead sea turtles. There has never been a documented interaction between a proposed action vessel and any of these species. While actively sampling, vessels move very slowly (i.e., 2-3 knots) or remain idle. Thus, we believe it is extremely unlikely a sea turtle would be struck during these activities. Vessels transiting to and from port or between sampling stations could travel at greater speeds. However, protocol requires the captain and/or crew to observe for any protected species in the path of a vessel. If one is detected, the vessel's course can be immediately altered or speed reduced to avoid incidental collisions. Given the lack of any previous documented interactions, the types of vessels, and monitoring for protected species anytime the vessel is moving, we believe that adverse effects from vessel operations are extremely unlikely to occur and are discountable.

Summary

Sonar scanning will not affect green, Kemp's ridley, loggerhead sea turtles, or shortnose and Atlantic sturgeon. Scuba monitoring, aerial monitoring, hook-and-line gear, and vessel operations associated with the proposed action are not likely to adversely affect the green, Kemp's ridley, loggerhead sea turtles, or shortnose and Atlantic sturgeon.

3.2 Analysis of Species Likely to be Adversely Affected

Green, Kemp's ridley, and loggerhead sea turtles, and Atlantic and shortnose sturgeons are all likely to be adversely affected by the proposed action. The remaining sections of this opinion will focus solely on these species.

The following subsections are synopses of the best available information on the status of the species that are likely to be adversely affected by one or more components of the proposed action, including information on the distribution, population structure, life history, abundance, and population trends of each species and threats to each species. The biology and ecology of these species as well as their status and trends inform the effects analysis for this opinion. Additional background information on the status of sea turtle species can be found in a number of published documents, including: recovery plans for the Atlantic green sea turtle (NMFS and USFWS 1991a), Kemp's ridley sea turtle (NMFS and USFWS 1992b), and loggerhead sea turtle (NMFS and USFWS 2008a); and sea turtle status reviews, stock assessments, and biological reports (Conant et al. 2009b; NMFS-SEFSC 2001; NMFS-SEFSC 2009b; NMFS and USFWS 1995; NMFS and USFWS 2007a; NMFS and USFWS 2007b; NMFS and USFWS 2007d; NMFS and USFWS 2007e; NMFS and USFWS 2007f; TEWG 1998b; TEWG 2000b; TEWG 2007; TEWG 2009a). Sources of background information on Atlantic sturgeon include the status review and proposed and final listing rules (77 FR 5880 and 77 FR 5914). Shortnose sturgeon background documents include the final listing rule (32 CFR 4001) and recovery plan (NMFS 1998a).

3.2.1 General Threats Faced by All Sea Turtle Species

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 are then discussed in the corresponding status sections where appropriate.

Fisheries

Incidental bycatch in commercial fisheries is identified as a major contributor to past declines, and threat to future recovery, for all of the sea turtle species (NMFS and USFWS 1991b; NMFS and USFWS 1992a; NMFS and USFWS 1993b; NMFS and USFWS 2008b; NMFS et al. 2011b). 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. Appendix D lists the some of the key U.S. federal fisheries that have and/or are affecting sea turtles in the U.S. South Atlantic, and provides take associated with each of the fisheries. 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). Bottom longlines and gillnet fishing is 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 impacts 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 1997a). 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 (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 of 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.

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 2007c). 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 2007c).

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 1990). 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 2007g). 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.

Other Threats
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.

3.2.2 Loggerhead Sea Turtles- Northwest Atlantic DPS

The loggerhead sea turtle was listed as a threatened species throughout its global range on July 28, 1978. In 2011, 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 costal scutes, 5 vertebral scutes, 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 1990). 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 2000a); 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[1]), (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)

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

(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 (Dodd Jr. 1988) which incubate for 42-75 days before hatching (NMFS and USFWS 2008b). Loggerhead hatchlings are 1.5-2 in 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 in (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 2000a; TEWG 2009b) 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.

<u>Peninsular Florida Recovery Unit</u>

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 2013 was 77,975 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 3.2). 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/).

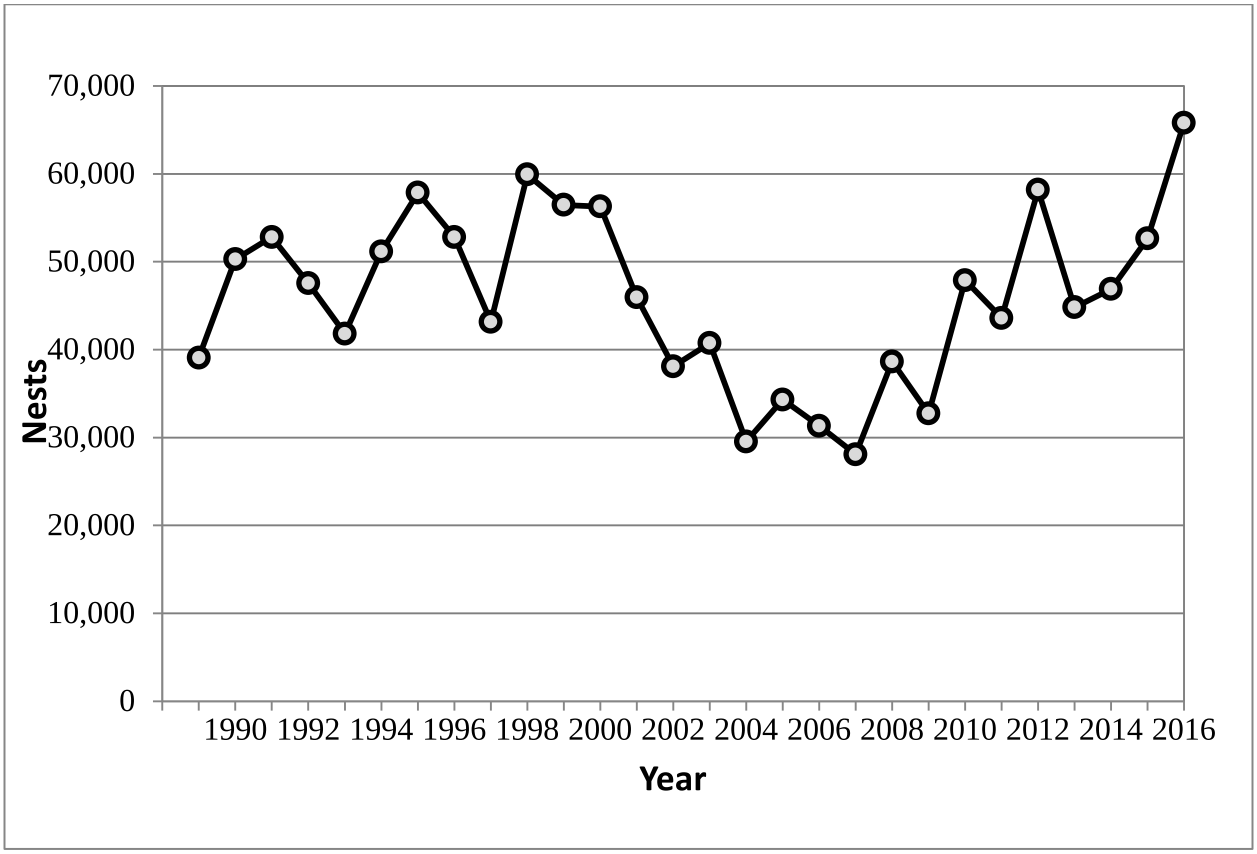

Figure 3.2. Loggerhead sea turtle nesting at Florida index beaches since 1989

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 3.3) 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 improve. 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 3.3. Total Number of Northern Recovery Units 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 2009-2012, and 2012 shows the highest index nesting total since the start of the program (Figure 3.3).

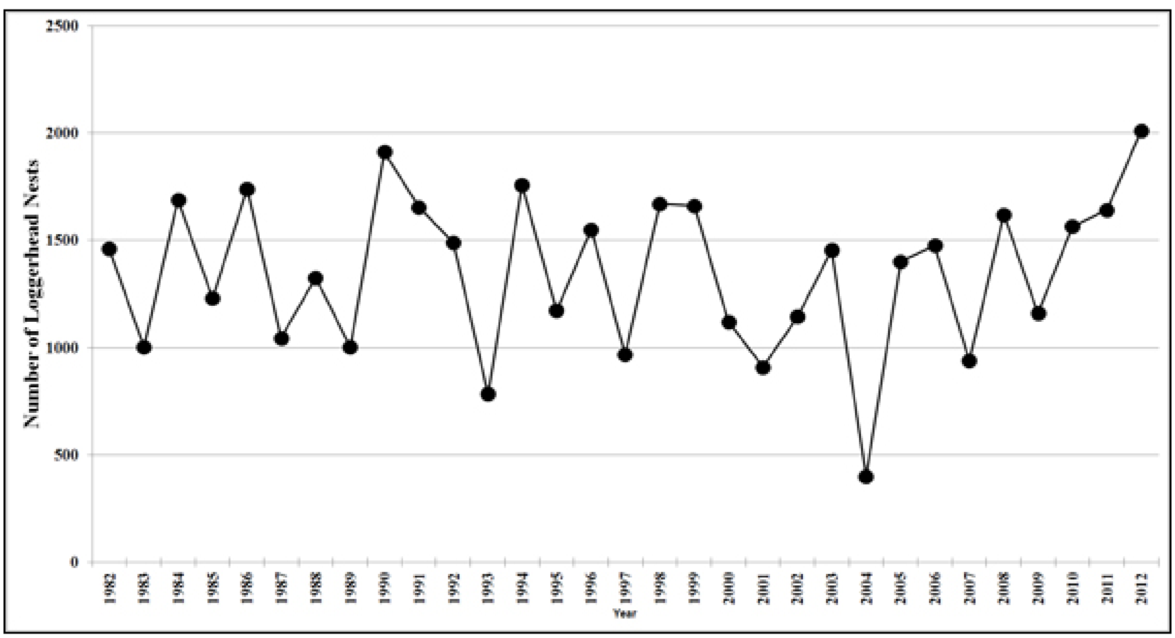

Figure 3.3. South Carolina index nesting beach counts for loggerhead sea turtles (from the SCDNR website: http://www.dnr.sc.gov/seaturtle/nest.htm)

Other Northwest Atlantic DPS Recovery Units

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 2009b). Past in-water studies throughout the eastern United States, however, indicated a substantial decrease in the abundance of the smallest oceanic/neritic juvenile loggerheads, a pattern corroborated by stranding data (TEWG 2009b), but newer analysis is needed to determine if this pattern still applies.

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 3.2.1. 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 food choices 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 3.2.1, 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 (Section 3.2.3), 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 NGMRU), 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 NGMRU 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 locations 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).

3.2.3 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 2000a; 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, with a rate of 2.9 in/year (7.5 cm/year) in the Gulf of Mexico, and 2.2 in/year (5.5 cm/year) in the Atlantic, (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 3.4), 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. In 2015, nesting in Mexico improved to 14,006 recorded nests (J. Pena, Gladys Porter Zoo, pers. comm. to M. Barnette, NMFS PRD, October 19, 2015). 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).

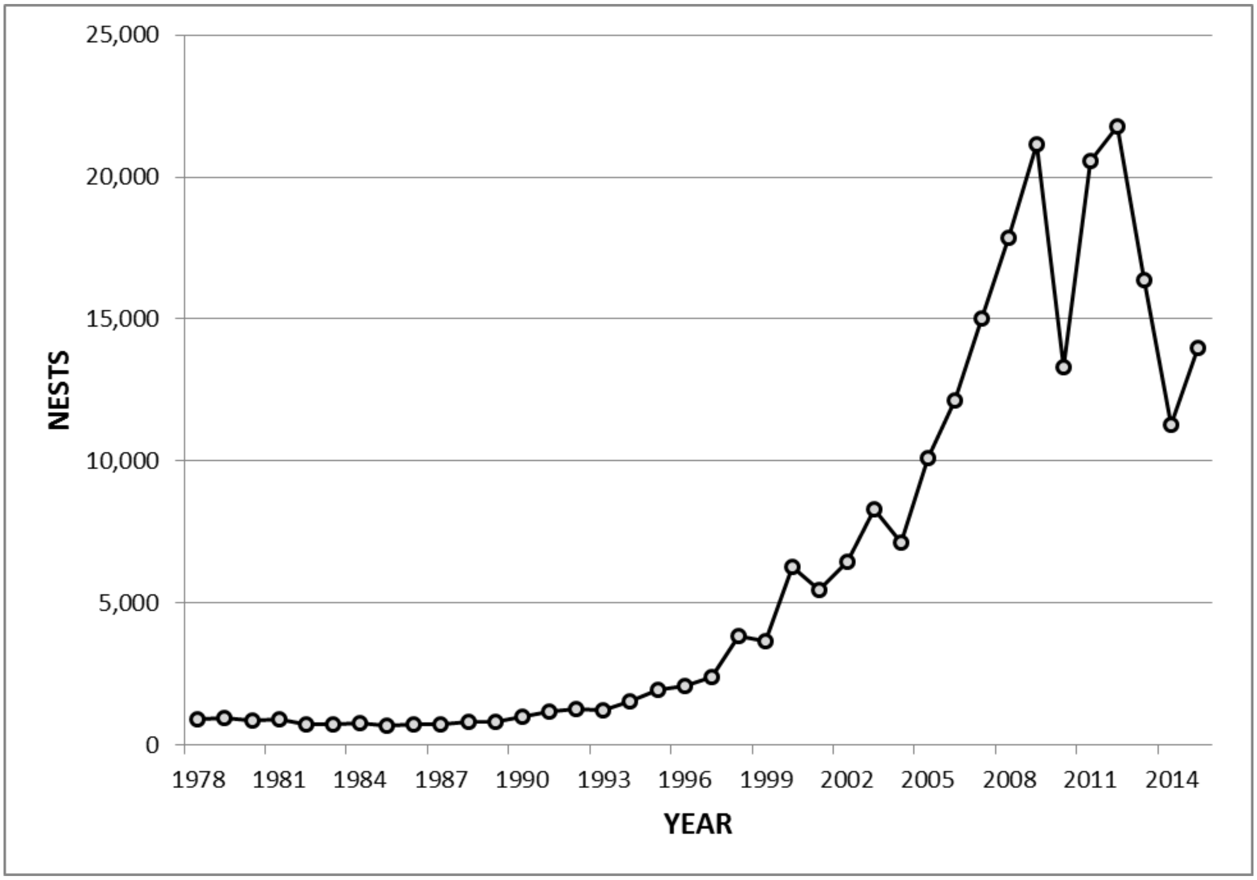

Figure 3.4. Kemp's ridley nest totals from Mexican beaches (Gladys Porter Zoo nesting database 2015)

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.

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 2000a). 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 3.2.1; 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[2] 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.

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

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.

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 3.2.1, 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.

3.2.4 Green Sea Turtles

Information Relevant to All 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). 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.

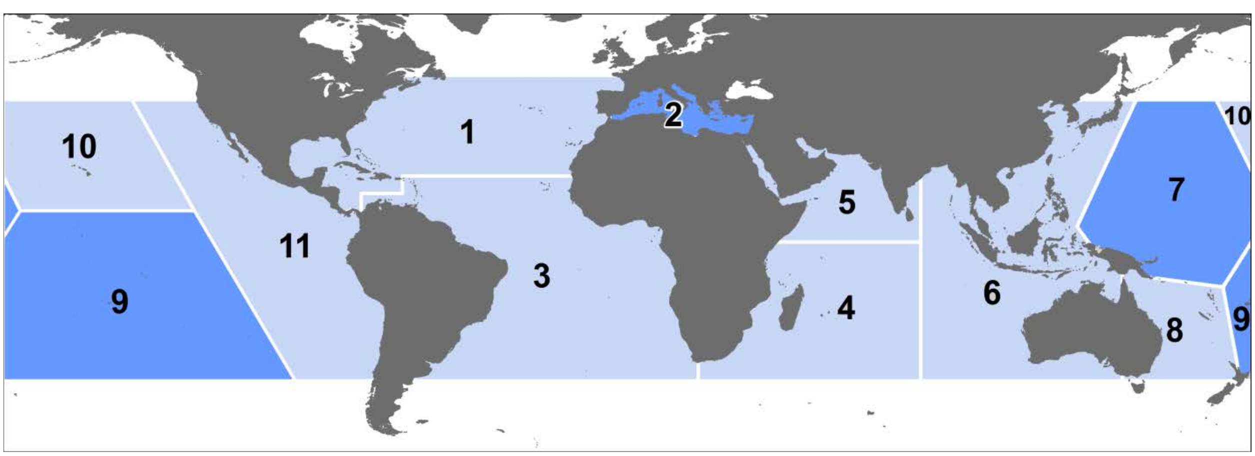

Figure 3.5. Threatened (light) and endangered (dark) green turtle DPSs: 1. North Atlantic, 2. Mediterranean, 3. South Atlantic, 4. Southwest Indian, 5. North Indian, 6. East Indian-West Pacific, 7. Central West Pacific, 8. Southwest Pacific, 9. Central South Pacific, 10. Central North Pacific, and 11. 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 of the U.S. Caribbean foraging grounds come from which DPS.

North Atlantic DPS Distribution

The NA DPS boundary is illustrated in Figure 3.5. 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.

South Atlantic DPS Distribution

The SA DPS boundary is shown in Figure 3.5, 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 1997; 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. 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.

North Atlantic DPS

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 3.6). 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. 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 3.6). 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%.

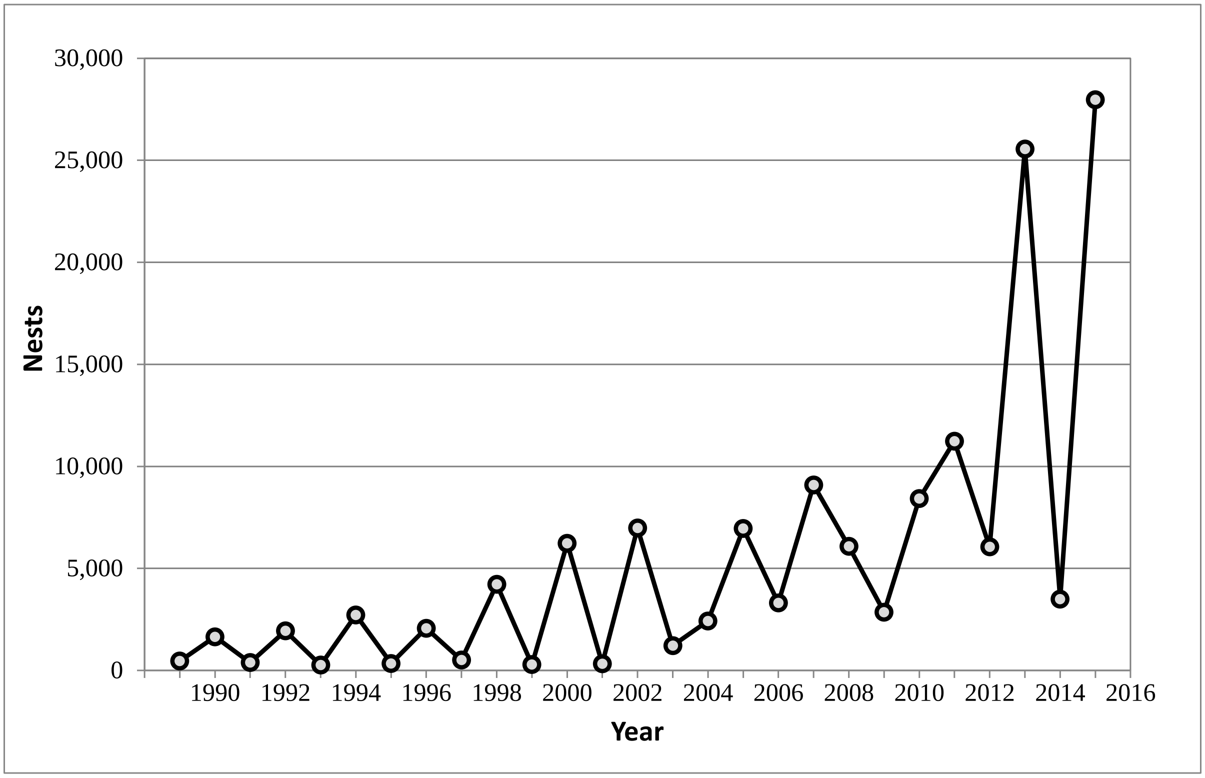

Figure 3.6. Green sea turtle nesting at Florida index beaches since 1989

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% 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).

South Atlantic DPS

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 3.2.1.

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 3.2.1, 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).

3.2.5 Shortnose Sturgeon

Shortnose sturgeon were initially listed as an endangered species by USFWS on March 11, 1967, under the Endangered Species Preservation Act (32 FR 4001). Shortnose sturgeon continued to meet the listing criteria as "endangered" under subsequent definitions specified in the 1969 Endangered Species Conservation Act and remained on the list with the inauguration of the ESA in 1973. NMFS assumed jurisdiction for shortnose sturgeon from USFWS in 1974 (39 FR 41370). The shortnose sturgeon currently remains listed as an endangered species throughout all of its range along the east coast of the United States and Canada. A recovery plan for shortnose sturgeon was published by NMFS in 1998 (63 FR 69613).

Species Description and Distribution

The shortnose sturgeon (*Acipenser brevirostrum)* is the smallest of the 3 sturgeon species that occur in eastern North America. They attain a maximum length of about 6 feet, and a weight of about 55 lbs. Shortnose sturgeon inhabit large coastal rivers of eastern North America. Although considered an anadromous species,[3] shortnose sturgeon are more properly characterized as "freshwater amphidromous," meaning that they move between fresh and salt

[3] One that lives primarily in marine waters and breeds in freshwater

water during some part of their life cycle, but not necessarily for spawning. Shortnose sturgeon rarely leave the rivers where they were born ("natal rivers"). Shortnose sturgeon feed opportunistically on benthic insects, crustaceans, mollusks, and polychaetes (Dadswell et al. 1984).

Historically, shortnose sturgeon were found in the coastal rivers along the east coast of North America from the Saint John River, New Brunswick, Canada, to the St. Johns River, Florida, and perhaps as far south as the Indian River in Florida (Evermann and Bean 1898; Gilbert 1989). Currently, the distribution of shortnose sturgeon across their range is disjunctive, with northern populations separated from southern populations by a distance of about 250 miles (400 km) near their geographic center in Virginia. In the southern portion of the range, they are currently found in the Cooper, Altamaha, Ogeechee, and Savannah Rivers in Georgia. Rogers and Weber (1995a), Kahnle et al. (1998a), and Collins et al. (2000b) concluded that shortnose sturgeon are extinct from the Satilla River in Georgia, the St. Marys River along the Florida and Georgia border, and the St. Johns River in Florida. However, a single specimen was found in the St. Johns River by the Florida Fish and Wildlife Conservation Commission during extensive sampling of the river in 2002 and 2003.

Life History Information

Shortnose sturgeon populations show clinal variation,[4] with a general trend of faster growth and earlier age at maturity in more southern systems. Fish in the southern portion of the range grow the fastest, but do not reach the larger size of fish in the northern part of the range that continue to grow throughout life. Male shortnose sturgeon mature at 2-3 years of age in Georgia, 3-5 years of age in South Carolina, and 10-11 years of age in the Saint John River, Canada. Females mature at 4-5 years of age in Georgia, 7-10 years of age in the Hudson River, and 12-18 years of age in the Saint John River, Canada. Males begin to spawn 1-2 years after reaching sexual maturity and spawn every 1-2 years (Dadswell 1979a; Kieffer and Kynard 1996; NMFS 1998b). Age at first spawning for females is about 5 years post-maturation with spawning occurring every 3-5 years (Dadswell 1979a). Fecundity of shortnose sturgeon ranges between approximately 30,000-200,000 eggs per female (Gilbert 1989).

Adult shortnose sturgeon spawn in the rivers where they were born. Initiation of the upstream movement of shortnose sturgeon to spawn is likely triggered partially by water temperatures above 46°F [8°C (Dadswell 1979a; Kynard 1997)]. This typically occurs during the late winter to early spring (December-March) in southern rivers (North Carolina and south) and the mid- to late spring in northern rivers. Southern populations of shortnose sturgeon usually spawn at least 125 miles (200 km) upriver (Kynard 1997) or throughout the fall line[5] zone if they are able to reach it. Substrate in spawning areas is usually composed of gravel, rubble, cobble, or large rocks (Buckley and Kynard 1985; Dadswell 1979a; Kynard 1997; Taubert and Dadswell 1980), or timber, scoured clay, and gravel (Hall et al. 1991). Water depth and flow are also important parameters for spawning sites (Kieffer and Kynard 1996). Spawning sites are characterized by moderate river flows with average bottom velocities between 1-2.5 ft (0.4-0.8 m) per second

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[4] A gradual change in a character or feature across the distributional range of a species or population, usually correlated with an environmental or geographic transition

[5] The fall line is the boundary between an upland region of continental bedrock and an alluvial coastal plain, sometimes characterized by waterfalls or rapids.

(Hall et al. 1991; Kieffer and Kynard 1996; NMFS 1998b). Spawning in the southern rivers has been reported at water temperatures of 51°F (10.5°C) in the Altamaha River (Heidt and Gilbert 1978) and 48°-54°F (9°-12°C) in the Savannah River (Hall et al. 1991). In the southern portion of the range, adults typically spawn well upriver in the late winter to early spring and spend the rest of the year in the vicinity of the saltwater/freshwater interface (Collins and Smith 1993).

Little is known about young-of-the-year (YOY) behavior and movements in the wild, but shortnose sturgeon at this age are believed to remain in channel areas within freshwater habitats upstream of the saltwater/freshwater interface for about 1 year, potentially due to their low tolerance for salinity (Dadswell et al. 1984; Kynard 1997). Residence of YOY in freshwater is supported by several studies on cultured shortnose sturgeon (Jarvis et al. 2001; Jenkins et al. 1993; Ziegeweid et al. 2008). In most rivers, juveniles aged 1 and older join adults and show similar patterns of habitat use (Kynard 1997). In the Southeast, juveniles aged 1 year and older make seasonal migrations like adults, moving upriver during warmer months where they shelter in deep holes, before returning to the fresh/saltwater interface when temperatures cool (Collins et al. 2002; Flournoy et al. 1992). Due to their low tolerance for high temperatures, warm summer temperatures (above 82°F) may severely limit available juvenile rearing habitat in some rivers in the southeastern United States. Juveniles in the Saint John, Hudson, and Savannah Rivers use deep channels over sand and mud substrate for foraging and resting (Dovel et al. 1992b; Hall et al. 1991; Pottle and Dadswell 1979).

Status and Population Dynamics

The 1998 shortnose sturgeon recovery plan identified 19 distinct shortnose sturgeon populations based on natal rivers. Since 1998, significantly more tagging/tracking data on straying rates to adjacent rivers has been collected, and several genetic studies have determined where coastal migrations and effective movement (i.e., movement with spawning) are occurring. New genetic analyses aided in identifying population structure across the range of shortnose sturgeon. Several studies (King et al. 2001; Waldman et al. 2002b; Wirgin et al. 2005; Wirgin et al. 2009; Wirgin et al. 2000) indicate that most, if not all, shortnose sturgeon riverine populations are statistically different ($p < 0.05$), based on tests using both mitochondrial and nuclear DNA genetic markers. That is, while shortnose sturgeon tagged in one river may later be recaptured in another, it is likely that the individuals are not spawning in those non-natal rivers, as gene flow is known to be low between riverine populations. This is consistent with our knowledge that adult shortnose sturgeon are known to return to their natal rivers to spawn. However, Wirgin et al. (2009) provide evidence that greater mixing of riverine populations occurs in areas where the distance between adjacent river mouths is relatively close, such as in the Southeast.

Significant levels of genetic diversity are present in the shortnose sturgeon genome. Characterization of genetic differentiation (haplotype frequency) and estimates of gene flow (genetic distance) provide a quantitative measure to investigate population structure across the range of the shortnose sturgeon and determine their reproductive isolation or connection. Researchers have identified levels of genetic differentiation that indicate high degrees of reproductive isolation in at least 3 groupings (i.e., metapopulations) of shortnose sturgeon (Figure 3.7). Genetic analyses grouped shortnose sturgeon populations in the Southeast into 1 metapopulation (shown within the “Carolinian Province” in Figure 3.7). Wirgin et al. (2009) note that genetic differentiation among populations within the Carolinian Province was considerably less pronounced than among those in the other 2 provinces and contemporary genetic data suggest that reproductive isolation among these populations is less than elsewhere.

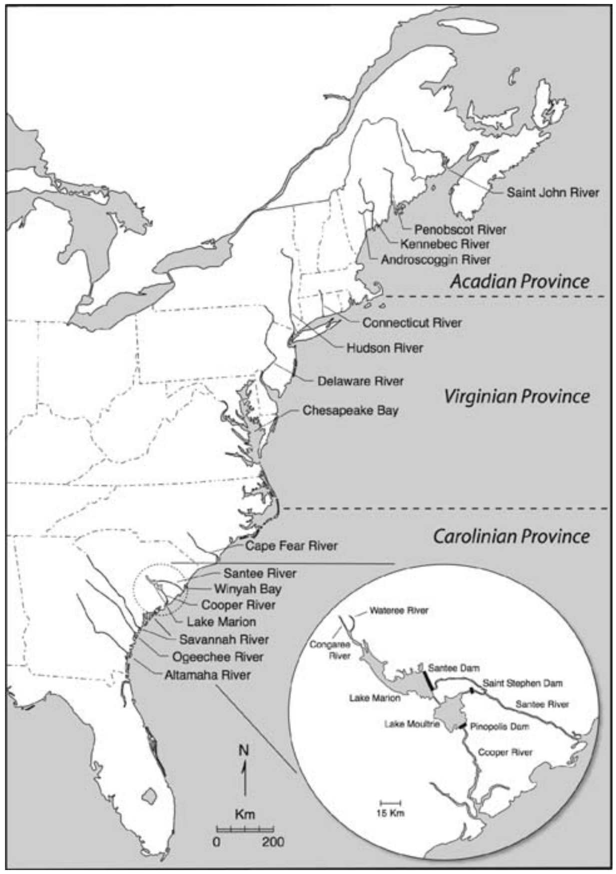

Figure 3.7. The North American Atlantic coast depicting 3 shortnose sturgeon metapopulations based on mitochondrial DNA control region sequence analysis (Wirgin et al. 2009).

The current status of the shortnose sturgeon in the Southeast is variable. Populations within the southern metapopulation are relatively small compared to their northern counterparts. Table 3.4 shows available abundance estimates for rivers in the Southeast. The Altamaha River supports the largest known shortnose sturgeon population in the Southeast with successful self-sustaining recruitment. Population estimates for shortnose sturgeon in the Altamaha have been calculated several times since 1993. Total population estimates in the Altamaha show large interannual variation is occurring; estimates have ranged from as low as 468 fish in 1993 to over 6,300 fish in 2006 (DeVries 2006b; NMFS 1998a). The Ogeechee River is the next most-studied river south of Chesapeake Bay, and abundance estimates indicate that the shortnose sturgeon population in this river is considerably smaller than that in the Altamaha River. The highest point estimate in 1993 using a modified Schnabel technique resulted in a total Ogeechee River population estimate of 361 shortnose sturgeon (95% confidence interval [CI]: 326-400). In contrast, the most recent survey resulted in an estimate of 147 shortnose sturgeon (95% CI: 104-249), suggesting that the population may be declining. Spawning is also occurring in the Savannah River, the Cooper River, the Congaree River, and the Yadkin-Pee Dee River. The Savannah River shortnose sturgeon population, possibly the second largest in the Southeast with an estimated 1,000-3,000 adults, is facing many environmental stressors and spawning is likely occurring in only a very small area. While active spawning is occurring in South Carolina's Winyah Bay complex (Black, Sampit, Yadkin-Pee Dee, and Waccamaw Rivers) the population status there is unknown. Status of the other riverine populations supporting the southern metapopulation is unknown due to limited survey effort, with capture in some rivers limited to less than 5 specimens.

