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

F/SER31: RWS
SER-2017-18749

Mr. Erik Blechinger
Deputy District Engineer for Planning,
Programs and Project Management
USACE, Savannah District
100 W. Oglethorpe Ave
Savannah, GA 31401

OCT 13 2017

Ref.: SER-2017-18749, amendment to the Biological Opinion for the Savannah Harbor Expansion Project

Dear Mr. Blechinger:

The enclosed amendment to the Biological Opinion for the Savannah Harbor Expansion Project was prepared by the National Marine Fisheries Service (NMFS) pursuant to Section 7(a)(2) of the Endangered Species Act (ESA). This is the second amendment to the original Biological Opinion (SER-2010-05579). This amendment analyzes the effects of project dredging and relocation trawling on the North Atlantic and South Atlantic distinct population segments (DPSs) of green sea turtles, and all five DPSs of Atlantic sturgeon (i.e., Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs). This amendment also addresses the potential effects that may result from delay in implementing fish passage at the New Savanah Bluff Lock and Dam. This amendment revises the Incidental Take Statement (ITS) for green sea turtles, Atlantic sturgeon, and shortnose sturgeon and provides revised Reasonable and Prudent Measures and associated Terms and Conditions. The new ITS supersedes the previous 2011 and 2013 ITSs for green sea turtles, Atlantic sturgeon, and shortnose sturgeon. The other ITSs of the original Opinion and the 2013 amendment remain in effect for all other species. NMFS determined the project is likely to adversely affect, but is not likely to jeopardize, green sea turtles, Atlantic sturgeon, and shortnose sturgeon.

Since the previous September 2013 amendment (SER-2013-11301) to the original Opinion was issued, critical habitat has been designated for the loggerhead sea turtle (Northwest Atlantic Ocean DPS; 79 FR 39855; July 10, 2014) and revised for the North Atlantic right whale (NARW; 81 FR 4838; January 27, 2016). Also, humpback whales in the action area have been delisted (81 FR 62259; September 8, 2016). In addition to analyzing the effects to green sea turtles and Atlantic sturgeon, this amended Biological Opinion analyzes project effects on designated critical habitat for loggerhead sea turtles and NARW. This amendment also acknowledges that humpback whales in the action area are no longer listed, and are therefore removed from the Opinion.

Please direct questions regarding this Opinion to Rachel Sweeney, by phone at (727) 551-5743, or by email at rachel.sweeney@noaa.gov.

Sincerely,

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

Enclosures:
Biological Opinion

File: 1514-22 F.4

Endangered Species Act – Section 7 Consultation
Biological Opinion Amendment

Action Agency:	U.S. Army Corps of Engineers (USACE), Savannah District
Activity:	Amendment to the biological opinion for the deepening of the Savannah Harbor Federal Navigational Channel in association with the Savannah Harbor Expansion Project (new NMFS Consultation No. SER-2017-18749)
Consulting Agency:	National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NMFS), Southeast Regional Office, Protected Resources Division, St. Petersburg, Florida
Approved By:	for Roy E. Crabtree, Ph.D., Regional Administrator NMFS, Southeast Regional Office St. Petersburg, Florida
Date Issued:	OCT 13 2017

Table of Contents

Figures

Tables

Acronyms and Abbreviations

ASMFC	Atlantic States Marine Fisheries Commission
BOEM	Bureau of Ocean Energy Management
BSB	Black Sea Bass

BSEE	Bureau of Safety and Environmental Enforcement
CAFO	Concentrated Animal Feeding Operation
CB	Chesapeake Bay
CFR	Code of Federal Regulations
CI	Confidence Interval
CMTTP	Cooperative Marine Turtle Tagging Program
CPUE	Catch per Unit Effort
DNA	Deoxyribonucleic Acid
DO	Dissolved Oxygen
DOIS	Dissolved Oxygen Injection System
DPS	Distinct Population Segment
DWH	Deepwater Horizon
EPA	Environmental Protection Agency
EPR	Eggs per Recruit
ERDC	Engineering Research and Development Center
ESA	Endangered Species Act of 1973
FIM	Fisheries Independent Monitoring
FMP	Fishery Management Plan
FR	Federal Register
FP	Fibropapillomatosis
FY	Fiscal Year
GADNR	Georgia Department of Natural Resources
GARFO	Greater Atlantic Regional Fisheries Office
GOM	Gulf of Maine
GRBO	2003 Gulf of Mexico Regional Biological Opinion
HMS	Highly Migratory Species
IPCC	Intergovernmental Panel on Climate Change
ITP	Incidental Take Permit
ITS	Incidental Take Statement
IUCN	International Union for Conservation of Nature and Natural Resources
LAA	Likely to Adversely Affect
MMPA	Marine Mammal Protection Act
MSA	Mixed Stock Analysis
MMZ	Marine Mixing Zone
NA	North Atlantic
NARW	North Atlantic Right Whale
NCCR	National Coastal Condition Report
NEAMAP	Northeast Area Monitoring and Assessment Program
NEFOP	Northeast Fisheries Observer Program
NLAA	Not Likely to Adversely Affect
NMFS	National Marine Fisheries Service
NRC	National Research Council
NSBLD	New Savanah Bluff Lock and Dam
NWA	Northwest Atlantic
NYB	New York Bight
ODMDS	Ocean Dredged Material Disposal Site

PAH	Polychlorinated Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCE	Primary Constituent Elements
PIT	Passive Integrated Transponder
PRD	Protected Resources Division
RBO	Regional Biological Opinion
RPM	Reasonable and Prudent Measure
SA	South Atlantic
SARBO	South Atlantic Regional Biological OpinionSAS Savannah District
SEFSC	Southeast Fisheries Science Center
SERO	Southeast Regional Office
SHEP	Savannah Harbor Expansion Project
SSB/R	Spawning Stock Biomass per Recruit
STSSN	Sea Turtle Stranding and Salvage Network
TCDD	Tetrachlorodibenzo-p-dioxin
TED	Turtle Excluder Device
TNC	The Nature Conservancy
USACE	United States Army Corps of Engineers
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
VHF	Very High Frequency
WES	Waterways Experimental Station
WIIN	Water Infrastructure Improvements for the Nation
YOY	Young-of-the-Year

Units of Measurement

ac	acre(s)
cm	centimeter(s)
cm^2	square centimeter(s)
°C	degrees Celsius
°F	degrees Fahrenheit
ft	foot/feet
in	inch(es)
kg	kilogram(s)
km	kilometer(s)
km^2	square kilometer(s)
lb	pound(s)
m	meter(s)
mgd	million gallons per day
mi	mile(s)
nmi	nautical miles
yd^3	cubic yard(s)

Introduction

As explained below, this document constitutes National Marine Fisheries Service's (NMFS) second amendment to the 2011 Biological Opinion (Opinion) for the Savanah Harbor Expansion Project (SHEP). This amendment addresses increased lethal and non-lethal takes of green sea turtles and Atlantic sturgeon associated with navigation channel dredging and associated relocation trawling. This amendment also addresses the potential effects that may result from delay in implementing fish passage at the New Savannah Bluff Lock and Dam (NSBLD). This amendment also revises the Incidental Take Statement (ITS) for green sea turtles, Atlantic sturgeon and shortnose sturgeon and provides revised Reasonable and Prudent Measures (RPMs) and associated Terms and Conditions.

This document is based on our review of the first 2 seasons (December 2015 through March 2016 and December 2016 through March 2017) of dredging-related activities that resulted in unforeseen impacts to green sea turtles and Atlantic sturgeon. The original SHEP biological Opinion (SER-2010-05579, referred to heretofore as the original Opinion) was issued in November 2011. It did not include an analysis of potential impacts to green sea turtles since this species had not been documented in previous dredging events within Savannah Harbor. After relocation trawling conducted during work on another project located in Brunswick Harbor resulted in the capture of green sea turtles and later during the project, leatherback sea turtles, the USACE requested reinitiation of consultation for the SHEP Opinion to include these species since it seemed likely that they could be encountered during the SHEP dredging. The amendment to the Opinion (SER-2013-11301) was issued in September 2013. Dredging of the Savannah Harbor Entrance Channel began in late 2015 and is expected to continue into 2018. Relocation trawling is being used to mitigate for the effects of the hopper dredging by relocating sturgeon and turtles out of the path of the hopper dredge. During the second season of the SHEP hopper dredging in the entrance channel, conducted during 2016-17, the Incidental Take level established for non-lethal take of Atlantic sturgeon in the original SHEP Opinion was exceeded, which triggered reinitiation of Endangered Species Act (ESA) consultation. Later, the lethal take limits for Atlantic sturgeon and green sea turtles were also exceeded. Information and analyses from the original Opinion and the 2013 amendment are incorporated into this amendment by reference, unless updated or superseded herein.

This amendment analyzes project dredging and relocation effects on the recently designated North Atlantic (NA) and South Atlantic (SA) distinct population segments (DPSs) of green sea turtles, and all 5 DPSs of Atlantic sturgeon (i.e., Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs), and provides a revised lethal and non-lethal ITS for both species. Information used in the preparation of this amendment was provided by the Savannah District during the first and second year of the offshore dredging of the entrance channel, which is the first portion of the deepening of the Savannah Harbor under SHEP. This amendment documents our analysis of the USACE's information, tiers off of our original 2011 biological Opinion and its 2013 amendment. The new ITS supersedes the previous 2011 and 2013 ITS for Atlantic sturgeon and both green sea turtle DPSs. The ITSs of the original Opinion and the 2013 amendment remain in effect for all other species.

This document also addresses changes resulting from passage of the Water Infrastructure Improvements for the Nation (WIIN) Act of 2016 which includes specific provisions regarding implementation of fish passage at the NSBLD.

During USACE's project study, design, and environmental compliance process, fish passage at the NSBLD was identified by the natural resource agencies as one appropriate mitigation measure to mitigate for the impacts of SHEP after their consideration of numerous other options. Because of the tidal nature of the estuary, the interagency team could not identify any measure that could be constructed in the harbor that would improve or increase sturgeon habitat on all tidal and river flows. NMFS specifically viewed NSBLD fish passage as a significant contribution to recovery of sturgeon and other anadromous fish in the Savannah River, especially when combined with other mitigation features such as dissolved oxygen injection systems (DOIS) and flow re-routing. NSBLD is the first dam up the Savannah River and it prohibits sturgeon access to historic spawning areas at the Augusta Shoals, some 20 miles (mi) further upstream.

The original Opinion evaluated fish passage at the NSBLD for Atlantic and shortnose sturgeon as one of several measures to avoid and minimize effects resulting from deepening and expansion of the navigation channel. This fish passage was intended to provide improved access to upstream spawning habitat by constructing an 'out of river' passage adjacent to the NSBLD. This design would require construction of an entirely new artificial channel adjacent to the Savannah River to provide a bypass around the dam structure. Section 1319 of the WIIN Act of 2016 deauthorized the federal interest in the NSBLD project, and directed USACE to re-consider fish passage alternatives for SHEP. Specifically, Section 1319 directs USACE to evaluate an 'in-river' fish passage design that would result in removal of the NSBLD structure entirely. Upon completion of the re-evaluation, WIIN 2016 authorizes USACE to implement one of two variations of an in-river alternative. The mandate provided in the WIIN Act results in a delay in the beginning of construction and also completion of fish passage at NSBLD; the original Opinion required that construction of fish passage commence prior to or concurrently with initiation of inner harbor dredging and be completed within two years. This amendment evaluates the effects on Atlantic and shortnose sturgeon from the delay in implementation of fish passage, and updates the associated ITS for these effects.

Since the September 2013 amendment to the Original SHEP Opinion was issued, critical habitat has been designated for the loggerhead sea turtle (Northwest Atlantic Ocean DPS; 79 FR 39855; July 10, 2014) and revised for the North Atlantic right whale (NARW; 81 FR 4838; January 27, 2016). Also, humpback whales in the action area have been delisted (81 FR 62259; September 8, 2016). In addition to analyzing the effects to green sea turtles and Atlantic sturgeon as requested by the USACE in their request for reinitiation, this amended Biological Opinion analyzes project effects on designated critical habitat for loggerhead sea turtles and NARW. This amendment also acknowledges that humpback whales in the action area are no longer listed, and are therefore removed from the Opinion.

1 CONSULTATION HISTORY

December 4, 2016: NMFS is notified that the non-lethal take level for Atlantic sturgeon has been exceeded and that the USACE will begin preparing a request to re-initiate Section 7 consultation for the SHEP. NMFS is continuously notified when additional takes occur until season 2 dredging ends on March 31, 2017.

December 16, 2016: WIIN Act passed.

January 24, 2017: NMFS receives a request from the Savannah District to reinitiate Section 7 consultation for SHEP (NMFS 2011 Biological Opinion – SER-2010-05579). Using the take rate when the entrance channel work for SHEP was 40% complete, the Savannah District requested that the lethal takes for the project be increased to 10 Atlantic sturgeon and 10 green sea turtles, and the non-lethal takes be increased to 200 Atlantic sturgeon and 10 green sea turtles. USACE prepared an ESA Section 7(a)(2)/7(d) analysis to validate that ongoing Savannah District dredging and relocation trawling activities during SHEP would not jeopardize the continued existence of listed species or make any irreversible or irretrievable commitments of resources. The analysis concludes that the continued use of relocation trawling in SHEP during the reinitiated consultation period as a tool to reduce the risk of lethal take from hopper dredging activities is appropriate and is not likely to jeopardize the continued existence of the species. USACE stated they will not make any irreversible or irretrievable commitment of resources that would foreclose the formulation or implementation of reasonable and prudent alternatives necessary to avoid jeopardizing the continued existence of Atlantic sturgeon or green sea turtle DPSs. USACE also requested that Reasonable and Prudent Measure #5 and Term and Condition #14 be modified to replace the requirement for sonic tags with passive integrated transponder (PIT) tags. They stated the request is being made to limit adverse impacts on sturgeon stressed from the relocation trawling and address concerns about human safety during the process of implanting the sonic tags. They also stated that requiring PIT tags instead of sonic tags would make the SHEP Biological Opinion more consistent with more recent biological Opinions for other USACE new work dredging projects on the Atlantic coast.

January 29, 2017: NMFS is notified that the lethal take level (under the 2011 SHEP Biological Opinion) for Atlantic sturgeon has been reached.

February 12, 2017: NMFS is notified that the lethal take level (under the 2011 SHEP Biological Opinion) for Atlantic sturgeon has been exceeded.

February 21, 2017: NMFS is notified that the non-lethal take level (under the 2013 amended SHEP Biological Opinion) for green sea turtles has been exceeded

February 27, 2017: NMFS is notified that the lethal take level (under the 2013 amended SHEP Biological Opinion) for green sea turtles has been exceeded.

May 19, 2017: Formal consultation reinitiated after NMFS receives and reviews the final dredging reports from season 2 dredging.

May 25, 2017: USACE issued Implementation Guidance to address implementation of Section 1319 of WIIN Act of 2016.

2 DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA

Please refer to the original Opinion for a detailed description of the proposed action and action area.

The current status of the SHEP navigation and mitigation features is as follows:

Navigation Features:

- First Dike Raising – Construction 100% complete (July 2017)
- Entrance Channel Dredging – 60% complete with 100% completion projected July 2018
- Inner Harbor Dredging – Anticipated to begin in October 2018 and scheduled for completion in January 2022.

Mitigation Features:

- Payment to Georgia Department of Natural Resources (GADNR) for Striped Bass Re-stocking – 100% complete (Mar 2015)
- Freshwater Wetlands Acquisition – 100% complete (July 2017)
- Flow Re-Routing in the Estuary:
  - Sediment Basin Tide Gate Removal – Construction 80% complete with 100% completion projected December 2017
  - McCoy's Cut Area Work – Design 100% complete and will be advertised in 2018
- Dissolved Oxygen Injection System (DOIS) – Construction 45% complete; project completion scheduled during 3rd Quarter Fiscal Year (FY) 2018; operations scheduled to begin summer of 2019.
- Raw Water Storage Impoundment for the City of Savannah – Construction 89% complete with project completion during 1st/2nd Quarter FY 2018
- Recovery of the Ironclad CSS Georgia from the Savannah River – Recovery 100% complete (August 2017)

USACE has dredged approximately 7,464,714 yd^3 of material from the entrance channel during the first 2 years of the project. Approximately 54% (4,026,278 yd^3) was completed using a hopper dredge and 46% (3,438,436 yd^3) was completed using a cutterhead dredge. USACE reports that a new survey shows that approximately 4,200,000 yd^3 of material still needs to be dredged from the entrance channel, bringing the total amount of entrance channel dredging (completed plus proposed) to 11,446,143 yd^3. It is unknown whether the remaining entrance channel dredging will be completed with hopper and/or cutterhead dredges.

To implement the provisions of WIIN 2016, USACE will first evaluate and choose between the two identified alternatives for fish passage at NSBLD (i.e., previous out of river alternative and new in-river alternative). The evaluation will include extensive hydraulic modeling to ascertain effects of removal of the dam and replacement with a different structure, including the potential for increased flooding in upstream communities, impacts to numerous industrial and water supply intakes, and impacts to recreational use of the upstream pool. USACE will use these analyses and input from the public to identify the best in-river design alternative. Once the conceptual plan is identified and approved, the USACE must then complete full detailed design, complete required environmental compliance clearances, acquire any necessary lands, easements, or rights-of-way, prepare a solicitation, advertise, and award a construction contract for fish passage.

USACE estimates the overall time to evaluate, document, design, review, obtain real estate, procure, and award a construction contract to be 40 months. USACE also estimates that the construction period for the in-river fish passage may take up to three years. The estimated construction period would be a year longer than the previously identified out of river alternative because the in-river design will require more complex "in the wet" construction methods.