Table 3.4 Shortnose Sturgeon Populations and Their Estimated Abundances

Population (Location)	Data Series	Abundance Estimate (CI)[a]	Population Segment	Reference
Cape Fear River (NC)		Unknown		
Winyah Bay (NC, SC)		Unknown		
Santee River (SC)		Unknown		
Cooper River (SC)	1996-1998	220 (87-301)	Adults	Cooke et al. 2004
ACE Basin (Ashepoo, Combahee, and Edisto Rivers) (SC)		Unknown		
Savannah River (SC, GA)		1,000 - 3,000	Adults	B. Post, SCDNR 2003; NMFS unpublished
Ogeechee River (GA)	1993	266 (236-300)		Weber 1996, 1998a
	1993	361 (326-400)	Total	Rogers and Weber 1994; NMFS 1998a
	1999-2004	147 (104-249)		Fleming et al. 2003; NMFS unpublished
Altamaha River (GA)	1988	2,862 (1,069-4,226)	Total	NMFS 1998a
	1990	798 (645-1,045)	Total	NMFS 1998a
	1993	468 (316-903)	Total	NMFS 1998a
		6,320 (4,387-9,249)	Total	DeVries 2006
Satilla River (GA)		Unknown		
Saint Marys River (FL)		Unknown		
St. Johns River (FL)		Unknown		FFWCC 2007c

[a] Population estimates (with confidence intervals [CIs]) are established using different techniques and should be viewed with caution. In some cases, sampling biases may have violated the assumptions of the procedures used or resulted in inadequate representation of a population segment. Some estimates (e.g., those without CIs or those that are depicted by ranges only) are the "best professional judgment" of researchers based on their sampling effort and success.

Annual variation in population estimates in many basins is due to changes in yearly capture rates, which are strongly correlated with weather conditions (river flow and water temperatures). In "dry years," fish move into deep holes upriver of the saltwater/freshwater interface, which can make them more susceptible to gillnet sampling. Consequently, rivers with limited data sets among years and limited sampling periods within a year may not offer a realistic representation of the size or trend of the shortnose sturgeon population in the basin. As a whole, the data on shortnose sturgeon populations is rather limited and some of the differences observed between years may be an artifact of the models and assumptions used by the various studies. Long-term data sets and an open population model would likely provide for more accurate population estimates across the species range, and could provide the opportunity to more closely link strong-year classes to habitat conditions.

The persistence of a species is dependent on the existence of metapopulations. As demonstrated there are 3 metapopulations of shortnose sturgeon. These 3 metapopulations of shortnose sturgeon should not be considered collectively but as individual units of management as each metapopulation is reproductively isolated from the other and therefore, constitutes an evolutionarily (and likely an adaptively) significant lineage. The loss of any metapopulation would result in the loss of evolutionarily significant biodiversity and would result in a significant gap(s) in the species' range. Loss of the southern shortnose sturgeon metapopulation would result in the loss of the southern half of the species' range (i.e., there is no known reproduction south of the Delaware River). Loss of the mid-Atlantic metapopulation (Virginian Province) would create a conspicuous discontinuity in the range of the species from the Hudson River to the northern extent of the Southern metapopulation. The northern metapopulation constitutes the northernmost portion of the U.S. range. Loss of this metapopulation would result in a significant gap in the range that would serve to isolate the shortnose sturgeon that reside in Canada from the remainder of the species' range in the United States. The loss of any metapopulation would result in a decrease in spatial range, biodiversity, unique haplotypes, adaptations to climate change, and gene plasticity. Loss of unique haplotypes that may carry geographic specific adaptations would lead to a loss of genetic plasticity and, in turn, decrease adaptability. The loss of any metapopulation would increase species' vulnerability to stochastic events.

Threats

The shortnose sturgeon was listed as endangered under the ESA as a result of a combination of habitat degradation or loss (resulting from dams, bridge construction, channel dredging, and pollutant discharges), mortality (from impingement on cooling water intake screens, turbines, climate change, dredging, and incidental capture in other fisheries), and the inadequacy of regulatory mechanisms in ameliorating these impacts and threats.

<u>Dams</u>

Dams for hydropower generation, flood control, and navigation adversely affect shortnose sturgeon habitat 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. Fish passage has not proven very successful in minimizing the impacts of dams on shortnose 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. Dams have separated the shortnose sturgeon population in the Cooper River, trapping some above the structure while blocking access upstream to sturgeon below the dam. Telemetry studies indicate that shortnose sturgeon do not pass upriver through the vessel lock in the Pinopolis Dam on the Cooper River. Shortnose sturgeon have been documented entering the lock, but they have never passed into the reservoir, probably because there is a 40 ft (12 m) vertical wall at the upstream end. Shortnose sturgeon inhabit only Lake Marion, the upper of the 2 reservoirs. There is currently no estimate for the portion of the population that inhabits the reservoirs and rivers above the dam.

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). Dredging in spawning and nursery grounds modifies the quality of the habitat and further restricts the extent of available habitat in the Cooper and Savannah Rivers, where shortnose sturgeon habitat has already been modified and restricted by the presence of dams.

Water Quality

Shortnose sturgeon rely on a variety of water quality parameters to successfully carry out their life functions. Low dissolved oxygen (DO) and the presence of contaminants modify the quality of 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 shortnose sturgeon in the Southeast. Sturgeon are more 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. Dredging activities in the Savannah River are modifying sturgeon habitat by lowering DO, and nonpoint source inputs are causing low DO in the Ogeechee River.

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. This transfer 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 shortnose sturgeon 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 River and other rivers within the range of the shortnose sturgeon are likely much higher. The removal of large amounts of water from the system alters flows, temperature, and DO. Water shortages and "water wars" are already occurring in the rivers occupied by the shortnose sturgeon and will likely be compounded in the future by human population growth and potentially by climate change.

Climate Change

Shortnose sturgeon in the Southeast are within a region the Intergovernmental Panel on Climate Change (IPCC) predicts will experience overall climatic drying (IPCC 2007). The Southeast has experienced an ongoing period of drought since 2007. During this time, South Carolina experienced drought conditions that ranged from moderate to extreme (SCSCO 2008). From 2006 until mid-2009, Georgia experienced the worst drought in its history. In September 2007, many of Georgia's rivers and streams were at their lowest levels ever recorded for the month, and new record low daily stream flows were recorded at 15 rivers with 20 or more years of data in Georgia (USGS 2007). The drought worsened in September 2008. All streams in Georgia except those originating in the extreme southern counties were extremely low. While Georgia has periodically undergone periods of drought—there have been 6 periods of drought lasting from 2-7 years since 1903 (USGS 2000)—drought frequency appears to be increasing (Ruhl 2003). Abnormally low stream flows can restrict access by sturgeon to habitat areas and exacerbate water quality issues such as water temperature, reduced DO, nutrient levels, and contaminants.

Shortnose sturgeon are already susceptible to reduced water quality resulting from dams, inputs of nutrients, contaminants from industrial activities and nonpoint sources, and interbasin transfers of water. The IPCC report projects with high confidence that higher water temperatures and changes in extremes in this region, 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 2007). 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 populated areas of this region are low-lying; the threat of saltwater entering into this region's 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 shortnose 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 shortnose sturgeon resulting from climate change will further modify and restrict the extent of suitable habitat for shortnose 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).

<u>Bycatch</u>

Overutilization of shortnose sturgeon from directed fishing caused initial severe declines in shortnose sturgeon populations in the Southeast, from which they have never rebounded. Further, continued collection of shortnose sturgeon as bycatch in commercial fisheries is an ongoing impact. Shortnose sturgeon are 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. In addition, stress or injury to shortnose 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.

As a wide-ranging anadromous species, shortnose sturgeon are subject to numerous federal (United States and Canadian), state, provincial, and interjurisdictional laws, regulations, and agencies' activities. While these mechanisms have addressed impacts to shortnose sturgeon through directed fisheries, there are currently no mechanisms in place to address the significant risk posed to shortnose sturgeon from commercial bycatch. Though statutory and regulatory mechanisms exist that authorize reducing the impact of dams on riverine and anadromous species, such as shortnose sturgeon, and their habitat, these mechanisms have proven inadequate for preventing dams from blocking access to habitat upstream and degrading habitat downstream. Further, water quality continues to be a problem in the historical spawning rivers along the Atlantic coast, even with existing controls on some pollution sources. Current regulatory authorities are not necessarily effective in controlling water allocation issues (e.g., no restrictions on interbasin water transfers in South Carolina, the lack of ability to regulate non-point source pollution).

3.2.6 Atlantic Sturgeon

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. 2000c; 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 1995b; 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 1995b), with running ripe males found August through October and post-spawning females captured in late September and October (Collins et al. 2000c).

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 3.5. 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 3.5 currently represent the best available population abundance estimates for the 5 U.S. Atlantic sturgeon DPSs.

Table 3.5 Summary of Calculated Population Estimates 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 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 River, are believed to be extirpated, and the status of the spawning population in the Broad-Coosawatchie River 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 River 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.

Carolina DPS

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.

Chesapeake Bay DPS

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; 1998b) 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. 1998b). 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. 1998b; 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.

<u>Gulf of Maine DPS</u>

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.

<u>Viability of Atlantic Sturgeon DPSs</u>

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. 2002a; 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.

<u>Dams</u>

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.

<u>Water Quantity</u>

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. 2004a). 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.

4.0 Environmental Baseline

This section describes the effects of past and ongoing human and natural factors contributing to the current status of the species, their habitats (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, their habitats and ecosystems. 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 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, and areas of designated critical habitat that occur in an action area, and that will be exposed to effects from the action under consultation. This is important because, in some states or life history stages, or areas of their ranges, listed individuals or critical habitat features 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.

4.1 Status of Species in the Action Area

As stated in Section 2, the proposed action would occur in nearshore, inshore, and offshore waters of the coast of Georgia and would include sampling and monitoring at the locations shown in the maps in Section 2, as well as transit to and from them.

Sea Turtles

The species of sea turtles that occur in the action area are all highly migratory. Given the large size of the action area, all sea turtle life stages, and associated behaviors occur in the action area. Therefore, the status of the species of sea turtles (including the DPSs where applicable) in the action area, as well as the threats to these species, are best reflected in their range-wide statuses and supported by the species accounts in Section 3 (Status of Species).

Atlantic Sturgeon

Animals from the South Atlantic DPS of the Atlantic sturgeon would be expected to be the most common in the action area (the location of the action area is in the South Atlantic and near spawning rivers for this DPS). However, animals from all DPSs move up and down the Atlantic coast and all 5 DPSs of Atlantic sturgeon could potentially occur in the action area. The 5 DPSs of Atlantic sturgeon on the East Coast of the United States mix extensively in marine waters (Erickson et al. 2011; Stein et al. 2004b). The status of the 5 DPSs of Atlantic sturgeon in the action area, as well as the threats to them, are best reflected in their range-wide statuses and supported by the species accounts in Section 3 (Status of Species).

Shortnose Sturgeon
All shortnose sturgeon life stages, and associated behaviors occur in the action area and are subject to threats which have caused the species endangered listing status (e.g., of access to historical habitat, loss of and alteration of spawning habitat, poor water quality and changes to water flow, substrate alteration, siltation and contamination). The status of the shortnose sturgeon in the action area, as well as the threats to them, are best reflected in their range-wide status and supported by the species accounts in Section 3 (Status of Species).

4.2 Factors Affecting Sea Turtles in the Action Area

The following analysis examines actions that may affect these species or their environments specifically within the action area. Sea turtles found in the immediate project area may travel widely throughout the Atlantic, Gulf of Mexico, and Caribbean Sea, and individuals found in the action area can potentially be affected by activities anywhere within this wide range. These impacts outside of the action area are discussed and incorporated as part of the overall status of the species as detailed in Status of Species section, above. The activities that shape the environmental baseline for sea turtles in the action area of this consultation are primarily fisheries, vessel operations, permits allowing take under the ESA, dredging, marine pollution, coastal development, and climate change.

4.2.1 Federal Actions

Fisheries
Threatened and endangered sea turtles are adversely affected by several types of fishing gears used throughout the action area. Gillnet, longline, other types of hook-and-line gear, trawl gear, and pot fisheries have all been documented as interacting with sea turtles. Available information suggests sea turtles can be captured in any of these gear types when the operation of the gear overlaps with the distribution of sea turtles. For all fisheries for which there is an FMP or for which any federal action is taken to manage that fishery, impacts have been evaluated under Section 7. Formal Section 7 consultations have been conducted on the following fisheries, occurring at least in part within the action area, found likely to adversely affect threatened and endangered sea turtles. An Incidental Take Statement (ITS) has been issued for the take of sea turtles in each of these fisheries (please refer to Appendix D). A brief summary of each fishery is provided below, but more detailed information can be found in the respective Biological Opinions.

Atlantic Bluefish Fishery
The fishery has been operating in the U.S. Atlantic (from Maine to Florida) for at least the last half century, although its popularity did not heighten until the late 1970s and early 1980s (MAFMC and ASMFC 1998). The majority of commercial fishing activity in the North Atlantic and mid-Atlantic occurs in the late spring to early fall, when bluefish (and sea turtles) are most abundant in these areas (NEFSC 2005). This fishery is known to interact with loggerhead sea turtles, given the time and locations where the fishery occurs. Gillnets account for the vast majority of bluefish landed by commercial harvesters. In 2011, gillnets accounted for 93.4% of

the directed catch of bluefish, while hook gear accounted for 4.5% and other gear categories caught the remaining 2.1% (MAFMC 2013). Aside from gillnets, gear types authorized for use in the commercial harvest of bluefish include trawl, longline, handline, bandit, rod and reel, pot, trap, seine, and dredge gear (50 CFR 600.725(v)).

Consultations on the fishery have been conducted in 1999, 2010, and most recently in 2013. The 2013 consultation included an evaluation of the effects of the fishery on ESA-listed whales, sea turtles, and the newly listed Atlantic sturgeon. The bluefish fishery was considered as part of a larger "batched" consultation that evaluated the effects of: (1) Northeast multispecies, (2) monkfish, (3) spiny dogfish, (4) Atlantic bluefish, (5) Northeast skate complex, (6) Atlantic mackerel/squid/butterfish, and (7) summer flounder/scup/black sea bass fisheries. The consultation concluded that the continued operation of the Atlantic bluefish fishery was likely to adversely affect, but not jeopardize, the continued existence of any species of sea turtle; incidental take was authorized (Appendix D).

Coastal Migratory Pelagics Fishery

In 2007, NMFS completed a Section 7 consultation on the continued authorization of the coastal migratory pelagics fishery in the Gulf of Mexico and South Atlantic (NMFS 2007). In the Gulf of Mexico, vertical line, gillnet, and cast net gears are used. Gillnets are the primary gear type used by commercial fishers in the south Atlantic regions as well, while the recreational sector uses hook-and-line gear. The vertical line effort is primarily trolling. The Opinion concluded that green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles may be adversely affected by operation of the fishery. In November 2012, NMFS requested reinitiation of consultation to evaluate the potential impact of this fishery on the recently listed 5 distinct population segments of Atlantic sturgeon and an Opinion was issued on June 18, 2015. The proposed action was not expected to jeopardize the continued existence of any of sea turtle species, and an ITS was provided. Appendix D reports the takes currently authorized for the fishery.

Dolphin/Wahoo Fishery

The South Atlantic FMP for the dolphin/wahoo fishery was approved in December 2003. The stated purpose of the Dolphin and Wahoo FMP is to adopt precautionary management strategies to maintain the current harvest level and historical allocations of dolphin (90% recreational) and ensure no new fisheries develop. NMFS conducted a formal Section 7 consultation to consider the effects on sea turtles of authorizing fishing under the FMP (NMFS 2003b). The August 27, 2003, Opinion concluded that green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles may be adversely affected by the longline component of the fishery, but it was not expected to jeopardize their continued existence. An ITS for sea turtles was provided with the Opinion. In addition, pelagic longline vessels can no longer target dolphin/wahoo with smaller hooks because of hook size requirements in the pelagic longline fishery. Appendix D reports the takes currently authorized for the fishery.

HMS-Atlantic Pelagic Fisheries for Swordfish, Tuna, and Billfish

Atlantic pelagic fisheries for swordfish, tuna, and billfish are known to incidentally capture large numbers of sea turtles, particularly in the pelagic longline component. Pelagic longline, pelagic driftnet, bottom longline, and/or purse seine gear have all been documented taking sea turtles.

The Northeast swordfish driftnet portion of the fishery was prohibited during an emergency closure that began in December 1996, and was subsequently extended. A permanent prohibition on the use of driftnet gear in the swordfish fishery was published in 1999. NMFS reinitiated consultation on the pelagic longline component of this fishery (NMFS 2004) because the authorized number of incidental takes for loggerheads and leatherbacks sea turtles were exceeded. The resulting Biological Opinion stated the long-term continued operation this sector of the fishery was likely to jeopardize the continued existence of leatherback sea turtles, but reasonable and prudent alternatives were identified allowing for the continued authorization of the pelagic longline fishing that would not jeopardize leatherback sea turtles. Appendix D reports the takes currently authorized for the fishery.

HMS Atlantic Shark and Smoothhound Fisheries

These fisheries include commercial shark bottom longline and gillnet fisheries and recreational shark fisheries under the FMP for Atlantic Tunas, Swordfish, and Sharks (HMS FMP). NMFS has formally consulted 3 times on the effects of HMS shark fisheries on sea turtles (i.e., (NMFS 2003a; NMFS 2008; NMFS 2012a). NMFS also began authorizing a federal smoothhound fishery that will be managed as part of the HMS shark fisheries. NMFS (2012a) analyzed the potential adverse effects from the smoothhound fishery on sea turtles for the first time. Both bottom longline and gillnet are known to adversely affect sea turtles. From 2007-2011, the sandbar shark research fishery had 100% observer coverage, with 4-6% observer coverage in the remaining shark fisheries. During that period, 10 sea turtle (all loggerheads) takes were observed on bottom longline gear in the sandbar shark research fishery, and 5 were taken outside the research fishery. The 5 non-research fishery takes were extrapolated to the entire fishery, providing an estimate of 45.6 sea turtle takes (all loggerheads) for non-sandbar shark research fishery from 2007-2010 (Carlson and Richards 2011). No sea turtle takes were observed in the non-research fishery in 2011 (NMFS unpublished data). Since the research fishery has a 100% observer coverage requirement those observed takes were not extrapolated (Carlson and Richards 2011). Because few smoothhound trips were observed, no sea turtle captures were documented in the smoothhound fishery.

The most recent ESA Section 7 consultation was completed on December 12, 2012, on the continued operation of those fisheries and Amendments 3 and 4 to the Consolidated HMS FMP (NMFS 2012a). The consultation concluded the proposed action was not likely to jeopardize the continued existence of sea turtles. An ITS was provided authorizing takes. Appendix D reports the takes currently authorized for the fishery.

South Atlantic Snapper-Grouper Fishery

The fishery uses spear and powerheads, BSB pot, and hook-and-line gear. Hook-and-line gear used in the fishery includes commercial bottom longline gear and commercial and recreational vertical line gear (e.g., handline, bandit gear, and rod-and-reel). The fishery has impacts turtle species. The most recent consultation (2016) concluded the continued authorization of the fishery was not likely to jeopardize the continued existence of any of these species. Appendix D reports the takes currently authorized for the fishery.

Southeastern Shrimp Trawl Fisheries

NMFS has prepared Opinions on the Gulf of Mexico shrimp trawling numerous times over the years (most recently 2002, 2012, and 2014). The consultation history is closely tied to the lengthy regulatory history governing the use of TEDs and a series of regulations aimed at reducing potential for incidental mortality of sea turtles in commercial shrimp trawl fisheries. The level of annual mortality described in (NRC 1990) is believed to have continued until 1992-1994, when U.S. law required all shrimp trawlers in the Atlantic and Gulf of Mexico to use TEDs, allowing at least some sea turtles to escape nets before drowning (NMFS 2002b).[6] TEDs approved for use have had to demonstrate 97% effectiveness in excluding sea turtles from trawls in controlled testing. These regulations have been refined over the years to ensure that TED effectiveness is maximized through proper placement and installation, configuration (e.g., width of bar spacing), flotation, and more widespread use.

Despite the apparent success of TEDs for some species of sea turtles (e.g., Kemp's ridleys), it was later discovered that TEDs were not adequately protecting all species and size classes of sea turtles. Analyses by Epperly and Teas (2002) indicated that the minimum requirements for the escape opening dimension in TEDs in use at that time were too small for some sea turtles and that as many as 47% of the loggerheads stranding annually along the Atlantic and Gulf of Mexico were too large to fit the existing openings. On December 2, 2002, NMFS completed an Opinion on shrimp trawling in the southeastern United States (NMFS 2002b) under proposed revisions to the TED regulations requiring larger escape openings (68 FR 8456, February 21, 2003). This Opinion determined that the shrimp trawl fishery under the revised TED regulations would not jeopardize the continued existence of any sea turtle species. The determination was based in part on the Opinion's analysis that shows the revised TED regulations are expected to reduce shrimp trawl related mortality by 94% for loggerheads and 97% for leatherbacks. In February 2003, NMFS implemented the revisions to the TED regulations.

On May 9, 2012, NMFS completed a Biological Opinion that analyzed the continued implementation of the sea turtle conservation regulations and the continued authorization of the Southeast U.S. shrimp fisheries in federal waters under the Magnuson-Stevens Act (NMFS 2012c). The Opinion also considered a proposed amendment to the sea turtle conservation regulations to withdraw the alternative tow time restriction at 50 CFR 223.206(d)(2)(ii)(A)(3) for skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls) and instead require all of those vessels to use TEDs. The Opinion concluded that the proposed action was not likely to jeopardize the continued existence of any sea turtle species. An ITS was provided that used anticipated trawl effort and fleet TED compliance (i.e., compliance resulting in overall average sea turtle catch rates in the shrimp otter trawl fleet at or below 12%) as surrogates for sea turtle takes. On November 21, 2012, NMFS determined that a Final Rule requiring TEDs in skimmer trawls, pusher-head trawls, and wing nets was not warranted and withdrew the proposal. The decision to not implement the Final Rule created a change to the proposed action analyzed in the 2012 Opinion and triggered the need to reinitiate consultation. Consequently, NMFS reinitiated consultation on November 26, 2012. Consultation was completed in April 2014 and determined the continued implementation of the sea turtle conservation regulations and the continued authorization of the Southeast U.S. shrimp fisheries in federal waters under the Magnuson-

[6] TEDs were mandatory on all shrimping vessels. However, certain shrimpers (e.g., fishers using skimmer trawls or targeting bait shrimp) could operate without TEDs if they agreed to follow specific tow time restrictions.

Stevens Act was not likely jeopardize the continued existence of any sea turtle species. The ITS maintained the use of anticipated trawl effort and fleet TED compliance as surrogates for numerical sea turtle takes (Appendix D).

Spiny Dogfish Fishery

The primary gear types for the spiny dogfish fishery are sink gillnets, otter trawls, bottom longline, and driftnet gear (NEFSC 2003). The predominance of any 1 gear type has varied over time (NEFSC 2003). In 2005, 62.1% of landings were taken by sink gillnet gear, followed by 18.4% in otter trawl gear, 2.3% in line gear, and 17.1% in gear defined as "other" (excludes drift gillnet gear) (NEFSC 2006). More recently, data from fish dealer reports in Fiscal Year 2008 indicate that spiny dogfish landings came mostly from sink gill nets (68.2%), and hook gear (15.2%), bottom otter trawls (4.9%), as well as unspecified (7.7%) or other gear (3.9%) (MAFMC 2010). Sea turtles can be incidentally captured in spiny dogfish gear, which can lead to injury and death as a result of forced submergence in the gear.

Biological Opinions on the continued operation of the fishery were completed in 2008, 2010, and most recently in December 2013. The 2013 consultation included an evaluation of the effects of the fishery on ESA-listed considered as part of a larger "batched" consultation which evaluated the effects of the (1) Northeast multispecies, (2) monkfish, (3) spiny dogfish, (4) Atlantic bluefish, (5) Northeast skate complex, (6) Atlantic mackerel/squid/butterfish, and (7) summer flounder/scup/BSB fisheries. The consultation concluded that the continued operation of the fishery was likely to adversely affect but not jeopardize the continued existence of any species of sea turtle. Incidental take was authorized. Appendix D reports the takes currently authorized for the fishery.

Fisheries Monitoring

NMFS Integrated Fisheries Independent Monitoring Activities in the Southeast (Atlantic) Region promotes and funds projects conducted by the SEFSC and other NMFS partners to collect fisheries independent data. The various projects use a variety of gear (e.g., trawls, nets, etc.) to conduct fishery research. Sea Turtles are incidentally taken during the course of these activities. Up to 34 loggerhead, 22 Kemp's ridley, 1 leatherback, and 18 green sea turtle lethal takes are expected over continuing 5 year periods (NMFS 2016a).

Vessel Activities

Watercraft are the greatest contributors to overall noise in the sea and have the potential to interact with sea turtles though direct impacts or propellers. Sound levels and tones produced are generally related to vessel size and speed. Larger vessels generally emit more sound than smaller vessels, and vessels underway with a full load, or those pushing or towing a load, are noisier than unladen vessels. Vessels operating at high speeds have the potential to strike sea turtles. Potential sources of adverse effects from federal vessel operations in the action area include operations of the United States Department of Defense (DOD), Bureau of Ocean Energy Management/Bureau of Safety and Environmental Enforcement (BOEM/BSEE), Federal Energy Regulatory Commission (FERC), United States Coast Guard (USCG), NOAA, and USACE.

ESA Section 10 Permits
The ESA allows for the issuance of permits authorizing take of certain ESA-listed species for the purposes of scientific research or enhancement (Section 10(a)(1)(A)). NMFS consults with itself to ensure that issuance of such permits can be done in compliance with Section 7 of the ESA.

Sea turtles are the focus of research activities in the action area for which take is authorized by Section 10 permits under the ESA. As of September 2016, there were 7 active scientific research permits directed toward sea turtles that are applicable to the action area of this Biological Opinion. 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. Permits are issued for 5 years. Most takes authorized under these permits are expected to be nonlethal. However, Permit No. 16733 authorizes 6 unintentional mortalities. Deaths may include up to: 4 green, 4 Kemp's ridley, 4 loggerhead, 2 hawksbill, 2 leatherback OR 2 olive ridley sea turtles over the course of the permit. Permit No. 19621 authorizes unintentional morality of 2 loggerhead, 1 Kemp’s ridley, and 1 green sea turtle over the course of the permit.

Before any research permit is issued, the proposal must be reviewed under the permit regulations (i.e., must show a benefit to the species). In addition, since issuance of the permit is a federal activity, Section 7 analysis is also required to ensure the issuance of the permit is not likely to result in jeopardy to the species.

Dredging
Marine dredging vessels are common within U.S. coastal waters. Although the underwater noises from dredge vessels are typically continuous in duration (for periods of days or weeks at a time) and strongest at low frequencies, they are not believed to have any long-term effect on sea turtles. However, the construction and maintenance of federal navigation channels and dredging in sand mining sites ("borrow areas") have been identified as sources of sea turtle mortality. Hopper dredges in the dredging mode are capable of moving relatively quickly compared to sea turtle swimming speed and can thus overtake, entrain, and kill sea turtles as the suction draghead(s) of the advancing dredge overtakes the resting or swimming turtle. Entrained sea turtles rarely survive. NMFS completed a regional Opinion on the impacts of USACE’s hopper-dredging in the South Atlantic in 1997 (NMFS 1997b). NMFS determined that (1) hopper dredging in the South Atlantic would adversely affect shortnose sturgeon and 4 sea turtle species (i.e., green, hawksbill, Kemp’s ridley, and loggerheads), but would not jeopardize their continued existence, and (2) South Atlantic dredging would not adversely affect leatherback sea turtles or ESA-listed large whales. An ITS for those species adversely affected was issued. The USACE requested reinitiation of consultation in 2007 to: (1) consider species and critical habitat, that may be affected by the action, which had not been listed at the time of the previous opinion and were not considered (e.g., smalltooth sawfish, ESA-listed corals, *Acropora* critical habitat); (2) update the areas, channels, and dredge techniques that the USACE wanted considered, and (3) to include BOEM as a co-action agency. NMFS is currently working on drafting an Opinion.

Other Opinions have been produced that analyzed hopper dredging projects that did not fall under the scope of actions contemplated by regional Opinions. In the South Atlantic, an Opinion issued for dredging and beach nourishment projects outside the scope of the SARBO and relevant to the action area includes the Savannah Harbor Federal Navigation Project (channel widening and deepening for Post-Panama vessels).

4.2.2 State or Private Actions

State Fisheries

Various fishing methods used in state commercial and recreational fisheries, including gillnets, trawling, trap fisheries, and vertical line are all known to incidentally take sea turtles, but information on these fisheries is sparse (NMFS-SEFSC 2001). Most of the state data are based on extremely low observer coverage, or sea turtles were not part of data collection; thus, these data provide insight into gear interactions that could occur, but are not indicative of the magnitude of the overall problem. The following sections will briefly discuss these fisheries.

Southeastern Shrimp Trawl Fisheries

Please refer to the discussion in section 4.2.1, shrimp fishing occurs both in state and federal waters.

Other Fisheries

In addition to the shrimp fishery, several other fisheries exist in Georgia waters using gillnets (the shad fishery, please note discussion of incidental take permit in the sturgeon sections), seines, pots or wire baskets (e.g., crab, catfish), and hook and line. The exact extent to which these fisheries directly or indirectly affect sea turtles is unknown, but some level of impact is expected, either through direct take or to the species habitat. Additionally, associated fishery research (e.g., the precursor to the proposed action) have taken sea turtles, however no injuries or mortalities have been recorded.

A state (non-shrimp) bottom trawl fishery that is suspected of incidentally capturing sea turtles is the whelk trawl fishery in Georgia (M. Dodd, GADNR, pers. comm. to J. Braun-McNeill, SEFSC, December 21, 2000). From 1996-1997, observers onboard whelk trawlers in Georgia reported a total of 3 Kemp's ridley, 2 green, and 2 loggerhead sea turtles captured in 28 tows for a CPUE of 0.3097 sea turtles/100 ft net hour. Since December 2000, TEDs have been required in Georgia state waters when trawling for whelk. Trawls for cannonball jellyfish may also be a source of interactions.

Beyond commercial fisheries, observations of state recreational fisheries have shown that loggerhead, leatherback, Kemp's ridley, and green sea turtles are known to bite baited hooks, and loggerheads and Kemp's ridleys frequently ingest the hooks. Data reported through Marine Recreational Fishery Statistical Survey/Marine Recreational Information Program and the Sea Turtle Stranding and Salvage Network (STSSN) show recreational fishers have hooked sea turtles when fishing from boats, piers, and beach, banks, and jetties. Although the past and current effects of these fisheries on listed species have not been quantified, NMFS believes that ongoing state fishing activities may be responsible for a portion of observed strandings of sea turtles on both the Atlantic and Gulf of Mexico coasts.

Private and Commercial Vessel Operations
Private and commercial vessels, including fishing vessels, operating in the action area of this consultation also have the potential to interact with ESA-listed species. The effects of fishing vessels, recreational vessels, or other types of commercial vessels on listed species may involve disturbance or injury/mortality due to collisions or entanglement in anchor lines. Commercial traffic and recreational pursuits can also adversely affect sea turtles through propeller- and boat strikes. The STSSN includes many records of vessel interaction (propeller injury) with sea turtles off south Atlantic coastal states such as Florida, where there are high levels of vessel traffic. The extent of the problem is difficult to assess because of not knowing whether the majority of sea turtles are struck pre- or post-mortem. Private vessels in the action area participating in high-speed marine events (e.g., boat races) are a particular threat to sea turtles. It is important to note that although minor vessel collisions may not kill an animal directly, they may weaken or otherwise affect an animal, which makes it more likely to become vulnerable to effects such as entanglements. NMFS and the USCG have completed several formal consultations on individual marine events that may affect sea turtles.