The original Opinion required that construction of fish passage begin concurrent with the start of inner harbor dredging, and fish passage would be completed slightly before or concurrent with the January 2022 completion of inner harbor dredging. Inner harbor dredging is currently scheduled to begin in October of 2018. The current timeline for the in-river fish passage feature estimates that a construction contract for the fish passage would be awarded in January 2021 and that fish passage would be completed in October 2022 (i.e., approximately 8 months after the end of the Inner Harbor Dredging). Therefore, this amendment addresses the effects of the 8-month delay for full implementation of fish passage at NSBLD.

Figure 1. SHEP Inner and Outer Harbor Dredging Stations

3 SPECIES AND CRITICAL HABITAT OCCURRING IN THE ACTION AREA

3.1 Species

The following table lists the endangered (E) and threatened (T) species and DPSs proposed under the jurisdiction of NMFS that may occur in the action area:

Table 1. Effect Determinations and Status for Species in or Near the Action Areas that Either the Action Agency or NMFS Believes May Be Affected by the Proposed Action

Species	ESA Listing Status	Action Agency Effect Determination	NMFS Effect Determination
Sea Turtles			
Green (NA DPS and SA DPS)	T	LAA	LAA
Kemp's ridley	E	LAA	LAA
Leatherback	E	LAA	LAA
Loggerhead (Northwest Atlantic Ocean [NWA] DPS)	T	LAA	LAA
Hawksbill	E	NLAA	NLAA
Fish			
Shortnose sturgeon	E	LAA	LAA
Atlantic sturgeon (All 5 DPSs)	E or T[1]	LAA	LAA
Whales			
North Atlantic right whale	E	NLAA	NLAA
Humpback whale (West Indies DPS)	E	NLAA	Delisted
E = endangered; T = threatened; LAA = likely to adversely affect; NLAA = may affect, not likely to adversely affect			

3.1.1 Species Not Likely to be Adversely Affected

In the original Opinion, we determined that the proposed action is not likely to adversely affect green sea turtles, hawksbill sea turtles, leatherback sea turtles, North Atlantic right whales, and humpback whales. We maintain our previous determinations that the proposed action is not likely to adversely affect hawksbill sea turtles or North Atlantic right whales, and these species are not further analyzed in this amendment. In September 2016, NMFS revised the ESA listing for the humpback whale to identify 14 DPSs, list 1 as threatened, 4 as endangered, and identify 9 others as not warranted for listing (81 FR 62259). The West Indies DPS occurring in the action area was delisted. Therefore, humpback whales are not included in the Opinion. The 2013 amendment to the original Opinion determined that the action was likely to adversely affect green sea turtles and leatherback sea turtles and an ITS was added for these species.

[1] The New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs are listed as endangered; the Gulf of Maine DPS is listed as threatened.

3.1.2 Species Likely to be Adversely Affected

The original Opinion and the 2013 amendment determined that green, Kemp's ridley, leatherback, and loggerhead sea turtles; and Atlantic sturgeon are likely to be adversely affected by the entrance channel dredging and relocation trawling associated with SHEP and an ITS for these species was provided. A review of the reports for the first 2 dredging seasons for SHEP indicate that the calculated incidental take limits for Kemp's ridley, leatherback, and loggerhead sea turtles appear to continue to be reasonable and will not be discussed further in this amended Opinion.

The original Opinion determined that juvenile Atlantic sturgeon and juvenile, sub-adult, and adult shortnose sturgeon would be adversely affected by habitat alterations resulting primarily from changes in water quality (salinity and dissolved oxygen) due to dredging of the Savannah inner harbor. The original Opinion also determined that adult and sub-adult Atlantic sturgeon are more salt tolerant and forage mainly in the Atlantic Ocean and habitat changes resulted from channel expansion would be insignificant on them. The original Opinion evaluated habitat alteration effects in consideration of the implementation of a suite of mitigations (i.e., DOIS, flow re-routing, NSBLD fish passage) designed to offset impacts associated with water quality changes. While the original Opinion determined that the inner harbor dredging associated with the SHEP project would have adverse effects to juvenile Atlantic sturgeon and juvenile, sub-adult, and adult shortnose sturgeon, resulting from habitat changes caused by the deepening, we were not able to determine numerical limits for how many Atlantic and shortnose sturgeon would be adversely affected due to uncertainties regarding ecosystem response to the changes in salinity and other conditions, limited available information regarding use of existing habitats, and lack of data regarding response of individual sturgeon or populations. In the original Opinion, we identified habitat loss as a surrogate measure by which to measure and monitor the extent of these effects. Hydrodynamic modeling conducted by USACE and included in the July, 2012, *Final Environmental Impact Statement for the Savannah Harbor Expansions Project, Chatham County, Georgia and Jasper County, South Carolina* was used to predict the distribution and magnitude of habitat alternations and to inform development of mitigation measures which include flow re-routing in the estuary, installation and operation of DOIS, and implementation of fish passage at the NSBLD. One of these mitigation measures, implementation of fish passage at NSBLD, will be delayed in response to directives in the WIIN Act of 2016. This amendment addresses the potential effects that may result from delayed fish passage.

In summary, this amendment for SHEP includes a revised analysis of the effects of the entrance channel dredging and relocation trawling on the green sea turtle NA and SA DPSs and all 5 DPSs of Atlantic sturgeon. The amendment also analyzes the potential effects of delaying completion of the fish passage at NSBLD due to evaluations required by the WIIN Act, which may affect Atlantic and shortnose sturgeon. The amendment is based upon the best available information on the status of the NA and SA DPSs of green sea turtle, the Atlantic sturgeon DPSs, and shortnose sturgeon, 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 analyses for this amendment. Additional background information on the status of green sea turtles can be found in a number of published documents, including the recovery plans for the Atlantic green sea turtle (NMFS and USFWS 1991). Sources of background information on Atlantic sturgeon include the status review and proposed and final listing rules (77 FR 5880 and 77 FR 5914). Sources of information on the shortnose sturgeon include the "Biological Assessment of Shortnose Sturgeon"(NMFS 2010).

3.2 Critical Habitat

The previous Opinion and amendment did not contain an analysis of effects to critical habitat. This amendment analyzes the potential effects to final critical habitat designated or revised since the previous Opinion and amendment were issued. Potential effects of the proposed action to newly designated Atlantic sturgeon critical habitat will be evaluated in a subsequent amendment.

NARW Critical Habitat
On January 27, 2016, NMFS published a new final rule (81 FR 4838) designating the marine waters from Cape Fear, North Carolina, southward to 28°N latitude (approximately 31 mi south of Cape Canaveral, Florida) as critical habitat for the NARW. This area was designated as critical habitat because it provides important calving grounds for the NARW. The new critical habitat rule identifies the physical features of calving critical 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 square kilometers (km^2) of ocean waters during the months of November through April.

The entrance channel deepening and relocation trawling for SHEP are occurring in NARW critical habitat; however, we believe these activities have no effect on NARW critical habitat. Deepening of the Savannah Harbor entrance channel and relocation trawling will have no effect on calm sea surface conditions or sea surface temperatures. While dredging will increase water depths from 42 feet (ft) (12.8 meters [m]) to 47 ft (14.3 m), this is still within the essential range of 6-28 m. Therefore, dredging will also have no effect on the essential feature of water depth.

NARW critical habitat will not be discussed further in this amended Opinion.

Loggerhead sea turtle NWA DPS Critical Habitat
Critical habitat for the NWA DPS of loggerhead sea turtles was designated in July 2014 (79 FR 39855) and is defined by 5 specific habitat types: nearshore reproductive, winter concentration, concentrated breeding, constricted migratory, and *Sargassum*. The project is not located in loggerhead critical habitat, but Nearshore Reproductive Critical Habitat Unit LOGG-N-10 is just south of the entrance channel dredging. The primary constituent elements (PCEs) of nearshore reproductive habitat are:

(1) Nearshore waters with direct proximity to nesting beaches that support critical aggregations of nesting turtles (e.g., highest density nesting beaches) to 1 mi (1.6 kilometers [km]) 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.

The entrance channel deepening and relocation trawling associated with SHEP are not likely to adversely affect Nearshore Reproductive Habitat Unit LOGG-N-10. Dredging and relocation trawling will have no effect on the proximity of nearshore waters to nesting beaches (PCE 1) and will not create manmade structures that could promote predators, disrupt wave patterns, or create excessive longshore currents (PCE 3). The presence of dredging and relocation trawling activities or lighting on the vessels could potentially affect the transit of sea turtles in the action area (PCE 2). However, these effects are discountable because the dredging and relocation trawling are occurring approximately 3-5 mi from Unit LOGG-N-10 and will only occur in one section of the entrance channel at a time. Therefore, these activities are extremely unlikely 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.

Loggerhead sea turtle critical habitat will not be discussed further in this amended Opinion.

3.3 Status of the Species that are Likely to be Adversely Affected by the Action in a Manner or to a Different Extent than Determined in the Original Opinion or 2013 Amendment

3.3.1 Status of Green Sea Turtles (NA DPS and SA DPS)

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 NA DPS and SA 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.

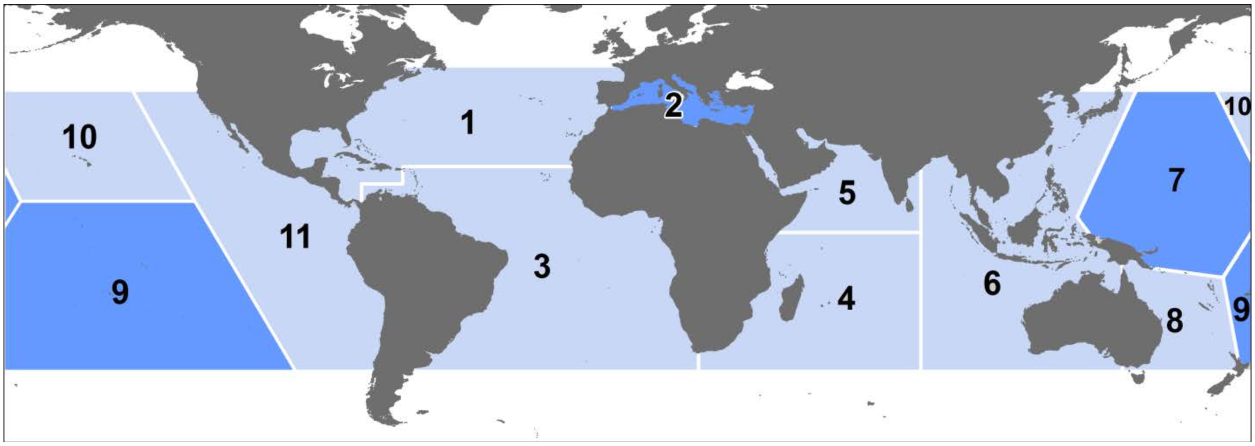

Figure 2. Threatened (light) and endangered (dark) green turtle DPSs: 1. North Atlantic, 2. Mediterranean, 3. South Atlantic, 4. Southwest Indian, 5. North Indian, 6. East Indian-West Pacific, 7. Central West Pacific, 8. Southwest Pacific, 9. Central South Pacific, 10. Central North Pacific, and 11.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

Species Description and Distribution

The green sea turtle is the largest of the hardshell marine turtles, growing to a weight of 350 pounds (lb) (159 kilograms [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.

Green sea turtle

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

NA DPS Distribution

The NA DPS boundary is illustrated in Figure 2. 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 1991). 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.

SA DPS Distribution

The SA DPS boundary is shown in Figure 2, 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 (NA 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 (in) (5 centimeters [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 2007). Green sea turtles exhibit particularly slow growth rates of about 0.4-2 in (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 in (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, and some post-nesting turtles also reside in Bahamian waters as well (NMFS and USFWS 2007).

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

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

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

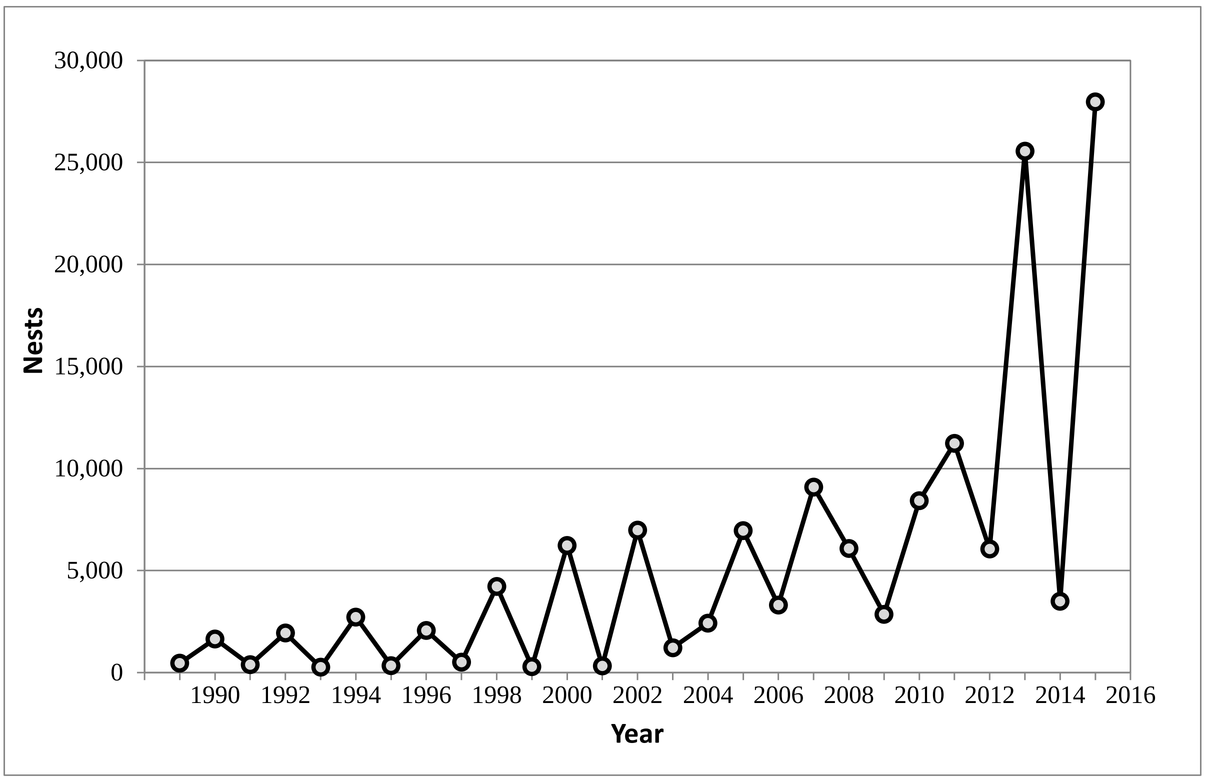

Figure 3. Green sea turtle nesting at Florida index beaches since 1989

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 (straight carapace length<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).

SA 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 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 in (0.1 cm) to greater than 11.81 in (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 Deepwater Horizon (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 DWH oil spill of 2010, 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).

3.3.2 Status of 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).

Atlantic Sturgeon

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

Life History Information
Atlantic sturgeon populations show clinal variation, with a general trend of faster growth and earlier age at maturity in more southern systems. Atlantic sturgeon mature between the ages of 5-19 years in South Carolina (Smith et al. 1982), between 11-21 years in the Hudson River (Young et al. 1988), and between 22-34 years in the St. Lawrence River (Scott and Crossman 1973). Most Atlantic sturgeon adults likely do not spawn every year. Multiple studies have shown that spawning intervals range from 1-5 years for males (Caron et al. 2002; Collins et al. 2000b; Smith 1985) and 2-5 years for females (Stevenson and Secor 1999; Van Eenennaam et al. 1996; Vladykov and Greely 1963). Fecundity of Atlantic sturgeon has been correlated with age and body size, with egg production ranging from 400,000 to 8,000,000 eggs per year (Dadswell 2006; Smith et al. 1982; Van Eenennaam and Doroshov 1998). The average age at which 50% of maximum lifetime egg production is achieved is estimated to be 29 years, approximately 3-10 times longer than for other bony fish species examined (Boreman 1997).

Spawning adult Atlantic sturgeon generally migrate upriver in spring/early summer, which occurs in February-March in southern systems, April-May in mid-Atlantic systems, and May-July in Canadian systems (Bain 1997; Caron et al. 2002; Murawski et al. 1977; Smith 1985; Smith and Clugston 1997). In some southern rivers, a fall spawning migration may also occur (Moser et al. 1998; Rogers and Weber 1995a; 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 1995a), with running ripe males found August through October and post-spawning females captured in late September and October (Collins et al. 2000b).

Status and Population Dynamics
At the time Atlantic sturgeon were listed, the best available abundance information for each of the 5 DPSs was the estimated number of adult Atlantic sturgeon spawning in each of the rivers on an annual basis. The estimated number of annually spawning adults in each of the river populations is insufficient to quantify the total population numbers for each DPS of Atlantic sturgeon due to the lack of other necessary accompanying life history data. A recently Atlantic sturgeon population estimate was derived from the 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 2. 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 2 currently represent the best available population abundance estimates for the 5 U.S. Atlantic sturgeon DPSs.

Table 2. 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 young-of-the-year (YOY) were observed, or mature adults were present, in freshwater portions of a system. However, in some

rivers, spawning by Atlantic sturgeon may not be contributing to population growth because of lack of suitable habitat and the presence of other stressors on juvenile survival and development.

Historically, both the Broad-Coosawatchie and St. Marys Rivers were documented to have spawning populations; there is also evidence that spawning may have occurred in the St. Johns River or one of its tributaries. The spawning population in the St. Marys River, as well as any historical spawning population in the St. Johns River, is 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.

<u>Carolina DPS</u>

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

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

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

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 2) indicate the current number of spawning adults is likely an order of magnitude lower than historical levels (ASSRT 2007; Kahnle et al. 2007). The NEAMAP model estimates a minimum ocean population of 8,811 Chesapeake Bay DPS Atlantic sturgeon, of which 2,319 are adults.

New York Bight DPS

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

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

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

<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.

Viability of Atlantic Sturgeon DPSs

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

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

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

Dams

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

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

Dredging

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

In the South Atlantic DPS, maintenance dredging is currently modifying Atlantic sturgeon nursery habitat in the Savannah River. Modeling indicates that the proposed deepening of the navigation channel will result in reduced DO and upriver movement of the salt wedge, restricting spawning habitat. Dredging is also modifying nursery and foraging habitat in the St. Johns River. For the Carolina DPS, dredging in spawning and nursery grounds modifies the quality of the habitat and is further restricting the extent of available habitat in the Cape Fear and Cooper Rivers, where Atlantic sturgeon habitat has already been modified and restricted by the presence of dams. Dredging for navigational purposes is suspected of having reduced available spawning habitat for the Chesapeake Bay DPS in the James River (ASSRT 2007; Bushnoe et al. 2005; Holton and Walsh 1995). Both the Hudson and Delaware rivers have navigation channels that are maintained by dredging. Dredging is also used to maintain channels in the nearshore marine environment. Many rivers in the range of the Gulf of Maine DPS also have navigation channels that are maintained by dredging. Dredging outside of federal channels and in-water construction occurs throughout the range of the New York Bight and Gulf of Maine DPSs.

Water Quality

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

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

Water Quantity

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

Climate Change

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

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

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

Vessel Strikes

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

Bycatch Mortality

Overutilization of Atlantic sturgeon from directed fishing caused initial severe declines in Atlantic sturgeon populations, from which they have never rebounded. Further, continued overutilization of Atlantic sturgeon as bycatch in commercial fisheries is an ongoing impact to Atlantic sturgeon in all 5 DPSs. Atlantic sturgeon are more sensitive to bycatch mortality because they are a long-lived species, have an older age at maturity, have lower maximum reproductive rates, and a large percentage of egg production occurs later in life. Based on these life history traits, Boreman (1997) calculated that Atlantic sturgeon can only withstand the annual loss of up to 5% of their population to bycatch mortality without suffering population declines. Mortality rates of Atlantic sturgeon taken as bycatch in various types of fishing gear range between 0% and 51%, with the greatest mortality occurring in sturgeon caught by sink gillnets. Currently, there are estimates of the number of Atlantic sturgeon captured and killed in sink gillnet and otter trawl fisheries authorized by Fishery Management Plans (FMPs) in the Northeast Region (Miller and Shepherd 2011). Those estimates indicate from 2006-2010, on average there were 1,548 and 1,569 encounters per year in observed gillnet and trawl fisheries, respectively, with an average of 3,118 encounters combined annually. Mortality rates in gillnet gear were approximately 20%, while mortality rates in otter trawl gear are generally lower, at approximately 5%. Atlantic sturgeon are particularly vulnerable to being caught in sink gillnets; therefore, fisheries using this type of gear account for a high percentage of Atlantic sturgeon bycatch. Atlantic sturgeon are incidentally captured in state and federal fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (ASMFC 2007; Stein et al. 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.

3.3.3 Status of Shortnose Sturgeon

Shortnose sturgeon were initially listed as an endangered species by the U.S. Fish and Wildlife Service (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 ft, and a weight of about 55 lbs. Shortnose sturgeon inhabit large coastal rivers of eastern North America. Although considered an anadromous species,[2] shortnose sturgeon are more properly characterized as "freshwater amphidromous," meaning that they move between fresh and salt 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

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

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 mi (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. While it had been 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 (Collins et al. 2000a; Kahnle et al. 1998; Rogers and Weber 1995b), recent targeted surveys in both the Satilla and St. Mary's have captured shortnose sturgeon. 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, [3] 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 1979; Kieffer and Kynard 1996; NMFS 1998). Age at first spawning for females is about 5 years post-maturation with spawning occurring every 3-5 years (Dadswell 1979). 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 1979; 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 mi (200 km) upriver (Kynard 1997) or throughout the fall line[4] 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 1979; 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

[3] 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

[4] 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 1998). 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 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 4). Genetic analyses grouped shortnose sturgeon populations in the Southeast into 1 metapopulation (shown within the “Carolinian Province” in Figure 4). 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.

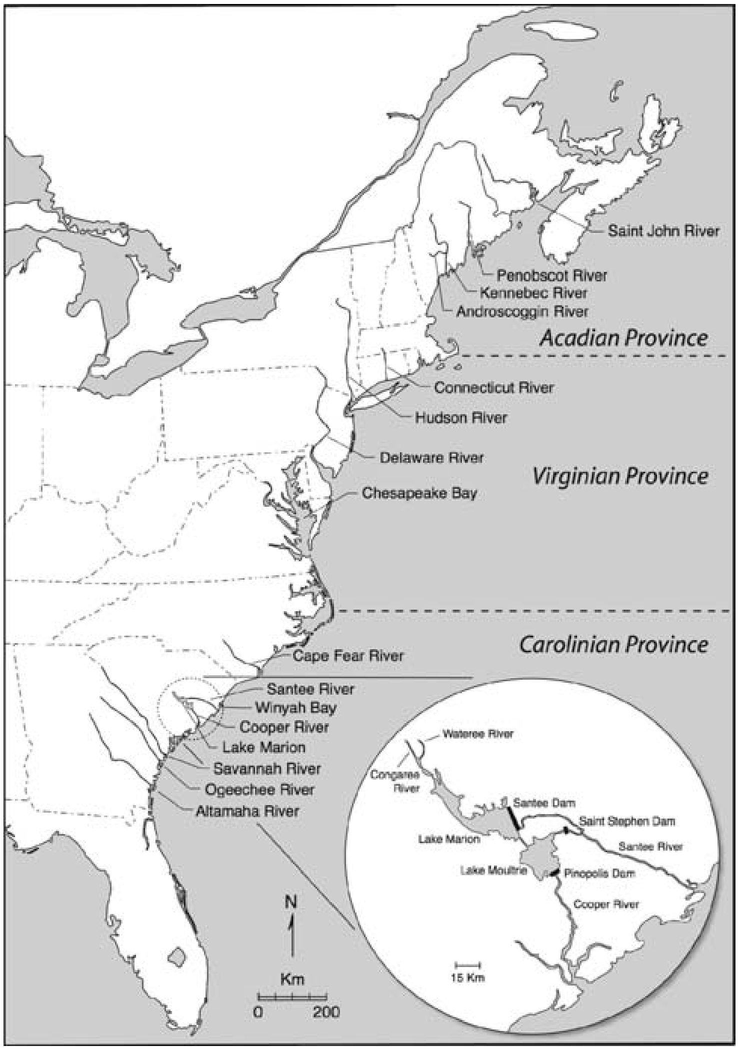

Figure 4. The North American Atlantic coast depicting 3 shortnose sturgeon metapopulations based on mitochondrial DNA control region sequence analysis (Wirgin et al. 2009).

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 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 2006; NMFS 1998). 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. 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, 1998
	1993	361 (326-400)	Total	Rogers and Weber 1994; NMFS 1998
	1999-2004	147 (104-249)		Fleming et al. 2003; NMFS unpublished
Altamaha River (GA)	1988	2,862 (1,069-4,226)	Total	NMFS 1998
	1990	798 (645-1,045)	Total	NMFS 1998
	1993	468 (316-903)	Total	NMFS 1998
		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 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 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 (Barber and Stamey 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).

Bycatch

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).

4 ENVIRONMENTAL BASELINE

This section describes the effects of past and ongoing human and natural factors contributing to the current status of the species, their 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, environmental baselines for biological opinions include the past and present impacts of all state, federal, or private actions and other human activities in the action area. 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 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 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 and Distribution of Green Sea Turtles, Atlantic Sturgeon, and Shortnose Sturgeon in the Action Area

Green Sea Turtles

The green sea turtles that occur in the action area are highly migratory, as are all sea turtle species worldwide. NMFS believes that no individual members of any sea turtle species are likely to be year-round residents of the action area. There are no nesting beaches in the action area. Individual animals will make migrations into nearshore waters as well as other areas of the North Atlantic Ocean, including the Gulf of Mexico and the Caribbean Sea. Therefore, the status of the green sea turtles in the Atlantic (see Section 3) most accurately reflects the species' status within the action area.

Atlantic Sturgeon
Atlantic sturgeon mix extensively in the marine environment (Erickson et al. 2011; Stein et al. 2004b). All 5 DPSs of Atlantic sturgeon could potentially occur in the marine portion of the action area where the entrance channel dredging is occurring. 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). While subadult Atlantic sturgeon utilize multiple estuaries other than the estuary associated with their natal river, we expect the Atlantic sturgeon potentially affected by the inner harbor dredging would be from the South Atlantic DPS due to the inland location of the Inner Harbor dredging in the Savannah River and the fidelity of Atlantic sturgeon to their natal rivers..

Shortnose Sturgeon
All shortnose sturgeon life stages may 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). We expect that shortnose sturgeon that may occur in the action area would be from the Savannah River spawning population, which is relatively isolated from other shortnose sturgeon river populations. Spawning occurs in the Savannah River, and the population is estimated to consist of between 1,000 and 3,000 spawning adults.

4.1.1 Factors Affecting Green Sea Turtles in the Action Area

The proposed project is located off Georgia, within the Savannah Harbor entrance channel. The following analysis examines actions that may affect these species' environment specifically within the defined action area.

Please refer to the original Opinion for a detailed description of the action area.

4.1.1.1 Federal Actions

In recent years, NMFS has undertaken several ESA Section 7 consultations to address the effects of federally-permitted fisheries and other federal actions on threatened and endangered sea turtle species, and when appropriate, has authorized the incidental taking of these species. Each of those consultations sought to minimize the adverse impacts of the action on sea turtles. Similarly, NMFS has undertaken recovery actions under the ESA to address sea turtle takes in the fishing and shipping industries and other activities such as USACE dredging operations. The summaries below address anticipated sources of incidental take of sea turtles and include- only those federal actions in or near the action area that have already concluded or are currently undergoing formal Section 7 consultation.

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, Bureau of Ocean Energy Management/Bureau of Safety and Environmental Enforcement (BOEM/BSEE), Federal Energy Regulatory Commission, 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 non-lethal. 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 mortality 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 1997). 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 (NMFS 1997). 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 updated South Atlantic Regional Biological Opinion (SARBO).

4.1.1.2 Federally-Managed Fisheries Effects on Sea Turtles

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 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.

Highly Migratory Species (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, black sea bass (BSB) pots, 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 turtle excluder devices (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 2002).[5] 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 2002) 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

[5] 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.

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-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 Southeast Fisheries Science Center (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 2016). NMFS also recently consulted on a project funded by the USFWS for fisheries monitoring to be conducted by GADNR 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. GADNR collects and reports information from the following studies: 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. Due to the use of trawls and nets, sea turtles may be taken during the studies. The USFWS consulted with NMFS (SER-2015-16739) on the potential effects to sea turtles (NMFS, 2017). The consultation concluded that the continued operation of GADNR's studies on recreationally important fish species was likely to adversely affect but not jeopardize the continued existence of sea turtles. Non-lethal incidental take was authorized (Appendix D).

4.1.1.3 State or Private Actions

Maritime Industry
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 Sea Turtle Stranding and Salvage Network (STSSN) includes many records of vessel interaction (propeller injury) with sea turtles 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 minor vessel collisions may not kill an animal directly, but may weaken or otherwise affect it so it is more likely to become vulnerable to effects such as entanglements.

Coastal Development
Beachfront development, lighting, and beach erosion control all are ongoing activities along the Georgia/South Carolina coastline. 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.

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 4.1.1.2; 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, 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) has 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 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.

4.1.1.4 Other Potential Sources of Impacts in the Environmental Baseline

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 polychlorinated biphenyls (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. 2008). 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. 1991). 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.

Acoustic Impacts

Acoustic impacts can include temporary or permanent injury, habitat exclusion, habituation, and disruption of other normal behavior patterns. NMFS and the U.S. Navy are working cooperatively to assess military acoustic impacts (e.g., mid-range sonar) along the east coast of the United States (i.e., primarily North Carolina through Florida). Although focused on marine mammals, sea turtles may benefit from increased research on acoustics and reduction in noise levels.

Climate Change
As discussed earlier, 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. Climate change may result in changes in species distribution including displacement from ideal habitats, decline in fitness of individuals, reduced population size due to the potential loss of foraging opportunities or other habitat alterations and adverse impacts on 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.

4.1.1.5 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 nautical miles [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 in. Federal waters north of Chincoteague, Virginia, remain unaffected by the large-mesh gillnet restrictions.

<u>Other Sea Turtle Conservation Actions</u>

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)].

4.1.2 Factors Affecting Atlantic Sturgeon in the Action Area

The following section examines actions that may affect Atlantic sturgeon or their 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.

4.1.2.1 Federal Actions

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 these, seven takes of Atlantic sturgeon (five lethal, two non-lethal) occurred in the action area during hopper dredging of the Savanah River under the 2003 Gulf of Mexico Regional Biological Opinion (GRBO). 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.

4.1.2.2 Federally Managed Fisheries Effects on Atlantic Sturgeon

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/BSB 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 2002) 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 in federal waters. 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).

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 2013b). 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.

Recreational Fisheries Studies
The Georgia Department of Natural Resources (GADNR) Coastal Resources Division collects, analyzes, and reports 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. GADNR collects and reports information from the following studies: 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. Due to the use of trawls and nets, Atlantic sturgeon may be taken during the studies. The USFWS provides funding for these studies and consulted with NMFS (SER-2015-16739) on the potential effects to Atlantic sturgeon (NMFS, 2017). The consultation concluded

that the continued operation of GADNR's studies on recreationally important fish species was likely to adversely affect but not jeopardize the continued existence of any DPS of Atlantic sturgeon. Incidental take was authorized (Appendix D).

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 2016).

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., Very High Frequency [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.

4.1.2.3 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.

4.1.2.4 Other Potential Sources of Impacts in the Environmental Baseline

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, 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 U.S. Environmental Protection Agency (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.

Climate Change
As discussed earlier, 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, 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.

4.1.2.5 Conservation and Recovery Actions Benefitting Atlantic Sturgeon

State and Federal Moratoria on Directed Capture of Atlantic Sturgeon
In 1998, the Atlantic States Marine Fisheries Commission (ASMFC) 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.

4.1.3 Factors Affecting Shortnose Sturgeon in 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 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.

4.1.3.1 Federal Actions

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 the permit, but they are released alive.

Federally Managed Fisheries Effects on Shortnose Sturgeon
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% (NMFS 2013c).

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. 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).

Dredging
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 shortnose sturgeon.

4.1.3.2 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 1979; Dovel et al. 1992a).

4.1.3.3 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 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, PAHs, organophosphate and organochlorine pesticides, 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 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.

4.1.3.4 Climate Change

As discussed earlier in <u>this amendment</u>, 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 <u>this amendment</u>, 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.

4.1.3.5 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 1998). 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 1998).

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 The Convention on International Trade in Endangered Species of Wild Fauna and Flora in 1975. Appendix I species are considered threatened by extinction and trade is permitted only in exceptional circumstances.

5 EFFECTS OF THE ACTION

This section includes our assessment of the unanticipated effects of the proposed action on green sea turtles, Atlantic sturgeon and shortnose sturgeon, beyond those described in the original Opinion and the 2013 amendment. The analysis in this section forms the foundation for our jeopardy analysis in Section 7.0. A jeopardy determination is reached if we would reasonably expect the proposed action to cause reductions in numbers, reproduction, or distribution that would appreciably reduce listed species' likelihood of surviving and recovering in the wild.

The original SHEP Biological Opinion (NMFS Consultation No. SER-2010-05579) included an analysis of potential impacts to Atlantic sturgeon that was based on historical takes in and near the project area. The original Opinion did not include an ITS for green sea turtles, due to the lack of historical information documenting take during hopper dredging. The 2013 amendment to the Opinion (NMFS Consultation No. SER-2013-11301) was issued after new information from the 2012 maintenance dredging of Savannah and Brunswick harbors and an evaluation of bed-leveling in Brunswick Harbor during 2013 revealed that green sea turtles could be off the Georgia Coast during SHEP dredging. This new amendment is based on information and data reports provided in emails from the USACE between 2015 - 2017 pertaining to project activities and the lethal and non-lethal takes of Atlantic sturgeon and green sea turtles during offshore hopper dredging and relocation trawling of the entrance channel. Other information from previous NMFS consultations conducted on the use of hopper dredging methods is also included in our analyses in this amendment. This section also analyzes the effects on sturgeon from delay in implementation of fish passage at NSBLD.

Hopper dredging can result in take (usually lethal) of sea turtles and sturgeon when these species become entrained in the draghead, the portion of the dredge that makes contact with the bottom substrate during dredging. Entrainment is defined as the direct uptake of aquatic organisms by the suction field generated at the draghead. Hopper dredges operate for prolonged periods underwater, with minimal disturbance, but generate continuous flow fields of suction forces while dredging. Entrainment is believed to occur primarily when the draghead is not in firm contact with the channel bottom, so the potential exists for sea turtles and sturgeon feeding or resting on or near the bottom may be vulnerable to entrainment. Additionally, the size and flow rates produced by the suction power of the dredge, the condition of the channel being dredged, and the method of operation of the dredge and draghead all relate to the potential of the dredge to entrain sea turtles or sturgeon. It is possible to monitor entrainment on a hopper dredge because the dredged material is retained on the vessels as opposed to the direct placement of dredged material both overboard or in confined disposal facilities by a hydraulic pipeline dredge. A hopper dredge contains screened inflow cages from which an observer can inspect recently dredged contents. Typically, the observer inspection is performed at the completion of each load while the vessel is transiting to the authorized placement area and does not impact production of the dredging operations.