Coastal Development
Beachfront development, lighting, and beach erosion control all are ongoing activities along the mid-Atlantic and south Atlantic coastlines of the United States. These activities potentially reduce or degrade sea turtle nesting habitats or interfere with hatchling movement to sea. Nighttime 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. However, more and more coastal counties are adopting stringent protective measures to protect hatchling sea turtles from the disorienting effects of beach lighting.

4.2.3 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 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. 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 specific predictions regarding impacts in the action area are not currently possible.

4.2.4 Marine Pollution

While some sources of marine pollution are difficult to attribute to a specific federal, state, local or private action, they may indirectly affect sea turtles in the action area. 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 (e.g., Mississippi River). 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 in the action area.

Nutrient loading from land-based sources, such as coastal communities and agricultural operations, stimulate plankton blooms in closed or semi-closed estuarine systems. Oxygen depletion, referred to as hypoxia, can negatively impact sea turtles' habitats, prey availability, and survival and reproductive fitness. But the effects of nutrient loading on larger embayments (and the pelagic environment of the action area) are unknown.

The development of marinas and docks in inshore waters can negatively impact nearshore habitats. Fueling facilities at marinas can sometimes discharge oil, gas, and sewage into sensitive estuarine and coastal habitats. Although these contaminant concentrations do not likely affect the more pelagic waters, the species of turtles analyzed in this Biological Opinion travel between nearshore and offshore habitats and may be exposed to and accumulate these contaminants during their life cycles.

Fuel oil spills could affect animals directly or indirectly through the food chain. Fuel spills involving fishing vessels are common events, although these spills typically involve small amounts of material. Larger oil spills may result from accidents, although these events would be rare. No direct adverse effects on listed species resulting from fishing vessel fuel spills have been documented.

4.2.5 Conservation and Recovery Actions Benefiting Sea Turtles in the Action Area

NMFS has implemented a series of regulations aimed at reducing potential for incidental mortality of sea turtles from commercial fisheries in the action area. These include sea turtle release gear requirements for the Atlantic HMS and South Atlantic snapper-grouper fisheries, TED requirements for the Southeast shrimp trawl and North Carolina flynet fisheries, mesh size restrictions in the North Carolina gillnet fishery and Virginia's gillnet fisheries, and area closures in the North Carolina gillnet fishery. 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. The summaries below discuss all of these measures in more detail.

Reducing Threats from Pelagic Longline and Other Hook-and-Line Fisheries
On July 6, 2004, NMFS published a Final Rule to implement management measures to reduce bycatch and bycatch mortality of Atlantic sea turtles in the Atlantic pelagic longline fishery (69 FR 40734). The management measures include mandatory circle hook and bait requirements, and mandatory possession and use of sea turtle release equipment to reduce bycatch mortality.

NMFS published Final Rules to implement sea turtle release gear requirements and sea turtle careful release protocols in the South Atlantic snapper-grouper fishery (November 8, 2011; 76 FR 69230). These measures require owners and operators of vessels with federal commercial or charter vessel/headboat permits for South Atlantic snapper-grouper to comply with sea turtle release protocols and have on board specific sea turtle-release gear.

Revised Use of Turtle Excluder Devices in Trawl Fisheries
NMFS has also implemented a series of regulations aimed at reducing potential for incidental mortality of sea turtles in commercial shrimp trawl fisheries. In particular, NMFS has required the use of TEDs in southeast United States shrimp trawls since 1989 and in summer flounder trawls in the mid-Atlantic area (south of Cape Charles, Virginia) since 1992. It has been estimated that TEDs exclude 97% of the sea turtles caught in such trawls. These regulations have been refined over the years to ensure that TED effectiveness is maximized through more widespread use, and proper placement, installation, configuration (e.g., width of bar spacing), and floatation.

Significant measures have been developed to reduce the take of sea turtles in summer flounder trawls and trawls that meet the definition of a summer flounder trawl (which would include fisheries for other species like scup and BSB) by requiring TEDs in trawl nets fished from the North Carolina/South Carolina border to Cape Charles, Virginia. However, the TED requirements for the summer flounder trawl fishery do not require the use of larger TEDs that are used in the shrimp trawl fisheries to exclude leatherbacks, as well as large benthic-immature and sexually mature loggerheads and green sea turtles.

In 1998, the SEFSC began developing a TED for flynets. In 2007, the Flexible Flatbar Flynet TED was developed and catch retention trials and usability testing was completed (Gearhart 2010). Experiments are still ongoing to certify a bottom-opening flynet TED.

Placement of Fisheries Observers to Monitor Sea Turtle Captures
On August 3, 2007, NMFS published a Final Rule that required selected fishing vessels to carry observers on board to collect data on sea turtle interactions with fishing operations, to evaluate existing measures to reduce sea turtle captures, and to determine whether additional measures to address prohibited sea turtle captures may be necessary (72 FR 43176). This Rule also extended the number of days NMFS observers could be placed aboard vessels, for 30-180 days, in response to a determination by the Assistant Administrator that the unauthorized take of sea turtles may be likely to jeopardize their continued existence under existing regulations.

Final Rules for Large-Mesh Gillnets
In March 2002, NMFS published new restrictions for the use of gillnets with larger than 8-in-stretched mesh, in federal waters (3-200 nmi) off North Carolina and Virginia. These restrictions were published in an interim Final Rule under the authority of the ESA (67 FR 13098) and were implemented to reduce the impact of the monkfish and other large-mesh gillnet fisheries on ESA-listed sea turtles in areas where sea turtles are known to concentrate. Following review of public comments submitted on the interim Final Rule, NMFS published a Final Rule on December 3, 2002, that established the restrictions on an annual basis. As a result, gillnets with larger than 8-in-stretched mesh were not allowed in federal waters (3-200 nmi) in the areas described as follows: (1) north of the North Carolina/South Carolina border at the coast to Oregon Inlet at all times; (2) north of Oregon Inlet to Currituck Beach Light, North Carolina, from March 16-January 14; (3) north of Currituck Beach Light, North Carolina, to Wachapreague Inlet, Virginia, from April 1-January 14; and (4) north of Wachapreague Inlet, Virginia, to Chincoteague, Virginia, from April 16-January 14. On April 26, 2006, NMFS published a Final Rule (71 FR 24776) that included modifications to the large-mesh gillnet restrictions. The new Final Rule revised the gillnet restrictions to apply to stretched mesh that is greater than or equal to 7 inches. Federal waters north of Chincoteague, Virginia, remain unaffected by the large-mesh gillnet restrictions.

4.2.6 Other Sea Turtle Conservation Efforts

Sea Turtle Handling and Resuscitation Techniques
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.

Outreach and Education, Sea Turtle Entanglement, and Rehabilitation
There is an extensive network of STSSN participants along the Atlantic and Gulf of Mexico coasts that not only collect data on dead sea turtles, but also rescue and rehabilitate any live stranded sea turtles.

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)].

4.3 Factors Affecting Atlantic Sturgeon within the Action Area

The following examines actions that may affect this species or its environments specifically within the action area. Atlantic sturgeon found in the immediate project area may travel widely throughout the Atlantic, and individuals found in the action area can potentially be affected by activities anywhere within this wide range. These impacts outside of the action area are discussed and incorporated as part of the overall status of the species as detailed in Status of Species section, above. The activities that shape the environmental baseline for Atlantic sturgeon in the action area of this consultation are primarily dams, fisheries, dredging, permits allowing take under the ESA, marine pollution, and climate change.

4.3.1 Federal Actions

Dams/Hydropower Project
Dam/hydropower projects within the southeast region can impact sturgeon, primarily by impeding passage. For example, the New Savannah Bluff Lock and Dam is located 187 river miles above Savannah Harbor, GA and is approximately 13 miles downstream of Augusta, GA. The project's original purpose was to provide for passage of commercial navigation on the Savannah River between the cities of Savannah and Augusta. The lock and recreation area are leased to Augusta/Richmond County. It currently impedes movement of sturgeon and represents the northern extent of the sturgeon species range on the river. Similarly dam issues exist on the Oconee River (upstream of the Altamaha River) at the Wallace Dam.

Fisheries
NMFS issues federal permits for a number of fisheries and other federal actions, and has undertaken a number of Section 7 consultations to address the effects of those activities on other threatened and endangered species, such as sea turtles. Atlantic sturgeon were not included in those consultations since they were only recently listed; however, each of those consultations sought to minimize the adverse impacts of the action on listed species and some of those conservation measures may benefit Atlantic sturgeon (e.g., the use of sea turtle excluder devices). The summary below of federal actions and the effects these actions have had on Atlantic sturgeon includes only those federal actions in the action area that have already concluded or are currently undergoing formal Section 7 consultation.

Atlantic sturgeon are adversely affected by fishing gears used throughout the action area. While a number of different gears are utilized (e.g., gillnet, longline, other types of hook-and-line gear, trawl gear, and pot fisheries), Atlantic sturgeon bycatch mainly occurs in gillnets, with the greatest number of captures and highest mortality rates occurring in sink gillnets. Atlantic sturgeon are also taken in trawl fisheries, though recorded captures and mortality rates are low. Formal Section 7 consultations have been conducted on the fisheries discussed in the following sections, occurring at least in part within the action area; these fisheries utilize gear known to adversely affect Atlantic sturgeon (i.e., gillnets and trawls). A brief summary of each fishery is provided below, but more detailed information can be found in the respective Biological Opinions. Appendix D lists the incidental takes authorized under the federal fisheries where Section 7 consultation has been completed.

Atlantic Bluefish Fishery

The Atlantic bluefish fishery has been operating in the U.S. Atlantic for at least the last half century, although its popularity did not heighten until the late 1970s and early 1980s (MAFMC and ASMFC 1998). The gears used include otter trawls, gillnets, and hook-and-line. The majority of commercial fishing activity in the north Atlantic and mid-Atlantic occurs in the late spring to early fall, when bluefish are most abundant in these areas (NEFSC 2005). Formal consultations on the fishery have been conducted in 1999, 2010, and most recently in December 2013. The 2013 consultation included an evaluation of the effects of the fishery on ESA-listed whales, sea turtles, and the newly listed Atlantic sturgeon. The bluefish fishery was considered as part of a larger "batched" consultation which evaluated the effects of the (1) Northeast multispecies, (2) monkfish, (3) spiny dogfish, (4) Atlantic bluefish, (5) Northeast skate complex, (6) Atlantic mackerel/squid/butterfish, and (7) summer flounder/scup/black sea bass fisheries. The consultation concluded that the continued operation of the Atlantic bluefish fishery was likely to adversely affect, but not jeopardize, the continued existence of any DPS of Atlantic sturgeon. Incidental take was authorized (Appendix D).

Coastal Migratory Pelagic Resources Fisheries

NMFS completed a Section 7 consultation on the continued authorization of the coastal migratory pelagic resources fishery in the Gulf of Mexico and South Atlantic (NMFS 2015). In the Gulf of Mexico and South Atlantic, commercial fishers target king and Spanish mackerel with hook-and-line (i.e., handline, rod-and-reel, and bandit), gillnet, and cast net gears. Recreational fishers in both areas use only rod-and-reel. Trolling is the most common hook-and-line fishing technique used by both commercial and recreational fishers. Although run-around gillnets accounted for the majority of the king mackerel catch from the late 1950s through 1982, in 1986, and in 1993, handline gear has been the predominant gear used in the commercial king mackerel fishery since 1993 (NMFS 2015). The consultation concluded that the continued operation of the coastal migratory pelagic resources fishery in the Gulf of Mexico and South Atlantic was likely to adversely affect, but not jeopardize, the continued existence of any DPS of Atlantic sturgeon. Incidental take was authorized (Appendix D).

HMS Atlantic Shark and Smoothhound Fisheries

These fisheries include commercial shark bottom longline and gillnet fisheries and recreational shark fisheries under the FMP for Atlantic Tunas, Swordfish, and Sharks (HMS FMP). NMFS (2012a) was the first formal consultation that evaluated the potential adverse effects of these fisheries on all 5 DPSs. Hook-and-line gear (including bottom longline gear) is considered not likely to adversely affect Atlantic sturgeon. NMFS (2012a) considered the potential adverse effects from bottom longline gear on Atlantic sturgeon to be discountable. It did, however, anticipate the capture of Atlantic sturgeon in shark and smoothhound gillnet gear, but it ultimately concluded the proposed action was not likely to jeopardize the continued existence of sea turtles. An ITS for the incidental take of Atlantic sturgeon by DPS was issued; Appendix D reports those takes.

Southeastern Shrimp Trawl Fisheries

On December 2, 2002, NMFS completed an Opinion for shrimp trawling in the southeastern United States (NMFS 2002a) under proposed revisions to the TED regulations (68 FR 8456, February 21, 2003). On May 9, 2012, NMFS completed the new Biological Opinion on the southeastern shrimp fisheries, which included an evaluation of the potential impacts of the fisheries on Atlantic sturgeon. Information considered in the Opinion included the North Carolina Division of Marine Fisheries reporting that no Atlantic sturgeon were observed in 958 observed tows conducted by commercial shrimp trawlers working in North Carolina waters (L. Daniel, NCDMF, pers. comm., via public comment on the proposed rule to list Atlantic sturgeon, 2010). Nine Atlantic sturgeon have been reported captured in the South Atlantic shrimp trawl fisheries. Seven Atlantic sturgeon were captured by a single shrimp trawler off Winyah Bay, South Carolina, from October 27-29, 2008). Six were caught in the main otter trawl gear and 1 was captured in the try net: 6 were released alive, 1 was released dead (NMFS 2014a). One Atlantic sturgeon was captured by a shrimp trawler off South Carolina near Kiawah Island, South Carolina, on December 13, 2011, and it was released alive. Two Atlantic sturgeon were captured by a shrimp trawler near Sapelo Island, Georgia, from December 27-29, 2011. Both were approximately 2 ft long, and both were released alive. No Atlantic sturgeon have been observed caught since 2011 (NMFS 2014a). Collins et al. (1996) did a study of commercial bycatch of shortnose and Atlantic sturgeon. Based on this and additional information, the 2012 Biological Opinion concluded that interactions between shrimp trawls and Atlantic sturgeon were likely but many of the animals were likely to survive the interactions. Ultimately, the Biological Opinion concluded that the proposed action was likely to adversely affect Atlantic sturgeon, but would not jeopardize the continued existence of any Atlantic sturgeon DPS; incidental take was authorized (Appendix D).

Spiny Dogfish Fisheries

The primary gear types for the spiny dogfish fishery are sink gillnets, otter trawls, bottom longline, and driftnet gear (NEFSC 2003). Observer data from 2001-2006 shows 32 recorded interactions between the dogfish fishery and Atlantic sturgeon, with 5 interactions resulting in death; a 16% mortality rate for Atlantic sturgeon that are taken as bycatch (Shepherd et al. 2007). The most recent consultation on the fishery was completed in December 2013 as part of a larger batched consultation. The consultation concluded that the continued operation of the spiny dogfish fishery was likely to adversely affect but not jeopardize the continued existence of any DPS of Atlantic sturgeon. Incidental take was authorized (Appendix D).

Dredging

Riverine, nearshore, and offshore areas are often dredged to support commercial shipping, recreational boating, construction of infrastructure, and marine mining. Dredging activities can pose significant impacts to sturgeon through direct capture. Environmental impacts of dredging that could also impact sturgeon include the following: (1) direct removal/burial of organisms; (2) turbidity/siltation effects; (3) contaminant resuspension; (4) noise/disturbance; (5) alterations to hydrodynamic regime and physical habitat; and (6) loss of riparian habitat (Chytalo 1996; Winger et al. 2000).

Maintenance dredging of federal navigation channels can adversely affect Atlantic sturgeon due to their benthic nature. Hydraulic dredges (e.g., hopper, cutterhead) can lethally harm sturgeon directly by entraining sturgeon in dredge drag arms and impeller pumps. Atlantic sturgeon mortalities in mechanical dredges (i.e., clamshell) have also been documented (Dickerson 2011). Potential impacts from hydraulic dredge operations may be avoided by imposing work restrictions during sensitive time periods (i.e., spawning, migration, feeding) when sturgeon are most vulnerable to mortalities from dredging activity.

Dickerson (2011) summarized observed takings of 29 sturgeon from dredging activities conducted by the USACE off of the Atlantic coast and observed from 1990-2010: 2 Gulf, 11 shortnose, and 15 Atlantic, and 1 unidentified due to decomposition. Of the 3 types of dredges included (hopper, clamshell, and pipeline) in the report, most sturgeon were captured by hopper dredge. Notably, reports include only those trips when an observer was on board to document capture.

On November 4, 2011, NMFS completed an Opinion on the dredging and expansion of the Savannah Harbor (NMFS 2011a). The Opinion concluded that the project was not likely to jeopardize any ESA-listed species (including Atlantic sturgeon) if it implemented and complied with these mitigating measures:

1) Finalization of the off-channel rock-ramp fish passage design in coordination with NMFS and the other federal and state resource agencies.
2) Construction of the fish passage facility at the New Savannah Bluff Lock and Dam to provide access to historical spawning habitat for sturgeon as a mitigation measure.
3) Completion of the development and implementation of a comprehensive monitoring and adaptive management plan in coordination with NMFS and the other federal and state resource agencies to help insure the success of all mitigating measures including the fish passage facility.

The Opinion concluded that 4 Atlantic sturgeon would be killed as a result of interactions with dredges and another 20 would be taken in relocation trawlers but released alive.

Fisheries Monitoring

NMFS Integrated Fisheries Independent Monitoring Activities in the Southeast (Atlantic) Region promotes and funds projects conducted by the SEFSC and other NMFS partners to collect fisheries independent data. The various projects use a variety of gear (e.g., trawls, nets, etc.) to conduct fishery research. Atlantic sturgeon are incidentally taken during the course of these activities. Up to 4 Gulf of Maine DPS, 7 New York Bight DPS, 4 Chesapeake Bay DPS, 1 Carolina DPS, and 5 South Atlantic DPS Atlantic sturgeon lethal takes are expected over continuing 5 year periods (NMFS 2016a).

4.3.2 State or Private Actions

State Fisheries
Atlantic sturgeon are known to be adversely affected by gillnets and otter trawls. Given these gear types are used most frequently used in state waters, state fisheries may have a greater impact on Atlantic sturgeon than federal fisheries using these same gear types.

Descriptions of Atlantic sturgeon captured in the South Atlantic shrimp fisheries operating in both federal and state waters is described previously in Section 4.3.1.

The commercial shad fisheries in Georgia incidentally capture Atlantic sturgeon. Georgia implemented regulations restricting fishing to the lower portions of the Savannah, Ogeechee, and Altamaha Rivers and close the fishery in the Satilla and St. Marys River to reduce sturgeon bycatch. The Georgia shad fishery is open from January 1 to as late as April 30 each year, but would typically end March 31. Georgia applied for, and received, an Incidental Take Permit from NMFS in 2013. The biological opinion evaluating the permit request determined the continued operation of the fishery was likely to adversely affect Atlantic sturgeon but would not jeopardize its continued existence. NMFS determined that incidental capture by fisherman will be 140 Atlantic sturgeon per year in the Altamaha River, 35 Atlantic sturgeon per year in the Savannah River, and 5 Atlantic sturgeon per year in the Ogeechee River; the animals will be juveniles and subadults. The biological opinion anticipated the maximum intercept rate for each Atlantic sturgeon DPS to be: South Atlantic DPS 95%; Chesapeake Bay DPS 20%; Carolina DPS 15%; New York Bight DPS 10%; and Gulf of Maine DPS 2% of the total number of incidental capture, and a mortality rate of 1% (NMFS 2013c). Two years of data indicates that the number of incidental captures in Georgia’s shad fisheries is less than anticipated. Subsequent, to the completion of the biological opinion, the Ogeechee River was closed to commercial shad fishing in 2014.

ESA Section 10 Scientific Research
Through issuance of ESA Section 10(a)(1)(A) permits, scientific and enhancement studies are conducted by researchers on Atlantic sturgeon.

There are currently 3 Section 10(a)(1)(A) scientific research permits issued to study Atlantic sturgeon in the action area. The studies authorize researchers to anesthetize; collect eggs; attach external instrument (e.g., VHF, satellite); insert internal instrument, (e.g., VHF, sonic); mark, PIT tag; measure; photograph/video; fin clip; and weigh animals. Permit No. 19642 authorizes up to 2 unintentional mortalities over the life of permit. Permit No. 16482 authorizes up to 6 unintentional mortalities annually. The third permit does not authorize any mortalities.

Permit No. 19621 authorizes research on turtles and in the course of that research authorizes incidental take of 10 Atlantic sturgeon over life of permit (5 years) but they must be released alive.

4.3.3 Marine Pollution and Environmental Contamination

Anthropogenic sources of marine pollution, while difficult to attribute to a specific federal, state, local or private action, may indirectly affect Atlantic sturgeon in the action area. Sources of pollutants in the action area include atmospheric loading of pollutants such as: PCBs; storm water runoff from coastal towns, cities, and villages; and runoff into rivers that empty into bays and groundwater.

Atlantic sturgeon may be particularly susceptible to impacts from environmental contamination due to their benthic foraging behavior and long-life span. Sturgeon using estuarine habitats near urbanized areas may be exposed to numerous suites of contaminants within the substrate. Contaminants, including toxic metals, polychlorinated aromatic hydrocarbons (PAHs), organophosphate and organochlorine pesticides, polychlorinated biphenyls (PCBs), and other chlorinated hydrocarbon compounds can have substantial deleterious effects on aquatic life. Effects from these elements and compounds on fish include production of acute lesions, growth retardation, and reproductive impairment (Cooper 1989; Sindermann 1994).

Heavy metals and organochlorine compounds accumulate in sturgeon tissue, but their long-term effects are not known (Ruelle and Henry 1992; Ruelle and Keenlyne 1993). Elevated levels of contaminants, including chlorinated hydrocarbons, in several other fish species are associated with reproductive impairment (Cameron et al. 1992; Drevnick and Sandheinrich 2003; Hammerschmidt et al. 2002; Longwell et al. 1992), reduced egg viability (Billsson et al. 1998; Giesy et al. 1986; Mac and Edsall 1991; Matta et al. 1997; Von Westernhagen et al. 1981), reduced survival of larval fish (Berlin et al. 1981; Giesy et al. 1986), delayed maturity (Jorgensen et al. 2004), and posterior malformations (Billsson et al. 1998). Pesticide exposure in fish may affect antipredator and homing behavior, reproductive function, physiological development, and swimming speed and distance (Beauvais et al. 2000; Moore and Waring 2001; Scholz et al. 2000; Waring and Moore 2004). Moser and Ross (1995) suggested that certain deformities and ulcerations found in Atlantic sturgeon in North Carolina's Brunswick River might be due to poor water quality in addition to possible boat-propeller-inflicted injuries. It should be noted that the effect of multiple contaminants or mixtures of compounds at sublethal levels on fish has not been adequately studied. Atlantic sturgeon use marine, estuarine, and freshwater habitats and are in direct contact through water, diet, or dermal exposure with multiple contaminants throughout their range.

Sensitivity to environmental contaminants varies among fish species and life stages. Early life stages of fish seem to be more susceptible to environmental and pollutant stress than older life stages (Rosenthal and Alderdice 1976). In aquatic toxicity tests (Dwyer et al. 2000), Atlantic sturgeon fry were more sensitive to 5 contaminants (carbaryl, copper sulfate, 4-nonylphenol, pentachlorophenol, and permethrin) than fathead minnow (*Pimephales promelas*), sheepshead minnow (*Cyprinodon variegatus*), and rainbow trout (*Oncorhynchus mykiss*) - 3 common toxicity test species - and 12 other species of threatened and endangered fishes. The authors note, however, that Atlantic sturgeon were difficult to test and conclusions regarding chemical sensitivity should be interpreted with caution.

Another suite of contaminants occurring in fish are metals (mercury, cadmium, selenium, lead, etc.), also referred to as trace metals, trace elements, or inorganic contaminants. Post (1987) states that toxic metals may cause death or sublethal effects to fish in a variety of ways and that chronic toxicity of some metals may lead to the loss of reproductive capabilities, body malformation, inability to avoid predation, and susceptibility to infectious organisms.

Dioxin and furans were detected in ovarian tissue from shortnose sturgeon caught in the Sampit River/Winyah Bay system (S.C.). Results showed that 4 out of 7 fish tissues analyzed contained tetrachlorodibenzo-p-dioxin (TCDD) concentrations greater than 50 pg/g (parts-per-trillion), a level which can adversely affect the development of sturgeon fry (J. Iliff, NOAA, Damage Assessment Center, Silver Spring, M.D., unpublished data).

The EPA published its second edition of the National Coastal Condition Report (NCCR II) in 2004, which is a "report card" summarizing the status of coastal environments along the coast of the United States (EPA 2005). The report analyzes water quality, sediment, coastal habitat, benthos, and fish contaminant indices to determine status. The Southeast region (North Carolina - Florida) received an overall grade of B. There was a mixture of poor benthic scores scattered along the Southeast region.

4.3.4 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. 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. As discussed in Section 3 of this Opinion, the South Atlantic and Carolina DPSs are within a region that will likely experience overall climatic drying. 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 Atlantic sturgeon and specific predictions regarding impacts in the action area are not currently possible.

4.3.5 Conservation and Recovery Actions Benefitting Atlantic Sturgeon

State and Federal Moratoria on Directed Capture of Atlantic Sturgeon
In 1998, the ASFMC instituted a coast-wide moratorium on the harvest of Atlantic sturgeon, which is to remain in effect until there are at least 20 protected age classes in each spawning stock (anticipated to take up to 40 or more years). NMFS followed the ASMFC moratorium with a similar moratorium on the harvest of Atlantic sturgeon in federal waters. Amendment 1 to ASMFC's Atlantic sturgeon FMP also includes measures for preservation of existing habitat, habitat restoration and improvement, monitoring of bycatch and stock recovery, and breeding/stocking protocols.

Use of TEDs in Trawl Fisheries
Atlantic sturgeon benefit from the use of devices designed to exclude other species from trawl nets, such as TEDs. TEDs and bycatch reduction device requirements may reduce Atlantic sturgeon bycatch in Southeast trawl fisheries (ASSRT 2007). NMFS has required the use of TEDs in southeast United States shrimp trawls since 1989 and in summer flounder trawls in the mid-Atlantic area (south of Cape Charles, Virginia) since 1992 to reduce the potential for incidental mortality of sea turtles in commercial trawl fisheries. These regulations have been refined over the years to ensure that TED effectiveness is maximized through more widespread use, and proper placement, installation, floatation, and configuration (e.g., width of bar spacing). NMFS has also been working to develop a TED, which can be effectively used in a type of trawl known as a flynet, which is sometimes used in the mid-Atlantic and Northeast fisheries to target sciaenids and bluefish. A top-opening flynet TED was certified in the summer of 2007, but experiments are still ongoing to certify a bottom-opening TED. All of these changes may lead to greater conservation benefits for Atlantic sturgeon.

4.4 Factors Affecting Shortnose Sturgeon within the Action Area

The following analysis examines actions that may affect the shortnose sturgeon or its environment specifically within the action area. The environmental baseline for this Opinion includes the effects of several activities affecting the survival and recovery of the shortnose sturgeon. The activities that shape the environmental baseline in the action area of this consultation include dams and hydroelectric projects, permits allowing take under the ESA, dredging, fisheries, pollution, and climate change.

4.4.1 Federal Actions

Dams/Hydropower Projects
Dam/hydropower projects within the southeast region can impact sturgeon, primarily by impeding passage. For example, the New Savannah Bluff Lock and Dam is located 187 river miles above Savannah Harbor, GA and is approximately 13 miles downstream of Augusta, GA. The project's original purpose was to provide for passage of commercial navigation on the Savannah River between the cities of Savannah and Augusta. The lock and recreation area are leased to Augusta/Richmond County. It currently impedes movement of sturgeon and represents the northern extent of the sturgeon species range on the river. Similarly dam issues exist on the Oconee River (upstream of the Altamaha River) at the Wallace Dam.

ESA Section 10 Permits
Through issuance of ESA Section 10(a)(1)(A) permits, scientific and enhancement studies are conducted by researchers on shortnose sturgeon. Permits are issued for 5 years.

There are currently 2 Section 10(a)(1)(A) scientific research permits issued to study shortnose sturgeon in the action area. The studies authorize researchers to anesthetize; collect eggs; attach external instrument (e.g., VHF, satellite); insert internal instrument, (e.g., VHF, sonic); mark, PIT tag; measure; photograph/video; fin clip; and weigh animals. Permit No. 19642 authorizes up to 1 unintentional mortality over life of permit. Permit No. 16482 authorizes up to 2 unintentional mortalities annually.

Permit No. 19621 authorizes research on turtles and in the course of that research authorizes incidental take of 5 shortnose sturgeon over the life of permit, but they are released alive.

Dredging
Riverine, nearshore, and offshore areas are often dredged to support commercial shipping, recreational boating, construction of infrastructure, and marine mining. Dredging activities can pose significant impacts to sturgeon through direct capture. Environmental impacts of dredging that could also impact sturgeon include the following: (1) direct removal/burial of organisms; (2) turbidity/siltation effects; (3) contaminant resuspension; (4) noise/disturbance; (5) alterations to hydrodynamic regime and physical habitat; and (6) loss of riparian habitat (Chytalo 1996; Winger et al. 2000).

Maintenance dredging of federal navigation channels can adversely affect or jeopardize shortnose sturgeon populations due to their benthic nature. Hydraulic dredges (e.g., hopper, cutterhead) can lethally harm sturgeon directly by entraining sturgeon in dredge drag arms and impeller pumps. Mechanical dredges (i.e., clamshell) have also been documented to kill shortnose and Atlantic sturgeon (Hastings 1983). Potential impacts from hydraulic dredge operations may be avoided by imposing work restrictions during sensitive time periods (i.e., spawning, migration, feeding) when sturgeon are most vulnerable to mortalities from dredging activity.

Although the potential for significant numbers of adult and juvenile sturgeon's being hit by a hydraulic cutterhead dredge is low, 5 shortnose sturgeon takes have been documented by this dredging method. Adult and juvenile sturgeon are believed to be very mobile, even when occupying resting areas during the summer months (deep holes and other deep areas). However, the eggs and larvae of sturgeon are not as mobile, but most of those life stages occur over 150 river miles upstream from where hydraulic dredges are typically proposed for use.

Though rare, documented incidental take of shortnose and Atlantic sturgeon by mechanical dredges have also been reported. Clamshell dredges operate by dropping an open bucket into the water column which plunges to the bottom where the bucket closes, ascends, and discards the dredged material into a scow or barge.

Dickerson (2011) summarized observed takings of 29 sturgeon from dredging activities conducted by the USACE and observed from 1990-2010: 2 Gulf, 11 shortnose, and 15 Atlantic, and 1 unidentified due to decomposition. Of the 3 types of dredges included (hopper, clamshell, and pipeline) in the report, most sturgeon were captured by hopper dredge. Notably, reports include only those trips when an observer was on board to document capture.

On November 4, 2011, NMFS completed an Opinion on the dredging and expansion of the Savannah Harbor (NMFS 2011a). The Opinion concluded that the project was not likely to jeopardize any ESA-listed species upon implementation and compliance with these mitigating measures:

1) Finalization of the off-channel rock ramp fish passage design in coordination with NMFS and the other federal and state resource agencies.

2) Construction of the fish passage facility at the New Savannah Bluff Lock and Dam to provide access to historical spawning habitat for sturgeon as a mitigation measure.

3) Completion of the development and implementation of a comprehensive monitoring and adaptive management plan in coordination with NMFS and the other federal and state resource agencies to help insure the success of all mitigative measures including the fish passage facility.

The Opinion concluded that juveniles and adults within the Savannah River population of shortnose sturgeon would be affected due to loss of estuarine habitat in the lower river.

On May 27, 1997, NMFS completed an Opinion on the continued hopper dredging of channels and borrow areas in the southeast United States. NMFS is currently reinitiating consultation on dredging and beach renourishment activities of the USACE, South Atlantic Region, which will address potential effects to sturgeon.