The function and purpose of capture relocation trawling is to capture sea turtles and sturgeon that may be in the dredge's path. By reducing the density of sea turtles and sturgeon immediately in front of the dredge's suction dragheads, the potential for lethal interactions with these species is reduced. The relocation trawler typically pulls two standard (60-foot headrope) shrimp trawl nets, as close as safely possible in front of the advancing hopper dredge, without TEDs. The trawler also continues sweeping the area to be dredged (channels or borrow areas) even while the hopper dredge is not actively dredging. NMFS believes that properly conducted relocation trawling (i.e., per NMFS's requirements regarding trawl speed, tow-time limits, release protocols and other conditions) that is monitored by trained observers will result in a low mortality rate to green sea turtles and Atlantic sturgeon while greatly reducing the number of these species lethally taken during hopper dredging of the entrance channel.

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 green sea turtle biology, Atlantic sturgeon biology, and the potential 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 to resolve uncertainty which provide the most conservative (conservation oriented) outcome for listed species.

5.1 Effects of the Action on Green Sea Turtles (SA DPS and NA DPS)

5.1.1 Entrance Channel Dredging

The potential for adverse effects of dredging operations on sea turtles has been previously assessed by NMFS in the various versions of the SARBO (NMFS 1991, 1995, 1997b) and the

(GRBO) that was revised in 2005 and 2007 (NMFS 2003, 2005, 2007). Additionally, the USACE prepared a comprehensive analysis of data from Gulf and Atlantic hopper dredging projects to identify factors affecting sea turtle take rates (Dickerson et al. 2007). The USACE previously maintained an online data warehouse (USACE 2013) with historical records of dredging projects and interactions with ESA species. It now maintains the Operations and Dredging Endangered Species System to manage new records of dredging projects and interactions with ESA species. Along with the dredging/relocation trawling reports from the first 2 hopper dredging seasons of the SHEP entrance channel, these are the primary sources, discussed further below, for our analysis of dredging effects on green sea turtles.

Hopper Dredging
Hopper dredging was implicated in the mortality of South Atlantic endangered and threatened sea turtles as early as the late 1970s and in NMFS's Opinions issued in 1979, 1980, and others leading to the SARBO issued in 1991. This determination was repeated in the 1995 and 1997 SARBOs (NMFS 1995, 1997b) and the 2003 GRBO. The measures established in consecutive SARBOs (NMFS 1991, 1995, 1997b) to avoid and minimize sea turtle interactions during hopper dredging operations permitted by the USACE in the southeastern United States are included in this project, with the exception of modifications to dredge timing (i.e., "dredging window") and conditions of/requirements for capture-type relocation trawling. For SHEP, the duration of the hopper dredging was extended to April 15 and a condition was made to accommodate the safe release of leatherback turtles by requiring a cargo net to be available on relocation trawlers.

Savannah Harbor Entrance Channel
The previous ITS in the 2013 amendment estimated 3 lethal green sea turtle takes due to hopper dredging of the entrance channel and 3 non-lethal takes due to relocation trawling. However, the first two seasons of work in the entrance channel revealed that these levels of green sea turtle take were underestimated. The USACE reports that 5 lethal takes and 2 non-lethal takes of green sea turtles occurred during the first 2 years of entrance channel hopper dredging. The 2 non-lethally taken green sea turtles were injured and transported to the Jekyll Island Rehabilitation Center. Both turtles have since been released after making a full recovery. We believe the survival of the 2 green sea turtles after being entrained by the hopper dredge was an extremely rare and unusual occurrence. Very few turtles (over the years, a fraction of a percent) survive entrainment in hopper dredges, usually smaller juveniles that are sucked through the pumps without being dismembered or badly injured. Often they will appear uninjured only to die days later of unknown internal injuries while in rehabilitation. Experience has shown that the vast majority of sea turtles entrained in hopper-dredges are immediately crushed or dismembered by the violent forces they are subjected to during entrainment. In addition, the 2 live-but-injured turtles taken by the dredge would have died in the hopper had they not been observed, rescued, and taken to the sea turtle rehabilitation center. Therefore, to be conservative in our take calculations for the remaining dredging, we are counting all 7 green sea turtles taken in the first 2 years of entrance channel dredging (5 taken lethally and 2 taken non-lethally but with injuries) as lethal takes and we will assume that any additional green sea turtles taken by hopper dredging will be lethal.

We calculated the "observed" CPUE of green sea turtles (turtles per yd^3 of dredged material) lethally taken during the first 2 years of hopper dredging the entrance channel. We did not consider the material removed using the cutterhead dredge in our calculation since non-hopper-type dredges are not known to take sea turtles. The "observed" CPUE only estimates the observed number of sea turtles taken per yd^3 of dredged material, and not the total number of green sea turtles we expect to be lethally taken during dredging. As discussed in the next section, observers are not able to detect all turtles taken during hopper dredging and we will calculate the total sea turtle takes after we first estimate observed takes.

We calculated the "observed" CPUE during the first 2 years of hopper dredging the entrance channel by dividing the number of observed takes (7 turtles) by the amount of material removed using a hopper dredge. The USACE estimates that 4,026,278 yd^3 of material was removed using a hopper dredge during the first 2 dredging seasons, yielding a CPUE of 0.00000173858 green turtles taken per yd^3 of hopper dredged material. The USACE reports that a recent survey determined an additional 4,200,000 yd^3 of material still needs to be dredged from the entrance channel. The remaining entrance channel dredging will be conducted via hydraulic cutterhead, hopper, or a combination of the two types. Because we do not know what type of dredge will be used, we will assume 100% will be conducted with a hopper dredge. Based on the estimated 8,226,278 yd^3 of material that will be removed from the entrance channel over the duration of the project (4,026,278 yd^3 of material already hopper dredged plus 4,200,000 yd^3 of material still to be dredged), we estimate that 15 green sea turtles may be observed to be lethally taken by hopper dredging in the entrance channel in total (8,226,278 yd^3 multiplied by 0.00000173858 green turtles observed taken per yd^3 of hopper dredged material, rounded up to the nearest whole number). Since USACE has already observed 7 green sea turtle takes during the first two seasons of entrance channel hopper dredging, we estimate up to 8 additional observed green sea turtles may be lethally taken during the remainder of the entrance channel hopper dredging.

As noted above, observers are not able to detect all turtles taken during hopper dredging. Hopper dredging projects are often required by the terms of their authorization to have NMFS-approved observers onboard to monitor dredged material inflow and overflow screening baskets. Dredged material screening is only partially effective, and observed takes likely provide only partial estimates of total sea turtle mortality. NMFS believes that some turtles killed by hopper dredges go undetected because body parts are forced through the sampling screens by water pressure and are buried in the dredged material, or animals are crushed or killed but their bodies or body parts are not entrained by the suction and so the takes may go unnoticed. The only mortalities that are noticed and documented are those where body parts float, are large enough to be caught in the screens, and can be identified as sea turtle parts. Body parts that are forced through the 4-in (or greater) inflow screens of the suction dragheads by the suction-pump pressure and that do not float are very unlikely to be observed, since they will sink to the bottom of the hopper and not be detected by the overflow screening. Unobserved takes are not documented, thus, observed takes likely under-represent actual lethal takes.

While it is unknown how many turtles are killed but unobserved, NMFS estimated in the GRBO (NMFS 2003b) that up to 1 out of 2 impacted turtles may go undetected (i.e., that observed take constituted only about 50% of total take). The 50% estimate was based on all hopper dredging projects in the Gulf of Mexico occurring year-round, including seasonal windows when no observers are required, times when 100% coverage is required, and times when only 50% observer coverage is required. The hopper dredging of the Savannah Harbor Entrance Channel is required to implement 100% observer coverage. Since the 100% observer coverage required for the SHEP dredging action is twice as intensive (and theoretically, twice as effective) as the 50% observer coverage requirement of the 2003 GRBO, NMFS believes that a significantly greater number of turtles are being detected with 100% observer coverage than with just 50% observer coverage (i.e., 1 of 2 turtles). NMFS's biological Opinion to the USACE's Galveston District on the Freeport Harbor Navigation Channel widening and deepening project (also with 100% observer coverage) anticipated that approximately 66.7 % (i.e., 2 out of 3) of entrained turtles would be detected. Similarly, we estimate that observers on this project will continue to detect approximately 2 of every 3 turtles entrained. This estimate is based on the use of 100% observer coverage, the best available empirical evidence, years of hopper dredging experience and observer reports, and the commonality of the 100% observer requirement with previous dredging consultations under similar conditions. This amendment estimates that observers will detect and record approximately 66.7 % of total mortality (i.e., 2 of every 3 turtles killed by the dredge will be detected, observed, and tallied by onboard observers). Therefore, based on our estimated observed lethal take of 15 green sea turtles by hopper dredging, we estimate that a total of 23 green sea turtles may be lethally taken during entrance channel hopper dredging (15 observed turtle takes divided by 0.667, rounded up to the nearest whole number).

As with previous NMFS biological Opinions on hopper dredging, our subsequent jeopardy analysis is necessarily based on our knowledge (in this case, our best estimate) of the total number of green sea turtles that will be lethally taken, which includes those that are killed but not observed. Our best estimate of turtles lethally taken will be the sum of the observed and unobserved takes, i.e., those observed and documented by onboard protected species observers, plus those unobserved, undocumented lethal takes (because the turtles/turtle parts were either not entrained, or were entrained but were not seen/counted by onboard protected species observers). Our ITS is based on observed takes, not only because observed mortality gives us an estimate of unobserved mortality, but because observed, documented take numbers serve as triggers for some of the reasonable and prudent measures, and for potential reinitiation of consultation if actual observed takes exceed the anticipated/authorized number of observed takes. Furthermore, our ITS level of anticipated/authorized lethal takes assumes ongoing sea turtle relocation trawling, since it is an integral and important part of the action. Without relocation trawling, mortalities resulting from hopper dredge activities could be higher.

5.1.2 Relocation Trawling

During the first 2 seasons of the deepening of the Savannah Harbor entrance channel, relocation trawling has been successful at relocating 8 Kemp's ridley, 10 loggerhead, 1 leatherback, and 2 green sea turtles from the intended path of the hopper dredge in the entrance channel. Dickerson et al. (2007) analyzed historical data for USACE dredging projects in the Atlantic Ocean and Gulf of Mexico and concluded that relocation trawling is effective at reducing the rate of sea turtle entrainment by hopper dredges. Dickerson et al. (2007) also found that the effectiveness of relocation trawling was increased when the trawling was initiated at the beginning or early in the project and by the intensity of trawling effort (i.e., more time trawling per hour). Dickerson et al. (2007) noted that when a relocation trawler is used – whether or not turtles are actually captured – the incidence of lethal sea turtle take by hopper dredges decreases. Dickerson et al. (2007) concluded that the action of the trawl gear on the bottom results in stimulating turtles off the bottom and into the water column, where they are no longer likely to be impacted by the suction draghead of a hopper dredge.

Sea Turtle Mortalities by Relocation Trawling
Between 1991 and 2011, the USACE has documented more than 75 hopper-dredging projects in the South Atlantic and Gulf of Mexico where a relocation trawler was used as part of the project, with thousands of individual net tows. In addition, the USACE has also conducted or permitted abundance assessments and/or project-specific relocation trawling of sea turtles in navigation channels and sand borrow areas in the Southeast and Gulf of Mexico using commercial shrimp vessels equipped with otter trawls (Sea Turtle Data Warehouse; D. Dickerson 2007). On 8 occasions a turtle has been lethally or injuriously taken by a relocation trawler (6 in the Gulf of Mexico and 2 in the South Atlantic) over the same 20-year period (USACE Sea Turtle Warehouse; pers. comm. T. Jordan, USACE, to E. Hawk, NMFS, May 23, 2011). Some of these incidents are described below.

Rarely, properly conducted relocation trawling can result in accidental sea turtle deaths, as the following examples illustrate. Henwood noted that trawl-captured loggerhead sea turtles died on several occasions during handling on deck during winter trawling in Canaveral Channel in the early 1980s, after short (approximately 30 minutes) tow times. However, Henwood (T. Henwood, NMFS SEFSC, pers. comm. to E. Hawk, NMFS, December 6, 2002) also noted that a significant number of the loggerheads captured at Canaveral during winter months appeared to be physically stressed and in "bad shape" compared to loggerheads captured in the summer months from the same site that appeared much healthier and robust.

In November 2002, during relocation trawling conducted in York Spit, Virginia, a Kemp's ridley sea turtle was likely struck by one of the heavy trawl doors or it may have been struck and killed by another vessel shortly before trawl net capture. The hopper dredge was not working in the area at the time. Additionally, during relocation trawling conducted off Destin, Florida, on December 2, 2006, a leatherback turtle was captured and killed. However, this mortality by drowning occurred after the trawler encountered and entangled its trawl net on a large section of uncharted bottom debris, and was unable to retrieve it from the bottom for several hours (Dickerson et al. 2007). During over 15 days of dredging and associated turtle relocation trawling conducted between July 9 and 23, 2010, for the construction of 35 mi of oil-barrier sand-berms at Hewes Point, Chandeleur Islands, Louisiana, 194 sea turtles were trawl-captured, with 3 mortalities in 584 thirty-minute tows, or a 1.5% mortality rate (R. Crabtree, NMFS, letter to USACE, dated January 14, 2011). NMFS considers that this rate is unusually high, given the last 2 decades of relocation trawling experience. The reason for the unusually high level of relocation trawler turtle mortalities associated with the berm project is unknown. At Mayport Channel dredging in April 2011, a green turtle was drowned when it entangled in an improperly designed non-capture trawl net (non-capture trawl nets have typical tow times of 3-4 hours, since they are not designed to capture turtles).

Trawl Tow Time Limits
The National Research Council (NRC) report "Decline of the Sea Turtles: Causes and Prevention" (NRC 1990) suggested that limiting tow durations to 40 minutes in summer and 60 minutes in winter would yield sea turtle survival rates that approximate those required for the approval of new TED designs, i.e., 97%. The NRC report also concluded that mortality of turtles

caught in shrimp trawls increases markedly for tow times greater than 60 minutes. Current NMFS TED regulations allow, under very specific circumstances, for shrimpers with no mechanical-advantage trawl retrieval devices on board, to be exempt from TED requirements if they limit tow times to 55 minutes during April through October and 75 minutes from November through March. The presumption is that these tow time limits will result in turtle survivability comparable to having TEDs installed. Based on 1,225 tows (584 in the nearshore Gulf of Mexico and 641 in the nearshore South Atlantic) following the time restrictions required for TED exemption, 295 sea turtles were captured during trawling. There were 7 mortalities (6 in the South Atlantic and 1 in the Gulf of Mexico) out of the 295 trawl-caught turtles, yielding a trawling mortality rate of 2.4% (7 mortalities divided by the total capture of 295 sea turtles).

Current NMFS SERO Opinions typically limit tow times for relocation trawling to 42 minutes or less, measured from the time the trawl doors enter the water when setting the net to the time the trawl doors exit the water during haulback ("doors in – doors out"). This approximates 30 minutes of bottom-trawling time. The USACE further limits authorized relocation trawling time in association with hopper dredging to 30 minutes or less, doors in to doors out. Overall, the significantly reduced relocation trawling tow times compared to those used during the 1998 studies on the effects of 55-minute and 75-minute tow times leads NMFS to conclude that current relocation trawling mortalities occur (and will continue to occur) at a much lower rate than 2.4%. Relocation trawling data bears this out strikingly: from October 2006 to July 2013, USACE dredging projects relocated 1,359 turtles in the Gulf of Mexico and South Atlantic. There were 8 documented mortalities during those relocation events or 0.6% mortality (8 mortalities divided by the total capture of 1,359 sea turtles) overall (USACE Sea Turtle Data Warehouse, queried July 2013 before the website was closed down by USACE).

Total Impact of Relocation Trawling on Sea Turtles

Even though relocation trawling involves the take (via capture, collection, and relocation) of sea turtles, it has constituted a legitimate RPM in past NMFS biological Opinions on hopper dredging because it reduces the level of almost certain mortality of sea turtles by hopper dredges, and it allows the sea turtles captured non-injuriously by trawl to be relocated out of the path of the dredges. NMFS believes that properly conducted relocation trawling (i.e., NMFS-recommended trawl speed and tow-time limits as required in SARBO are implemented and adequate precautions to release captured animals are taken) that is monitored by trained observers will result in a low mortality rate (0.6%) to green sea turtles while greatly reducing the number of green sea turtles lethally taken during hopper dredging of the entrance channel. Without relocation trawling, the number of sea turtle mortalities resulting from hopper dredging would likely be significantly greater than the estimated number discussed above and specified in the ITS. The Consultation Handbook (for Procedures for Conducting Consultation and Conference Activities under Section 7 of the Endangered Species Act, U.S. Fish and Wildlife Service and National Marine Fisheries Service, March 1998) expressly authorizes such directed take as an RPM at pages 4-54. Therefore, NMFS will in this section evaluate the expected number of sea turtles collected or captured during the remainder of relocation trawling for the project, so that these numbers can be included in the evaluation of whether the action will jeopardize the continued existence of the species.

Dickerson et al. (2007) concluded that relocation trawling is an effective management option for reducing incidental take of sea turtles during hopper dredging in some locations, provided aggressive trawling effort is initiated either at the onset of dredging or early in the project. It is reasonable to assume that, in the absence of relocation trawling the number of sea turtle mortalities would increase, but predicting a precise number would be problematic due to the fact that the USACE has not been consistent in previous years in using relocation trawling as a standard practice for the maintenance dredging of the Savannah Harbor Entrance Channel. The number of sea turtles captured by relocation trawlers does not directly translate into potential mortalities by hopper dredges in the absence of relocation trawling, due to the differences in footprint between the 2 gear types. The spread of a relocation trawler's net is much greater than the width of a hopper dredge's dragheads; therefore, the trawler will encounter a significantly greater number of sea turtles.