New Savannah Bluff Lock and Dam Fish Passage project harbor deepening is expected to adversely impact habitat for one endangered species, the shortnose sturgeon. Harbor deepening would allow additional saltwater to enter the harbor and travel further upstream into areas currently used by this species. The increased salinity would reduce the suitability of some of these areas. To compensate for those impacts, the project includes construction of a fish passageway around the New Savannah Bluff Lock & Dam. This passage would restore access to historical spawning grounds for the shortnose sturgeon and other species.
http://www.sas.usace.army.mil/Missions/Civil-Works/Savannah-Harbor-Expansion/

<u>Fisheries Monitoring</u>

NMFS Integrated Fisheries Independent Monitoring Activities in the Southeast (Atlantic) Region promotes and funds projects conducted by the SEFSC and other NMFS partners to collect fisheries independent data. The various projects use a variety of gear (e.g., trawls, nets, etc.) to conduct fishery research. Shortnose sturgeon are incidentally taken during the course of these activities. Up to 1 lethal take is expected over the course of continuing five year periods (NMFS 2016a).

4.4.2 State Actions or Private Actions

Fisheries

Directed harvest of shortnose sturgeon is currently prohibited, but shortnose sturgeon are taken incidentally in state fisheries that deploy nets. Entanglement of sturgeon in gillnets can result in injury and mortality, reduced fecundity, and delayed or aborted spawning migrations of sturgeon (Collins et al. 2000a; Moser et al. 2000; Moser and Ross 1993; Moser and Ross 1995; Weber 1996). Collins et al. (1996) also reported rare instances of shortnose sturgeon captures in the shrimp trawl fishery. Poaching is also still occurring throughout their range, but the impacts from poaching are currently unknown (Collins et al. 1996; Dadswell 1979b; Dovel et al. 1992a).

The commercial shad fisheries in Georgia incidentally capture shortnose sturgeon. Georgia implemented regulations restricting fishing to the lower portions of the Savannah, Ogeechee, and Altamaha Rivers and close the fishery in the Satilla and St. Marys River to reduce sturgeon bycatch. The Georgia shad fishery is open from January 1 to as late as April 30 each year.

Georgia applied for, and received, an Incidental Take Permit from NMFS in 2013. The biological opinion evaluating the permit request determined the continued operation of the fishery was likely to adversely affect shortnose sturgeon but would not jeopardize its continued existence. NMFS determined that incidental capture by fisherman will not exceed 140 shortnose sturgeon per year (no more than 420 in a 3-year period) in the Altamaha River, 70 shortnose sturgeon per year (no more than 210 in a 3-year period) in the Savannah River, and 5 shortnose sturgeon per year (no more than 20 in a 3-year period) in the Ogeechee River. The biological opinion anticipated a mortality rate of approximately 2.3% is (NMFS 2013c).

4.4.3 Marine Pollution and Environmental Contamination

Anthropogenic sources of marine pollution, while difficult to attribute to a specific federal, state, local or private action, may indirectly affect shortnose sturgeon in the action area. Sources of pollutants in the action area include atmospheric loading of pollutants such as: PCBs; storm water runoff from coastal towns, cities, and villages; and runoff into rivers that empty into bays and groundwater.

Shortnose sturgeon may be particularly susceptible to impacts from environmental contamination due to their benthic foraging behavior and long-life span. Sturgeon using estuarine habitats near urbanized areas may be exposed to numerous suites of contaminants within the substrate. Contaminants, including toxic metals, polychlorinated aromatic hydrocarbons (PAHs), organophosphate and organochlorine pesticides, polychlorinated biphenyls (PCBs), and other chlorinated hydrocarbon compounds can have substantial deleterious effects on aquatic life. Effects from these elements and compounds on fish include production of acute lesions, growth retardation, and reproductive impairment (Cooper 1989; Sindermann 1994).

Heavy metals and organochlorine compounds accumulate in sturgeon tissue, but their long-term effects are not known (Ruelle and Henry 1992; Ruelle and Keenlyne 1993). Elevated levels of contaminants, including chlorinated hydrocarbons, in several other fish species are associated with reproductive impairment (Cameron et al. 1992; Drevnick and Sandheinrich 2003; Hammerschmidt et al. 2002; Longwell et al. 1992), reduced egg viability (Billsson et al. 1998; Giesy et al. 1986; Mac and Edsall 1991; Matta et al. 1997; Von Westernhagen et al. 1981), reduced survival of larval fish (Berlin et al. 1981; Giesy et al. 1986), delayed maturity (Jorgensen et al. 2004), and posterior malformations (Billsson et al. 1998). Pesticide exposure in fish may affect antipredator and homing behavior, reproductive function, physiological development, and swimming speed and distance (Beauvais et al. 2000; Moore and Waring 2001; Scholz et al. 2000; Waring and Moore 2004). Moser and Ross (1995) suggested that certain deformities and ulcerations found in sturgeon in North Carolina's Brunswick River might be due to poor water quality in addition to possible boat-propeller-inflicted injuries. It should be noted that the effect of multiple contaminants or mixtures of compounds at sublethal levels on fish has not been adequately studied. Shortnose sturgeon use marine, estuarine, and freshwater habitats and are in direct contact through water, diet, or dermal exposure with multiple contaminants throughout their range.

Sensitivity to environmental contaminants varies among fish species and life stages. Early life stages of fish seem to be more susceptible to environmental and pollutant stress than older life stages (Rosenthal and Alderdice 1976). Post (1987) states that toxic metals may cause death or sublethal effects to fish in a variety of ways and that chronic toxicity of some metals may lead to the loss of reproductive capabilities, body malformation, inability to avoid predation, and susceptibility to infectious organisms.

Dioxin and furans were detected in ovarian tissue from shortnose sturgeon caught in the Sampit River/Winyah Bay system (S.C.). Results showed that 4 out of 7 fish tissues analyzed contained tetrachlorodibenzo-p-dioxin (TCDD) concentrations greater than 50 pg/g (parts-per-trillion), a level which can adversely affect the development of sturgeon fry (J. Iliff, NOAA, Damage Assessment Center, Silver Spring, M.D., unpublished data).

The EPA published its second edition of the National Coastal Condition Report (NCCR II) in 2004, which is a "report card" summarizing the status of coastal environments along the coast of the United States (EPA 2005). The report analyzes water quality, sediment, coastal habitat, benthos, and fish contaminant indices to determine status. The Southeast region (North Carolina - Florida) received an overall grade of B. There was a mixture of poor benthic scores scattered along the Southeast region.

4.4.4 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 for shortnose sturgeon in the action area include overall climatic drying, drought, and negative impacts on rivers and streams. Abnormally low stream flows can restrict access by sturgeon to habitat areas and exacerbate water quality issues such as water temperature, reduced DO, nutrient levels, and contaminants. Higher water temperatures and changes in extremes in this region, including floods and droughts, could 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 ecosystem. In addition, as discussed in Section 3 of this Opinion, changes in water availability (depth and velocities) and water quality (temperature, salinity, DO, contaminants, etc.) in rivers and coastal waters inhabited by shortnose sturgeon resulting from climate change could further modify and restrict the extent of suitable habitat for this species. Still, more information is needed to better determine the full and entire suite of impacts of climate change on shortnose sturgeon and specific predictions regarding impacts in the action area are not currently possible.

4.4.5 Conservation Activities Benefitting Shortnose Sturgeon

Federal Actions
NMFS finalized the Recovery Plan for the Shortnose Sturgeon in 1998 as required by ESA Section 4. The Recovery Plan identified 19 discrete riverine populations of shortnose sturgeon (NMFS 1998a). The 1998 Shortnose Sturgeon Recovery Plan also identified 4 main recovery actions: (1) establish listing criteria for shortnose sturgeon population segments; (2) protect shortnose sturgeon and their habitats; (3) rehabilitate shortnose sturgeon populations and

habitats; and (4) implement recovery tasks. To rehabilitate shortnose sturgeon habitats and population segments, the Recovery Plan specifically calls for actions to restore access to habitats, spawning habitat and conditions, and foraging habitat (NMFS 1998a).

Through ESA Section 6 cooperative agreements, NMFS has supported numerous research projects within the South Atlantic to investigate the life history of the shortnose sturgeon. Since 2003, NMFS has funded 7 shortnose sturgeon research projects within the South Atlantic region to obtain the best available information to investigate life history and effects of existing project operations.

Other Actions

Shortnose sturgeon were added to the International Union for Conservation of Nature and Natural Resources (IUCN) Red List in 1986 as vulnerable. Shortnose sturgeon remain listed by the IUCN as vulnerable based in part on an estimated range reduction of greater than 30% over the past 3 generations, irreversible habitat losses, effects of habitat alteration and degradation, degraded water quality, and extreme fluctuations in the number of mature individuals between rivers. Shortnose sturgeon were listed in Appendix I by CITES in 1975. Appendix I species are considered threatened by extinction and trade is permitted only in exceptional circumstances.

5.0 Effects of the Action

Regulations implementing section 7(a)(2) of the ESA require biological opinions to evaluate the direct and indirect effects of federal actions to determine if it would be reasonable to expect them to appreciably reduce listed species' likelihood of surviving and recovering in the wild by reducing their reproduction, numbers, or distribution (16 U.S.C. '1536; 50 CFR 402.02). The term "species" includes any subspecies of fish or wildlife or plants, and any distinct population segment (DPS) of any species of vertebrate fish or wildlife which interbreeds when mature. Section 7 of the ESA and its implementing regulations also require (as applicable) biological opinions to determine if federal actions would appreciably diminish the value of critical habitat for the survival and recovery of listed species (16 U.S.C. '1536; 50 CFR 402.02).

In this section of the Opinion we assess the direct and indirect effects of the proposed action on threatened and endangered species. Indirect effects are those that are caused later in time, but are still reasonably certain to occur. Interrelated actions are those that are part of a larger action and depend upon the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration (50 CFR 402.02). No interrelated or interdependent actions were identified for analysis in this opinion.

Conservative Decisions- Providing the Benefit of the Doubt to the Species
The analysis in this section is based upon the best available commercial and scientific data on sea turtle biology, shortnose sturgeon biology, Atlantic sturgeon biology, and the effects of the proposed action. However, there can be instances where there is limited information upon which to make a determination. In those cases, in keeping with the direction from the U.S. Congress to provide the “benefit of the doubt” to threatened and endangered species [House of Representatives Conference Report No. 697, 96th Congress, Second Session, 12 (1979)], we will generally make determinations which provide the most conservative (conservation oriented) outcome for listed species.

5.1 Stressors

In order to assess the effects of the proposed action, we must first identify the “stressors” or components of the action that could adversely affect the sea turtles and sturgeon that are the subject of this consultation. The GADNR research and monitoring activities that would be funded by the USFWS would subject the loggerhead, Kemp’s ridley, and green sea turtles, as well as shortnose and Atlantic sturgeon to the following activities that could adversely affect them: 1) capture in trawl gear and/or temporary suspension of solids and increase in turbidity during trawling; 2) entanglement in gillnet or trammel net gear; 3) handling to remove animals from gear; 4) basic data collection including handling, measuring, checking for tags, fin clipping (sturgeon), and tagging if none exist.

Please note that potential impacts from hook and line sampling, sonar scanning, scuba monitoring, aerial monitoring, as well as vessel collision were addressed in Section 3.1.3 and will not be repeated here.

5.2 Exposure

Exposure analyses identify the co-occurrence of ESA-listed species with the actions' stressors (and their effects) in space and time, and identify the nature of that co-occurrence. The analysis identifies, as possible, the number, age or life stage, and gender of the individuals likely to be exposed to the actions' effects and the population(s) or subpopulations(s) those individuals represent. Atlantic and shortnose sturgeon of both genders and any age class could be exposed to stressors associated with the proposed action. Adult, sub-adult, and juvenile sea turtles of both genders could be exposed to the stressors. Hatchlings are not expected to be affected.

In the subsections below, we estimate the number of each species that is likely to be incidentally taken in the future. Since researchers act as observers, NMFS believes that GADNR activities effectively have 100% observer coverage and we feel confident that all past ESA-listed species captures were documented and can be reliably used to make inferences on future takes based on expected effort over the next five years. All animals captured (any gear) will be subject to handling and data collection activities.

First, historical take from 2003 to 2015 is presented and catch per unit effort (CPUE) for each species is calculated. The CPUEs are then used to calculate future estimated take based on expected effort.

5.2.1 Historical GADNR Surveys Endangered Species Interactions

The following Table 5.1 presents the CPUE from historical data for shortnose sturgeon and sea turtles. Atlantic sturgeon CPUE is calculated separately based on a linear regression model to account for increasing interaction rates observed for this species, as shown in Figure 5.1.

Table 5.1 Incidental catch per unit effort (CPUE) for Shortnose Sturgeon and Sea Turtles

Shortnose Sturgeon

Project	Overall 2003-2015		
	TotNum	CPUE	N
EMTS - Trawl	1	0.0002	6302
JTS - Trawl	1	0.0006	1632
MSPHS-GILL	0	0	3763
MSPHS-TRAMMEL	1	0.0003	3198

(E.g., for EMTS – Trawl, 1 take/6302 survey trawls= .0002 CPUE)

Loggerhead Turtle

Project	Overall 2003-2015		
	TotNum	CPUE	N
EMTS - Trawl	16	0.0025	6302
JTS - Trawl	1	0.0006	1632
MSPHS-GILL	2	0.0005	3763
MSPHS-TRAMMEL	0	0	3198

Atl. Green Turtle

Project	Overall 2003-2015		
	TotNum	CPUE	N
EMTS - Trawl	18	0.0029	6302
JTS - Trawl	0	0	1632
MSPHS-GILL	1	0.0003	3763
MSPHS-TRAMMEL	9	0.0028	3198

Kemp's Ridley Turtle

Project	Overall 2003-2015		
	TotNum	CPUE	N
EMTS - Trawl	33	0.0052	6302
JTS - Trawl	1	0.0006	1632
MSPHS-GILL	0	0	3763
MSPHS-TRAMMEL	0	0	3198

Atlantic Sturgeon

Unlike data for sea turtles and shortnose sturgeon, recent historical data suggest an increasing trend in take of this species. For this reason a linear regression model was used to estimate CPUEs and the associated take for each year through 2021. The results of the model are presented here

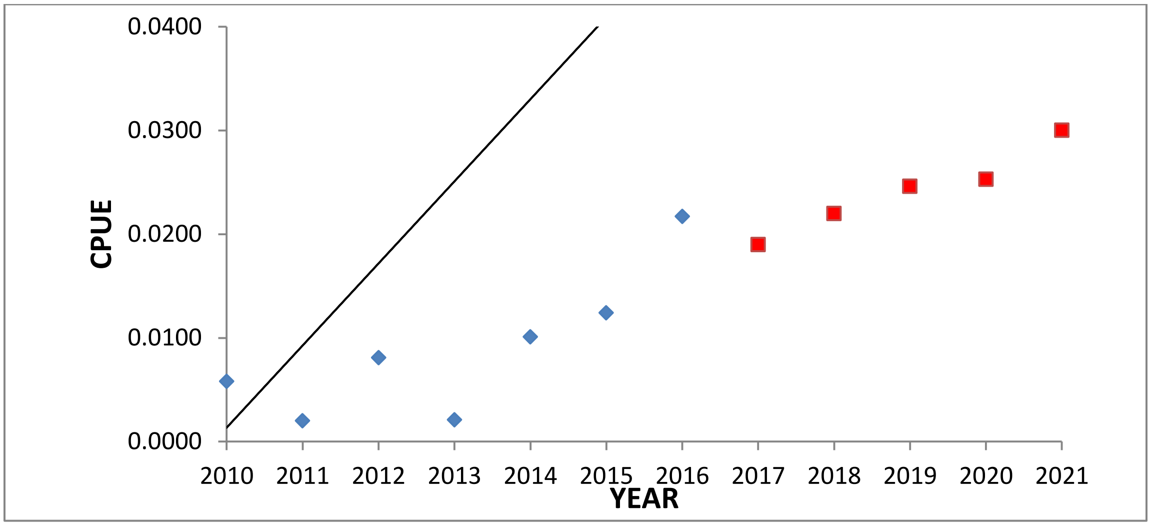

Figure 5.1 Atlantic sturgeon Incidental Take is adjusted from the annual sampling goal, N=504 (42 sites per month x 12 months) and a linear regression model that estimates annual incidental catch from the years 2010-2016(◆). Estimated annual CPUEs vary from 0.019 – 0.03 for the proposed 2017-2021 period (■). CPUE values were 2017 = 0.0190, 2018 = 0.0220, 2019 = 0.0246, 2020 = 0.0253, and 2021 = 0.0300.

5.2.2 Future Estimated Take

Table 5.2 provides information on expected sampling effort and multiplies it by the calculated catch CPUE (from 5.2.1) to provide the estimated take of species by gear type for the 5 year period 2017-2021.

Table 5.2 Total Sampling Effort, Historical CPUEs, and the Projected Estimated Incidental Take of Species by the GADNR survey and monitoring projects from 2017-2021.

	EMTS - Trawl	**JTS - Trawl**	**MSPHS – Gill Net**	**MSPHS - Trammel**
Total Sampling Effort	2520 trawls[1]	720 trawls[2]	1,080 samples[3]	750 samples[4]
	CPUE[5] and (Estimated Total Incidental Take for sampling years 2017-2021)[6]			
Atlantic Sturgeon	0.019-0.03 (60.93)[7]	0.0049 (3.53)	0.0003 (0.324)	0 (0)
Shortnose sturgeon	0.0002 (0.504)	0.0006 (0.43)	0 (0)	0.0003 (0.225)

Loggerhead	0.0025 (6.3)	0.0006 (0.43)	0.0005 (0.54)	0 (0)
Atlantic Green Sea Turtle	0.0029 (7.308)	0 (0)	0.0003 (0.324)	0.0028 (2.1)
Kemps Ridley Sea Turtle	0.0052 (13.1)	0.0006 (0.43)	0 (0)	0 (0)

[1] 42 sites per month x 12 months x 5 years = total # of trawls
[2] 12 sites per month x 12 months x 5 years = total # of trawls
[3] A total of 216 30-minute gill net sets per year are done in the Altamaha Sound and Wassaw Sound.
[4] A total of 150 30-minute trammel net sets are conducted each year. 50 stations are sampled in the Altamaha Sound and Wassaw Sound each month from September through November.
[5] CPUE = fish or turtles per standard 15-minute trawl (EMTS), 5-minute trawl (JTS), or 30-minute soak time (Gill Net and Trammel).
[6] Estimated Incidental Take is in parentheses
[7] Atlantic sturgeon Incidental Take is adjusted from the annual sampling goal, N=504 (42 sites per month x 12 months) and a linear regression model that estimates incidental catch from the years 2010-2016. Estimated annual CPUEs vary from 0.019 – 0.03 for the proposed 2017-2021 period.

However, we must further refine (if practicable) the numbers in Table 5.2 to reflect any information we have on sex ratios, life history stages, or DPSs. This Opinion must also analyze the effects of potential mortality from interaction with the various gear types. The following analyzes the numbers in Table 5.2 to consider this information. Where appropriate, it aggregates expected take by gear. There are four projects (EMTS trawl, JTS trawl, MSPHS gill net, MSPHS trammel net) that take animals. The stresses and potential mortality rates are the same for EMTS trawl and JTS trawl captured animals, therefore the interactions with these two gear types are aggregated for all species (i.e., by trawl gear). Similarly, the stresses and potential mortality rates are the same for gill net and trammel net for all *sea turtles* taken in these gears, so the interactions for each turtle species are combined for analysis (i.e., by one category, net gear).

Gill net and trammel interactions and mortality rates associated with gear are potentially *different for sturgeon* species interactions. Atlantic sturgeon are only expected to be taken in gill net gear, and are analyzed by expected interactions in that gear. Shortnose sturgeon are only expected to be taken in trammel net gear, and are analyzed by expected interactions in that gear.

5.2.2.1 Sex, Life Stage

Sea Turtles
We do not have sufficient data to determine the sex ratio of sea turtles incidentally captured during survey activities and expect that both males and females could be captured. Similarly, we expect that adults or subadults could be captured during sampling activities.

Atlantic Sturgeon
We do not have sufficient data to determine the sex ratio of Atlantic sturgeon incidentally captured during survey activities.

However, information does exist regarding adults and subadults. Historical interaction data from previous trawling activities by the GADNR suggests that most Atlantic sturgeon interactions are with subadults (maximum capture size of 97.2 cm; animals sexually mature at approximately 150 cm). However, this data represents a very small sample size (n=18). Analysis done by NMFS in the northeastern United States provides additional information (n = 726) on the potential interaction ratio between subadult and adult animals. We use it (discussed in the next paragraph), as it has a larger sample size, and provides a more cautiously conservative input for the analysis of effects of the proposed action.

In the previous section, we estimated total takes. In general, impacts to adults (i.e., sexually mature animals) are more likely to affect population growth rates than impacts to subadults. The Northeast Fisheries Science Center (NEFSC) conducted an analysis of the Atlantic sturgeon captures observed by the Northeast Fisheries Observer Program (NEFOP), categorizing them by length. The NEFOP data used by the NEFSC represents the best available information to determine the percentage of subadults in the Southeast. While other Atlantic sturgeon samples have been collected from other areas (i.e., Bay of Fundy, Long Island Sound, North Carolina) they encompass smaller localized sample areas than the information in the NEFOP. A comparable program to the NEFOP does not exist off the coast of the Southeast (Damon-Randall et al. 2013), though the NEFOP data does include information from North Carolina. Of 726 NEFOP observations that could be categorized in this way, 75% (545) were subadults and 25% (182) were adults. Multiplying this ratio by our take estimate, we estimated the number of subadults and adults taken over 5-year periods**.** Based on the estimated take in Table 5.2, **48.35 (64.46 x 0.75) subadults and 16.12 (64.46 x 0.25) adults** would be taken in *trawl gear* by the proposed action (over the 5 year project). **Approximately 0.243 (0.324 x .75) subadults and 0.081 (0.324 x .25) adults** would be taken in *net gear*.

Shortnose Sturgeon
We do not have sufficient data to determine the sex ratio of shortnose sturgeon incidentally captured during survey activities.

A study with information similar to what was used to calculate life stages for Atlantic sturgeon does not exist for the shortnose sturgeon, therefore no estimation is made for this species, and it is assumed that either subadult or adult animals could be taken.

5.2.2.2 Assignment of Takes to DPSs

The only sea turtle species for which multiple DPSs are affected by the proposed action is the green sea turtle. Based on Table 5.2, a total of 7.308 green sea turtles would be taken in trawl gear over a 5 year period, and a total of 2.424 green sea turtles would be taken in net gear over a 5 year period.

<u>Assigning Takes to Green Sea Turtle DPSs</u>
As discussed in the status of the species (Section 3 of this Opinion), on April 6, 2016, the single species listing was replaced with the listing of 11 DPSs. Individuals from both the NA and SA DPSs can be found in waters where the proposed action would occur. While there are currently

no in-depth studies available to determine the percent of NA and SA DPS individuals in any given location, as discussed in Section 3, a study on the foraging grounds off Hutchinson Island, Florida found that approximately 5% of the turtles sampled came from the Aves Island/Suriname nesting assemblage, which is part of the SA DPS. All of the individuals in the study were benthic juveniles. This is only one study, but is recent, is from waters relatively close to Georgia, and represents a reasonable and most relevant means of estimating relative occurrence of DPSs in the area. 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, and that any adult animals taken would be from the NA DPS. Since either adult or juveniles animals could occur in the action area, the lowest percentage of the animals that would likely come from the NA DPS would be 95% (if no adults were taken). If adults were also taken, this number would approach some number closer to 100%. To analyze effects in a precautionary manner, we will assume animals would be taken from both DPSs. We will conservatively analyze impacts to the NA DPS assuming that 100% of the takes would come from that DPS (this is the greatest percentage that could be taken from the DPS). Similarly, the greatest percentage of animals that would likely be taken from the SA DPS would be 5% (likely less if adults are taken, but we assume the most precautionary outcome).

Trawl Gear (EMTS and JTS combined)
NA Green Sea Turtle DPS= **Up to 8** (7.308 rounded to 8) animals could be taken in trawl gear over 5 years of the proposed action. This is calculated by adding the EMTS (7.308) and JTS (0) values from Table 5.2, and assumes 100% of the takes are coming from this DPS.

SA Green Sea Turtle DPS= **Up to 1** (0.365 rounded to 1) animals could be taken in trawl gear over 5 years of the proposed action. This is calculated by adding the EMTS (7.308) and JTS (0) values from Table 5.2, and assumes 5% of the takes are coming from this DPS (.05 x 7.308 = 0.365).

Net Gear (Gill and Trammel combined)
NA Green Sea Turtle DPS= **Up to 3** (2.424 rounded to 3) animals could be taken in net gear over 5 years of the proposed action. This is calculated by adding the MSPHS-Gill Net (0.324) and MSPHS-Trammel (2.1) values from Table 5.2, and assumes 100% of the takes are coming from this DPS.

SA Green Sea Turtle DPS= **Up to 1** (0.121 rounded to 1) animals could be taken in net gear over 5 years of the proposed action. This is calculated by adding the MSPHS-Gill Net (0.324) and MSPHS-Trammel (2.1) values from Table 5.2, and assumes 5% of the takes are coming from this DPS (.05 x 2.424 = 0.121).

<u>Assigning Takes to the 5 Atlantic Sturgeon DPSs</u>
Because subadult and adult Atlantic sturgeon mix extensively in the marine and estuarine environments, individuals from all 5 Atlantic sturgeon DPSs could occur within the action area. Therefore, we must determine from which DPSs the takes will occur. Unfortunately, data is limited regarding the distributions of Atlantic sturgeon DPSs when mixed in marine or estuarine waters. To date, there is only 1 report available which examines the distributions of the individual DPSs in offshore environments – NMFS's Greater Atlantic Regional Fisheries Office

(GARFO) PRD's Mixed Stock Analysis (MSA) (Damon-Randall et al. 2013). The report is an analysis of the composition of Atlantic sturgeon stocks along the East Coast, using tag-recapture data and genetic samples that identify captured fish back to their DPS of origin. Atlantic sturgeon can be assigned to their DPS based on genetic analyses with 92-96% accuracy (ASSRT and NMFS 2007), though some fish used in the MSA could not be assigned to a DPS. Data from NEFOP and the At Sea Monitoring (ASM) programs were used in the MSA to determine the percentage of fish from each of the DPSs at the selected locations along the coast. This report is the best available information, and we will use this to assign the Atlantic sturgeon takes to the 5 DPSs.

As part of their analysis, GARFO-PRD examined the raw results of the genetic analyses to determine if natural geographic boundaries emerged. Given the relatively small number of samples, boundaries were not obvious from the genetics data alone (Damon-Randall et al. 2013). The results of the MSA for the coastal samples indicated groupings of animals that coincided with 3 "marine ecoregions." These marine ecoregions were defined by The Nature Conservancy and refined in 2007. Within a marine ecoregion, the composition of marine species is relatively homogenous and clearly distinct from adjacent ecoregions. The Nature Conservancy focused on features such as population isolation,[7] upwelling, nutrient inputs, freshwater influx, temperature regimes, ice regimes, exposure, sediments, currents, and bathymetric or coastal complexity, when defining ecoregions. Along the east coast of the United States, there are 3 marine ecoregions (Figure 5.2). The proposed action occurs in the Carolinian ecoregion.

[7] Isolation in the marine environment may be caused by "deep water, narrow straits, or rapid changes in shelf conditions" Spalding, M. D., H. E. Fox, G. R. Allen, and N. Davidson. 2007. Marine ecoregions of the world. Pages Companion publication: Spalding, M. D., Fox, H. E., Allen, G. R., Davidson, N., Ferdaña, Z. A., Finlayson, M., Halpern, B. S., Jorge, M. A., Lombana, A., Lourie, S. A., Martin, K. D., McManus, E., Molnar, J., Recchia, C. A., Robertson, J. (2007) Marine Ecoregions of the World: a bioregionalization of coast and shelf areas. BioScience 57: 573-583 *in*. The Nature Conservancy, Arlington, Virginia.

Figure 5.2. Three marine ecoregions off the east coast of the United States
Source: (Damon-Randall et al. 2013)

GARFO-PRD refined these marine ecoregions using the boundaries for existing fisheries statistical areas and known Atlantic sturgeon migratory pathways (Damon-Randall et al. 2013). According to Damon-Randall et al. (2013) , the Gulf of Maine/Bay of Fundy marine ecoregion falls into Marine Mixing Zone (MMZ) 1, the Virginian marine ecoregion falls into MMZ 2, and the Carolinian marine ecoregion falls into MMZ 3 (Figure 5.3). Marine Mixing Zone 3, which extends from Cape Hatteras to the tip of Florida, corresponds to the portion of the action area where the Atlantic sturgeon are likely to occur in the marine environment. While updates to this analysis were conducted in 2013, Damon-Randall et al. (2013) report no new data for MMZ 3 were available. NMFS determined that the original data from the NEFOP and ASM programs still represent the best available information with respect to the DPS composition of animals in MMZ 3. The composition of Atlantic sturgeon residing in MMZ 3 are a range around a mean value, with a 5% confidence interval on either side. The mean composition point estimates are listed below with each respective range in parenthesis:

- 1% St. John (0-6%)
- 11% Gulf of Maine (6-16%)
- 51% New York Bight (46-56%)
- 13% Chesapeake Bay (8-18%)
- 2% Carolina (0-7%)
- 22% South Atlantic (17-27%)

It important to note that we estimate a few subadult Atlantic sturgeon takes are likely from the population in St. John, Canada. Since these animals are from a population outside the United States that was not listed under the ESA, we do not consider the take of these animals further in this Biological Opinion. Removing the contributions of those fish means the average composition estimates (e.g., 11% + 51%, etc.) do not add to 100 (i.e., only sums to 99%).

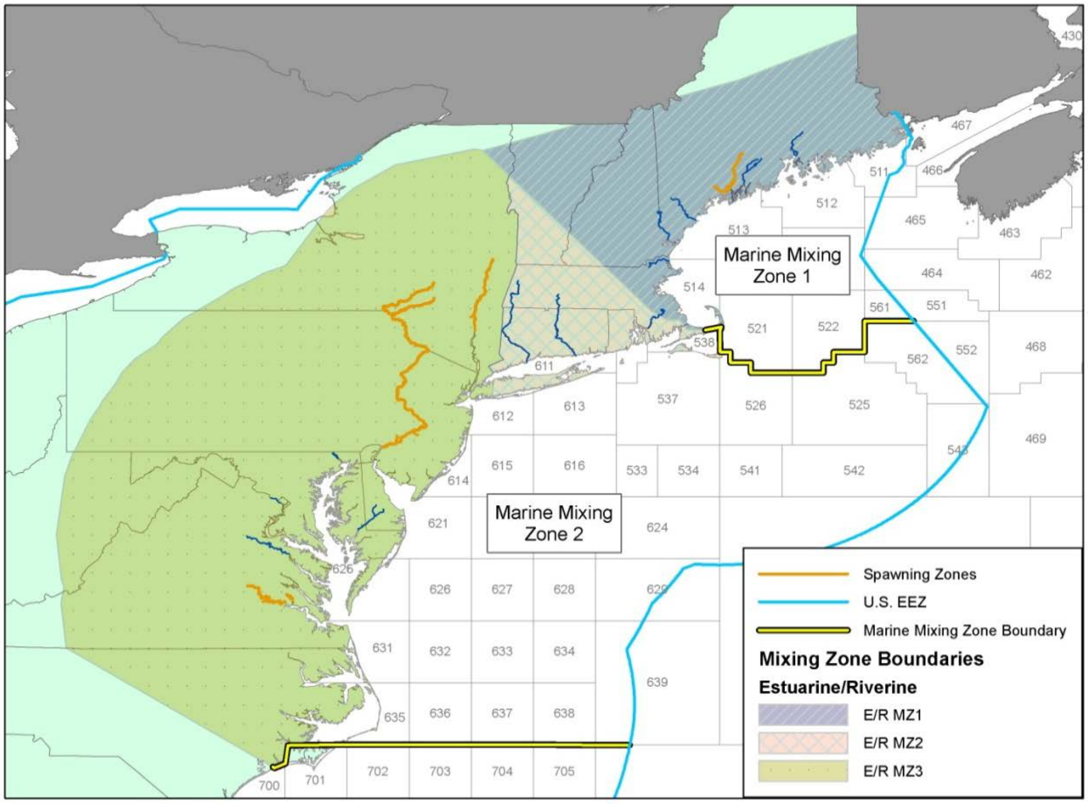

Figure 5.3. Map of Mixing Zones Source: (Damon-Randall et al. 2013)

Applying the DPS percentages to the subadult and adult calculations from section 5.2.2.1 produces:

Table 5.3 Atlantic Sturgeon Sub Adult and Adult Takes

Species	Sub Adult		Adult	
	Trawl	*Net*	*Trawl*	*Net*
Atlantic Sturgeon GOM DPS (11%)	5.32	0.03	1.78	0.01
Atlantic Sturgeon NYB DPS (51%)	24.66	0.12	8.23	0.04
Atlantic Sturgeon CB DPS (13%)	6.29	0.03	2.10	0.01
Atlantic Sturgeon Carolina DPS (2%)	0.97	0.01	0.33	0.01
Atlantic Sturgeon SA DPS (22%)	10.64	0.05	3.55	0.02

*example calculation using GOM DPS:
TRAWL GEAR 48.35 subadults x .11 = 5.32 subadults GOM; 16.12 adults x .11 =1.78 adults GOM.
NET GEAR 0.243 subadult x .11 =0 .03 subadult GOM; 0.081 adult x .11 = 0.01 adult GOM. Numbers rounded up to two decimals to conservatively estimate impact.
NOTE: Atlantic sturgeon are only expected to be taken in gill net gear.