Estimating the Number of Relocation Trawler Takes during Project Dredging

Due to lack of data, the take of green sea turtles during relocation trawling was underestimated in the ITS in the 2013 Amendment to the 2011 SHEP Biological Opinion. In the past few years since that amendment was written, we have seen an increasing number of green sea turtles in areas or during periods when they were previously not abundant. This may be due to many factors such as a change in sea temperatures, climate change, or prey abundance causing turtles to move into areas earlier than expected or greater efficiency in the ability of relocation trawling to capture turtles. During the first 2 seasons of relocation trawling for the Savannah Harbor entrance channel dredging, 2 green sea turtles were non-lethally captured. Approximately 48.9% of the hopper dredging (4,026,278 yd^3 out of 8,226,278 yd^3 total) was completed during this time period. Therefore, we expect up to 3 more green sea turtles will be captured during the remaining relocation trawling for a total of 5 trawl-caught green sea turtles (2 green sea turtles captured divided by 0.489, rounded up to the nearest whole number).

Relocation trawling usually results in non-lethal, non-injurious take due to the short duration of the tow times (15 to 30 minutes per tow; not more than 42 minutes) and required safe-handling procedures. Though rare, mortality of trawl-caught sea turtles can occur. As previously explained, NMFS estimates that relocation trawling could result in up to 0.6% mortality of captured turtles, primarily due to their being previously stressed or diseased, or if struck by trawl doors, or from accidents occurring during handling in the water and on deck. During the first 2 years of relocation trawling, 2 green sea turtles were taken non-lethally. We anticipate that up to 3 additional green sea turtles will be captured during relocation trawling and that no more than 1 green sea turtle mortality (3 turtles multiplied by 0.6% mortality, rounded to the nearest whole number) will occur during the remaining relocation trawling.

Flipper Tagging

Tagging is a non-injurious form of take. Flipper tagging of turtles captured during relocation trawling is not expected to have any detrimental effects on captured animals. Tagging prior to release will help NMFS learn more about the habits and identity of trawl-captured animals after they are released, and if they are recaptured they will enable improvements in relocation trawling design to further reduce the effect of the hopper dredging activities. External and internal flipper tagging with Inconel and PIT tags is not considered a dangerous procedure by the sea turtle research community, is routinely done by thousands of volunteers in the United States and abroad, and can be safely accomplished with minimal training. NMFS knows of no instance where flipper tagging has resulted in mortality or serious injury to a trawl-captured sea turtle. Such an occurrence would be extremely unlikely because the technique of applying a flipper tag is minimally traumatic and relatively noninvasive; in addition, these tags are attached using sterile techniques. Important growth, life history, and migratory behavior data may be obtained from turtles captured and subsequently relocated. Therefore, these turtles should not be released without tagging (and prior scanning for pre-existing tags).

Genetic Sampling
Analysis of genetic samples may provide information on sea turtle populations such as life history, nesting beach identification, and distribution/stock overlap. This may ultimately lead to enhanced sea turtle protection measures. Tissue sampling is performed to determine the genetic origins of captured sea turtles, and learn more about turtle nesting beach/population origins. For all tissue sample collections, a sterile 4- to 6-mm punch sampler is used. Researchers who examined turtles caught 2 to 3 weeks after sample collection noted that the sample collection site was almost completely healed. Genetic sampling is a non-injurious form of take. NMFS does not expect that the collection of a tissue sample from each captured turtle will cause any additional stress or discomfort to the turtle beyond that experienced during capture, collection of measurements, and tagging. Tissue sampling procedures are specified in the Terms and Conditions in Section 9.

5.1.3 Dredged Material Disposal

No new information has become available since the original Opinion and 2013 amendment were issued to change our original determination that dredged material disposal activities are not likely to adversely affect green sea turtles. Sea turtles may be attracted to Ocean Dredged Material Disposal Sites (ODMDSs) to forage on the bycatch that may be occasionally found in the dredged material being dumped. As such, turtles could be potentially impacted by the sediments being discharged overhead. However, NMFS does not expect an injury from, nor has ever received a report of an injury to a sea turtle resulting from disposal of hopper-dredge-released sediments, either from inshore or offshore disposal sites, anywhere the USACE conducts dredged material disposal operations. Green sea turtles are highly mobile and due to their swimming speed, we believe they are able to avoid a descending sediment plume discharged at the surface by a hopper dredge opening its hopper doors, or pumping its sediment load over the side. Even if temporarily enveloped in a sediment plume, NMFS believes the possibility of injury or burial of normal, healthy sea turtles by dredged material (i.e., sand and silt) disposal, is discountable or its effects insignificant. NMFS believes that foraging habitat for green sea turtles is not likely a limiting factor in the action area, and thus the loss of potential sand bottom foraging habitat adjacent to, or on the surface of, the disposal areas (compared to remaining foraging habitat) from burial by dredged material sediments will have insignificant effects on green sea turtles. The risk of injury to green sea turtles from collisions with dredge-related vessels is also considered discountable, considering the species' mobility and the slow speed of the hopper dredge vessels and associated barges and scows.

5.1.4 Assignment of Takes to NA DPS and SA DPS

Entrance channel dredging and associated relocation trawling will result in takes of green sea turtles. Based on the above estimates, a total of 15 green sea turtles would be observed lethally taken by the hopper dredging over 3 seasons of dredging, but up to 23 green sea turtles total could be lethally taken since we estimate that only 67% of sea turtle takes are observed. A total of 5 green sea turtles would be taken by relocation trawling during the 3 seasons of the project dredging, with no more than 1 expected to be a lethal take. As discussed in the status of the species (Section 3), on April 6, 2016, the single species listing was replaced with the listing of 11 DPSs. Therefore, this amendment must evaluate the effects of the action on the newly listed DPSs that may be in the action area.

Individuals from both the NA and SA DPSs can be found in the action area of the project. 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 the best available science 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 juvenile 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).

Hopper Dredging
NA Green Sea Turtle DPS= **Up to 23** (100% of 23) green sea turtles from the NA DPS could be lethally taken during hopper dredging during the 3 seasons of dredging.

SA Green Sea Turtle DPS= **Up to 2** (5% of 23, rounded to the nearest whole number) green sea turtles from the SA DPS could be lethally taken during hopper dredging during the 3 seasons of dredging.

Relocation Trawling
NA Green Sea Turtle DPS= **Up to 5** (100% of 5) green sea turtles from the NA DPS could be captured in relocation trawling gear during the 3 seasons of dredging. No more than 1 green sea turtle mortality (0.6% of 5, rounded to the nearest whole number) from this DPS is expected to occur.

SA Green Sea Turtle DPS= **Up to 1** (5% of 5, rounded to the nearest whole number) green sea turtles from the SA DPS could be captured in relocation trawling gear during the 3 seasons of dredging. No more than 1 green sea turtle mortality (0.6% of 1, rounded to the nearest whole number) from this DPS is expected to occur.

5.2 Effects of the Action on Atlantic Sturgeon (All 5 DPSs)

5.2.1 Entrance Channel Hopper Dredging

Sturgeon are vulnerable to entrainment in hopper dredges. As noted previously, the size and flow rates produced by the suction power of the dredge, the condition of the channel being dredged, and the method of operation of the dredge and draghead all relate to the potential of the dredge to entrain sturgeon (Reine and Clarke, 1998). Additionally, the likelihood of entrainment is influenced by the swimming stamina and size of the individual fish at risk (Boysen and Hoover, 2009). Swimming stamina is positively correlated with total fish length. Entrainment of larger sturgeon is less likely due to the increased swimming performance and the relatively small size of the draghead opening. Juvenile entrainment is possible depending on the location of the dredging operations and the time of year in which the dredging occurs. Typically major concerns of juvenile entrainment relate to fish below 200 mm (Hoover et al., 2005; Boysen and Hoover, 2009). Juvenile sturgeon are not powerful swimmers and they are prone to bottom-holding behaviors, which make them vulnerable to entrainment when in close proximity to dragheads (Hoover et al., 2011).

In general, entrainment of large mobile animals, such as sturgeon, is relatively rare. Several factors are thought to contribute to the likelihood of entrainment. In areas where animals are present in high density, the risk of an interaction is greater because more animals are exposed to the potential for entrainment. The risk of entrainment is likely to be higher in areas where the movements of animals are restricted (e.g., in narrow rivers or confined bays) where there is limited opportunity for animals to move away from the dredge than in unconfined areas such as wide rivers or open bays. The hopper dredge draghead operates on the bottom and is typically at least partially buried in the sediment. Sturgeon are benthic feeders and are often found at or near the bottom while foraging or while moving within rivers. Sturgeon at or near the bottom could be vulnerable to entrainment if they were unable to swim away from the draghead.

The original SHEP Opinion estimated that 4 Atlantic sturgeon would be lethally taken during hopper dredging; this estimate remained the same in the 2013 amendment to the SHEP Opinion. During the first 2 seasons of the Savannah Harbor entrance channel hopper dredging conducted 2015-2017, 5 Atlantic sturgeon were lethally taken. There are several possible reasons that could explain why the lethal take was exceeded. Prior to the extension of the entrance channel as a part of the SHEP, the new area extending the channel seaward had never been dredged. This is important to note because the information for calculating take of Atlantic sturgeon was based on takes occurring during regular maintenance dredging conducted within the existing navigational channel, which has been dredged for many years. This data indicated very few Atlantic sturgeon had been killed during hopper dredging and were the basis for determining that there would be 4 lethal takes of Atlantic sturgeon during the 3 years of offshore dredging. The exceedance of the lethal take limit did not occur until hopper dredging reached the previously undredged area where the entrance channel is being extended. It is possible that this new area (the channel extension) offers good foraging habitat to sturgeon as it may benefit from receiving nutrient-rich water from the riverine estuaries during tidal exchanges. If the area does benefit from the estuarine discharge, perhaps sturgeon prey are more abundant than in the surrounding sandy substrate beyond the channel and as a result, sturgeon congregate in greater numbers while using the area for foraging. An increased number of sturgeon congregated in a small area would lead to an increase in the potential for encounters with dredging equipment. The increased number of unanticipated takes may reflect what happens when intense dredging is sustained over a long period of time in one area such as with SHEP's deepening actions versus smaller scale navigational channel maintenance dredging. Another theory is that a warmer winter may have resulted in a shift in the distribution of sturgeon causing them to be more abundant off the Georgia coast during the dredging. It is also possible that Atlantic sturgeon may be more abundant than previously thought, but significant increases in takes in other areas have not been documented.

In order to revise our estimate of the number of Atlantic sturgeon lethally taken during hopper dredging over the life of the project, we first calculated the "observed" CPUE of Atlantic sturgeon (sturgeon per yd^3 of dredged material) lethally taken during the first 2 years of hopper dredging the entrance channel. We did not consider the material removed using the cutterhead dredge in our calculation since non-hopper-type dredges are not known to take sturgeon. The "observed" CPUE only estimates the observed number of sturgeon taken per yd^3 of dredged material, and not the total number of Atlantic sturgeon we expect to be lethally taken during dredging. As discussed in the next section, observers are not able to detect all sturgeon taken during hopper dredging and we will calculate the total Atlantic sturgeon takes after we first estimate observed takes.

We calculated the "observed" CPUE during the first 2 years of hopper dredging the entrance channel by dividing the number of observed takes (5 Atlantic sturgeon) by the amount of material removed using a hopper dredge. The USACE estimates that 4,026,278 yd^3 of material were removed using a hopper dredge during the first 2 dredging seasons, yielding a CPUE of 0.00000124184 Atlantic sturgeon taken per yd^3 of hopper dredged material. The USACE reports that a recent survey determined an additional 4,200,000 yd^3 of material still needs to be dredged from the entrance channel. The dredge type that will be used to complete the work is unknown at this time. In order to be conservative, we will assume 100% will be conducted with a hopper dredge. Based on the estimated 8,226,278 yd^3 of material that will be removed from the entrance channel over the duration of the project (4,026,278 yd^3 of material already hopper dredged plus 4,200,000 yd^3 of material still to be dredged), we estimate that as many as 11 Atlantic sturgeon may be observed to be lethally taken by hopper dredging in the entrance channel (8,226,278 yd^3 multiplied by 0.00000124184 Atlantic sturgeon observed taken per yd^3 of hopper dredged material, rounded up to the nearest whole number). Since USACE has already observed 5 Atlantic sturgeon takes during entrance channel hopper dredging, we estimate up to 6 additional Atlantic sturgeon may be observed to be lethally taken during the remainder of the entrance channel hopper dredging.

As noted above, observers are not able to detect all sturgeon taken during hopper dredging. Hopper dredging projects are often required by the terms of their authorization to have NMFS-approved observers onboard to monitor dredged material inflow and overflow screening baskets. Dredged material screening is only partially effective, and observed takes likely provide only partial estimates of total sturgeon mortality. NMFS believes that some sturgeon killed by hopper dredges go undetected because body parts are forced through the sampling screens by water pressure and are buried in the dredged material, or animals are crushed or killed but their bodies or body parts are not entrained by the suction and so the takes may go unnoticed. The only mortalities that are noticed and documented are those where body parts float, are large enough to be caught in the screens, and can be identified as sturgeon parts. Body parts that are forced through the 4-in (or greater) inflow screens of the suction dragheads by the suction-pump pressure and that do not float are very unlikely to be observed, since they will sink to the bottom of the hopper and not be detected by the overflow screening. Unobserved takes are not documented, thus, observed takes likely under-represent actual lethal takes.

As discussed in the section above on green sea turtles, we anticipate that approximately 66.7% of (i.e., 2 out of 3) entrained turtles would be detected. We do not have data specific to Atlantic sturgeon, however we believe that not all sturgeon that are killed by the hopper dredge will be observed. Without specific sturgeon data, we believe that the data on sea turtle observations is the best available science, and we apply a similar observation rate to Atlantic sturgeon takes. This amendment estimates that observers will detect and record approximately 66.7 % of total sturgeon mortality (i.e., 2 of every 3 sturgeon killed by the dredge will be detected, observed, and tallied by onboard observers). Therefore, based on our estimated total observed lethal take of 11 Atlantic sturgeon for all entrance channel hopper dredging, we estimate that a total of 17 Atlantic sturgeon may be lethally taken during all entrance channel hopper dredging (11 observed sturgeon takes divided by 0.667, rounded up to the nearest whole number).

As with previous NMFS biological Opinions on hopper dredging, our subsequent jeopardy analysis is necessarily based on our knowledge (in this case, our best estimate) of the total number of Atlantic sturgeon that will be lethally taken, which includes those that are killed but not observed. Our best estimate of sturgeon lethally taken will be the sum of the observed and unobserved takes, i.e., those observed and documented by onboard protected species observers, plus those unobserved, undocumented lethal takes (because the sturgeon/sturgeon parts were either not entrained, or were entrained but were not seen/counted by onboard protected species observers).

In our amended Incidental Take Statement (ITS), observed, documented take numbers serve as triggers for some of the reasonable and prudent measures, and for potential reinitiation of consultation if actual observed takes exceed the anticipated/authorized number of observed takes. Furthermore, our ITS level of anticipated/authorized lethal takes assumes ongoing sturgeon relocation trawling, since it is an integral and important part of the action. Without relocation trawling, mortalities resulting from hopper dredge activities could be higher.

5.2.2 Relocation Trawling

The original SHEP Opinion and the 2013 amendment did not predict that any lethal takes of Atlantic sturgeon would occur during relocation trawling. However, 1 Atlantic sturgeon was lethally taken during the second season of relocation trawling. The mortality was presumably caused when an Atlantic sturgeon was caught under several hundred pounds of cannonball jellyfish (*Stomolophus meleagris*) during trawl retrieval. Attempts to revive the sturgeon were unsuccessful. We believe this may be the first documented case of an Atlantic sturgeon being killed during relocation trawling.

The original SHEP Opinion estimated that 20 Atlantic sturgeon would be non-lethally captured and relocated during hopper dredging; this estimate remained the same in the 2013 amendment to the SHEP Opinion. However, within the first few days of the second season of relocation trawling, the non-lethal take was exceeded and take continued to occur during relocation trawling on an almost daily basis until dredging was stopped during the end of March. A total of 96 Atlantic sturgeon were caught; 95 were relocated and 1 Atlantic sturgeon died, as noted above. As discussed in the section above on hopper dredging, NMFS believes that dredging and relocation trawling within the new channel extension may have been a contributing factor to the higher than predicted take numbers. The graph below shows where the relocation trawler encountered Atlantic sturgeon. As can be seen, a greater number of Atlantic sturgeon were encountered at the outermost stations of the channel extension, the area that had not been previously dredged.

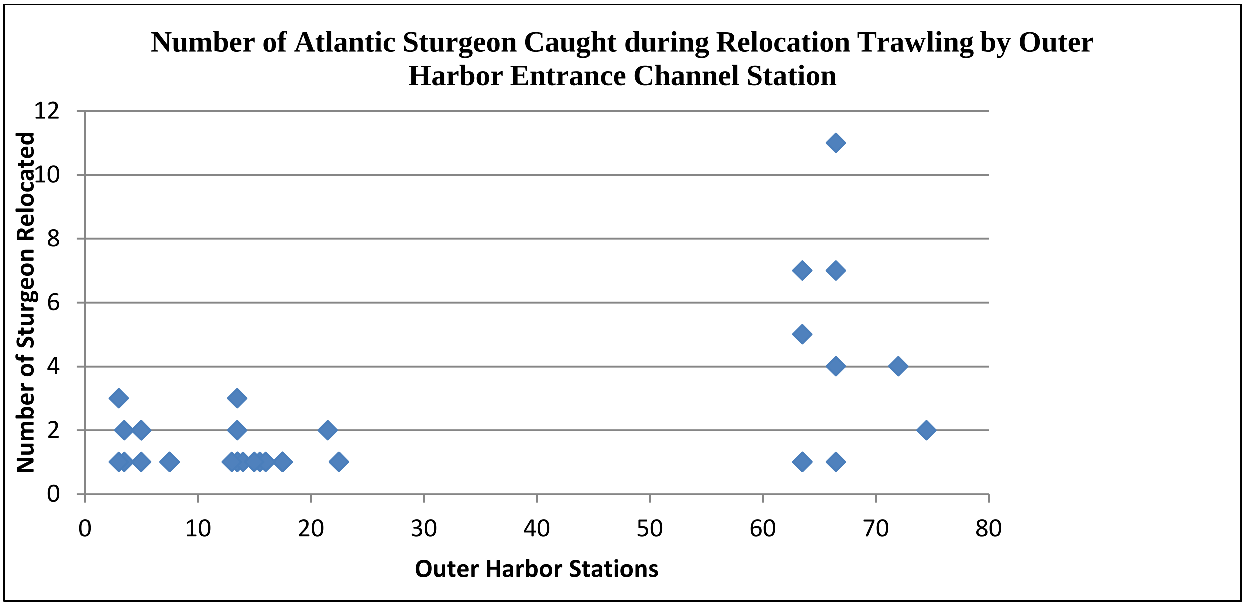

Figure 5. No. of Sturgeon Relocated from Outer Harbor Stations -0+000 to -76+000 during dredging seasons 1-2

We believe that Atlantic sturgeon may be congregating there because they consider it to be suitable for foraging and resting. The season 3 dredging to begin December 2017 and conclude in 2018, will be conducted adjacent to the areas dredged during season 2 and will also include the very terminal end of the channel extension, which has also never been dredged before (Stations -73+000 to -97+680).