Atlantic Sturgeon Sub Adult and Adult Takes rounded to the nearest whole number (these numbers are used in later analyses and the incidental take statement):

Species	Sub Adult		Adult	
	Trawl	*Net*	*Trawl*	*Net*
Atlantic Sturgeon GOM DPS	**6**	**1**	**2**	**1**
Atlantic Sturgeon NYB DPS	**25**	**1**	**9**	**1**
Atlantic Sturgeon CB DPS	**7**	**1**	**3**	**1**
Atlantic Sturgeon Carolina DPS	**1**	**1**	**1**	**1**
Atlantic Sturgeon SA DPS	**11**	**1**	**4**	**1**

5.3 Response

5.3.1 Capture in Trawl Gear And/Or Temporary Suspension of Solids and Increase in Turbidity During Trawling

Sea Turtles and Trawl Gear

The GADNR trawl sampling activities could accidentally capture sea turtles. As discussed in the Exposure analysis, animals could be from either sex and could be juvenile, sub-adult, or adult. Sea turtles forcibly submerged in any type of restrictive gear that holds them under water will eventually suffer fatal consequences from prolonged anoxia and/or seawater infiltration of the lung (Lutcavage et al. 1997). Generally, when sea turtles dive, their bodies create energy for their cells in a process that uses oxygen from their lungs. Sea turtles that are stressed from being forcibly submerged eventually use up all their oxygen stores. Since they must continue to create energy with or without oxygen, when their oxygen stores are used up, they begin to create energy via a process that does not require oxygen (i.e., anaerobic glycolysis). However, this process can significantly increase the level of lactic acid in a sea turtle's blood (Lutcavage and Lutz 1997); if the level gets too high it can cause death. Numerous factors affect the survival rate of forcibly submerged sea turtles. It is likely that the speed at which physiological changes occur and how long they last are related to the intensity of struggling and how long the animal is underwater (Lutcavage and Lutz 1997). The size, activity level, and condition of the sea turtle; the ambient water temperature; and if multiple forced submergences have recently occurred all affect how badly an animal may be injured by forced submergence. Disease factors and hormonal status may also influence survival during forced submergence. Larger sea turtles are capable of longer voluntary dives than small sea turtles, so young sea turtles may be more vulnerable to the stress from forced submergence. The normal process for creating cellular energy happens more quickly in warmer waters. Since this process takes place more quickly, oxygen stores are also used more quickly, and anaerobic glycolysis may begin sooner. Subsequently, the negative effects from forced submergence may occur more quickly. With each forced submergence event, the level of lactic acid in the blood increases and can require a long (up to 20 hours) time to recover to normal levels. Sea turtles are probably more susceptible to dying from high levels of lactic acid if they experience multiple forced submergence events in a short period of time. Recurring submergence does not allow sea turtles to get rid of high levels of lactic acid (Lutcavage and Lutz 1997). Stabenau and Vietti (2003) illustrated that sea turtles given time to stabilize their pH level after being forcibly submerged have a higher survival rate. How quickly this happens depends on the overall health, age, size, etc. of the sea turtle, time of last breath, time of submergence, environmental conditions (e.g., sea surface temperature, wave action), and the nature of any sustained injuries at the time of submergence (NRC 1990).

A study examining the relationship between otter trawl tow time and sea turtle mortality showed that mortality was dependent on trawling duration. The studies analyzing the shrimp fishery show that tows of short duration have little effect on mortality, intermediate tow times result in a rapid escalation to mortality, and eventually reach a plateau of high mortality (Epperly et al. 2002). As in the case of forced submergence during shrimp trawling, it is probable that the different sea turtle species captured during the GADNR research have different physiological responses to lengthy forced submergence by research trawls due to differing average body sizes and corresponding oxygen capacities. In the absence of species-specific estimates, however, the trawl studies represent the best available scientific information available. The proportion of dead or comatose turtles rose from 0% for the first 50 minutes of capture to 70% after 90 minutes of capture in work by (Henwood and Stuntz 1987) done on forced submergence in the shrimp fishery. However, metabolic changes that can impair a sea turtle's ability to function can occur within minutes of a forced submergence. Forced submergence of Kemp's ridley sea turtles in shrimp trawls resulted in an acid-base imbalance after just a few minutes (times that were within the normal dive times for the species) (Stabenau et al. 1991) and as mentioned above recovery times for acid-base levels to return to normal may be prolonged as long as 20 hours or more (Henwood and Stuntz). This effect is expected to be worse for sea turtles that are recaptured before metabolic levels have returned to normal. If it were to occur, forced submergence from capture in the trawls used for sampling by GADNR trawls would be comparable to forced submergence in otter trawls of the shrimp fishery pulled without turtle excluder devices. Turtles would be unable to reach the surface in a relatively stressful situation.

NMFS expects the majority of sea turtles that are incidentally captured by GADNR's activities to experience no more than short-term effects due to the very short tow times, and proper animal handling. The short-term stresses resulting from the non-lethal portion of the permit activities discussed above are expected to be minimal. The project protocols would contain conditions to mitigate adverse impacts to turtles from these activities. Overall, the individual and combined impacts of the above non-lethal portion of activities are not expected to have more than short-term effects on individual sea turtles and any increase in stress levels would dissipate quickly.

The GADNR has conducted trawl sampling research since 1976. No turtles have died immediately as a result of the research. NMFS considered concluding zero lethal takes would result from the trawl sampling. However, given the uncertain nature of trawling NMFS decided to conservatively assess post release mortality. As discussed in the previous Exposure section NMFS expects the proposed trawl activities would take up to **7 (6.3 + 0.43 rounded to 7) loggerhead, 8 NA green, 1 SA green, and 14 (13.1 + 0.43 rounded to 14) Kemps ridley sea turtles over a 5 year period.** While mortalities are not likely, they are possible. In August 2015, NMFS convened a workshop of experts to develop criteria for estimating post-interaction mortality (PIM) of sea turtles caught in trawl, gillnet and trap fishing gear (Stacy et al. 2016). The results of the workshop were used in the development of draft national post-interaction mortality criteria and a criteria application process. The draft procedural directive, Process For

Post-Interaction Mortality Determinations of Sea Turtles Bycaught In Trawl, Net, And Pot/Trap Fisheries (NMFS 2016b), was recently issued. This draft directive reflects the most recent and best available information regarding PIM, and use of its criteria provides a mechanism to conservatively assess the potential impacts of the proposed action on sea turtles.

The criteria provided in the draft directive are based on the apparent degree of impairment, severity of physical injury, and relative risk of developing life-threatening conditions as a result of the interaction with gear. Sea turtles caught in fishing gear that are alive upon discovery exhibit a range of outward effects, from seemingly normal behavior and activity to complete unresponsiveness. Similarly, traumatic injuries of different degrees of severity are encountered, ranging from minor, superficial wounds to those that present an immediate threat to survival and risk of serious complications, such as secondary infections and diminished ability to forage and perform other vital biological functions. Because in most instances it is difficult to measure whether a sea turtle lived or died after being captured in fishing gear, the likelihood of mortality is best determined by activity level and the presence or absence of any abnormal behavior or injuries. There is inherent variability in the conditions under which observations are made and the amount of time sea turtles are available for examination due to factors such as fishing operations, sea state, weather, and time of day. In the criteria, each observation is categorized as low risk of mortality (Category 1), intermediate risk of mortality (Category 2), or high risk of mortality (Category 3). Each mortality risk category is associated with percentages that reflect the proportion of sea turtles that are estimated to later die following release. In addition, injuries or conditions that are incompatible with survival are considered deaths (100% mortality). The mortality percentages applied to these risk categories were derived from a combination of expert opinion and available studies pertinent to sea turtle post-interaction mortality. Under the criteria, the lowest mortality risk category (Category 1) assigned for any interaction includes apparently uninjured sea turtles that exhibit indications of normal behavior and activity, those with slight alterations in behavior or activity that may still be considered within the bounds of normal, and turtles with minor, non-life threatening traumatic injuries. Category 1 has two estimated rates of post-interaction mortality, 10% (interactions at minimal risk of causing decompression sickness (DCS)), and 20% (interactions at risk of causing DCS). DCS concerns apply to sea turtles caught by sampling operating at a depth of 40 m or greater. As discussed earlier, all animals captured by GADNR sampling since it was started have been released in excellent condition. Additionally, as described in the proposed action, none of the gear is deployed at a depth of 40 m or greater. Therefore, Category 1 and the 10% rate best reflect the impacts that would result from the proposed action and will be used in this Opinion.

Applying the 10% post release mortality rate from the directive produces the following numbers:

Expected Mortalities, Trawl Gear
Up to **0.8** (0.1 x 8 = 0.8) NA green over a five year period
Up to **0.1** (0.1 x 1 = 0.1) SA green over a five year period
Up to **0.7** (0.1 x 7 = 0.7) loggerhead over a five year period
Up to **1.4** (0.1 x 14 = 1.4) Kemp's ridley over a five year period

To reduce the likelihood of the unintentional turtle mortalities during the research, NMFS would require strict adherence to protocols that ensure that tow times do not exceed 15 minutes (EMTS project) and 5 minutes (JTS project). Additionally, researchers would comply with established sea turtle resuscitation and handling protocols.

Sturgeon and Trawl Gear

Shortnose and Atlantic sturgeon capture in bottom trawls is also possible. While little information exists about the effects to sturgeons from capture in trawl nets, stress, abrasions, and scute damage may occur. Blunt force trauma may also occur if the animal contacts the frame of the trawl net. Little is known about post-release mortality of sturgeons taken in trawl gear, however best available information is presented here.

No GADNR trawl projects have ever reported a sturgeon mortality. In 2007, the Atlantic States Marine Fisheries Commission (ASMFC) and NMFS sponsored a workshop to provide an updated assessment on the impacts of commercial otter trawl, sink gillnet, and anchored gillnet fishing on Atlantic sturgeon from 2001-2006 (Shepherd et al. 2007) . The ASMFC report also evaluated how a number of specific factors (mesh size, twine material, tie-down use, etc.) can affect mortality rates in different gear types (Shepherd et al. 2007) . The (Shepherd et al. 2007) report indicates a mortality rate in all trawl gears of approximately 6%. Miller and Shepherd (2011) also provided an estimate of Atlantic sturgeon bycatch in sink gillnet and otter trawl fisheries in the mid-Atlantic and Northeast. Miller and Shepherd (2011) reported the average Atlantic sturgeon mortality rate in federal otter trawl fisheries from 2006-2010 was approximately 5%. We used the mortality estimate from Miller and Shepherd (2011) because it was estimated based on the most recent data. The study was for observed mortality (not post release), so use of this rate is cautiously conservative. Also, since shortnose sturgeon and Atlantic sturgeon are very similar species, the 5% can be applied to the shortnose sturgeon.

To estimate the number of potential future mortalities, we multiplied our estimated interaction estimates by the 5% mortality rate estimated in Miller and Shepherd (2011), which produces the following:

Expected Atlantic Sturgeon Mortalities, Trawl Gear

Up to **0.3** (6 x .05) **subadult**, and **0.1** (2 x .05) **adult** Atlantic Sturgeon GOM DPS
Up to **1.25** (25 x .05) **subadult**, and **0.45** (9 x .05) **adult** Atlantic Sturgeon NYB DPS
Up to **0.35** (7 x .05) **subadult**, and **0.15** (3 x .05) **adult** Atlantic Sturgeon CB DPS
Up to **0.05** (1 x .05) **subadult**, and **0.05** (1 x .05) **adult** Atlantic Sturgeon Carolina DPS
Up to **0.55** (11 x .05) **subadult**, and **0.2** (4 x .05) **adult** Atlantic Sturgeon SA DPS
(All over a five year period.)

Expected Shortnose Sturgeon Mortalities, Trawl Gear

Up to **0.05** (1 x .05) shortnose sturgeon (any age) over a five year period.

Sea Turtles, Sturgeon, and Temporary Suspension of Solids and Increase in Turbidity During Trawling

Bottom trawling can disturb substrate used by sea turtles and sturgeon, resulting in potential indirect effects including modification of substrate, disturbance of benthic habitat communities, and displacement of prey/foraging base species. Although trawls physically disturb habitat as they are dragged along the bottom, the manner in which trawl gear temporarily degrades habitat by disturbing seabed animals and sediments is not likely to significantly affect sea turtles or sturgeon. We do not expect the disturbances to seabed habitat and animals in the action area to result in a significant reduction, or access to, sea turtle or sturgeon prey/foraging base. Benthic molluscan and crustacean prey items of sea turtles and sturgeon could conceivably be affected by trawl disturbance, but such disturbance would be small in scale and in some instances could potentially enhance foraging opportunities by making prey items more accessible.

5.3.2 Entanglement in Gillnet or Trammel Net Gear

<u>Sea Turtles</u>
Sea turtles are susceptible to capture in gillnets or trammel nets. Sea turtles incidentally captured in net gear are subject to the same stresses (e.g., forced submergence) discussed for trawl capture (please refer to the previous section "Sea Turtles and Trawl Gear"). Applying the same 10% mortality rate from the PIM directive discussed in previous section to the numbers derived in the Exposure section produces the following:

Expected Gill Net and Trammel Net (combined) Mortalities
Up to **0.3** (0.1 x 3 = 0.3) NA green over a five year period
Up to **0.1** (0.1 x 1 = 0.1) SA green over a five year period
Up to **0.1** (0.1 x 1 = 0.1) loggerhead over a five year period
Up to **0** (0.1 x 0 = 0) Kemp's ridley over a five year period

<u>Sturgeon</u>
Sturgeon are susceptible to capture in gillnets. Sturgeon can be wedged (i.e., held by a mesh or meshes around the body) or become entangled when teeth, maxillae, scutes, snout, or other projections become entangled in netting (Hamley 1975). Entanglement of this type often leads to struggling that subsequently wraps the animal in additional webbing. A sturgeon's cone-shaped snout allows meshes to pass over the head and along the body, which allows gilling and wedging to occur rapidly. Their bony scutes also increase the likelihood of entanglement and wedging. Larger fish may get wrapped in nets once entangled while they struggle to free themselves. Smaller fish may be entangled by a single monofilament strand hung around a scute (Damon-Randall et al. 2010). The mesh of gillnets can also cause cuts, scrapes, bleeding, and hinder feeding behavior. Entanglement in nets can result in injury, reduced fecundity, and delayed or aborted spawning migrations of sturgeon (Collins et al. 2000a); (Kahn and Mohead 2010); (Moser and Ross 1995). If interactions are severe, they can result in mortality.

No GADNR gillnet projects have ever reported a sturgeon mortality resulting from capture, likely due to the constantly tended nets and short soak times. The (Shepherd et al. 2007) report and Miller and Shepherd (2011) calculated morality rates in commercial sink gillnet gear by mesh size for Atlantic sturgeon. Table 5.4 reports those rates by mesh size.

Table 5.4 Gillnet Mesh Size Categories and Associated Mortality Rates

Report	Mesh Size	Estimated Mortality Rate
Miller and Shepherd 2011	Small Mesh: < 5.5 in	0.2%
	Large Mesh: 5.5-8.0 in	7.9%
	Extra Large Mesh: > 8.0 in	46.6%
(Shepherd et al. 2007)	Small Mesh: ≤ 5.0 in	2%
	Medium Mesh: > 5.0 - < 7.0 in	20%
	Large Mesh: > 7.0 in	36%

However, these rates are for fisheries and reflect actual observed mortalities. The proposed action has observed all captures in the GADNR sampling since it was started and has observed no mortalities. Therefore, it could be argued that it is inappropriate to apply these rates directly to interactions that occur during the GADNR research. However, it is possible that some post mortality could occur. Given no information exists regarding what the post release mortality rate might be, this Opinion will use the rates from the most recent (Miller and Shepherd 2011) study. Use of information from this study is cautiously conservative.

*Expected **Atlantic Sturgeon** Mortalities, Gill Net*
The gill net panel used by the GADNR would have 2.5 in stretched mesh. Only Atlantic sturgeon are expected to interact with this gear. Based on mesh size, the appropriate rate from Miller and Shepherd (2011) to apply is 0.2%.

Up to **0.002** (1 x 0.002) **subadult**, and **0.002** (1 x 0.002) **adult** GOM DPS
Up to **0.002** (1 x 0.002) **subadult**, and **0.002** (1 x 0.002) **adult** NYB DPS
Up to **0.002** (1 x 0.002) **subadult**, and **0.002** (1 x 0.002) **adult** CB DPS
Up to **0.002** (1 x 0.002) **subadult**, and **0.002** (1 x 0.002) **adult** Carolina DPS
Up to **0.002** (1 x 0.002) **subadult**, and **0.002** (1 x 0.002) **adult** SA DPS

*Expected **Shortnose Sturgeon** Mortalities, Trammel Net*
Only shortnose sturgeon are expected to interact with trammel net gear. There have been no reported shortnose sturgeon mortalities during GADNR trammel net sampling. We would expect that short soak times, constant tending, and care taken by researchers would minimize the potential mortality.

Bahn et al. (2012) looked specifically at the bycatch of shortnose sturgeon in the American shad fishery in the Altamaha River from 2007-2009. They report that Georgia state regulations require that anchored gillnets use a 4.5-in mesh. Bahn et al. (2012) stated that soak times varied, but nets were generally left in all day and were checked only once or twice a day. In 2007, on the Lower Altamaha, a mortality rate of 8.6% was observed, and in 2009 on the Upper Altamaha a mortality rate of 2.8% was documented. Over the course of the study, in both river regions, the average morality rate was 2.3% (Bahn et al. 2012). However, the proposed action would use trammel net, consisting of two outer panels with 35.6 cm (14 in) stretch mesh, and an inner panel with 70 mm (2.75 in) stretch mesh. So while Bahn et al. (2012) does provide information relating to shortnose sturgeon, and from Georgia, it does not provide information on the gear with the mesh size of the proposed trammel gear. Miller and Shepherd (2011) provided a mortality rate for “extra-large mesh” (> 8 in) gill net of 46.6%. While it was an Atlantic sturgeon study, it provides information on a larger mesh size that is closer to what the GADNR project would use, and for a taxonomically similar species. However, it is not a post release rate.

It is estimated that 1 (rounded from 0.225) shortnose sturgeon would be captured by the proposed action over the course of 5 years. Based on historical project data, no mortalities are expected during capture and release. No information exists regarding potential post release mortality. Given the number is less than 1, any rate we would apply (that is < 100%) would still result in a number less than 1, which we would round to 1 in order to provide a cautiously conservative estimate. Therefore, this Opinion assumes that **1 shortnose sturgeon mortality** would result from interaction with trammel net gear.

5.3.3 Handling to Remove from Gear, Basic Data Collection Including Handling, Measuring, Sampling, Checking For Tags, And Tagging

All sea turtles and sturgeon captured would be exposed to handling to remove them from gear, assess their condition, measure and weigh them, tag (if needed) them, and return them to the water. Fin clips would also be taken from sturgeon.

Sea Turtles

Effects of Handling, Measuring, and Weighing
Handling, measuring, and weighing can result in raised levels of stressor hormones in sea turtles. However, the handling, measuring, and weighing procedures are simple and not invasive and NMFS does not expect that individual turtles would normally experience more than short-term stresses as a result of these activities. No injury is expected from these activities, and turtles would be worked up as quickly as possible to minimize stresses. GADNR would also be required to follow procedures designed to minimize the risk of either introducing a new pathogen into a population or amplifying the rate of transmission from animal to animal of an endemic pathogen when handling animals.

Flipper Tagging and PIT Tagging
Tagging activities are minimally invasive and all tag types have negatives associated with them, especially concerning tag retention. Plastic tags can become brittle, break and fall off underwater, and titanium tags can bend during implantation and thus not close properly, leading to tag loss. Tag malfunction can result from rusted or clogged applicators or applicators that are worn from heavy use (Balazs 1999). Turtles that have lost external tags must be re-tagged if captured again at a later date, which subjects them to additional effects of tagging. PIT tags have the advantage of being encased in glass, which makes them inert, and are positioned inside the turtle where loss or damage due to abrasion, breakage, corrosion or age over time is virtually non-existent (Balazs 1999). Turtles can experience some discomfort during the tagging procedures and these procedures will produce some level of pain. The discomfort is usually short and highly variable between individuals (Balazs 1999). Most barely seem to notice, while a few others exhibit a marked response. However, NMFS expects the stresses to be minimal and short-term and that the small wound-site resulting from a tag should heal completely in a short period of time. Similarly, turtles that must be re-tagged should also experience minimal short term stress and heal completely in a short period of time. Re-tagging is not expected to appreciably affect these turtles. NMFS does not expect that individual turtle would experience

more than short-term stresses during the application of the PIT tags. These tags have been used for cattle and pets for years without any adverse effects. The proposed tagging methods have been regularly employed in sea turtle research with little lasting impact on the individuals tagged and handled (Balazs 1999). The NMFS Southeast Fisheries Science Center Galveston Laboratory has flipper-tagged and PIT-tagged numerous loggerheads since 1999, and has held them for approximately up to 3 years after tagging. Turtles were held in a laboratory setting, remained healthy, did fine, and were later released. This suggests that if a turtle is tagged using proper techniques and protocol and released back into a suitable environment, the chances for problems associated with the tagging are negligible (B. Higgins, NMFS SEFSC, pers. comm. to P. Opay, NMFS SERO, October 31, 2016). Additionally, in 17 years that the NMFS Southeast Fisheries Science Center has used Inconel (metal) in flipper tagging, all turtle exhibited normal behavior shortly after being tagged and swam normally once released. In the 9 years that the NMFS Southeast Fisheries Science Center has been PIT-tagging turtles, turtle discomfort was observed to be temporary, as the turtle exhibit normal behavior shortly after tagging and swim normally after release. The proposed tagging methods have been regularly employed in sea turtle research with little lasting impact on the individuals tagged and handled (Balazs 1999).

NMFS does not expect the proposed handling, measuring, or tagging activities to result in more than short-term effects on individual animals due to the conditions concerning research protocols and animal handling. In addition, NMFS does not expect any delayed mortality of turtles following their release as a direct result of the research based on past research efforts by other researchers (numerous section 10(a)(1)(A) scientific research permits issued by NMFS) and adherence to proper research protocols.

Sturgeon

Effects of Handling, Measuring, and Weighing
Handling and restraining sturgeon may cause short term stress responses, and stress can escalate if sturgeon are held for long periods after capture. Conversely, stress is reduced the sooner fish are returned to their natural environment to recover. Signs of handling stress are redness around the neck and fins and soft fleshy areas, excess mucus production on the skin, and a rapid flaring of the gills. Sturgeon are a hardy species, but these fish can be lethally stressed during handling when water temperatures are high or D.O. is low (Kahn and Mohead 2010; Moser et al. 2000). Sturgeon may also inflate their swim bladder when held out of water (Kahn and Mohead 2010; Moser et al. 2000) and if they are not returned to neutral buoyancy prior to release, they will float and be susceptible to sunburn and bird attacks. In some cases, if pre-spawning adults are captured and handled, it is possible that they would interrupt or abandon their spawning migrations after being handled (Moser and Ross 1995). Although sturgeon are sensitive to handling stress, handling of fish will be kept to a minimum, and responses are not likely to result in long-term adverse effects because of the short duration of handling.

Fin Clipping
Immediately prior to each sturgeon's release, a small sample of soft fin tissue (approximately 1.0 cm^2) would be collected. This procedure does not harm sturgeon (Kahn and Mohead 2010) and is common practice in fisheries science to characterize the genetic “uniqueness” and quantify the level of genetic diversity within a population. Tissue sampling does not appear to impair the sturgeon’s ability to swim and is not thought to have any long-term adverse impact. Therefore,

we do not anticipate any long-term adverse effects to individual sturgeon from this activity and, as proposed, this activity is not likely to reduce the fitness of individuals or the viability of sturgeon populations.

Passive Integrated Transponder tagging

All sturgeon captured that are previously unmarked would be marked with PIT tags if they are of sufficient size. No fish would be double-tagged with PIT tags since the entire dorsal surface of each fish would be scanned to detect previous PIT tags before continuing with tagging. PIT tags have been used with a wide variety of animal species that include fish (Clugston 1996; Dare 2003; Skalski et al. 1998) When PIT tags are inserted into animals that have large body sizes relative to the size of the tag, empirical studies have generally demonstrated that the tags have no adverse effect on the growth, survival, reproductive success, or behavior of individual animals (Brännäs et al. 1994; Clugston 1996; Elbin and Burger 1994; Hockersmith et al. 2003; Keck 1994; Skalski et al. 1998). However, some fish, particularly juvenile fish, could die within 24 hours after tag insertion, others could die after several days or months, and some could have sub-lethal reactions to the tags. Studies on a variety of fish species suggest that attachment of tags, both internal and external, can result in a variety of sublethal effects including delayed growth and reduced swimming performance (Bégout Anras et al. 2003; Bergman et al. 1992; Brattey and Cadigan 2004; Isaksson and Bergman. 1978; Sutton and Benson 2003). Larger tags and external tags have more adverse consequences (e.g., impaired swimming) than smaller tags (Bégout Anras et al. 2003; Sutton and Benson 2003). These biologically inert tags have been shown not to cause some of the problems associated with other methods of tagging fish, that is, scarring and damaging tissue or otherwise adversely affecting growth or survival (Brännäs et al. 1994). If mortality of fish occurs, they often die within the first 24 hours, usually as a result of inserting the tags too deeply or from pathogen infection. About 1.3% of the yearling Chinook salmon (*Oncorhynchus tshawytscha*) and 0.3% of the yearling steelhead (*O. mykiss*) studied by Muir et al. (2001) died from PIT tag insertions after 24 hours. In a study conducted on sturgeon mortality and PIT tags, Henne et al. (unpublished) found that 14 mm tags inserted into shortnose sturgeon under 330 mm causes 40% mortality after 48 hours, but no additional mortalities after 28 days. Henne et al. (2008) also show that there is no mortality to sturgeon under 330 mm after 28 days if 11.5mm PIT tags are used. Gries and Letcher (2002) found that 0.7% of age-0 Atlantic salmon (*Salmo salar*) died within 12 hours of having PIT tags surgically implanted posterior to their pectoral fins, but nine months later, 5.7% of the 3,000 tagged fish had died. At the conclusion of a month long study by Dare (2003), 325 out of 144,450 tagged juvenile spring chinook salmon died, but only 42 died in the first 24 hours. The juvenile sturgeon proposed to be implanted with PIT tags will be over 300 mm and PIT tags will be no larger than 11.5 mm. Tagging individuals of this size is consistent with the recommendations of Kahn and Mohead (2010) and (Damon-Randall et al. 2010). This recommendation is based on (Henne et al. 2009) which found that 11 and 14 mm length tags inserted into shortnose sturgeon longer than 300 mm was safe (cited in Kahn and Mohead 2010). Based on the information presented above and the precautions regarding tagging protocol (e.g., minimum fish size), the proposed tagging of sturgeon with PIT tags is unlikely to have long-term adverse impacts on individual fish. Therefore, the PIT tag methodology as proposed is not likely to reduce the fitness of individual fish, or the viability of the Atlantic and shortnose sturgeon populations.

6.0 Cumulative Effects

Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur within the action area of this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA.

Human-induced mortality and/or injury of ESA-listed sea turtles and sturgeon occurring in the action area are reasonably certain to occur in the future. The sources of those effects include state fisheries, vessel interactions, pollution and ingestion of marine debris, pollution, coastal development and global climate change. While the combination of these activities may prevent or slow the recovery of populations of sea turtles and sturgeon, the magnitude of these effects is currently unknown.

6.1 State Fisheries

Fisheries in state waters of the action area have been known to adversely affect sea turtles and ESA-listed sturgeon. The past and present impacts of these activates discussed in the Environmental Baseline section of this opinion are expected to continue into the foreseeable future, concurrent with the proposed action. NMFS is not aware of any proposed or anticipated changes in these fisheries that would substantially change the impacts each fishery has on sea turtles and ESA-listed sturgeon covered by this opinion.

6.2 Vessel Interactions

NMFS's STSSN data indicate that vessel interactions are responsible for a large number of sea turtles stranding within the action area each year. Such collisions are reasonably certain to continue into the future. Collisions with boats can stun or easily kill sea turtles, and many stranded sea turtles have obvious propeller or collision marks (Dwyer et al. 2003). Still, it is not always clear whether the collision occurred pre- or post-mortem. NMFS believes that sea turtle takes by vessel interactions will continue in the future. An estimate of the number of sea turtles that will likely be killed by vessels is not available from data at this time. Since ESA-listed sturgeon are benthic species, vessel strikes are not considered a major threat to them in the action area.

6.3 Pollution

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

6.4 Coastal Development/Maintenance

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

Dredging of harbors and rivers are likely to impact (capture and injure) both turtles and sturgeon in the future.

6.5 Global Climate Change

Global climate change is likely adversely affecting sea turtles and ESA-listed sturgeon. Some of the likely effects commonly mentioned are sea level rise, increased frequency of severe weather events, and change in air and water temperatures. The effects on ESA-listed species are unknown at this time. There are multiple hypothesized effects to ESA-listed sea turtles, and ESA-listed sturgeon including changes in their range and distribution, as well as prey distribution and/or abundance due to water temperature changes. Ocean acidification may also negatively affect marine life, particularly organisms with calcium carbonate shells that serve as important prey items for many species. Global climate change may also affect reproductive behavior in sea turtles, including earlier onset of nesting, shorter intervals between nesting, and a decrease in the length of nesting season. Sea level rise may also reduce the amount of nesting beach available. Changes in air temperature may also affect the sex ratio of sea turtle hatchlings. Water temperature is a main factor affecting the distribution of large whales, and may affect the range of these species. A decline in reproductive fitness as a result of global climate change could have profound effects on the abundance and distribution of sea turtles in the Atlantic.

Sea levels and water temperatures are expected to rise, and levels of precipitation are likely to fluctuate. Drought and inter- and intra-state water allocations and their associated impacts to ESA-listed sturgeon will continue and may intensify. A rise in sea level may drive the salt wedge upriver on river systems inhabited by sturgeon, potentially constricting sturgeon habitat. NMFS will continue to work with states to implement ESA Section 6 agreements, and with researchers holding Section 10 permits, to enhance programs to quantify and mitigate these takes and effects.

7.0 Integration and Synthesis- Jeopardy Analyses

This section provides an integration and synthesis of the information presented in the Status of the Species, Environmental Baseline, Cumulative Effects, and Effects of the Action sections of this Opinion. The intent of the following discussion is to provide a basis for determining the additive effects of the take of the proposed action on loggerhead, green, Kemp's ridley sea turtles, and shortnose and Atlantic sturgeon in light of their present and anticipated future status.