During the first 2 seasons of relocation trawling for the Savannah Harbor entrance channel dredging, 95 Atlantic sturgeon were non-lethally captured. Approximately 48.9% of the hopper dredging (4,026,278 yd^3 out of 8,226,278 yd^3 total) was completed during this time period. Therefore, we expect up to 100 more Atlantic sturgeon will be captured during the remaining relocation trawling for a total of 195 trawl-caught Atlantic sturgeon (95 Atlantic sturgeon captured divided by 0.489, rounded up to the nearest whole number).

Relocation trawling usually results in non-lethal, non-injurious take due to the short duration of the tow times (15 to 30 minutes per tow; not more than 42 minutes) and required safe-handling procedures. The single Atlantic sturgeon mortality that occurred during the second season of dredging the Savannah Harbor entrance channel is the first report we have received of a lethal take of sturgeon during relocation trawling. Approximately 48.9% of the hopper dredging (4,026,278 yd^3 out of 8,226,278 yd^3 total) was completed during this time period. Therefore, we expect up to 2 more Atlantic sturgeon will be lethally captured during the remaining relocation trawling for a total of 3 lethally trawl-caught Atlantic sturgeon (1 Atlantic sturgeon captured divided by 0.489, rounded up to the nearest whole number).

Tagging and Genetic Sampling
In addition to not having dredging/relocation trawling data for the outer harbor area while preparing the 2011 SHEP Biological Opinion, the lack of distribution data on Atlantic sturgeon in this area hindered our efforts to develop a realistic ITS for this species. Genetic sampling and tagging efforts carried out during SHEP's relocation trawling will provide helpful information that will assist in better protection of sturgeon in the future, and will allow identification of the DPS of fish captured. During relocation trawling in the first 2 dredging seasons, 59 Atlantic sturgeon were tagged with PIT tags. All sturgeon were scanned for PIT tags and 3 were detected with tags already in place. Those sturgeon had been previously tagged by sturgeon researchers in the Savannah River during 2015 and 2016 as a part of ongoing studies on sturgeon.

Tagging is a non-injurious form of take. Continued tagging of sturgeon caught during relocation trawling is not expected to have any detrimental effects on these fish. Tagging prior to release will help NMFS learn more about the habits and identity of trawl-captured animals after they are released, and if they are recaptured they will enable improvements in relocation trawling design to further reduce the effect of the hopper dredging activities. Tagging with PIT tags is not considered a dangerous procedure by the sturgeon research community, is routinely done by observers onboard vessels and can be safely accomplished with minimal training. NMFS knows of no instance where PIT tagging has resulted in mortality or serious injury to a trawl-captured sturgeon. Such an occurrence would be extremely unlikely because the technique of applying a PIT tag is minimally traumatic and relatively noninvasive; in addition, these tags are attached using sterile techniques. Important growth, life history, and migratory behavior data may be obtained from sturgeon captured and subsequently relocated. Therefore, sturgeon should be scanned for pre-existing tags and tagged before release if they are not already tagged.

Likewise, analysis of genetic samples may provide information on sturgeon DPS populations such as life history, and distribution/stock overlap. This may ultimately lead to enhanced sturgeon protection measures. Tissue sampling is performed to determine the genetic origins of captured sturgeon, and learn more about their distribution. Researchers who examined sturgeon caught after sample collection noted that the sample collection site was almost completely healed. Genetic sampling is a non-injurious form of take. NMFS does not expect that the collection of a tissue sample from each captured sturgeon will cause any additional stress or discomfort to the fish beyond that experienced during capture, collection of measurements, and tagging. Tissue sampling procedures are specified in the Terms and Conditions in Section 9.

5.2.3 Dredged Material Disposal

No new information has become available since the original Opinion and 2013 amendment were issued to change our original determination that dredged material disposal activities are not likely to adversely affect Atlantic sturgeon. Sturgeon may be attracted to the ODMDS to forage on prey that may be disturbed when the dredged material is being dumped. They could also be potentially impacted by the sediments being discharged overhead. However, NMFS does not expect an injury from, nor has ever received a report of an injury to a sturgeon resulting from disposal of hopper-dredge-released sediments, either from inshore or offshore disposal sites, anywhere the USACE conducts dredged material disposal operations. Sturgeon are highly mobile and we believe their swim speeds allow them to avoid a descending sediment plume discharged at the surface by a hopper dredge opening its hopper doors, or pumping its sediment load over the side. Even if temporarily enveloped in a sediment plume, NMFS believes the possibility of injury or burial+ of normal, healthy sturgeon by dredged material (i.e., sand and silt) disposal, is discountable or its effects insignificant. NMFS believes that foraging habitat for sturgeon is not likely a limiting factor in the action area, and thus the loss of potential foraging habitat adjacent to, or on the surface of, the disposal areas (compared to remaining foraging habitat) from burial by dredged material sediments will have insignificant effects on sturgeon.

5.2.4 Delay in Fish Passage Implementation

Implementation of NSBLD fish passage is delayed by provisions of the WIIN Act of 2016 which directs USACE to compare an in-river fish passage alternative (including removal of the existing lock and dam structure) to the previously evaluated out-of-river bypass design prior to implementation of fish passage at NSBLD. As described in Section 2, Proposed Action, the original Opinion required that construction of fish passage would begin prior to or concurrent with the start of inner harbor dredging so that fish passage would be completed slightly before or concurrent with the completion of inner harbor dredging. As described in the original Opinion, timing of fish passage implementation is an important measure to minimize adverse effects to Atlantic and shortnose sturgeon that will result from reduction in availability of suitable habitat caused by expansion of the navigation channel. Inner harbor dredging is currently scheduled to begin in October 2018. Due to the requirements of the WIIN Act, the current timeline for the in-river fish passage estimates that a construction contract for the selected fish passage alternative will be awarded in January 2021 and that fish passage will be complete 8 months after the end of the inner harbor dredging in 2022. Therefore, this amendment addresses the effects of the 8-month delay in full implementation of fish passage at NSBLD beyond that evaluated in the original Opinion.

As described in Section 3, water quality, salinity, DO, and access to spawning areas are all important factors influencing the status, conservation and recovery of Atlantic and shortnose sturgeon populations. The original Opinion identified fish passage at NSBLD as one of several project measures required to offset impacts to sturgeon habitat by increasing access to historically important, high quality spawning areas. Dredging of the inner harbor associated with SHEP is anticipated to affect sturgeon habitat through changes in water quality (primarily salinity and dissolved oxygen). Measures to offset low DO are also being implemented.

As evaluated in the original Opinion, the channel deepening will result in a 5,000-ft upstream movement in the salinity wedge in the main Savannah River. The Middle River will experience a smaller upstream movement in salinity, while the Back River will experience a larger downstream movement. Freshwater flow rerouting will provide some benefits to sturgeon habitat by offsetting upstream salinity movement. The 5,000-ft upstream movement in the salinity wedge in the Savannah River would not affect spawning areas, which are located over 100 mi upriver. However, salinity increases in the Savannah River will result in the loss of winter habitat for juvenile sturgeon. Specifically, based on hydrodynamic modeling and habitat change analyses, it is expected that 251 acres (ac) of juvenile Atlantic sturgeon habitat will be altered by SHEP, which represents 7.6% of their current estuarine habitat in the lower river. While the original Opinion determined that the SHEP project would have adverse effects to juvenile Atlantic sturgeon, we were not able to determine numerical limits for the number of Atlantic sturgeon that will be adversely affected due to uncertainty regarding population estimates as well as uncertainty regarding potential development and utilization of habitats affected by both the navigation project and the associated mitigation measures. However, as described in the original Opinion, we used habitat loss as a surrogate measure to monitor anticipated effects on Atlantic sturgeon and provide for reinitiation of consultation, and in the absence of more certain information we believe it is reasonable to project that the loss of 7.6% of juvenile foraging habitat will adversely affect 7.6% of the juvenile Atlantic sturgeon population in the river.

In the original Opinion, we discussed how prompt implementation of fish passage at NSBLD would minimize the habitat-related adverse effects to sturgeon described above. The original Opinion determined that time lags between inner harbor dredging and completion of fish passage will result in adverse effects on the year-class strength of sturgeon. Reduction in year-class is a major consequence for the late-maturing, long-lived sturgeon that spawn infrequently. Therefore, we expect the delay of fish passage implementation will further adversely affect juvenile Atlantic sturgeon, since dredging of the inner harbor downstream will now be completed prior to completion of the fish passage. We believe the delay in implementation evaluated in this amendment will result in adverse effects to juvenile Atlantic sturgeon by reductions in survival and maturation of an undetermined number of juveniles during the 8-month delay in fish passage implementation. This delay in fish passage implementation will result in a prolonged period of adverse effects to an unknown number of individuals. Newly spawned juvenile sturgeon are very sensitive to salinity. Salinity tolerance of juvenile sturgeon develops as they migrate downstream from spawning grounds. Sturgeon spawned in the habitat upstream of NSBLD would have greater time and distance over which to develop salinity tolerance before they encounter the salinity wedge. Without the completion of fish passage at NSBLD prior to completion of the dredging, juvenile Atlantic sturgeon spawned below NSBLD will have less time and distance to develop salinity tolerance before reaching the salinity wedge.

Due to fidelity to natal rivers, we expect that impacts resulting from inner harbor dredging, including associated habitat changes, will affect only juvenile Atlantic sturgeon of the South Atlantic DPS. Analysis of the best available information indicates that juvenile Atlantic sturgeon from the Savannah River population of the South Atlantic DPS will be affected by habitat loss due to the inner harbor dredging, though no estimates (of either the number of juveniles in the population or the number of juveniles likely to be affected) are available. The loss of foraging area mentioned above will reduce the amount of prey available to juveniles, making successful foraging more difficult. This reduction in prey and reduction in foraging success will result in slower growth rates and reduced fitness of juvenile sturgeon. Reduced fitness can also lead to disease and mortality. These effects will occur over the same habitat area described in the original Opinion, but sturgeon will be exposed to these effects for a longer time period due to delay in fish passage implementation. However, we do not believe the 8-month delay will change these sublethal effects to lethal effects, or affect a greater percentage of the population of juvenile Atlantic sturgeon in the action area.

With the transition from lower salinities to higher salinities, the estuarine species (vegetation and benthos) currently found in the area will shift further upriver. Surveys conducted by the USACE indicate that substrate suitable for the prey species preferred juvenile Atlantic sturgeon is found immediately upriver from the estuarine foraging habitat that will be modified by the increased salinity. The USACE surveys did not establish whether these areas support sturgeon prey species, but NMFS believes that this upriver habitat will eventually be colonized by prey species as the habitat equalizes to the higher salinities resulting from the upriver movement of the salt wedge. To compensate for the lost foraging habitat, sturgeon will be forced to shift foraging efforts into new areas, once suitable prey become available, or to intensify their foraging in the remaining suitable habitats, if sufficient prey remains there. To the extent that sturgeon and the ecosystem are capable of making these responses, the overall impacts of lost foraging habitat may eventually be reduced.

While fish passage will be delayed by 8 months, other measures for offsetting effects to sturgeon habitat are being implemented. The original Opinion summarized effects resulting from anticipated changes in water quality and determined that salinity increases and dissolved oxygen decreases would adversely affect foraging and resting habitat for sturgeon in the estuarine portion of the Savannah River. To offset low dissolved oxygen (DO), a DOIS is sited in the critical low DO area in the harbor. Summer DO levels in the harbor are regularly quite low, commonly dropping below 2 parts per million (ppm). Construction of the DOIS is 45% complete and the system is scheduled to become fully operational by the summer of 2019. This is expected to increase the habitat suitable for sturgeon by 6.5% in summer. Sturgeon will experience a 6.5% increase in available summer habitat for the majority of the period when inner harbor dredging is occurring (2018-2022) and for the full duration of the project life. Due to chronically low DO during the summer months, the availability of additional summer habitat is considered a benefit to sturgeon in the Savannah River.

The original Opinion also determined that adult and sub-adult Atlantic sturgeon are more salt tolerant than juvenile Atlantic sturgeon and forage mainly in the Atlantic Ocean and the effects of habitat alterations to adult and sub-adult Atlantic sturgeon would be insignificant. Though these Atlantic sturgeon life stages will be denied access to a larger area of important, high quality spawning habitat for an additional 8-month period due to the delay of fish passage implementation, we expect the delay to be insignificant. Adult Atlantic sturgeon are currently using spawning areas downstream of NSBLD, and we do not expect the quantity or success of spawning to be reduced by the delay in 8-month delay in fish passage implementation.

5.2.5 Assigning Takes to the 5 Atlantic Sturgeon DPSs

Atlantic sturgeon mix extensively in the marine environment, and 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 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) Protected Resources Division'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, though some fish used in the MSA could not be assigned to a DPS. Data from Northeast Fisheries Observer Program (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,[6] 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 6). The proposed action occurs in the Carolinian ecoregion.

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[6] 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 6. 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 7). 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 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%).

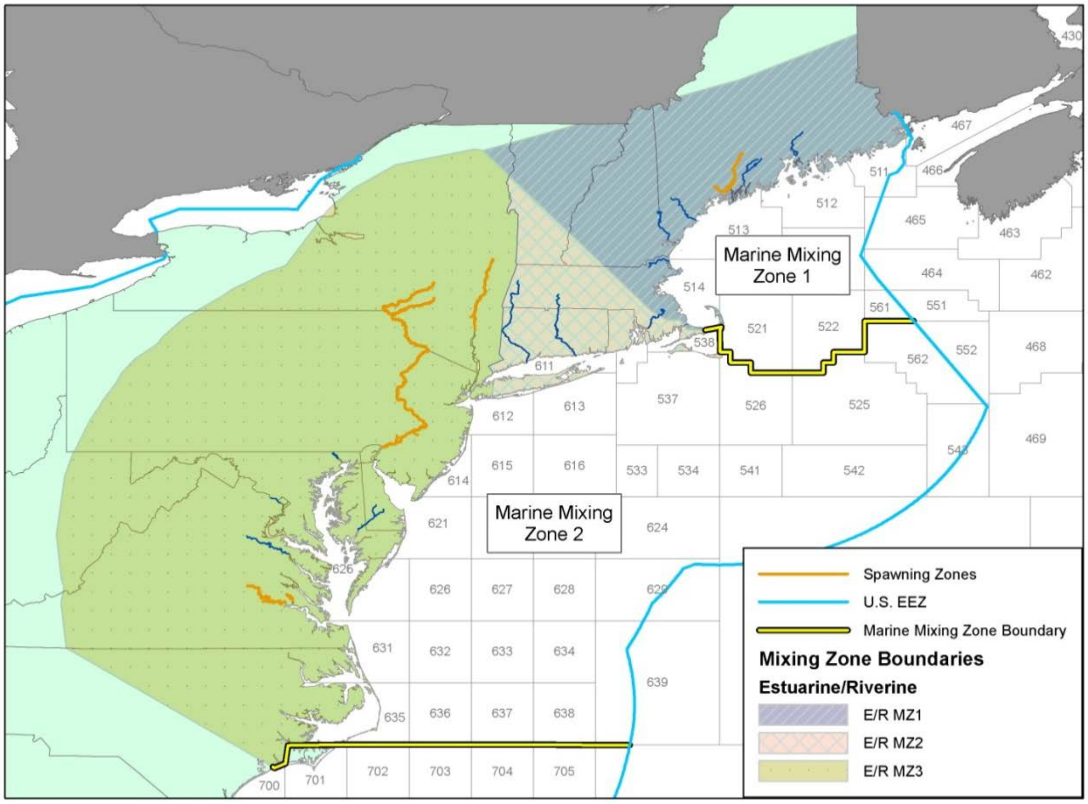

Figure 7. Map of Mixing Zones Source: (Damon-Randall et al. 2013)

We determined the number of Atlantic sturgeon from each DPS that would be taken during hopper dredging and relocation trawling by multiplying the total expected lethal and non-lethal take of Atlantic sturgeon by the percentage of sturgeon from each DPS expected to be in the action area based on the MSA and rounded up to the nearest whole number. Because we rounded up to the nearest whole number, the number of sturgeon taken from each DPS will be greater than the total estimated number of sturgeon. Tables 4-6 show the estimated take for each Atlantic sturgeon DPS by activity and type of take (lethal versus non-lethal).