The analyses conducted in the previous sections of this Opinion serve to provide a basis to determine whether the proposed action would be likely to jeopardize the continued existence of ESA-listed sea turtles or sturgeon. In Section 5, 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 (Section 3), the environmental baseline (Section 4), and the cumulative effects (Section 6), 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 Section 3. 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.

7.1 Green Sea Turtles (NA DPS and SA DPS)

As discussed in the Exposure section this Opinion, within U.S. waters individuals from both the NA and SA DPSs can be found in waters where the proposed action would occur. To analyze effects in a precautionary manner, we will conduct two jeopardy analyses, one for each DPS (i.e., assuming animals would be taken from both DPSs). We will conservatively analyze impacts to the NA DPS assuming that 100% of the takes would come from that DPS (this is the greatest percentage that could be taken from the DPS). Similarly, the greatest percentage of animals that would likely be taken from the SA DPS would be 5% (likely less if adults are taken, but we assume the most precautionary result).

7.1.1 Green Sea Turtle NA DPS

The proposed action could take up to 11 animals, and could result in up to 2 (0.8 + 0.3 = 1.1, rounded to 2 for this analysis) lethal takes NA DPS green sea turtles over a five year period. The potential nonlethal capture of 9 green sea turtles from the NA DPS over 5 years is not expected to have any measurable impact on the reproduction, numbers, or distribution of these species. The individuals suffering nonlethal 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. Because any incidentally caught animal would be released within the general area where caught, no change in the distribution of NA DPS green sea turtles is anticipated.

The potential lethal take (occurring post release) of 2 NA DPS green sea turtles over a five 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. Lethal interactions would also result in a potential reduction in future reproduction, assuming some individuals 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 interactions are expected to occur anywhere in the action area and only affect a small portion of the DPS, and sea turtles generally have large ranges in which they disperse; thus, no reduction in the distribution of green sea turtles within the NA DPS is expected from these captures.

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 increased (Seminoff et al. 2015). In the early 1980s, approximately 875 nests/year were 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 3.3.3, nesting has increased substantially over the last 20 years and peaked in 2015 with 27,975 nests statewide in 2015. In-water studies conducted over 24 years in the Indian River Lagoon, Florida, suggest similar increasing trends, with green sea turtle captures up 661% (Ehrhart et al. 2007). Similar in-water work at the St. Lucie Power Plant site revealed a significant increase in the annual rate of capture of immature green sea turtles over 26 years (Witherington et al. 2006).

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 NA DPS green sea turtles is clearly increasing, we believe the potential lethal capture of 2 NA DPS green sea turtles over 5 years 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/2015-nesting-trends/). 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 capture of up to 2 NA DPS green sea turtles over 5 years will result in a reduction in numbers when captures occur, 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. Nonlethal 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. Additionally, our estimate of future captures is based on our belief that the same or a similar level of capture occurred in the past and that we have still seen positive trends in the status of this species with that level.

Conclusion

The lethal and nonlethal 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 NA DPS of green sea turtle in the wild.

7.1.2 Green Sea Turtle SA DPS

The proposed action may result in 2 green sea turtle captures from the SA DPS (1 nonlethal, 1 (0.1 + 0.1 = 0.2 rounded to 1) lethal) over 5 years. The potential nonlethal capture of 1 SA DPS green sea turtle over 5 years is not expected to have any measurable impact on the reproduction, numbers, or distribution of these species. The individuals suffering nonlethal 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 and the action area encompasses a tiny portion of green sea turtles' overall range/distribution within the SA DPS. Since any incidentally caught animal would be released within the general area where caught, no change in the distribution of SA DPS green sea turtles is anticipated.

The potential lethal capture of 1 green sea turtle over 5 years 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 individuals caught would at least in some years 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 interactions are expected to occur anywhere in the action area and sea turtles generally have large ranges in which they disperse; thus, no reduction in the distribution of green sea turtles within the SA DPS is expected from these captures.

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 3.2.5, 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).

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 capture of 1 green sea turtle over 5 years 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 capture of up to 1 SA DPS green sea turtle over 5 years will result in a reduction in numbers when capture occur, 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. Nonlethal capture of a sea turtle would not affect the adult female nesting population or number of nests per nesting season. Thus, the proposed action is not in opposition to 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. Additionally, our estimate of future captures is based on our belief that the same or a similar level of capture occurred in the past, and yet we have still seen positive trends in the status of this species.

Conclusion

The lethal and nonlethal 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.

7.2 Loggerhead Sea Turtle NWA DPS

The proposed action may result in 8 loggerhead sea turtle captures (7 nonlethal, 1 (0.7 + 0.1 = 0.8 rounded to 1) lethal) over 5 years. The potential nonlethal capture and release of 7 loggerhead sea turtles every over 5 years is not expected to have a measurable impact on the reproduction, numbers, or distribution of this species. The individuals suffering nonlethal injuries are expected to fully recover such that no reductions in reproduction or numbers of loggerhead sea turtles are anticipated. The captures may occur anywhere in the action area, and the action area encompasses a tiny portion of the overall range/distribution of the NWA DPS of loggerhead sea turtles. Since any incidentally caught animal would be released within the general area where caught, no change in the distribution of loggerhead sea turtles is anticipated.

The 1 lethal capture over 5 years associated with the proposed action represent a reduction in numbers. These lethal captures would also result in a future reduction in reproduction as a result of lost reproductive potential, as some of these individuals would be females who would have survived other threats and reproduced in the future, thus eliminating each female individual's contribution to future generations. 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 adult female sea turtles 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. Because all the potential interactions are expected to occur at random throughout the proposed action area, which accounts for a tiny fraction of the species' overall range, the distribution of loggerhead sea turtles is expected to be unaffected.

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

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). 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/).

As described in the Status of Species section, we believe that the DWH oil spill event had an adverse impact on loggerhead sea turtles, and resulted in mortalities of individuals, along with lingering impacts resulting from nest relocations, nonlethal exposure, and foraging resource impacts. However, there is no information to indicate, or basis to believe, that a significant population-level impact has occurred that would have changed the species' status to an extent that the expected interactions with proposed action activities would result in a detectable change in the population status of the NWA DPS of loggerhead turtles. This is especially true given the size of the population and that, unlike Kemp's ridleys, the NWA DPS is proportionally much less intrinsically linked with the Gulf of Mexico.

It is possible that the DWH oil spill event reduced that survival rate of all age classes to varying degrees, and may continue to do so for some undetermined time into the future. However, there is no information at this time that it has, or should be expected to have, substantially altered the long-term survival rates in a manner that would significantly change the population dynamics compared to the conservative estimates used in this Opinion. Any impacts are not thought to alter the population status to a degree in which the number of mortalities from the proposed action could be seen as reducing the likelihood of survival and recovery of the species.

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 remove up to 1 individual over 5 years. This removed individual represents approximately .00027% over 5 years of the low end of the NMFS (2011) estimate that reflects a subset of the entire loggerhead population in the western North Atlantic Ocean. While the loss of 1 individual over 5 years is an impact to the population, in the context of the overall population's size and current trend, it would not be expected to result in a detectable change to the population numbers or 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 potential lethal take of 1 loggerhead sea turtle over 5 years 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 inwater populations. For these reasons, we do not believe the proposed action will impede achieving recovery.

Conclusion

The lethal and nonlethal captures 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.

7.3 Kemp's Ridley Sea Turtle

The proposed action may result in up to 14 Kemp's ridley sea turtle captures (12 nonlethal, 2 (1.4 + 0 = 1.4 rounded to 2) lethal) over 5 years. The nonlethal captures of 12 Kemp's ridley sea turtles over 5 years is not expected to have any measurable impact on the reproduction, numbers, or distribution of this species. The individuals are expected to fully recover such that no reductions in reproduction or numbers of Kemp's ridley sea turtles are anticipated. The captures may occur anywhere in the action area and the action area encompasses a tiny portion of Kemp's ridley sea turtles' overall range/distribution. Since any incidentally caught animals would be released within the general area where caught, no change in the distribution of Kemp's ridley sea turtles is anticipated.

The lethal capture of up to 2 Kemp's ridley sea turtles over 5 years 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 TEWG (1998a) estimates age at maturity from 7-15 years. Females return to their nesting beach about every 2 years (TEWG 1998a). The mean clutch size for Kemp's ridleys is 100 eggs/nest, with an average of 2.5 nests/female/season. Lethal captures could also result in a potential reduction in future reproduction, assuming at least some of these individuals would be female and would have survived to reproduce in the future. While we have no reason to believe the proposed action will disproportionately affect females, the annual loss of up to 2 sea turtles over 5 years, could preclude the production of thousands of eggs and hatchlings, of which a fractional percentage is 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 captures are expected to occur anywhere in the action area and sea turtles generally have large ranges; thus, no reduction in the distribution of Kemp's ridley sea turtles is expected from the capture 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 Kemp's ridley, outlined threats, and discussed information on estimates of the number of nesting females and nesting trends. 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 the absence of any total population estimates for Kemp's ridley sea turtles, nesting trends are the best proxy we have for estimating population changes. 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. In 2009, the population was on track with 21,144 nests, but an unexpected and as yet unexplained drop in nesting occurred in 2010 (loss of 13,302 nests), deviating from the NMFS et al. (2011d) model prediction. A subsequent increase to 20,570 nests occurred in 2011. In 2012, the number had increased again. Researchers documented 21,797 nests in Tamaulipas, Mexico (Burchfield 2013), and 209 nests were reported in Texas as of August 2012. The number of nests documented in Mexico declined to 16,385 again in 2013 and to 11,279 nests in 2014. In 2015, nesting in Mexico improved to 14,006 recorded nests (J. Pena, Gladys Porter Zoo, pers. comm. to M. Barnette, NMFS PRD, October 19, 2015). Based on preliminary numbers, 2016 is looking like a very good year for Kemp's nesting with around 18,000 registered nests in Mexico. This would be the 4th highest ever nesting season for Kemp's nests in Mexico. We will not know the population general trajectory until future nesting data are available. The recent increases in Kemp's ridley sea turtle nesting seen in the last two 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 U.S., and possibly other changes in vital rates (TEWG 1998b; TEWG 2000b). 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 of which are often difficult to predict with any certainty.

The nesting trend over the last 2 decades appears to be evidence of an increasing population against the background of the past and ongoing human and natural factors (environmental baseline) that have contributed to the current status of the species, although recent drops in nesting remain a source of concern. Additionally, our evaluation of potential future mortalities is based our belief that the same level of interactions occurred in the past, and with that level we have still seen positive trends in the status of this species. Thus, we believe the potential loss of up to 2 Kemp's ridley sea turtles over 5 years will not have any detectable effect on the population, distribution or reproduction of Kemp's ridley sea turtles. After analyzing the magnitude of the effects of the proposed action, in combination with the past, present, and future expected impacts to the species 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 Kemp's ridley sea turtle NA DPS in the wild.

<u>*Recovery*</u>
The Kemp's ridley recovery plan defines the recovery goal as: "…conserv[ing] and protect[ing] the Kemp's ridley sea turtle so that protections under the Endangered Species Act are no longer necessary and the species can be removed from the List of Endangered and Threatened Wildlife" (NMFS et al. 2011a). The recovery plan for the Kemp's ridley sea turtle (NMFS et al. 2011c) lists the following relevant recovery objective:

> *Objective:* A population of at least 10,000 nesting females in a season (as measured by clutch frequency per female per 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.

With respect to this recovery objective, the preliminary nesting numbers for in 2015, indicate there were 10,351 nests in Rancho Nuevo, 890 in Tepehuajes, and 1,535 in Playa Dos, Mexico, for a total of 12,776 nests. This number represents approximately 5,110 nesting females for the season based on 2.5 clutches/female/season. The number of nests reported annually from 2010 to 2014 overall declined; however they rebounded some in 2015. Although there has been a substantial increase in the Kemp's ridley population within the last few decades, the number of nesting females is still below the number of 10,000 nesting females per season required for downlisting (NMFS and USFWS 2015). Since we concluded that the potential loss of up to 2 Kemp's ridley sea turtles over 5 years is not likely to have any detectable effect on nesting trends, we do not believe the proposed action will impede the progress toward achieving this recovery objective even when considered in the context of the Status of the Species, Environmental Baseline, and Cumulative Effects discussed in this Opinion. We believe the proposed action will not result in an appreciable reduction in the likelihood of Kemp's ridley sea turtles' recovery in the wild.

Conclusion
The lethal or nonlethal captures of a Kemp's ridley sea turtle associated with the proposed action is not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the Kemp's ridley sea turtle in the wild.

7.4 Atlantic Sturgeon

Five DPSs of Atlantic sturgeon have been 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. Therefore, a jeopardy determination must be made for each Atlantic sturgeon

DPS and would be reached if the proposed action would appreciably reduce the likelihood of survival and recovery of any of the DPSs.

7.4.1 Gulf of Maine DPS

The proposed action may result in 9 Atlantic sturgeon takes from the Gulf of Maine (GOM) DPS over 5 years. We estimate those takes would be up to 3 adults (2 nonlethal, 1 (0.1 + 0.002 rounded to 1) lethal) and 7 subadults (6 nonlethal, 1 (0.3 + 0.002, rounded to 1) lethal). Note that due to that fact that gill net takes could be adult or subadult, and each take is included in its respective category, the total take adds to greater than 9 in order to calculate both scenarios for the jeopardy analysis.

The potential nonlethal take is not expected to have any measurable impact on the reproduction, numbers, or distribution of animals from the GOM DPS. The individuals are expected to fully recover such that no reductions in reproduction or numbers of Atlantic sturgeon are anticipated.

Atlantic sturgeon travel extensively throughout the marine environment and have large ranges over which they disperse. Because the anticipated takes (both lethal and nonlethal) could occur anywhere within the range of the species, no change in the distribution of the GOM DPS Atlantic sturgeon is anticipated.

The potential lethal take would reduce the population of Atlantic sturgeon in the GOM DPS by 2 Atlantic sturgeon (1 adult, 1 subadult) over consecutive 5-year periods. Adult Atlantic sturgeon are generally considered more important to the species because of their ability to breed. For this reason, we believe the best way to evaluate the impacts of the proposed action on Atlantic sturgeon reproduction is to consider not only how it is likely to affect adults, but also how it would affect subadults that may have lived to become adults ("adult equivalents"). GARFO-PRD developed an approach for estimating "adult equivalents." They calculated the proportion of subadults likely to survive to be adults by first adding up the total number of Atlantic sturgeon subadults (i.e., ages 2-10) in any year. Then they added up all the adults (i.e., ages 11-20). They then divided these sums to get the ratio of adults per subadult. When using the age-variable natural mortality, they estimated that each subadult equates to 0.48 adults. By multiplying that value by our estimates of subadult takes for each DPS from Section 5 we calculated the likely number of adult equivalents that may be captured during GADNR projects. For the GOM DPS, we anticipate 0.48 adult equivalent may be killed over 5 years during GADNR projects. [8] Therefore, we anticipate the proposed action is likely to result in 1.48 (1 adult, 0.48 adult equivalent) lethal adult Atlantic sturgeon takes over 5 years from the GOM DPS. We will conduct this same conversion exercise for each subsequent DPS.

For the population of GOM DPS Atlantic sturgeon to remain stable over generations, a certain amount of spawning must occur across the entire DPS to offset deaths within the population. Two ways to measure spawning potential are 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

[8] 1 lethal GOM subadult takes x 0.48 subadult survival = 0.48 adult equivalents

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 (F = 0.14) with maintaining an EPR of at least 20% of $EPR_{max,}$ is appropriate for evaluating the potential impacts of the proposed action on the likelihood the GOM DPS will survive in the wild.

Other Biological Opinions have also considered the effects from other federal fisheries on Atlantic sturgeon. Likewise, a quantitative estimate of current/future Atlantic sturgeon takes exists for the American shad fishery in Georgia North Carolina's inshore gillnet fishery. Our analysis will include the authorized/calculated takes reported in the federal Biological Opinions as well as the Georgia and North Carolina fisheries since our analysis uses published literature standard ($F=0.14= EPR_{20\%}$) that includes known fishing mortality from all fishing sources (i.e., federal and state fisheries). Specifically, the Biological Opinion on the HMS Atlantic shark and smoothhound fisheries (NMFS 2012a) estimated 2 lethal takes of adult/adult equivalents GOM DPS fish would occur annually. The GARFO batched consultation on 7 FMPs (NMFS 2013a) also determined up to 22 Atlantic sturgeon adult/adult equivalents would be lethally taken annually from the GOM DPS. The incidental take of Atlantic sturgeon in the commercial shrimp fishery of the South Atlantic (NMFS 2012b; NMFS 2014a) estimated 1 Atlantic sturgeon from the GOM DPS would be killed annually.

The Incidental Take Permit (ITP) (No. 16645) provided to Georgia in response to their Section 10 application provides for up to 0.55 lethal takes of Atlantic sturgeon annually from the GOM DPS over the course their 10 year permit and the Opinion analyzing those takes indicates those takes will be juveniles and subadults (NMFS 2013c). Converting those animals to adult equivalents as done previously decreases the number further, but not zero.[9] To be conservative for the species, we round the 0.55 animal to 1 animal.

The ITP (No. 18102) provided to North Carolina in response to their Section 10 application provides for up to 7 lethal takes of Atlantic sturgeon annually through 2023. The Opinion issuing those takes indicates those takes will be juveniles and subadults (NMFS 2014b).

[9] 0.55 annual juvenile/subadult Georgia shad gillnet takes x 0.48 subadult survival = 0.264 adult equivalents

Following the previously discussed process for estimating the adult equivalents, we will consider 4 of those captures as adult equivalents.[10]

Each year the Southeast Fisheries Science Center, state resource management agencies, USFWS, and academic institutions receive funding support from NMFS to collect fisheries independent data. This suite of independent but related activities collectively makes up NMFS's integrated fisheries independent monitoring (FIM) activities in the Southeast Region. Up to 0.6 adult animals from this DPS are expected to be lethally taken annually from these activities. To be conservative, we round the 0.6 to 1.

The anticipated 2 (1.48 rounded to 2) adults/adult equivalents may be taken by the proposed action over 5 years (0.4/year). Together, the Biological Opinions for the HMS shark/smoothhound fishery, the GARFO batched FMP, Southeast shrimp trawl fishery, the Georgia shad fishery, the North Carolina gillnet fisheries, and the proposed action estimate 31.4 GOM DPS adult/adult equivalent mortalities annually. The NEAMAP model referenced earlier in this Opinion estimates a minimum ocean population of 7,455 Atlantic sturgeon in the GOM DPS, of which 4,548 are adults/subadults (Table 7.1). Therefore, our anticipated lethal takes represent 0.69% of the adult/adult equivalent population in the GOM DPS.[11] This is below the estimated 14% fishing mortality rate we believe the population could likely withstand and still maintain $EPR_{20\%.}$ Based on this information, we believe the proposed action's removal of up to 2 adults/adult equivalents over 5 years (0.4 annually) will cause a reduction in numbers and reproduction. However, we do not believe these reductions will appreciably reduce the likelihood that the GOM DPS will survive in the wild.

Table 7.1. Calculated Ocean Population Estimates with Adult Equivalents (A.E.)

DPS	Estimated Ocean Population	Estimated Adult Ocean Population	Estimated Subadult Ocean Population*	Estimated Ocean Population of A.E.**	Estimated Ocean Population of Adults/A.E.
GOM (11%)	7,455	1,864	5,591	2,684	4,548
NYB (51%)	34,566	8,642	25,925	12,444	21,086
CB (13%)	8,811	2,203	6,608	3,172	5,375
Carolina (2%)	1,356	339	1,017	488	827
SA (22%)	14,911	3,728	11,183	5,368	9,096

*This estimate reflects the animals of a size vulnerable to capture in fisheries.
**This column estimated by multiplying the subadult population from previous column by 0.48.

Recovery

Our analysis must also consider whether the proposed action is likely to impede the recovery of Atlantic sturgeon from the GOM DPS. Because the GOM DPS of Atlantic sturgeon has only recently been listed, a recovery plan for this segment of the population has not yet been

[10] 7 annual juvenile/subadult North Carolina gillnet takes x 0.48 subadult survival = 3.36 adult equivalents

[11] (1 Shrimp fishery take + 2 HMS shark/smoothhound fishery takes + 22 GARFO batched fisheries takes + 4 North Carolina gillnet fisheries + 1 Georgia shad fishery + 1 FIM research + 0.4 estimated takes from the proposed action) ÷ 4,548 estimated adults/adult equivalents in the GOM DPS = 0.69% of the GOM DPS taken

developed. However, a key step in recovering a species is to reduce threats identified as contributing to a species' threatened or endangered status; only by alleviating these threats can lasting recovery be achieved.

The final listing rule noted several major threats affecting the GOM DPS:

1) Dredging that can displace sturgeon while it is occurring and affect the quality of the habitat afterwards by changing the depth, sediment characteristics, and prey availability.
2) Degraded water quality in areas as a result of withdrawals for public use, runoff from agriculture, industrial discharges, and the alteration of river systems by dams and reservoirs.
3) Impeded access to historical habitat by dams and reservoirs.
4) Bycatch of Atlantic sturgeon in commercial fisheries.
5) Inadequacy of regulatory mechanisms to control bycatch and the modification and curtailment of Atlantic sturgeon habitat.

Nothing about the proposed action will significantly affect the habitat or water quality or curtail the range of the species in the GOM DPS. The proposed action has no relationship to the blockage of access to historical habitats by dams or reservoirs. The proposed action will have not negative impact on the issue of regulatory mechanisms regarding control of bycatch and the modification and curtailment of Atlantic sturgeon habitat. The bycatch of Atlantic sturgeon in fishing gear will occur under the proposed action. However, we anticipate primarily nonlethal incidental captures that will be documented and procedures have been established to minimize the impact of any interactions that do occur. For these reasons, we believe the proposed action is not likely to appreciably reduce the likelihood that the GOM DPS will recover in the wild.

Conclusion
Based on the information of this section, we believe the effects from the proposed action are not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the GOM DPS of Atlantic sturgeon.

7.4.2 New York Bight DPS

The proposed action may result in 35 Atlantic sturgeon takes from the New York Bight (NYB) DPS over 5 years. We estimate those takes would be up to 10 adults (9 nonlethal, 1 (0.45 + 0.002 rounded to 1) lethal) and 26 subadults (24 nonlethal, 2 (1.25 + 0.002 rounded to 2) lethal). Note that due to that fact that gill net takes could be adult or subadult, and each take is included in its respective category, the total take adds to greater than 35 in order to calculate both scenarios for the jeopardy analysis.

The potential nonlethal takes of Atlantic sturgeon are not expected to have any measurable impact on the reproduction, numbers, or distribution of these animals from the NYB DPS. The individuals are expected to fully recover such that no reductions in reproduction or numbers of Atlantic sturgeon are anticipated.

Atlantic sturgeon travel extensively throughout the marine environment and have large ranges over which they disperse. Because the anticipated takes (both lethal and nonlethal) could occur anywhere within the range of the species, no change in the distribution of the NYB DPS Atlantic sturgeon is anticipated.

The potential lethal take of 3 Atlantic sturgeon over 5 years (1 adult, 2 subadults) would reduce the population of Atlantic sturgeon in the NYB DPS by that amount. As discussed previously, we believe breeding adults are especially important to the overall populations of the Atlantic sturgeon DPSs. For that reason, we followed the same approach described in Section 7.4.1 to estimate adult equivalents for the NYB DPS. Based on those calculations, we estimated the number of adult equivalents for the NYB DPS affected by the proposed action was 1 over 5 years. [12] Thus, we anticipate the proposed action is likely to result in 2 Atlantic sturgeon (1 adult, 1 adult equivalent) lethal takes over 5 years (0.4 annually) from the NYB DPS.

To determine whether that reduction would appreciably reduce the species' likelihood of survival in the wild we will follow the same approach and assumptions we discussed previously in Section 7.4.1. We will evaluate those takes relative to the 14% fishing mortality rate Boreman (1997) reported adult female Atlantic sturgeon in the Hudson River could have likely sustained and still retained enough spawners for the population to remain stable (i.e., maintain an EPR of at least 20% of EPR_{max}).

We anticipated 2 adult/adult equivalents may be lethally taken by the proposed action over 5 years (0.4 annually). Additionally, we anticipate lethal NYB DPS takes in the HMS Atlantic shark and smoothhound fisheries (10 annually) (NMFS 2012a), the Southeastern shrimp fishery (3 annually) (NMFS 2012b), the 7 fisheries analyzed in the GARFO batched consultation (100 annually) (NMFS 2013a).

The Georgia ITP provides for up to 2.55 lethal takes of Atlantic sturgeon annually from the NYB DPS over the course their 10 year permit, indicating those takes will be juveniles and subadults (NMFS 2013c). Converting those animals to adult equivalents as done previously yields a number less than 2.[13] To be conservative for the species, we round to 2 animals.

The ITP (No. 18102) provided to North Carolina provides for up to 18 lethal takes of Atlantic sturgeon from the NYB DPS annually through 2023. The Opinion issuing those takes indicates those takes will be juveniles and subadults (NMFS 2014b). Following the previously discussed process for estimating the adult equivalents, we will consider 9 of those captures as adult equivalents.[14]

Each year the Southeast Fisheries Science Center, state resource management agencies, USFWS, and academic institutions receive funding support from NMFS to collect fisheries independent data. This suite of independent but related activities collectively makes up NMFS's integrated fisheries independent monitoring (FIM) activities in the Southeast Region. Up to 1 adult animal from this DPS is expected to be lethally taken annually from these activities.

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[12] 2 lethal NYB subadult takes x 0.48 subadult survival = .96 adult equivalents
[13] 2.55 annual juvenile/subadult Georgia shad gillnet takes x 0.48 subadult survival = 1.23 adult equivalents
[14] 18 annual juvenile/subadult North Carolina gillnet takes x 0.48 subadult survival = 8.64 adult equivalents

We anticipate that 125.4 adult/adult equivalent Atlantic sturgeon may be taken annually in these fisheries and by the proposed action. The NEAMAP model estimates a minimum ocean population of 34,556 Atlantic sturgeon in the NYB DPS, of which 21,086 are adults/subadults (Table 7.1). Based on this information, we believe 0.60% of the adult/adult equivalent population in the NYB DPS will be killed annually.[15] This 0.60% is below the estimated 14% total fishing mortality rate we believe the population could likely withstand and still maintain $EPR_{20\%}$. Based on this information, we believe the proposed action's removal of up to 2 adults/adult equivalents over 5-years will cause a reduction in numbers and reproduction. However, we do not believe these reductions are likely to cause an appreciable reduction in the likelihood that the NYB DPS will survive in the wild.

Recovery

Our analysis must also consider whether the proposed action is likely to impede the recovery of Atlantic sturgeon from this DPS. Because this DPS of Atlantic sturgeon has only recently been listed, a recovery plan for this segment of the population has not yet been developed. However, a key step in recovering a species is to reduce threats identified as contributing to a species' threatened or endangered status; only by alleviating these threats can lasting recovery be achieved.

The final listing rule noted several major threats affecting Atlantic sturgeon in the NYB DPS:

1) Dredging that can displace sturgeon while it is occurring and affect the quality of the habitat afterwards by changing the depth, sediment characteristics, and prey availability.
2) Degraded water quality in areas throughout the range of the five DPSs as a result of withdrawals for public use, runoff from agriculture, industrial discharges, and the alteration of river systems by dams and reservoirs.
3) Impeded access to historical habitat by dams and reservoirs.
4) Bycatch of Atlantic sturgeon in commercial fisheries.
5) Vessel strikes within the riverine portions of the range of the New York Bight.
6) Inadequacy of regulatory mechanisms to control bycatch and the modification and curtailment of Atlantic sturgeon habitat.

Nothing about the proposed action will affect the habitat or water quality or curtail the range of the species, in the NYB DPS. The proposed action has no relationship to the blockage of access to historical habitats by dams or reservoirs.

The proposed action could introduce threats of vessel strikes and bycatch from fishing gear. We believe the threats from vessel strikes to the NYB DPS of Atlantic sturgeon are not of concern when considering the potential effect from this threat to the recovery of the NYB DPS. Given the lack of any previous documented interactions, the types of vessels, and monitoring for

[15] (3 Shrimp fishery takes + 10 HMS shark/smoothhound fishery takes + 100 GARFO batched fisheries takes + 2 Georgia shad fishery + 9 North Carolina gillnet fisheries + 1 FIM research + 0.4 estimated takes from the proposed action) ÷ 21,086 estimated adults/adult equivalents in the NYB DPS = 0.60% of the NYB DPS taken

protected species anytime the vessel is moving, this Opinion found that adverse effects from vessel operations are extremely unlikely to occur and were discountable.

The bycatch of Atlantic sturgeon in fishing gear will occur under the proposed action. However, we anticipate primarily nonlethal incidental captures that will be documented and procedures have been established to minimize the impact of any interactions that do occur. The proposed action will have not negative impact on the issue of regulatory mechanisms regarding control of bycatch and the modification and curtailment of Atlantic sturgeon habitat. For these reasons, we believe the proposed action is not likely to appreciably reduce the likelihood that the NYB DPS will recover in the wild.

Conclusion
Based on the information of this section, we believe the effects from the proposed action are not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the NYB DPS of Atlantic sturgeon.

7.4.3 Chesapeake Bay DPS

The proposed action may result in 11 Atlantic sturgeon takes from the Chesapeake Bay (CB) DPS over 5-years. We estimate those takes would be 4 adults (3 nonlethal, 1 (0.15 + 0.002 rounded to 1) lethal) and 8 subadults (7 nonlethal, 1 (0.35 + 0.002 rounded to 1) lethal). Note that due to that fact that gill net takes could be adult or subadult, and each take is included in its respective category, the total take adds to greater than 11 in order to calculate both scenarios for the jeopardy analysis.

The potential nonlethal takes of are not expected to have any measurable impact on the reproduction, numbers, or distribution of these animals from the CB DPS. The individuals are expected to fully recover such that no reductions in reproduction or numbers of Atlantic sturgeon are anticipated.

Atlantic sturgeon travel extensively throughout the marine environment and have large ranges over which they disperse. Because the anticipated takes (both lethal and nonlethal) could occur anywhere within the range of the species, no change in the distribution of the CB DPS Atlantic sturgeon is anticipated.

The potential lethal take would reduce the population of Atlantic sturgeon in the CB DPS. As discussed previously, we believe breeding adults are especially important to the overall populations of the Atlantic sturgeon DPSs. For that reason, we followed the same approach described in Section 7.4.1 to estimate adult equivalents for the CB DPS. Based on those calculations we estimated the number of adult equivalents for the CB DPS affected by the proposed action was 0.48 over 5-years.[16] Thus, we anticipate the proposed action is likely to result in 1.48 Atlantic sturgeon (1 adult, 0.48 adult equivalent) lethal takes over 5-years from the CB DPS.

[16] 1 lethal CB subadult takes x 0.48 subadult survival = 0.48 adult equivalents

To determine whether that reduction would appreciably reduce the species' likelihood of survival in the wild we will follow the same approach and assumptions we discussed previously in Section 7.4.1. We will evaluate those takes relative to the 14% fishing mortality rate Boreman (1997) reported adult female Atlantic sturgeon in the Hudson River could have likely sustained and still retained enough spawners for the population to remain stable (i.e., maintain an EPR of at least 20% of EPR_{max}).

We anticipated 2 (1.48 rounded to 2) adult/adult equivalents may be taken by the proposed action over consecutive 5-year periods (0.4 annually). Additionally, we anticipate lethal CB DPS takes in the HMS Atlantic shark and smoothhound fisheries (3 annually) (NMFS 2012a), the Southeastern shrimp fishery (2 annually) (NMFS 2012b), the 7 fisheries analyzed in the GARFO batched consultation (27 annually) (NMFS 2013a).