Table 4. Estimated lethal take by hopper dredging for each DPS

DPS	Hopper Dredging
	Lethal
Total	**17**
Gulf of Maine DPS (11%)	2
New York Bight DPS (51%)	9
Chesapeake Bay DPS (13%)	3
Carolina DPS (2%)	1
South Atlantic DPS (22%)	4

Table 5. Estimated lethal and non-lethal take during relocation trawling for each DPS

DPS	Relocation Trawling	
	Non-lethal	**Lethal**
Total	**195**	**3**
Gulf of Maine DPS (11%)	22	1
New York Bight DPS (51%)	100	2
Chesapeake Bay DPS (13%)	26	1
Carolina DPS (2%)	4	1
South Atlantic DPS (22%)	43	1

Table 6. Total estimated lethal and non-lethal take for each DPS

DPS	Total Take by DPS	
	Non-lethal	**Lethal**
Total	**195**	**20**
Gulf of Maine DPS (11%)	22	3
New York Bight DPS (51%)	100	11
Chesapeake Bay DPS (13%)	26	4
Carolina DPS (2%)	4	2
South Atlantic DPS (22%)	43	5

5.3 Effects of the Action on Shortnose Sturgeon

The only action evaluated in this amendment that may adversely affect shortnose sturgeon is the delayed implementation of fish passage at NSBLD. Implementation of NSBLD fish passage is delayed by provisions of the WIIN Act of 2016 which directs USACE to compare an in-river fish passage alternative (including removal of the existing lock and dam structure) to the previously evaluated out-of-river bypass design, prior to implementation of fish passage at NSBLD. As described in the Section 2, Proposed Action, the 2011 Opinion required that construction of fish passage begin prior to or concurrent with the start of inner harbor dredging so that fish passage would be completed slightly before or concurrent with the completion of inner harbor dredging. Inner harbor dredging is currently scheduled to begin in October 2018. Due to the requirements of the WIIN Act, the current timeline for the in-river fish passage estimates that a construction contract for the fish passage will be awarded in January 2021 and that fish passage will be complete 8 months after the end of the inner harbor dredging in 2022. Therefore, this amendment addresses the effects of the 8-month delay in full implementation of fish passage at NSBLD beyond that evaluated in the original Opinion.

As described in Section 3, the status and recovery of sturgeon populations in the Savannah River is affected by water quality, DO, access to spawning areas, and salinity. As described in the original Opinion, fish passage at NSBLD is one of several project measures being implemented to offset impacts to sturgeon habitat by increasing access to historically important, high quality spawning areas. Dredging of the inner harbor associated with SHEP is anticipated to affect sturgeon habitat through changes in water quality (primarily salinity and dissolved oxygen). Measures to offset low DO are also being implemented, and flow re-routing has been implemented which will offset some of the impacts of increased salinities in the action area.

As evaluated in the original Opinion, the deepening within the inner harbor will result in impacts to shortnose sturgeon foraging habitat and the foraging base found there, which will affect an unknown portion of the Savannah River population of shortnose sturgeon that is believed to reside only within the action area. Habitat changes will result from changes in salinity and dissolved oxygen concentrations. Expansion of the navigation channel will result in a 5,000-ft upstream movement in the salinity wedge in the main Savannah River. The Middle River would experience a smaller upstream movement in salinity, while the Back River would experience a larger downstream movement. Freshwater flow rerouting will provide some benefits to sturgeon habitat by offsetting upstream salinity movement. The 5,000-ft upstream movement in the salinity wedge in the Savannah River would not affect spawning areas, which are located over 100 mi upriver. However, salinity increases throughout the Savannah river will result in the loss of winter habitat for juvenile sturgeon. Specifically, based on hydrodynamic modeling and habitat change analyses, it is expected that 251 ac of juvenile shortnose sturgeon habitat will be altered by SHEP, which represents 7.6% of their current estuarine habitat in the lower river. It is also expected that 266 ac of habitat important to adult and sub-adult shortnose sturgeon will be altered, which represents 6.9% of their current estuarine habitat in the lower river. In the absence of more certain information, it is reasonable to predict that approximately 7.6% of juvenile and 6.9% of adult shortnose sturgeon will be adversely affected by the deepening, though we are not able to reliably determine the specific number of shortnose sturgeon that would be affected due to uncertainty regarding population estimates as well as uncertainty regarding potential development and utilization of habitats affected by both the navigation project and the associated mitigation measures. Consequently, as described in the original Opinion and in more detail in the ITS below, we identified habitat change as a surrogate measure that is causally related to the potential take of shortnose sturgeon, and can be measured and monitored.

The loss of foraging area mentioned above will reduce the amount of prey available to juveniles, making successful foraging more difficult. This reduction in prey and reduction in foraging success will result in slower growth rates and reduced fitness of juvenile sturgeon. Reduced fitness can also lead to disease and mortality. Adult shortnose sturgeon will also face a reduction in foraging success which will lead to reduced fitness. Reduced fitness in adult shortnose sturgeon can lead to disease and mortality, lower fecundity in females, and a reduction in the energy required to make spawning runs, thereby, causing a lowering of reproductive success.

In the original Opinion, we discussed how prompt implementation of fish passage at NSBLD would minimize the habitat-related adverse effects to sturgeon described above. The original Opinion determined that time lags between inner harbor dredging and completion of fish passage will result in adverse effects on the year-class strength of sturgeon. Reduction in year-class is a major consequence for the late-maturing, long-lived sturgeon that spawn infrequently. Therefore, we expect the delay of fish passage implementation will further adversely affect shortnose sturgeon, since dredging of the inner harbor downstream will now be completed prior to completion of the fish passage. We believe the delay in implementation evaluated in this amendment will result in reductions in fitness of both juvenile and adult shortnose sturgeon, and reductions in maturation of juveniles, as a result of decreased foraging success. This delay in fish passage implementation will result in a prolonged period of adverse effects to an unknown number of individuals. Newly spawned juvenile sturgeon are very sensitive to salinity. Salinity tolerance of juvenile sturgeon develops as they migrate downstream from spawning grounds. Sturgeon spawned in the habitat upstream of NSBLD would have greater time and distance over which to develop salinity tolerance before they encounter the salinity wedge. Without the completion of fish passage at NSBLD prior to completion of the dredging, juvenile shortnose sturgeon spawned below NSBLD will have less time and distance to develop salinity tolerance before reaching the salinity wedge.

Habitat changes resulting from channel expansions will also adversely affect adult shortnose sturgeon through reduction in forage and resting habitats. Adult shortnose sturgeon will also face a reduction in foraging success which will lead to reduced fitness. Reduced fitness in adult shortnose sturgeon can lead to disease and mortality, lower fecundity in females, and a reduction in the energy required to make spawning runs, thereby, causing a lowering of reproductive success.

With the transition from lower salinities to higher salinities, the estuarine species (vegetation and benthos) currently found in the area will shift further upriver. To compensate for the lost foraging habitat, sturgeon will be forced to shift foraging efforts into new areas, once suitable prey become available, or to intensify their foraging in the remaining suitable habitats, if sufficient prey remains there. To the extent that sturgeon and the ecosystem are capable of making these responses, the overall impacts of lost foraging habitat may eventually be reduced.

These adverse effects to shortnose sturgeon will occur over the same habitat area described in the original Opinion, but will occur for a longer time period due to delay in fish passage implementation. However, we do not believe the 8-month delay will change these sublethal effects to lethal effects, or affect a greater percentage of the population of juvenile or adult shortnose sturgeon in the action area.

While fish passage will be delayed by 8 months, other measures for offsetting effects to sturgeon habitat are currently being implemented. The original Opinion summarized effects resulting from anticipated changes in water quality and determined that salinity increases and dissolved oxygen decreases would adversely affect foraging and resting habitat for sturgeon in the estuarine portion of the Savannah River. To offset low dissolved oxygen (DO), a DOIS is sited in the critical low DO area in the harbor. Summer DO levels in the harbor are regularly quite low, commonly dropping below 2 parts per million (ppm). Construction of the DOIS is 45% complete and the system is scheduled to become fully operational by the summer of 2019. This is expected to increase the habitat suitable for sturgeon by 6.5% in summer. Sturgeon will experience a 6.5% increase in available summer habitat for the majority of the period when inner harbor dredging is occurring (2018-2022) and for the full duration of the project life.

6 CUMULATIVE EFFECTS

Cumulative effects are the effects of future state, local, or private activities that are reasonably certain to occur within the action area considered in this biological Opinion. 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.

Within the action area, no reasonably certain future state, local or private activities beyond the continuation of those discussed in the environmental baseline section are expected. In addition, major future changes are not anticipated in ongoing human activities described in the environmental baseline. The present human uses of the action area, such as commercial shipping, boating, and fishing, are expected to continue at the present levels of intensity in the near future as are their associated risks of injury or mortality to sea turtles or sturgeon posed by incidental capture by fishermen, vessel collisions, pollution, coastal development, and 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.

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.

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.

Pollution
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).

Coastal Development/Maintenance
Beachfront development, lighting, and beach erosion control are all ongoing activities along the southeastern coast of the United States. These activities potentially reduce or degrade sea turtle nesting habitats or interfere with hatchling movement to sea. Human activities and development 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 have or are adopting more 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 who

charged the counties with failing to uphold the ESA by allowing unregulated beach lighting which results in takes of hatchlings.

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

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 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 amendment. The intent of the following discussion is to provide a basis for determining the additive effects of the take on green sea turtles and sturgeon in light of their present and anticipated future statuses.

The analyses conducted in the previous sections of this amendment serve to provide a basis to determine whether the proposed action would be likely to jeopardize the continued existence of green sea turtle DPSs, Atlantic sturgeon DPSs, and shortnose sturgeon. In Section 5, we outlined how the proposed action can affect green sea turtles and sturgeon and the extent of those effects in terms of estimates of the numbers or extent of each species expected to be killed. Now we turn to an assessment of each species' response to this impact, in terms of overall population effects from the estimated take, 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), will jeopardize the continued existence of the affected species.

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 status of each species likely to be adversely affected by the changes in the proposed action covered by this amendment is reviewed in Section 3.

Please refer to the original Opinion for detailed information on the jeopardy analyses for the species not evaluated in this amendment.

7.1 Green Sea Turtles (NA DPS and SA DPS)

Within U.S. waters, individuals from both the NA and SA DPSs can be found where the proposed action would occur. To analyze effects in a precautionary manner to address the uncertainty in level of impacts to each DPS , 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). Table 7 shows the estimated take of green sea turtles from each DPS under these two approaches.

Table 7. Estimated Take of Green Sea Turtles

	Hopper Dredging	Relocation Trawling			Total Maximum Take		Grand Total[7]
	Lethal	Lethal (Max)	Non-lethal (Max)	Total[8]	Lethal	Non-lethal	
Green Sea Turtles (SA + NA DPS)	**23**	**1**	**5**	**5**	**24**	**5**	**28**
NA DPS	23	1	5	5	24	5	28
SA DPS	2	1	1	1	3	1	3

[7] This column lists the total numbers of green sea turtles estimated to be taken, either lethally or non-lethally, during hopper dredging and relocation trawling. This number will not equal total maximum lethal takes plus the total maximum non-lethal take. See the next footnote for further explanation.

[8] This is the total number of green sea turtles we estimate will be captured during relocation trawling. There is a small likelihood (0.6%) that one of the captures could be lethal, though we expect all will likely be non-lethal (as has been the case during the project to date.) This table lists both the maximum lethal take and maximum non-lethal take estimated to occur during relocation trawling. The total numbers listed in this column will not equal the lethal plus the non-lethal take during relocation trawling.

7.1.1 Green Sea Turtle NA DPS

Hopper dredging of the entrance channel could result in the lethal take of up to 23 green sea turtles. To be conservative, we assumed that 100% of the 23 turtles lethally taken could come from the NA DPS. Further, we expect 5 green sea turtles, to be captured during relocation trawling, with no more than 1 of those captures being lethal. Therefore, up to 24 green sea turtles from the NA DPS could be lethally taken during hopper dredging of the entrance channel and the associated relocation trawling. The potential non-lethal capture of up to 5 green sea turtles from the NA DPS during relocation trawling over the 3 dredging seasons is not expected to have any measurable impact on the reproduction, numbers, or distribution of these species. The individuals suffering non-lethal injuries or stresses are expected to fully recover such that no reductions in reproduction or numbers of green sea turtles are anticipated. The captures may occur anywhere in the action area, which encompasses only a tiny portion of green sea turtles' overall range/distribution within the NA DPS. 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 of 24 NA DPS green sea turtles over the 3 dredging seasons 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, , 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 section of this amendment, 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 amendment 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 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 2007)(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 24 NA DPS green sea turtles over the 3 dredging seasons will not have any measurable effect on that trend. After analyzing the magnitude of the project dredging, in combination with the past, present, and future expected impacts to the DPS discussed in this amendment, we believe the 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 1991) 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 24 NA DPS green sea turtles over the 3 dredging seasons will result in a reduction in numbers when captures occur and a potential reduction in future reproduction, 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 amendment. Non-lethal captures of these sea turtles would not affect the adult female nesting population or number of nests per nesting season. Thus, the project dredging and relocation trawling 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.

Conclusion
The lethal and non-lethal captures associated with the project dredging 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

Hopper dredging of the entrance channel could result in the lethal take of up to 23 green sea turtles. To be conservative, we assumed that up to 5% or 2 of the 23 turtles lethally taken could come from the SA DPS. Further, we expect 5 green sea turtles to be captured during relocation trawling, with 1 of those turtles originating from the SA DPS. We expect that the trawl capture of the SA DPS green turtle will be non-lethal, however there is a small possibility (0.6%) that it could be lethal. Therefore, up to 3 green sea turtles from the SA DPS could be lethally taken during hopper dredging of the entrance channel and the associated relocation trawling. The potential non-lethal capture of 1 green sea turtle from the SA DPS during relocation trawling over the 3 dredging seasons is not expected to have any measurable impact on the reproduction, numbers, or distribution of these species. The individual suffering non-lethal injuries or stresses is expected to fully recover such that no reductions in reproduction or numbers of green sea turtles are anticipated. The capture 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 capture of 3 green sea turtles over 3 dredging seasons would reduce the number of green sea turtles, compared to their numbers in the absence of the project's 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 Section 3, 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 interaction is 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 this capture.

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 amendment, 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 amendment 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 considered the effects of future state, tribal, local, or private actions that are reasonably certain to occur within the action area.

In Section 3.4.1, 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 were 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 1989), 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 the SA DPS of green sea turtles is clearly increasing, we believe the potential lethal capture of 3 sea turtles over 3 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 amendment, 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.

Recovery

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 1991) 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 3 SA DPS green sea turtles over 3 dredging seasons will result in a reduction in numbers when a capture occurs and a potential reduction in future reproduction, 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 amendment. Non-lethal capture of a sea turtle would not affect the adult female nesting population or number of nests per nesting season. Thus, the project dredging and relocation trawling 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.

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

7.2 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. A jeopardy determination is made if the proposed action would appreciably reduce the likelihood of survival and recovery of any of the DPSs. Table 8 shows the estimated take of Atlantic sturgeon from each DPS during hopper dredging of the entrance channel and the associated relocation trawling.

Table 8. Estimated Take of Atlantic sturgeon

	Hopper Dredging	Relocation Trawling			Total Take		Grand Total
	Lethal	Lethal	Non-lethal	Total	Lethal	Non-lethal	
Atlantic Sturgeon (All DPSs)	**17**	**3**	**195**	**198**	**20**	**195**	**215**
Gulf of Maine DPS (11%)	2	1	22	23	3	22	25
New York Bight DPS (51%)	9	2	100	102	11	100	111
Chesapeake Bay DPS (13%)	3	1	26	27	4	26	30
Carolina DPS (2%)	1	1	4	5	2	4	6
South Atlantic DPS (22%)	4	1	43	44	5	43	48

7.2.1 Gulf of Maine DPS

The proposed action may result in 25 lethal and non-lethal Atlantic sturgeon takes from the Gulf of Maine (GOM) DPS over 3 dredging seasons. Hopper dredging of the entrance channel could result in the lethal take of 2 Atlantic sturgeon from the GOM DPS. Further, we expect 23 GOM DPS Atlantic sturgeon to be captured during relocation trawling. Based on the first 2 dredging seasons, we anticipate that 3 total lethal captures could occur during relocation trawling, and 1 of those lethal captures could be a fish from the GOM DPS. We estimate the remaining captures of 22 Atlantic sturgeon from the GOM DPS will be non-lethal. Therefore, up to 3 Atlantic sturgeon from the GOM DPS could be lethally taken during hopper dredging of the entrance channel and the associated relocation trawling. The potential non-lethal takes of 22 sturgeon are not expected to have any measurable impact on the reproduction, numbers, or distribution of animals from the GOM DPS, as the individuals captured and released are expected to fully recover.

We do not believe the potential lethal take of up to 3 Atlantic sturgeon from the GOM DPS would affect the distribution of the GOM DPS. The potential lethal take would reduce the population of Atlantic sturgeon in the GOM 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 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 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.

GADNR's trawling and net studies of recreationally important fish species are expected to result in 9 captures of Atlantic sturgeon from the GOM DPS over a 5-year period (NMFS, 2017).

While the initial captures are expected to be non-lethal, some post-release mortality is expected to occur. The ITS provided to the USFWS for their funding of GADNR (NMFS, 2017) estimated that up to 2 lethal takes of adults/adult equivalents from the GOM DPS could occur as a result of post-release mortality.

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 2013b). 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). Following the previously discussed process for estimating the adult equivalents, we will consider 4 of those captures as adult equivalents.[10]

Each year the SEFSC, 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.

An anticipated 3 sturgeon may be taken by the proposed action over the 3 hopper dredging seasons (an average of 1 sturgeon annually). 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, the USFWS-funded studies by GADNR of recreationally important finfish, and the proposed action estimate 34 GOM DPS adult/adult equivalent mortalities annually. The NEAMAP model referenced earlier in this section estimates a minimum ocean population of 7,455 Atlantic sturgeon in the GOM DPS, of which 4,548 are adults/subadults (Table 9). Therefore, our anticipated lethal takes represent 0.75% 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 $EPR_{20\%.}$ Therefore, although the proposed action's removal of 3 sturgeon over 3 dredging seasons will cause a reduction in numbers and reproduction, we do not believe the reductions will appreciably reduce the likelihood that the GOM DPS will survive in the wild.