The Georgia ITP provides for up to 0.65 lethal takes of Atlantic sturgeon from the CB DPS over the course their 10 year permits; indicating those takes will be juveniles and subadults (NMFS 2013c). Converting those animals to adult equivalents as done previously yields a number less than 1, but not zero.[17] To be conservative, we will assume the 0.52 animal potentially taken annually would have survived to be an adult and will consider it an adult equivalent.

The North Carolina ITP (No. 18102) provides for up to 69 lethal takes of Atlantic sturgeon from the CB DPS annually through 2023. The Opinion issuing those takes indicates those takes will be juveniles and subadults (NMFS 2014b). Following the previously discussed process for estimating the adult equivalents, we will consider 33 of those captures as adult equivalents.[18]

Each year the Southeast Fisheries Science Center, state resource management agencies, USFWS, and academic institutions receive funding support from NMFS to collect fisheries independent data. This suite of independent but related activities collectively makes up NMFS's integrated fisheries independent monitoring (FIM) activities in the Southeast Region. Up to 0.6 adult animals from this DPS are expected to be lethally taken annually from these activities. To be conservative, we round this number to 1.

We anticipate that 67.4 adult Atlantic sturgeon may be taken annually in these fisheries and by our proposed action. The NEAMAP model estimates a minimum ocean population of 8,811 Atlantic sturgeon in the CB DPS, of which 5,375 are adults/subadults (Table 7.1). Based on this information, we believe 1.25% of the adult/adult equivalent population in the CB DPS will be killed annually.[19] This 1.25% is below the estimated 14% total fishing mortality rate we believe the population could likely withstand and still maintain $EPR_{20\%}$. Based on this information, we believe the proposed action's removal of up to 2 adult/adult equivalent over 5 years will cause a reduction in numbers and reproduction. However, we do not believe these reductions are likely to cause an appreciable reduction in the likelihood that the CB DPS will survive in the wild.

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[17] 0.65 annual juvenile/subadult Georgia shad gillnet takes x 0.48 subadult survival = 0.32 adult equivalents
[18] 69 annual juvenile/subadult North Carolina gillnet takes x 0.48 subadult survival = 33 adult equivalents
[19] (2 Shrimp fishery takes + 3 HMS shark/smoothhound fishery takes + 27 GARFO batched fisheries takes + 1 Georgia shad fishery + 33 North Carolina fisheries + 1 FIM + 0.4 estimated takes from the proposed action) ÷ 5,375 estimated adults/adult equivalents in the CB DPS = 1.25% of the CB DPS taken.

Recovery
Our analysis must also consider whether the proposed action is likely to impede the recovery of Atlantic sturgeon from this DPS. Because this DPS of Atlantic sturgeon has only recently been listed, a recovery plan for this segment of the population has not yet been developed. However, a key step in recovering a species is to reduce threats identified as contributing to a species' threatened or endangered status; only by alleviating these threats can lasting recovery be achieved.

The final listing rule noted several major threats affecting Atlantic sturgeon in the CB DPS:

1) Dredging that can displace sturgeon while it is occurring and affect the quality of the habitat afterwards by changing the depth, sediment characteristics, and prey availability.
2) Degraded water quality in areas throughout the range of the 5 DPSs as a result of withdrawals for public use, runoff from agriculture, industrial discharges, and the alteration of river systems by dams and reservoirs.
3) Bycatch of Atlantic sturgeon in commercial fisheries.
4) Vessel strikes in within the riverine portions of the range of CB DPS.
5) Inadequacy of regulatory mechanisms to control bycatch and the modification and curtailment of Atlantic sturgeon habitat.

Nothing about the proposed action will significantly affect the habitat or water quality or curtail the range of the species, in the CB DPS. The proposed action could introduce threats of vessel strikes and bycatch from fishing gear. However, given the lack of any previous documented interactions, the types of vessels, and monitoring for protected species anytime the vessel is moving, this Opinion found that adverse effects from vessel operations are extremely unlikely to occur and were discountable. Therefore, we believe the threats from vessel strikes to the CB DPS of Atlantic sturgeon are not of concern when considering the potential effect from this threat to the recovery of the CB DPS. The proposed action will have not negative impact on the issue of regulatory mechanisms regarding control of bycatch and the modification and curtailment of Atlantic sturgeon habitat. The bycatch of Atlantic sturgeon in fishing gear will occur under the proposed action. However, we anticipate primarily nonlethal incidental captures that will be documented and procedures have been established to minimize the impact of any interactions that do occur. For these reasons, we believe the proposed action is not likely to appreciably reduce the likelihood that the CB DPS will recover in the wild.

Conclusion
Based on the information of this section, we believe the effects from the proposed action are not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the CB DPS of Atlantic sturgeon.

7.4.4 South Atlantic DPS

The proposed action may result in 16 Atlantic sturgeon takes from the South Atlantic (SA) DPS over 5 years. We estimate those takes would be 5 adults (4 nonlethal, 1 (0.2 + 0.002 rounded to 1) lethal) and 12 subadults (11 nonlethal, 1 (0.55 + 0.002 rounded to 1) lethal). Note that due to that fact that gill net takes could be adult or subadult, and each take is included in its respective category, the total take adds to greater than 16 in order to calculate both scenarios for the jeopardy analysis.

The potential nonlethal takes are not expected to have any measurable impact on the reproduction, numbers, or distribution of these animals from the SA DPS. The individuals are expected to fully recover such that no reductions in reproduction or numbers of Atlantic sturgeon are anticipated.

Atlantic sturgeon travel extensively throughout the marine environment and have large ranges over which they disperse. Because the anticipated takes (both lethal and nonlethal) could occur anywhere within the range of the species, no change in the distribution of the SA DPS Atlantic sturgeon is anticipated.

The potential lethal take of 2 Atlantic sturgeon over 5 years (1 adult, 1 subadult) would reduce the Atlantic sturgeon SA DPS. As discussed previously, we believe breeding adults are especially important to the overall populations of the Atlantic sturgeon DPSs. For that reason, we followed the same approach described in Section 7.4.1 to estimate adult equivalents for the SA DPS. Based on those calculations we estimated the number of adult equivalents for the SA DPS affected by the proposed action was 0.48 over 5 years. [20] Thus, we anticipate the proposed action is likely to result in 1.48 Atlantic sturgeon (1 adult, 0.48 adult equivalents) lethal takes over 5 years from the SA DPS.

To determine whether that reduction would appreciably reduce the species' likelihood of survival in the wild we will follow the same approach and assumptions we discussed previously in Section 7.4.1. We will evaluate those takes relative to the 14% fishing mortality rate Boreman (1997) reported adult female Atlantic sturgeon in the Hudson River could have likely sustained and still retained enough spawners for the population to remain stable (i.e., maintain an EPR of at least 20% of EPR_{max}).

We anticipated 2 (1.48 rounded to 2) adult/adult equivalents may be taken by the proposed action over 5 years (0.4 annually). Additionally, we anticipate lethal SA DPS takes in the HMS Atlantic shark and smoothhound fisheries (4 annually) (NMFS 2012a), the Southeastern shrimp fishery (7 annually) (NMFS 2012b), the 7 fisheries analyzed in the GARFO batched consultation (43 annually) (NMFS 2013a).

The Georgia ITP provides for up to 1.1 lethal takes of Atlantic sturgeon annually from the SA DPS over the their 10 year permit, indicating those takes will be juveniles and subadults (NMFS 2013c). Following the previously discussed process for estimating the adult equivalents, we will consider this as 1 adult equivalent.[21]

The North Carolina ITP (No. 18102) provides for up to 69 lethal takes of Atlantic sturgeon from the SA DPS annually through 2023. The Opinion issuing those takes indicates those takes will

[20] 1 lethal SA subadult takes x 0.48 subadult survival = .48 adult equivalents
[21] 1.1 annual juvenile/subadult Georgia shad gillnet takes x 0.48 subadult survival = 0.528 adult equivalents

be juveniles and subadults (NMFS 2014b). Following the previously discussed process for estimating the adult equivalents, we will consider 33 of those captures as adult equivalents.[22]

Each year the Southeast Fisheries Science Center, state resource management agencies, USFWS, and academic institutions receive funding support from NMFS to collect fisheries independent data. This suite of independent but related activities collectively makes up NMFS's integrated fisheries independent monitoring (FIM) activities in the Southeast Region. Up to 0.8 adult (rounded to 1) animals from this DPS are expected to be lethally taken annually from these activities.

We anticipate that 89.4 adult Atlantic sturgeon may be taken annually in these fisheries and by our proposed action. The NEAMAP model estimates a minimum ocean population of 14,911 Atlantic sturgeon in the SA DPS, of which 9,096 are adults/subadults (Table 7.1). Based on this information, we believe 0.99% of the adult/adult equivalent population in the SA DPS will be killed annually.[23] This 0.99% is below the estimated 14% total fishing mortality rate we believe the population could likely withstand and still maintain EPR20%. Based on this information, we believe the proposed action's removal of up to 2 adult/adult equivalent over 5 years will cause a reduction in numbers and reproduction. However, we do not believe these reductions are likely to cause an appreciable reduction in the likelihood that the SA DPS will survive in the wild.

Recovery
Our analysis must also consider whether the proposed action is likely to impede the recovery of Atlantic sturgeon from this DPS. Because this DPS of Atlantic sturgeon has only recently been listed, a recovery plan for this segment of the population has not yet been developed. However, a key step in recovering a species is to reduce threats identified as contributing to a species' threatened or endangered status; only by alleviating these threats can lasting recovery be achieved.

The final listing rule noted several major threats affecting the SA DPS:

1) Dredging that can displace sturgeon while it is occurring and affect the quality of the habitat afterwards by changing the depth, sediment characteristics, and prey availability.
2) Degraded water quality in areas as a result of withdrawals for public use, runoff from agriculture, industrial discharges, and the alteration of river systems by dams and reservoirs.
3) Impeded access to historical habitat by dams and reservoirs.
4) Bycatch of Atlantic sturgeon in commercial fisheries.
5) Inadequacy of regulatory mechanisms to control bycatch and the modification and curtailment of Atlantic sturgeon habitat.

[22] 69 annual juvenile/subadult North Carolina gillnet takes x 0.48 subadult survival = 33 adult equivalents
[23](7 Shrimp fishery takes + 4 HMS shark/smoothhound fishery takes + 43 GARFO batched fisheries takes + 1 Georgia shad fishery + 33 North Carolina fisheries + 1 FIM + 0.4 estimated takes from the proposed action) ÷ 9,096 estimated adults/adult equivalents in the SA DPS = 0.99% of the SA DPS taken.

Nothing about the proposed action will affect the habitat or water quality or curtail the range of the species in the SA DPS. The proposed action has no relationship to the blockage of access to historical habitats by dams or reservoirs. The bycatch of Atlantic sturgeon in fishing gear will occur under the proposed action. However, we anticipate primarily nonlethal incidental captures that will be documented and procedures have been established to minimize the impact of any interactions that do occur. For these reasons, we believe the proposed action is not likely to appreciably reduce the likelihood that the SA DPS will recover in the wild.

Conclusion
Based on the information of this section, we believe GADNR projects are not expected to jeopardize the continued existence of the SA DPS of Atlantic sturgeon.

7.4.5 Carolina DPS

The proposed action may result in 3 Atlantic sturgeon takes from the Carolina DPS over 5 years. We estimate those takes would be 2 adults (1 nonlethal, 1 (0.05 + 0.002 rounded to 1) lethal) and 2 subadults (1 nonlethal, 1 (0.05 + 0.002 rounded to 1) lethal). Note that due to that fact that gill net takes could be adult or subadult, and each take is included in its respective category, the total take adds to greater than 3 in order to calculate both scenarios for the jeopardy analysis.

The potential nonlethal takes are not expected to have any measurable impact on the reproduction, numbers, or distribution of these animals from the Carolina DPS. The individuals are expected to fully recover such that no reductions in reproduction or numbers of Atlantic sturgeon are anticipated.

Atlantic sturgeon travel extensively throughout the marine environment and have large ranges over which they disperse. Because the anticipated takes (both lethal and nonlethal) could occur anywhere within the range of the species, no change in the distribution of the Carolina DPS Atlantic sturgeon is anticipated.

The potential lethal take of 2 Atlantic sturgeon over 5-years (1 adult, 1 subadult) would reduce the population of Atlantic sturgeon in the Carolina DPS. As discussed previously, we believe breeding adults are especially important to the overall populations of the Atlantic sturgeon DPSs. For that reason, we followed the same approach described in Section 7.4.1 to estimate adult equivalents for the Carolina DPS.[24] Based on those calculations we estimated the number of adult equivalents for the Carolina DPS affected by the proposed action was 0.48 over 5 years. Thus, we anticipate the proposed action is likely to result in 1.48 Atlantic sturgeon (1 adult and 1 adult equivalent) lethal takes over consecutive 5-year periods from the Carolina DPS. We believe the lethal take could occur anywhere within the range of the animals from the DPS. Because these takes are likely to occur at random we do not anticipate any change in the distribution of Atlantic sturgeon in the DPS.

To determine whether that reduction would appreciably reduce the species' likelihood of survival in the wild we will follow the same approach and assumptions we discussed previously in Section 7.4.1. We will evaluate those takes relative to the 14% fishing mortality rate Boreman

[24] 1 lethal Carolina subadult takes x 0.48 subadult survival = 0.48 adult equivalents

(1997) reported adult female Atlantic sturgeon in the Hudson River could have likely sustained and still retained enough spawners for the population to remain stable (i.e., maintain an EPR of at least 20% of EPR_{max}).

We anticipated lethal take of 2 adults by the proposed action over 5 years (0.4 annually). Additionally, we anticipate lethal Carolina DPS takes in the HMS Atlantic shark and smoothhound fisheries (2 annually) (NMFS 2012a), the Southeastern shrimp fishery (3 annually) (NMFS 2012b), the 7 fisheries analyzed in the GARFO batched consultation (5 annually) (NMFS 2013a).

The Georgia ITP provides for up to 0.1 lethal takes of Atlantic sturgeon annually from the Carolina DPS over the course their 10 year permit, indicating those takes will be juveniles and subadults (NMFS 2013c). Converting those animals to adult equivalents as done previously yields a number less than 1, but not zero.[25] To be conservative, we round the 0.048 to 1 adult equivalent.

The ITP (No. 18102) provided to North Carolina provides for up to 127 lethal takes of Atlantic sturgeon from the Carolina DPS annually through 2023. The Opinion issuing those takes indicates those takes will be juveniles and subadults (NMFS 2014b). Following the previously discussed process for estimating the adult equivalents, we will consider 61 of those captures as adult equivalents.[26]

Each year the Southeast Fisheries Science Center, state resource management agencies, USFWS, and academic institutions receive funding support from NMFS to collect fisheries independent data. This suite of independent but related activities collectively makes up NMFS's integrated fisheries independent monitoring (FIM) activities in the Southeast Region. Up to 0.2 adult animals (rounded to 1) from this DPS are expected to be lethally taken annually from these activities.

We anticipate that 73.4 adult Atlantic sturgeon may be taken annually in these fisheries and by our proposed action. The NEAMAP model estimates a minimum ocean population of 1,356 Atlantic sturgeon in the Carolina DPS, of which 827 are adults/subadults (Table 7.1). Based on this information, we believe 8.9% of the adult/adult equivalent population in the Carolina DPS will be killed annually.[27] This 8.9% is below the estimated 14% total fishing mortality rate we believe the population could likely withstand and still maintain $EPR_{20\%}$. Based on this information, we believe the proposed action's removal of up to 2 adult/adult equivalent over 5 years will cause a reduction in numbers and reproduction. However, we do not believe these reductions are likely to cause an appreciable reduction in the likelihood that the Carolina DPS will survive in the wild.

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[25] 0.1 annual juvenile/subadult Georgia shad gillnet takes x 0.48 subadult survival = 0.048 adult equivalents

[26] 127 annual juvenile/subadult North Carolina gillnet takes x 0.48 subadult survival = 61 adult equivalents

[27] (3 Shrimp fishery takes + 2 HMS shark/smoothhound fishery takes + 5 GARFO batched fisheries takes + 1 Georgia shad fishery + 61 North Carolina gillnet fisheries + 1 FIM + 0.4 estimated takes from the proposed action) ÷ 827 estimated adults/adult equivalents in the Carolina DPS = 8.9% of the Carolina DPS taken

Recovery
The final listing rule noted several major threats affecting the Carolina DPS:

1) Dredging that can displace sturgeon while it is occurring and affect the quality of the habitat afterwards by changing the depth, sediment characteristics, and prey availability.
2) Degraded water quality in areas as a result of withdrawals for public use, runoff from agriculture, industrial discharges, and the alteration of river systems by dams and reservoirs.
3) Impeded access to historical habitat by dams and reservoirs.
4) Bycatch of Atlantic sturgeon in commercial fisheries.
5) Inadequacy of regulatory mechanisms to control bycatch and the modification and curtailment of Atlantic sturgeon habitat.

Nothing about the proposed action will affect the habitat or water quality or curtail the range of the species in the Carolina DPS. The proposed action has no relationship to the blockage of access to historical habitats by dams or reservoirs. The bycatch of Atlantic sturgeon in fishing gear will occur under the proposed action. However, we anticipate primarily nonlethal incidental captures that will be documented and procedures have been established to minimize the impact of any interactions that do occur. The proposed action will have no negative impact on the issue of regulatory mechanisms regarding control of bycatch and the modification and curtailment of Atlantic sturgeon habitat. For these reasons, we believe the proposed action is not likely to appreciably reduce the likelihood that the Carolina DPS will recover in the wild.

Conclusion
Based on the information of this section, we believe the effects from the proposed action are not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the Carolina DPS of Atlantic sturgeon.

7.5 Shortnose Sturgeon

The proposed action may result in up to 2 shortnose sturgeon takes (2 (0.05 + 1 rounded to 2) lethal), over 5 years.

The loss of 2 shortnose sturgeon (we conservatively assume both are adults) over consecutive 5-year periods would reduce the number of shortnose sturgeon relative to the number that would have been present in the absence of the proposed action, assuming all other variables remained the same. This lethal take could also result in the loss of reproductive value as compared to the reproductive value in the absence of the proposed action, if a female was taken.

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 this sturgeon, outlined threats, and discussed information on estimates of the population numbers. In the Environmental Baseline, this Opinion outlined the various past and ongoing problems (e.g., dams, dredging, climate change) that have impacted and continue to impact this species. The Cumulative Effects section of this Opinion discussed future activities or concerns (e.g., fisheries, pollution, climate change) that pose challenges to the species.

The status of the shortnose sturgeon in the Southeast United States is mixed. Populations within the southern metapopulation are relatively small compared to their northern counterparts. The Altamaha River supports the largest known shortnose sturgeon population in the Southeast with successful self-sustaining recruitment. Total population estimates in the Altamaha show large interannual variation is occurring; estimates have ranged from as low as 468 fish in 1993 to over 6,300 fish in 2006 (DeVries 2006a; NMFS 1998a). The Ogeechee River abundance estimates indicate that the shortnose sturgeon population in this river is considerably smaller than that in the Altamaha River. In 1993, the total Ogeechee River population was estimated to be 361 shortnose sturgeon (95% CI: 326-400). The most recent survey resulted in an estimate of 147 shortnose sturgeon (95% CI: 104-249), suggesting that the population may be declining. Spawning is also occurring in the Savannah, Cooper, Congaree, and Yadkin-Pee Dee Rivers (though the spawning in the Cooper is not believed to be effective). In the Savannah River, possibly the second largest population in the Southeast with an estimated 1,000-3,000 adults, spawning is likely occurring in only a very small area. While active spawning is occurring in South Carolina’s Winyah Bay complex (Black, Sampit, Yadkin-Pee Dee, and Waccamaw Rivers) the population status is unknown. Status of the other riverine populations supporting the Southern metapopulation is unknown due to limited survey effort, with capture in some rivers limited to less than 5 specimens.

As noted in Section 3, there are 3 metapopulations of shortnose sturgeon. The loss of any metapopulation would result in the loss of evolutionarily significant biodiversity and would result in a significant gap(s) in the species’ range. The loss of any metapopulation would result in a decrease in spatial range, biodiversity, unique haplotypes, and adaptations to climate change. Loss of unique haplotypes that may carry geographic specific adaptations would lead to a loss of genetic plasticity and, in turn, decrease adaptability.

We believe the potential loss of 2 animals over 5 years will likely be undetectable within any riverine population. Since we do not believe the loss of these individuals will be detectable to any given riverine population, we also believe such a loss would not be detectable against the entire southern metapopulation, nor would the loss change their distribution. After analyzing the magnitude of the effects of the proposed action, in combination with the past, present, and future expected impacts to the species 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 shortnose sturgeon in the wild.

<u>Recovery</u>
The recovery plan for the shortnose sturgeon (NMFS 1998a) lists 3 main objectives as recovery criteria for the species. One objective is relevant to the proposed action. That objective and the relevant sub-objectives appear below.

Objective - Protect Shortnose Sturgeon Populations and Habitats

Sub-objective:

- Ensure agency compliance with the ESA.

- Reduce bycatch of shortnose sturgeon.
- Minimize the effects of incidental capture of shortnose sturgeon.

The proposed action would not impede any of these relevant recovery actions. One of the primary drivers behind the development of this Opinion is ensuring that NMFS is complying with the ESA and properly evaluating the potential effects of the USFWS funded GADNR projects on listed species. This Opinion will also prescribe specific actions meant to help minimize the potential adverse effects from incidental capture. While the proposed action is not specifically proposing measures to reduce the bycatch of shortnose sturgeon, the USFWS funded project is designed such that effects of the incidental catch of non-target species is minimal.

The potential lethal take of 2 shortnose sturgeon over 5 years will result in a reduction in overall population numbers. We have already determined that while this take would result in a reduction in absolute population number, we do not believe that reduction will have any measurable effects on the species even when considered in the context of the Status of the Species, Environmental Baseline, and Cumulative Effects discussed in this Opinion. Additionally, we believe the proposed action will not impede the achievement of the relevant recovery objectives or sub-objectives. Thus, the effects of the proposed action will not result in an appreciable reduction in the likelihood of shortnose sturgeon recovery in the wild.

Conclusion

Based on the information of this section, we believe the effects from proposed action are not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of shortnose sturgeon.

8.0 Conclusion

After reviewing the current status of the species, the environmental baseline, the effects of the proposed action, and cumulative effects, it is NMFS's Biological Opinion that the proposed action is not likely to jeopardize the continued existence of the NWA DPS loggerhead sea turtle, NA DPS green sea turtle, SA DPS green sea turtle, Kemp's ridley sea turtle, Atlantic sturgeon, or shortnose sturgeon.

9.0 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.

Section 7(b)(4)(c) of the ESA specifies that to provide an ITS for an endangered or threatened species of marine mammal, the taking must be authorized under Section 101(a)(5) of the Marine Mammal Protection Act (MMPA). Since no incidental take of listed marine mammals is expected or has been authorized under Section 101(a)(5) of the MMPA, no statement on incidental take of protected marine mammals is provided and no take is authorized. Nevertheless, USFWSF/SER1 and SEFSC must immediately notify (within 24 hours, if communication is possible) NMFS's Office of Protected Resources should a take of a listed marine mammal occur.

9.1 Anticipated Amount of Incidental Take

The numbers presented herein Table 9.1 represent total takes over a 5-year period. Annual take estimates of these species can have variability because of natural and anthropogenic factors, or because documented interactions are relatively rare. As a result, monitoring the proposed action using 1-year estimated take levels based on documented interactions is largely impractical. Based on our experience monitoring fisheries, we believe a 5-year time period is appropriate. This approach will allow us to reduce the likelihood of requiring reinitiation unnecessarily because of inherent variability in take levels, but still allow for an accurate assessment of how the proposed action is affecting these species versus our expectations.

Table 9.1 Summary of Anticipated 5-Year Take Estimate*

Turtle Species	Trawl Gear	Gill Net or Trammel Net	Total	
NWA DPS Loggerhead Sea Turtle	7	1	8	
Kemp's Ridley Sea Turtle	14	0	14	
NA DPS Green Sea Turtle	8	3	11	
SA DPS Green Sea Turtle	1	1	2	
Sturgeon Species	Trawl Gear	Gill Net**	Trammel Net	Total
Atlantic Sturgeon GOM DPS	6 subadult/2 adult	1 subadult OR 1 adult	0	9
Atlantic Sturgeon NYB DPS	25 subadult/9 adult	1 subadult OR 1 adult	0	35
Atlantic Sturgeon CB DPS	7 subadult/ 3 adult	1 subadult OR 1 adult	0	11
Atlantic Sturgeon Carolina DPS	1 subadult/ 1 adult	1 subadult OR 1 adult	0	3
Atlantic Sturgeon SA DPS	11 subadult/ 4 adult	1 subadult OR 1 adult	0	16
Shortnose Sturgeon	1	0	1	2

*Numbers calculated in Opinion and presented here are rounded up to next closest whole number, and these numbers used for post release mortality estimates and effects analysis in the Opinion. No immediate mortalities authorized, all previous historical captures were released in "Excellent" condition. Sea turtle and shortnose sturgeon takes are any mix of subadults or adults.

**Numbers so low (e.g., 0.01 to 0.05) for both subadult and adult that rounded to 1 but only subadult OR adult authorized. The Jeopardy analysis considered effects of take to both subadults and adults.

NOTE: Subadult takes may be substituted for any adult takes (i.e., applied against adult takes) in the Trawl gear category for Atlantic sturgeon. E.g., 6 subadult/2 adult takes are authorized for the GOM DPS. Up to 8 subadults could be taken without reinitiation. Two adult takes provides coverage in the event they occur. If necessary, any substitution would actually reduce the expected impacts of the proposed action given the adult equivalent calculation. However, adult takes beyond that specified in the table can NOT be applied against subadult takes.

This Opinion also serves as the permitting authority for taking associated with handling, identifying, measuring, weighing, photographing, tagging (flipper tagging, passive integrated transponder [PIT] tagging), tissue sampling (e.g., fin clip of sturgeon), releasing incidentally taken sea turtles, shortnose sturgeon or Atlantic sturgeon, and retaining carcasses (without the need for an ESA Section 10 permit). The effects of these activities have been analyzed in this Opinion. The measures authorized in this Opinion provide data necessary to monitor our anticipated incidental take. The data collected helps ensure the action is not disproportionately affecting a portion of the population while also supporting recovery objectives.

9.2 Effect of the Take

NMFS has determined the level of anticipated take associated with the proposed action and specified in Section 9.1 is not likely to jeopardize the continued existence of the loggerhead NWA DPS sea turtle, Kemp's ridley sea turtle, green NA and SA DPS sea turtles, Atlantic sturgeon, or the shortnose sturgeon.

9.3 Reasonable and Prudent Measures (RPMs)

Section 7(b)(4) of the ESA requires NMFS to issue to any agency whose proposed action is found to comply with Section 7(a)(2) of the ESA, but may incidentally take individuals of listed species, a statement specifying the impact of that taking. It also states that RPMs necessary or appropriate to minimize the impacts from the agency action, and terms and conditions to implement those measures, must be provided and implemented.

The RPMs and terms and conditions are required, per 50 CFR 402.14(i)(1)(ii) and (iv), to minimize the impact of that take on ESA-listed species. These measures and terms and conditions are non-discretionary, and must be implemented by NMFS for the protection of Section 7(o)(2) to apply. GADNR has a continuing duty to regulate the activity covered by this incidental take statement. If it fails to adhere to or require grantees to adhere to the terms and conditions of the incidental take statement through enforceable terms of grants or other documents, and/or fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of Section 7(o)(2) may lapse for prohibited take. To monitor the impact of the incidental take, GADNR must report the progress of the action and its impact on the species to F/SER3 as specified in the incidental take statement [50 CFR 402.14(i)(3)].

We have determined that the following RPMs are necessary or appropriate to minimize the impacts of future sea turtle and sturgeon takes or to limit adverse effects to these species to predictable levels, and to monitor levels of incidental take during the proposed action:

1) <u>Minimizing Stress and Increasing Survival Rates Through Best Handling and Tagging Practices:</u>

In our evaluation of the effects of the proposed action, we described how capture gear can adversely affect sea turtles and sturgeon. Most, if not all, sea turtles and sturgeon released after capture during GADNR activities have experienced some degree of physiological injury (e.g., forced submergence, lacerations/abrasions). The severity of these events depends not only upon actual interaction, but also on proper release. The handling of an animal can greatly affect its chance of surviving the event. USFWS must work with the GADNR to ensure that caught sea turtles or sturgeon are handled in a way that minimizes adverse effects (e.g., capture stress) to the animal and increases the likelihood of its survival. Similarly, data collection and tagging of captured protected species must be done with care to minimize potential for injury and disease transmission.

2) <u>Trawl and Net Times:</u>

Analyses in this Opinion are based on EMTS trawl times of no longer than 15 minutes, JTS trawls times of 5 minutes, and gill net and trammel net set times of no longer than 30 minutes.

Exceedance of these times would mean the proposed action is not being conducted as analyzed in this Opinion and the ITS and its take exemptions would not be valid. In order to ensure that the effects of the proposed action are minimized, these trawl and net times must be carefully followed.

3) <u>Monitoring the Frequency and Magnitude of Incidental Take:</u>

The jeopardy analyses for sea turtles and sturgeon are all based on the assumption that the frequency, magnitude, and impact of takes estimated in this Opinion are generally accurate. If our estimates prove to be incorrect, we risk having misjudged the potential adverse effects to these species. Thus, it is important that we monitor and track the level of take occurring specific to the GADNR research. Therefore, USFWS must ensure that monitoring and reporting: (1) detects and documents any adverse effects resulting from the GADNR research; (2) assesses the actual level of incidental take in comparison with the anticipated incidental take documented in this Opinion; (3) detects when the level of anticipated take is exceeded; and (4) collects improved data.

9.4 Terms and Conditions

To be exempt from take prohibitions established by Section 9 of the ESA, USFWS must comply with or ensure compliance with the following terms and conditions, which implement the RPMs described above. These terms and conditions are non-discretionary.

The following terms and conditions implement RPM No. 1.

1) USFWS must continue to conduct outreach and ensure in-person training occurs to promote that any listed species captured are handled in a way that minimizes adverse effects and increases the likelihood of survival. Outreach and in-person training should be directed at increasing the knowledge, experience, ability, and willingness of GADNR researchers and samplers to remove gear from animals and/or handle them in a way that minimizes adverse effects. As part of these efforts, USFWS must:

   (a) Establish and/or maintain a USFWS point of contact (POC) to answer questions pertaining to sea turtle and sturgeon release and safe handling protocols. POC(s) should actively reach out to GADNR researchers to (1) learn about their experiences, (2) trouble-shoot problems, and (3) share solutions and successful experiences among researchers and scientists and managers.

   (b) Distribute information and ensure in-person training and education on: (1) identifying listed species, (2) how to follow handling protocols to maximize post-release survival, and (3) the importance of maximizing gear removal to maximize post-release survival, and (4) and on reporting interactions with listed species. (Note: The GADNR non-game coastal wildlife staff in the sea turtle program have agreed to help their GADNR colleagues regarding sea turtle information and tags, so USFWS just needs to ensure the GADNR fish sampling group utilizes this resource. Contact information has been supplied to the USFWS.)

   (c) Sturgeon proposed to be implanted with PIT tags must be over 300 mm and PIT tags must be no larger than 11.5 mm.

(d) Proper handling protocols shall be followed when handling sea turtles. All equipment (e.g., tagging equipment, tape measures, etc.) that comes into contact with sea turtle body fluids, cuts, or lesions must be disinfected between the processing of each turtle. USFWS must ensure that the GADNR staff are aware of the contents of Appendix A of this Opinion and also follow protocols in Chapter 2 of the NMFS Southeast Fisheries Science Center Sea Turtle Research Techniques Manual found at http://www.sefsc.noaa.gov/turtles/TM_579_SEFSC_STRTM.pdf

(e) Proper handling protocols shall be followed when handling sturgeon. Fish should be handled rapidly, but with care and kept in water to the maximum extent possible during handling. During handling procedures, each fish should be immersed in a continuous stream of ambient water passing over the sturgeon's gills. USFWS must ensure that GADNR project staff understand the contents of Appendix A, Appendix C, and A Protocol for Use of Shortnose, Atlantic, Gulf, and Green Sturgeons found at http://www.nmfs.noaa.gov/pr/pdfs/species/kahn_mohead_2010.pdf

The following terms and conditions implement RPM No. 2:

2) USFWS and GADNR must ensure that EMTS trawl times do not exceed 15 minutes, JTS trawls times do not exceed 5 minutes, and gill net and trammel net set times do not exceed 30 minutes.

The following terms and conditions implement RPM No. 3:

3) USFWS must require GADNR to record all interactions with sea turtles and sturgeon, and must review all available data sources for observed documented take of sea turtles and sturgeon in the GADNR research activities to monitor their incidental take.

4) USFWS must ensure that the GADNR projects record information as specified on the Protected Species Incidental Take Form (Appendix B), unless the safety or health of the animal would be compromised. GADNR researchers must have a scanner to scan incidentally taken animals for PIT tags. Project personnel must visually look for external tags (e.g., flipper tags). Photographs must be taken whenever feasible to confirm species identity and release condition. If feasible, observers should also tag any sea turtles or sturgeon caught. Sturgeon fin clip samples should be collected for genetic analysis. This Opinion serves as the permitting authority for these activities (without the need for an additional Section 10 permit). USFWS must ensure that GADNR ensures that any observers employed are equipped with the tools, supplies, training, and instructions to collect and store samples. Samples collected must be analyzed to determine the genetic identity of individuals caught in the fisheries. HOWEVER, if GADNR staff on a sampling trip are untrained in any of these activities, or encounter a situation where they are unsure whether they can conduct the activities safely to the animals, GADNR staff shall release the animals without conducting any sampling or tagging activities. Only GADNR staff that have taken the NMFS Southeast Fishery Science Center Sea Turtle Training or can provide proof of an equivalent level of training (e.g., through the GADNR sea turtle program) shall tag sea turtles. Similarly, only GADNR staff that can provide proof of sturgeon research sampling and tagging training shall conduct these activities. This proof must be provided to the USFWS and the USFWS must send

GADNR written confirmation that GADNR staff have been approved to conduct sea turtle and sturgeon data collection activities.

5) USFWS must collaborate with the GADNR to prepare an annual report that includes the following information:
   (a) Detailed information on any take (including mortalities or injuries)
   (b) Total observed and reported and /or estimated effort by GADNR sampling type
   (c) A summary of outreach and training conducted under term and condition No.1.

6) USFWS must ensure GADNR researchers or participants use the Protected Species Incidental Take Form (Appendix B) to notify F/SER3 and NMFS's Assistant Regional Administrator for Protected Resources, Southeast Regional Office, within 48 hours or as soon as reasonably possible at the email address nmfs.ser.EA_LOA.Takereport@noaa.gov. Submitted take reporting forms should reference the following information: USFWS Funded Georgia Marine Recreational Fisheries Surveys and Inventories Protected Species Take (BiOp SER-2015-16739), in the subject line and include the project name and species in the text of the email.

In addition to the requirement to report incidental takes within 48 hours, USFWS must ensure a report detailing the amount of effort (i.e., number of sets (gillnets, trammel nets), number of trawls, trawl times, type of gear used, number of stations/season, number of sets/stations, soak times) and the number of protected species incidentally taken is submitted annually. In cases where genetic samples of Atlantic sturgeon and shortnose sturgeon were submitted for analysis, annual reports must also include information on the finding of those analyses. A report providing the information described above must be submitted no later than January 31 of the following year. Submit protected species interaction reports to the following address, and refer to this Biological Opinion's take reporting requirements.

Assistant Regional Administrator
Protected Resources
Southeast Regional Office
National Marine Fisheries Service
263 13th Avenue South
St. Petersburg, Florida 33701

10.0 Conservation Recommendations

Section 7(a)(1) of the ESA directs federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The following additional measures are recommended.

Sea Turtles:

1. USFWS should support in-water abundance estimates and demographic information of sea turtles to achieve more accurate status assessments for these species and to better assess the impacts of incidental take during funded projects like the GADNR sampling activities.

Sturgeon:

2. USFWS should help fund future research to better understand life stage composition of shortnose sturgeon in U.S. Atlantic coastal waters.
3. USFWS should help fund or conduct future research that gathers information that furthers understanding of DPS distribution of Atlantic Sturgeon in U.S. southern Atlantic coastal waters, including location and movement in the Atlantic Ocean by depth and substrate to assist in future assessments of interactions between fishing gear (i.e., commercial, recreational, or research) and sturgeon migratory and feeding behavior.
4. USFWS should collect information on incidental catch rates and condition of sturgeon captured in fisheries independent research gear to assist in future assessments of gear impacts to sturgeon.

11.0 Reinitiation of Consultation

This concludes formal consultation on the proposed action. As provided in 50 CFR 402.16, reinitiation of formal consultation is required if discretionary federal action agency involvement or control over the action has been retained, or is authorized by law, and if (1) the amount or extent of the taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the agency action that may affect listed species or designated critical habitat in a manner or to an extent not previously considered in this Opinion; (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 Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, USFWS must immediately request reinitiation of formal consultation.

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Appendix A - Sea Turtle, Smalltooth Sawfish, and Sturgeon Safe Handling and Release

In the event of any sea turtle, sawfish, and/or sturgeon entanglement, hooking, or trawling capture, please do the following:

For Live Entanglements/Hookings/Trawl Captures:

Sea Turtles:

1) Upon sighting an entangled or hooked sea turtle, slow the vessel and move in the direction of the sea turtle. Once the animal is alongside the vessel, place the vessel's engines in neutral. Minimize tension on the line and avoid pulling up the sea turtle by the gear.
2) Do not use gaffs or other sharp objects to retrieve or control the sea turtle, although a gaff may be used to control the line.
3) Researchers that have taken the Southeast Fishery Science Center Sea Turtle Training class should follow the sea turtle handling instructions found in Chapter 2 of the Sea Turtle Research Techniques Manual (http://www.sefsc.noaa.gov/turtles/TM_579_SEFSC_STRTM.pdf) when working to release animals. All researchers and GADNR participants should handle incidentally captured sea turtles in a manner consistent with those described in NOAA's Careful Release Protocols for Sea Turtle Release with Minimal Injury (NOAA Technical Memorandum NMFS-SEFSC-580 (http://www.sefsc.noaa.gov/turtles/TM_NMFS_SEFSC_580.pdf) to remove as much gear from the animal as possible.
4) If can be done so immediately without further harming the animal, photograph the hooking/entanglement location prior to gear removal. After the gear is removed, please photograph the head, carapace, and plastron of all captured sea turtles.
5) Remove all externally embedded hooks. REMOVING AS MUCH LINE AS POSSIBLE IF THE HOOK CANNOT BE REMOVED SHOULD BE THE HIGHEST PRIORITY IN ALL CASES. If unsure whether hook removal will cause injury to the sea turtle, do not remove the hook.
6) Only remove hooks when the insertion point of the barb is clearly visible, and exercise extreme caution during hook removal. Never remove a hook that has been swallowed when the insertion point is not visible.
7) The easiest way to remove a hook may be to cut off the eye or barb so that the hook can be pushed through or backed out without causing further injury to the sea turtle. If hook is visible and accessible, but cannot be removed, bolt cutters should be used to cut off as much of the hook as possible. If the hook cannot be cut or removed, cut the line close to the eye of the hook, removing all line if possible.
8) Once gear is removed, check the animal for flipper tags and scan for PIT tags.
9) Release the animal by lowering it over the aft portion of the vessel, close to the water's surface. Make sure fishing gear is not in use and the engines are in neutral. Release in an area where it is unlikely to be recaptured or injured by vessels.

10) If captured in trawl gear, take care not to drop the turtle from the net onto the deck below or allow the bag to slam into the side of the vessel. If the sea turtle requires resuscitation, follow the guidance described on the following page(s).
11) If the animal is seriously injured, and could feasibly be returned to shore, call 1-877-942-5343 to coordinate with local sea turtle stranding responders.

Smalltooth Sawfish:

12) Leave the sawfish, especially the gills, in the water as much as possible.
13) Do not remove the saw (rostrum) or injure the animal in any way.
14) Remove as much fishing gear as safely possible from the body of the animal.
15) If can be done safely, untangle any net or line from the animal's saw. Remove gear with a boat hook or line-cutting pole. Cut gear tangled around the saw by cutting along the length of the saw. Once gear is cut, work it free with a boat hook or line-cutting pole.
16) If can be done so immediately without further harming the animal, photograph the hooking/entanglement location prior to release. Take multiple photographs of the body, if possible.
17) Use extreme caution when handling and releasing sawfish as the saw can thrash violently from side to side.

Sturgeon (Atlantic, Gulf, and Shortnose):

18) Ensure animals are handled rapidly, but with care and kept underwater to the maximum extent possible during handling.
19) If can be done so immediately without further harming the animal, photograph the hooking/entanglement location prior to release. Take multiple photographs of the body, if possible.
20) Release the animal as soon as possible, near the capture area, but in a manner that minimizes the likelihood of recapture if sampling continues.
21) If the fish has air in its bladder, efforts must be made to return the fish to neutral buoyancy prior to and during release. Release air by gently applying pressure to the animal's stomach, moving from the tail toward the head.
22) Before releasing the animal it should be held underwater, gently moving the tail fin back and forth to aid water passage over the gills.
23) The fish should be released when it shows signs of increased activity and is able to swim away under its own power.
24) The fish should be watched to make sure it stays underwater and does not float to the surface. If it does resurface, make one additional attempt to recapture the animal and repeat steps 21-24.
25) For help with any questions relating to sturgeon, researchers should contact Stephania Bolden, Protected Resources, Southeast Regional Office, NMFS, at (727) 824-5312 (Fax: 727-824-5309).

For Comatose/Inactive or Otherwise Unresponsive Sea Turtles:

26) A sea turtle is determined to be dead if the muscles are stiff (rigor mortis) and/or the flesh has begun to rot; otherwise, the turtle is determined to be comatose or inactive and resuscitation attempts are necessary.

27) Place the sea turtle on its bottom shell (plastron) so that the turtle is right side up and elevating its hindquarters 15-30 degrees for a period of 4 hours up to 24 hours.
28) Periodically, rock the sea turtle gently left to right and right to left by holding the outer edge of the shell (carapace) and lifting one side about 3 inches (7.6 cm), then alternate to the other side. Gently touch the eye and pinch the tail and flippers (reflex tests) periodically to see if there is a response.
29) The sea turtle must be shaded and kept damp or moist but should not be placed into a container holding water. A water-soaked towel placed over the head, carapace, and flippers is recommended. Do not cover the sea turtle's nostrils.
30) Sea turtles that revive and become active must be released in the manner described in #9 above.
31) Please photograph the head and carapace of all captured turtles. If can be done so without further harming the animal, photograph the hooking/entanglement location.
32) If the animal is seriously injured and could feasibly be returned to shore, call 1-877-942-5343 to coordinate with local sea turtle stranding responders.

Appendix B - Protected Species Incidental Take Form

NOAA Fisheries

Southeast Region Protected Species Incidental Take Reporting Form

version 1.3 10/2014

REPORTER INFORMATION

Reporting Agency:

Project/Survey Name:

VESSEL/TRIP INFORMATION

Vessel Name/ID	Cruise/Trip#	Station/Site#	Collection #	Specimen #	Vessel Size	Unique Identifier (generated):

If vessel strike, also complete the SER Vessel Strike form and immediately contact 877-433-8299.

GEAR CHARACTERISTICS

Trawl Type

Headrope length (ft) ______ # of nets TED present?

Footrope length (ft) ______

Trawl Body

material type

mesh size (in) ______ (stretched)

Cod End

material type

mesh size (in) ______ (stretched)

Ground Gear

length (ft) ______

size (in) ______

Doors

type

length (ft) _____ height (ft) _____

Lazy Line

material type

net sampling location (water column)

net sampling depth (m) ______

Other Net Types

Seine/Gillnet/Trammel:

Floatline length (ft)_____ diameter (in)____

Leadline length (ft)_____ diameter (in)____

Fyke:

Leader length (ft)____

All Net Types:

mesh material type

twine size (in)______

Gillnet:

net sampling location (water column)

mode of fishing

Panels/bags in net

# of panels

length (ft) ________

height (ft) ________

spacing (ft)

mesh size (in): (stretched)

panel 1____ panel 4____

panel 2____ panel 5____

panel 3____ panel 6____

Longline/Hook and Line Type

Mainline length (m) ______ test (lb) ______ line type

Gangion length (m) ______ test (lb) ______ line type

Backbone length (m) ______ test (lb) ______ line type

(vertical line/bandit reel only)

bait type

If bait type "other/multiple", please describe ______________________________

Hook size (s): (check all that applies)

☐ 4/0 ☐ 11/0

☐ 6/0 ☐ 12/0

☐ 7/0 ☐ 13/0

☐ 8/0 ☐ 15/0

☐ 9/0 ☐ 18/0

hook type

hooks/line ______ (rod and reel only)

gangions ______

Manufacturer

Style No. __________ offset _____

***All Other Gear** (describe)*:

CAPTURE INFORMATION

	Date	Time (24hr)	Zone
Start of Set:			
End of Set:			

Standard Soak Time (min)

Soak Time (calculated) 0

Water Depth (m) ______

Surface Water Temp (°C) ______

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CAPTURE INFORMATION (Cont.)

Latitude: (DD.DDDD) ☐ Longitude: (DD.DDDD) ☐ Marine Jurisdiction ☐ Animal Boarded? ☐

Date ☐ Time (24hr) ☐ Zone ☐ Condition of animal at time of capture ☐

If comatose/unresponsive, attempted resuscitation? ☐

IDENTIFICATION

Species ☐ Confidence in species ID ☐

Photographs taken? ☐ # of Photos ____ Video taken? ☐ Contact Info for photo/video (person, email) ____

GEAR INTERACTION

ALL NET GEAR:

Capture Location in Gear
(check all that applies)

- ☐ cod end
- ☐ lazy line
- ☐ wing extension
- ☐ in the body mesh size(in) (stretched) ____
- ☐ near lead line
- ☐ near float line
- ☐ other (describe): ____

Entanglement Location on Animal (check all that applies)	Gear left on Animal?	How Much?
☐ beak/neck/head/saw/rostrum	☐	____ ☐
☐ rear flipper/groin/peduncle	☐	____ ☐
☐ front flipper/shoulder/armpit	☐	____ ☐
☐ carapace/plastron/body	☐	____ ☐
☐ pectoral flipper	☐	____ ☐
☐ dorsal fin	☐	____ ☐
☐ tail/fluke	☐	____ ☐
☐ other (describe): ____	☐	____ ☐

ALL LONGLINE/HOOK AND LINE GEAR:

Capture Location in Gear
(check all that applies)

- ☐ entangled in mainline
- ☐ entangled in floatline
- ☐ entangled in gangion
- ☐ entangled in float
- ☐ hooked (size) ☐
- ☐ other (describe): ____

Entanglement Location on Animal (check all that applies)	Gear left on Animal?	How Much?
☐ beak/neck/head/saw/rostrum	☐	____ ☐
☐ rear flipper/groin/peduncle	☐	____ ☐
☐ front flipper/shoulder/armpit	☐	____ ☐
☐ carapace/plastron/body	☐	____ ☐
☐ pectoral flipper	☐	____ ☐
☐ dorsal fin	☐	____ ☐
☐ tail/fluke	☐	____ ☐
☐ other (describe): ____	☐	____ ☐

If Hooked, Hook Location on Animal

Internal:
(check all that applies)

- ☐ beak/mouth jaw location: ☐ upper ☐ lower ☐ side (mouth only)
  - mouth location: ☐ tongue ☐ jaw joint
  - ☐ glottis/throat ☐ roof of mouth
- ☐ swallowed/esophagus (hook visible)
- ☐ swallowed/esophagus (hook not visible)
- ☐ unknown
- ☐ other (describe): ____

External:
(check all that applies)

- ☐ beak/neck/head/saw/rostrum
- ☐ rear flipper/groin/peduncle
- ☐ front flipper/shoulder/armpit
- ☐ carapace/plastron/body
- ☐ pectoral flipper
- ☐ dorsal fin
- ☐ tail/fluke
- ☐ other (describe): ____

BIOLOGICAL INFORMATION

Measurements

Finfish

total length ______ ☐ estimated

fork length ______ ☐ estimated

Marine Mammals

total length ______ ☐ estimated

Sea Turtles

curved carapace length (cm) ______

curved carapace width (cm) ______

straight carapace length (cm) ______ ☐ estimated

straight carapace width (cm) ______

All Incidentally Captured Animals

Weight ______ ☐ estimated

Sex

Tag/ID #

	Tag/ID Presence	Tag/ID Type	Tag/ID Color	Tag/ID Position	Tags Removed?
Tag/ID #1 ______					
Tag/ID #2 ______					
Tag/ID #3 ______					
Tag/ID #4 ______					

Other tag (describe) ______ PIT scan?

Samples

Final Disposition

Samples Taken	Type	Sample Number	Person	Affiliation
	blood			
	fin clip			
	tissue			
	carcass			
	other (describe): ______			

RELEASE INFORMATION

Latitude: (DD.DDDD) Longitude: (DD.DDDD) How was animal released?

Date Time (24hr) Zone

Time taken to release animal 0 ______
(calculated)

Final Disposition:

☐ discarded dead/comatose/unresponsive carcass (marked?)

☐ salvaged carcass/parts (list all): ______

☐ released alive

☐ taken to holding facility (location): ______

☐ unknown (explain): ______

Behavior upon release:

☐ swam away vigorously ☐ dove quickly

☐ swam away slowly ☐ dove slowly

☐ remained at surface ☐ sank

☐ surfaced to breathe

☐ other (describe): ______

Describe the nature of any injuries caused by capture and release (i.e. blood in water, location of bleeding, how much bleeding, cuts/lacerations on body and where):

Data Recorder ______ Tagger ______

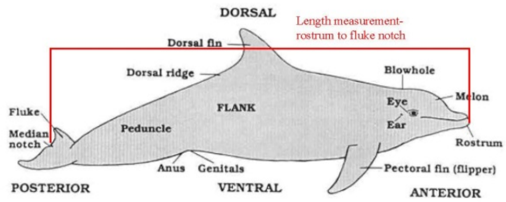
Mitigation Measures in place at time of capture:

Additional Comments:

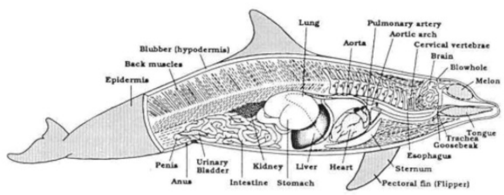
Print Form Reset Form Page 3 of 4

Use these diagrams to annotate any details as specifically noted above and any anomalies, wounds, location of living tags, etc. Also, be sure to indicate locations of all biological samples collected. To annotate the diagrams, on your menu, go to *Tools->Comment and Mark up* and select a drawing tool. Use the typewriter tool to enter text.

Marine Mammals

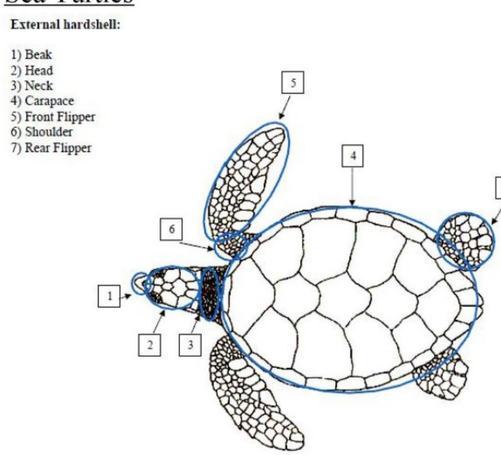


Basic External Anatomy

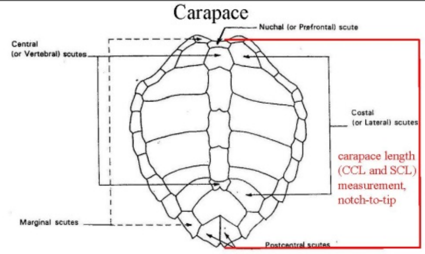


Basic Internal Anatomy

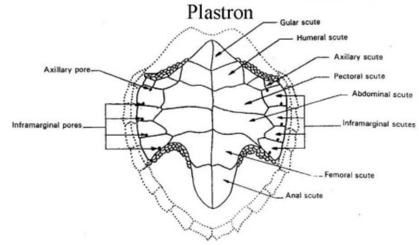
Sea Turtles



Carapace

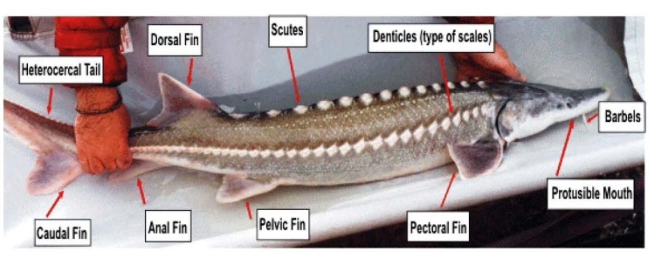


Plastron

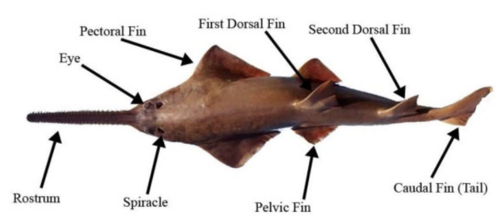


Finfish

Sturgeon



Sawfish



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Appendix C - Requirements for Collection of Biological and Genetic Information on Incidentally Taken Sturgeon

General Handling and Holding of Sturgeon

1. All handling procedures (i.e., measuring, weighing, PIT tagging, and tissue sampling) should be completed as quickly as possible, and should not exceed 15 minutes.
2. Fish should be handled rapidly, but with care and kept in water to the maximum extent possible during handling. During handling procedures, each fish should be immersed in a continuous stream of ambient water passing over the sturgeon's gills. Because sturgeon are sensitive to direct sunlight, they should be covered and kept moist.
3. When the water temperature is above 25°C, sturgeon should be held for as little time as possible. Holding time includes the time to remove any other captured sturgeon, time to process other fish, and time necessary for recovery ensuring the safety of the fish.
4. Prior to release, sturgeon should be examined and, if necessary, recovered by holding fish upright and immersed in river water, gently moving the fish front to back, aiding freshwater passage over the gills to stimulate it. The fish should be released when showing signs of increased activity and is able to swim away under its own power.
5. When possible, researchers should also attempt to support larger sturgeon in slings preventing struggle during transfer. Sturgeon should be weighed using hand held sling scales or a platform scale for larger sturgeon.
6. When sturgeon are held on-board research vessels, they should be placed in flow through tanks where the total volume of water is replaced every 15-20 minutes.

PIT Tagging

7. Every sturgeon should be scanned for PIT tags along its entire body surface ensuring it has not been previously tagged.
8. Untagged sturgeon should then be a PIT tagged and the identifying number recorded. The recommended frequency for PIT tags is 134.2 kHz.
9. PIT tags should be placed to the left of the spine, immediately anterior to the dorsal fin, and posterior to the dorsal scutes (Figure E.1). This positioning optimizes the PIT tag's readability over the animal's lifetime.

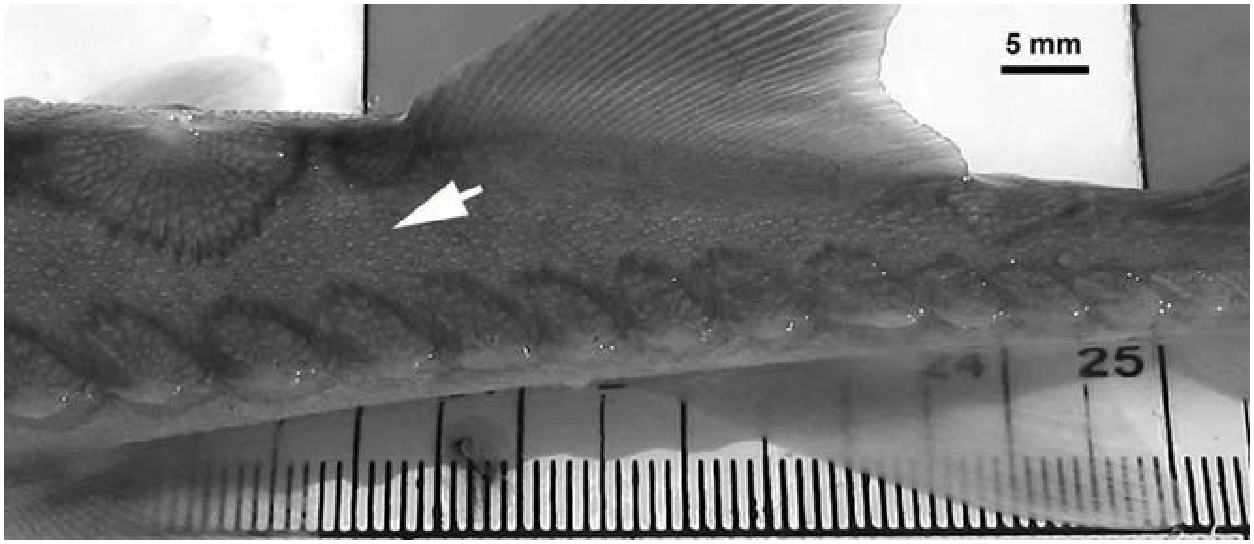

Figure E1. Standardized Location for PIT Tagging all Gulf, Atlantic, and shortnose sturgeon
(Photo Credit: J. Henne, USFWS)

10. Scan the tag following insertion to ensure it is readable before the fish is released. If necessary, to ensure tag retention and prevent harm or mortality to small juvenile sturgeon of all species, the PIT tag can also be inserted at the widest dorsal position just to the left of the 4th dorsal scute.

11. Only sturgeon over 300 mm shall receive PIT tags, and tags can be no larger than 11.5mm.

Genetic Tissue Sampling

12. Tissue samples should be a small (1.0 cm^2) fin clip collected from soft pelvic fin tissue. Use a knife, scalpel, or scissors that has been thoroughly cleaned and wiped with alcohol. Tissue samples should be preserved in individually labeled vials containing either non-denatured ethanol (95%) or SDS-UREA. Due to the rate of ethanol evaporation, only vials with lids that are intended to prevent evaporation should be used (e.g., vial with a ring-sealed, screw-on lid). Vials must then be gently shaken to ensure the solution covers the fin clip. Once the fin clip is in buffer, refrigeration/freezing is not required. Once in the solution, care should be taken not to expose the sample to excessive heat or intense sunlight, but refrigeration is not necessary.

13. NMFS strongly recommends genetic tissue samples be taken from every sturgeon captured unless, due to marks or tags, the researcher knows a genetic sample has already been obtained, or the sampling cannot be done safely.

Transport of Samples

14. For instruction on where to send Atlantic and shortnose sturgeon tissue samples contact:

Barb Lubinski
U.S. Geological Survey
Leetown Science Center, Aquatic Ecology Branch
11649 Leetown Road
Kearneysville, West Virginia 25430
PH: 304-724-4450

Appendix D - Anticipated Incidental Take of ESA-Listed Species in Federal Fisheries

Anticipated Take of Sea Turtles

Fishery	ITS Authorization Period	Sea Turtle Species				
		Loggerhead (NWA DPS)	**Leatherback**	**Kemp's ridley**	**Green (NA DPS)**	**Hawksbill**
Batched Consultation* (gillnet) [NER]	1 Year	269-No more than 167 lethal (Takes based on a 5-yr average)	4-No more than 3 lethal	4-No more than 3 lethal	4-No more than 3 lethal	None
Batched Consultation* (bottom trawl) [NER]	1 Year	213-No more than 71 lethal (Takes based on a 4-yr average)	4-No more than 2 lethal	3-No more than 2 lethal	3-No more than 2 lethal	None
Batched Consultation* (trap/pot) [NER]	1 Year	1-Lethal or nonlethal	4-Lethal or nonlethal	None	None	None
Coastal Migratory Pelagics [SER]	3 Years	27 Total, 7 lethal	1- Lethal	8- Total, 2 lethal	31-Total, 9 lethal	1- Lethal
Dolphin-Wahoo [SER]	1 Year	12-No more than 2 lethal	12-No more than 1 lethal	3 for all species in combination-no more than 1 lethal take		
HMS-Pelagic Longline [SER]	3 Years	1,905-No more than 339 lethal	1,764-No more than 252 lethal	105-No more than 18 lethal for these species in combination		
HMS-Shark Fisheries [SER]	3 Years	126-No more than 78 lethal	18-No more than 9 lethal	36-No more than 21 lethal	57-No more than 33 lethal	18-No more than 9 lethal
Red Crab [NER]	1 Year	1-Lethal or nonlethal	1-Lethal or nonlethal	None	None	None

Anticipated Incidental Takes of Sea Turtles, continued

Fishery	ITS Authorization Period	Sea Turtle Species				
		Loggerhead	Leatherback	Kemp's ridley	Green	Hawksbill
South Atlantic Snapper-Grouper [SER]	3 Years	613-No more than 192 lethal	7-No more than 5 lethal	177-No more than 8 lethal	103 NA DPS-No more than 35 lethal; 6 SA DPS- No more than 2 lethal	7-No more than 3 lethal
Southeastern U.S. Shrimp [SER]	1 Year	Anticipated shrimp trawl effort (i.e., 132,900 days fished in the Gulf of Mexico and 14,560 trips in the south Atlantic) and fleet TED compliance (i.e., compliance resulting in overall average sea turtle catch rates in the shrimp otter trawl fleet at or below 12%) are used as surrogates for numerical sea turtle take levels.				
Atlantic Sea Scallop – Dredge [NER]	1 Year	161 – No more than 46 lethal	2 –Lethal Takes (gears combined)	3 – No more than 2 Lethal (gears combined)	2 - Lethal takes (gears combined)	None
Atlantic Sea Scallop – Trawl [NER]	1 Year	140 – No more than 66 lethal				None

Anticipated Incidental Take of Atlantic Sturgeon by DPS

Fishery	ITS Authorization Period	Atlantic Sturgeon DPS				
		Gulf of Maine	New York Bight	Chesapeake Bay	Carolina	South Atlantic
Southeastern U.S. Shrimp [SER]	3 years	Up to 162 interactions - including 27 captures, no more than 3 lethal	Up to 465 interactions – including 66 captures, no more than 9 lethal	Up to 312 interactions – including 54, no more than 6 lethal	Up to 519 interactions – including 87 captures, no more than 9 lethal	Up to 1,404 interactions – including 228 captures, no more than 21 lethal
HMS Shark and Smoothhound [SER]	3 years	36-No more than 9 lethal	159-No more than 30 lethal	45-No more than 9 lethal	63-No more than 12 lethal	18-No more than 6 lethal
Batched Consultation* (gillnet) [NER]	1 year (Takes based on a 5-yr average)	137-No more than 17 lethal A.E.s	632-No more than 79 lethal A.E.s	162-No more than 21 lethal A.E.s	25-No more than 4 lethal A.E.s	273-No more than 34 lethal A.E.s
Batched Consultation* (bottom trawl) [NER]	1 year (Takes based on a 5-yr average)	148-No more than 5 lethal A.E.s	685-No more than 21 lethal A.E.s	175-No more than 6 lethal A.E.s	27-No more than 1 lethal A.E.s	296-No more than 6 lethal A.E.s
Coastal Migratory Pelagic	3 years	2 non-lethal	4 non-lethal	3 non-lethal	4 non-lethal	10- non-lethal
Atlantic Sea Scallop Dredge [NER]	20 years	1 – Lethal (any DPS)				

A.E. = Adult equivalents

* Batched consultation includes the Northeast Multispecies, Monkfish, Spiny Dogfish, Atlantic Bluefish, Northeast Skate Complex, Mackerel/Squid/Butterfish, and Summer Flounder/Scup/Black Sea Bass Fisheries