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

[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 + 2 USFWS-funded GADNR study takes + 4 North Carolina gillnet fisheries + 1 Georgia shad fishery + 1 FIM research + 1 estimated take from SHEP) ÷ 4,548 estimated adults/adult equivalents in the GOM DPS = 0.75% of the GOM DPS taken

Table 9. 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 DPS 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 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 project's offshore dredging and relocation trawling will significantly affect the habitat or water quality or curtail the range of the species in the GOM DPS. The action has no relationship to the blockage of access to historical habitats by dams or reservoirs. The 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 project 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 project dredging and relocation trawling are not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the GOM DPS of Atlantic sturgeon.

7.2.2 New York Bight DPS

The proposed action may result in 111 lethal and non-lethal Atlantic sturgeon takes from the New York Bight (NYB) DPS over 3 dredging seasons. Hopper dredging of the entrance channel could result in the lethal take of 9 Atlantic sturgeon from the NYB DPS. Further, we expect 102 NYB DPS Atlantic sturgeon to be captured during relocation trawling. Based on the first 2 dredging seasons, we anticipate that 3 total lethal captures could occur during relocation trawling, and up to 2 of those lethal captures could be a fish from the NYB DPS. We estimate the remaining captures of 100 Atlantic sturgeon from the NYB DPS will be non-lethal. Therefore, up to 11 Atlantic sturgeon from the NYB DPS could be lethally taken during hopper dredging of the entrance channel and the associated relocation trawling. The potential non-lethal takes of 100 sturgeon are not expected to have any measurable impact on the reproduction, numbers, or distribution of animals from the NYB DPS, as the individuals captured and released are expected to fully recover such that no reductions in reproduction or numbers of Atlantic sturgeon are anticipated.

We do not believe the potential lethal take of up to 11 Atlantic sturgeon from the NYB DPS would affect the distribution of the NYB DPS. The potential lethal take of 11 Atlantic sturgeon (an average of 3.67 sturgeon annually) would reduce the population of Atlantic sturgeon in the NYB DPS by that amount. To be conservative for the species in this calculation, we round up to 4 fish. 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 the previous section on the GOM DPS for the NYB DPS and for the remaining DPSs. 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}). 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).

GADNR's trawling and net studies of recreationally important fish species are expected to result in 35 captures of Atlantic sturgeon from the NYB DPS over a 5-year period (NMFS, 2017). While the initial captures are expected to be non-lethal, some post-release mortality is expected to occur. The ITS provided to the USFWS for their funding of GADNR (NMFS, 2017) estimated that up to 3 lethal takes of adults/adult equivalents from the NYB DPS could occur as a result of post-release mortality.

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 2013b). Converting those animals to adult equivalents as done previously yields a number less than 2.[12] To be conservative for the species, we round to 2 animals.

[12] 2.55 annual juvenile/subadult Georgia shad gillnet takes x 0.48 subadult survival = 1.23 adult equivalents

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.[13]

Each year the SESFC, 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 FIM activities in the Southeast Region. Up to 1 adult animal from this DPS is expected to be lethally taken annually from these activities.

We anticipate that 132 Atlantic sturgeon may be taken annually in these fisheries and by the SHEP project's offshore dredging and relocation trawling actions. 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 9). Based on this information, we believe 0.63% of the adult/adult equivalent population in the NYB DPS will be killed annually.[14] This 0.63% is below the estimated 14% total fishing mortality rate we believe the population could likely withstand and still maintain $EPR_{20\%.}$ Therefore, although the proposed action's removal of up to 4 Atlantic sturgeon over 3 dredging seasons will cause a reduction in numbers and reproduction, 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 project's offshore dredging 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 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) Impeded access to historical habitat by dams and reservoirs.

[13] 18 annual juvenile/subadult North Carolina gillnet takes x 0.48 subadult survival = 8.64 adult equivalents

[14] (3 Shrimp fishery takes + 10 HMS shark/smoothhound fishery takes + 100 GARFO batched fisheries takes + 3 USFWS-funded GADNR study takes + 2 Georgia shad fishery + 9 North Carolina gillnet fisheries + 1 FIM research + 4 estimated takes from SHEP) ÷ 21,086 estimated adults/adult equivalents in the NYB DPS = 0.63% of the NYB DPS taken

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 project's offshore dredging and relocation trawling will significantly affect the habitat or water quality or curtail the range of the species in the NYB DPS. The action has no relationship to the blockage of access to historical habitats by dams or reservoirs. The 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 project 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 project dredging and relocation trawling are not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the NYB DPS of Atlantic sturgeon.

7.2.3 Chesapeake Bay DPS

The proposed action may result in 30 lethal and non-lethal Atlantic sturgeon takes from the Chesapeake Bay (CB) DPS over 3 dredging seasons. Hopper dredging of the entrance channel could result in the lethal take of 3 Atlantic sturgeon from the CB DPS. Further, we expect 27 CB DPS Atlantic sturgeon to be captured during relocation trawling. Based on the first 2 dredging seasons, we anticipate that 3 total lethal captures could occur during relocation trawling, and 1 of those lethal captures could be a fish from the CB DPS. We estimate the remaining captures of 26 Atlantic sturgeon from the CB DPS will be non-lethal. Therefore, up to 4 Atlantic sturgeon from the CB DPS could be lethally taken during hopper dredging of the entrance channel and the associated relocation trawling. The potential non-lethal takes of 26 sturgeon are not expected to have any measurable impact on the reproduction, numbers, or distribution of animals from the CB DPS, as the individuals captured and released 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 non-lethal) could occur anywhere within the range of the species, no change in the distribution of the CB DPS Atlantic sturgeon is anticipated.

We do not believe the potential lethal take of up to 1 Atlantic sturgeon from the CB DPS would affect the distribution of the CB DPS. 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. 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 4 Atlantic sturgeon may be taken by the project's offshore dredging and relocation trawling actions (an average of 1.33 sturgeon annually). To be conservative in our calculation, we will round up to 2 sturgeon 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).

GADNR's trawling and net studies of recreationally important fish species are expected to result in 11 captures of Atlantic sturgeon from the CB DPS over a 5-year period (NMFS, 2017). While the initial captures are expected to be non-lethal, some post-release mortality is expected to occur. The ITS provided to the USFWS for their funding of GADNR (NMFS, 2017) estimated that up to 2 lethal takes of adults/adult equivalents from the CB DPS could occur as a result of post-release mortality.

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 2013b). Converting those animals to adult equivalents as done previously yields a number less than 1, but not zero.[15] 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.[16]

Each year the SEFSC, 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 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 71 adult Atlantic sturgeon may be taken annually in these fisheries and by the SHEP project's offshore dredging and relocation trawling actions. 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 9). Based on this information, we believe 1.32% of the adult/adult equivalent population in the CB DPS will be killed annually.[17] This 1.32% is below the estimated 14% total fishing mortality rate we believe the population could likely withstand and still maintain $EPR_{20\%}$. Therefore, although the project's offshore dredging action's removal of 1 Atlantic sturgeon over 3 dredging season will cause a reduction in numbers and

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[15] 0.65 annual juvenile/subadult Georgia shad gillnet takes x 0.48 subadult survival = 0.32 adult equivalents
[16] 69 annual juvenile/subadult North Carolina gillnet takes x 0.48 subadult survival = 33 adult equivalents
[17] (2 Shrimp fishery takes + 3 HMS shark/smoothhound fishery takes + 27 GARFO batched fisheries takes + 2 USFWS-funded GADNR study takes + 1 Georgia shad fishery + 33 North Carolina fisheries + 1 FIM + 2 estimated takes from the SHEP project) ÷ 5,375 estimated adults/adult equivalents in the CB DPS = 1.32% of the CB DPS taken.

reproduction, we do not believe the reduction is likely to cause an appreciable reduction in the likelihood that the CB DPS will survive in the wild.

Recovery
Our analysis must also consider whether the project dredging 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 project's offshore dredging and relocation trawling actions will significantly affect the habitat or water quality or curtail the range of the species, in 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. For these reasons, we believe the project dredging 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 project dredging and relocation trawling are not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the CB DPS of Atlantic sturgeon.

7.2.4 Carolina DPS

The proposed action may result in 6 lethal and non-lethal Atlantic sturgeon takes from the Carolina DPS over 3 dredging seasons. Hopper dredging of the entrance channel could result in the lethal take 1 of Atlantic sturgeon from the Carolina DPS. Further, we expect 5 Carolina DPS Atlantic sturgeon to be captured during relocation trawling. Based on the first 2 dredging seasons, we anticipate that 3 total lethal captures could occur during relocation trawling, and 1 of those lethal captures could be a fish from the Carolina DPS. We estimate the remaining captures of 4 Atlantic sturgeon from the Carolina DPS will be non-lethal. Therefore, up to 2 Atlantic sturgeon from the Carolina DPS could be lethally taken during hopper dredging of the entrance channel and the associated relocation trawling. The potential non-lethal takes of 4 sturgeon are not expected to have any measurable impact on the reproduction, numbers, or distribution of animals from the Carolina DPS as the individuals are expected to fully recover such that no reductions in reproduction or numbers of Atlantic sturgeon are anticipated.

We do not believe the potential lethal take of up to 2 Atlantic sturgeon from the Carolina DPS would affect the distribution of this DPS. The potential lethal take of 2 Atlantic sturgeon (an average of 0.67 sturgeon annually) would reduce the population of Atlantic sturgeon in the Carolina DPS by that amount. To be conservative for the species in this calculation, we round up to 1 fish. As discussed previously, we believe breeding adults are especially important to the overall populations of the Atlantic sturgeon DPSs. 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}). 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).

GADNR's trawling and net studies of recreationally important fish species are expected to result in 3 captures of Atlantic sturgeon from the Carolina DPS over a 5-year period (NMFS, 2017). While the initial captures are expected to be non-lethal, some post-release mortality is expected to occur. The ITS provided to the USFWS for their funding of GADNR (NMFS, 2017) estimated that up to 2 lethal takes of adults/adult equivalents from the Carolina DPS could occur as a result of post-release mortality.

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 2013b). Converting those animals to adult equivalents as done previously yields a number less than 1, but not zero.[18] 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.[19]

Each year the SESFC, 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.

[18] 0.1 annual juvenile/subadult Georgia shad gillnet takes x 0.48 subadult survival = 0.048 adult equivalents
[19] 127 annual juvenile/subadult North Carolina gillnet takes x 0.48 subadult survival = 61 adult equivalents

We anticipate that 76 Atlantic sturgeon may be taken annually in these fisheries and by the SHEP project's offshore dredging and relocation trawling actions. The NEAMAP model estimates a minimum ocean population of 1,356 Atlantic sturgeon in the Carolina DPS, of which 827 are adults/subadults (Table 9). Based on this information, we believe 9.2% of the adult/adult equivalent population in the Carolina DPS will be killed annually.[20] This 9.2% 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 project's offshore dredging action's removal of 1 Atlantic sturgeon over 3 dredging season will cause a reduction in numbers and reproduction, however, we do not believe the reduction is likely to cause an appreciable reduction in the likelihood that the Carolina DPS will survive in the wild.

Recovery

Our analysis must also consider whether the project's offshore dredging 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 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 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) 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 project's offshore dredging and relocation trawling will significantly affect the habitat or water quality or curtail the range of the species in the Carolina DPS. The action has no relationship to the blockage of access to historical habitats by dams or reservoirs. The 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

[20] (3 Shrimp fishery takes + 2 HMS shark/smoothhound fishery takes + 5 GARFO batched fisheries takes + 2 USFWS-funded GADNR study takes + 1 Georgia shad fishery + 61 North Carolina gillnet fisheries + 1 FIM + 1 estimated takes from the SHEP project) ÷ 827 estimated adults/adult equivalents in the Carolina DPS = 9.2% of the Carolina DPS taken

believe the project 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 project dredging and relocation trawling are not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the Carolina DPS of Atlantic sturgeon.

7.2.5 South Atlantic DPS

The proposed action may result in 48 lethal and non-lethal Atlantic sturgeon takes from the South Atlantic (SA) DPS over 3 dredging seasons. Hopper dredging of the entrance channel could result in the lethal take of 4 Atlantic sturgeon from the SA DPS. Further, we expect 44 SA DPS Atlantic sturgeon to be captured during relocation trawling. Based on the first 2 dredging seasons, we anticipate that 3 total lethal captures could occur during relocation trawling, and 1 of those lethal captures could be a fish from the SA DPS. We estimate the remaining captures of 43 Atlantic sturgeon from the SA DPS will be non-lethal. Therefore, up to 5 Atlantic sturgeon from the SA DPS could be lethally taken during hopper dredging of the entrance channel and the associated relocation trawling. The potential non-lethal takes of 43 sturgeon are not expected to have any measurable impact on the reproduction, numbers, or distribution of animals from the SA DPS, as the individuals are expected to fully recover such that no reductions in reproduction or numbers of Atlantic sturgeon are anticipated.

We do not believe the potential lethal take of up to 5 Atlantic sturgeon from the SA DPS would affect the distribution of this DPS. The potential lethal take of 5 Atlantic sturgeon (an average of 1.67 sturgeon annually) would reduce the population of Atlantic sturgeon in the SA DPS by that amount. To be conservative for the species in this calculation, we round up to 2 fish. As discussed previously, we believe breeding adults are especially important to the overall populations of the Atlantic sturgeon DPSs. 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}). 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).

GADNR's trawling and net studies of recreationally important fish species are expected to result in 16 captures of Atlantic sturgeon from the SA DPS over a 5-year period (NMFS, 2017). While the initial captures are expected to be non-lethal, some post-release mortality is expected to occur. The ITS provided to the USFWS for their funding of GADNR (NMFS, 2017) estimated that up to 2 lethal takes of adults/adult equivalents from the SA DPS could occur as a result of post-release mortality.

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

2013b). 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 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 SEFSC, 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 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 93 Atlantic sturgeon may be taken annually in these fisheries and the project dredging 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 9). Based on this information, we believe 1.0% of the adult/adult equivalent population in the SA DPS will be killed annually.[23] This 1.0% 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 project's offshore dredging action's removal of up to 5 Atlantic sturgeon over 3 dredging seasons will cause a reduction in numbers and reproduction.

In addition to the takes attributed to the dredging and relocation trawling, juvenile Atlantic sturgeon from the SA DPS are likely to be adversely affected by habitat losses caused by the harbor deepening and additional delay in the completion of the fish passage at NSBLD. Based on USACE hydrodynamic modeling or projected site conditions, we estimate that approximately 251 ac of juvenile habitat will be impacted by channel expansion. Since the fish passage will not be completed prior to completion of the inner harbor dredging, the increases in upstream spawning success due to access to habitat above NSBLD will not offset the losses in habitat downstream due to increases in salinity and reductions in DO. Using a habitat-based surrogate, we estimate that these impacts may affect 7.6% of the juvenile Atlantic sturgeon population in the Savanah River, resulting in adverse effects to an unknown number of individuals. We believe these adverse effects will result in weakening of each year-class.

These effects are expected to be sub-lethal for individual sturgeon of the existing population, and will not reduce their numbers, but may reduce the river's carrying capacity and its overall ability to provide suitable foraging habitat for juvenile Atlantic sturgeon. We believe that the additional delay in fish passage implementation will not result in lethal effects to individuals, NMFS also

[21] 1.1 annual juvenile/subadult Georgia shad gillnet takes x 0.48 subadult survival = 0.528 adult equivalents
[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 + 2 USFWS-funded GADNR study takes + 1 Georgia shad fishery + 33 North Carolina fisheries + 1 FIM + 2 estimated takes from the SHEP project) ÷ 9,096 estimated adults/adult equivalents in the SA DPS = 1.0% of the SA DPS taken.

believes that juvenile Atlantic sturgeon will use the remaining 92.4% of available habitat below NSBLD and will move to suitable foraging and resting habitats further upstream upon completion of the NSBLD fish passage.

NMFS believes that the proposed action is not likely to cause a reduction in reproduction. Adult Atlantic sturgeon will still be able to use the spawning habitat below NSBLD until fish passage is implemented. Based on the fact the NMFS does not believe the proposed action will result in a reduction in reproduction or numbers of Atlantic sturgeon in the Savannah River, the proposed action will not result in a decrease in the species distribution. Based on this information, the proposed action will not appreciably reduce the likelihood of the Atlantic sturgeon's survival in the Savannah River.

Recovery

Our analysis must also consider whether the project's offshore dredging and relocation trawling actions are 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.

Nothing about the project's offshore dredging and relocation trawling actions will significantly 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. We anticipate primarily non-lethal incidental captures will be documented and procedures have been established to minimize the impact of any interactions that do occur. For these reasons, we believe the project dredging action is not likely to appreciably reduce the likelihood that the SA DPS will recover in the wild.

The required fish passage at NSBLD addresses the threat of impeded access to historical habitat by dams (#3 above). The NSBLD fish passage will restore access to approximately 20 mi of historically important, high quality spawning access for Atlantic sturgeon. Though completion of the fish passage will be delayed by 8 months, we believe this is not likely to appreciably reduce the likelihood that the SA DPS will recover in the wild. While delay in implementation will result in temporary adverse effects to juvenile Atlantic sturgeon, we believe that the current mandate under the WIIN Act to consider all alternatives for providing passage above NSBLD to sturgeon, including alternatives previously not considered, will ensure the best opportunity for successful sturgeon passage in the Savannah River.

Conclusion
Based on the information of this section, we believe the effects from the project's offshore dredging action is not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the SA DPS of Atlantic sturgeon.

7.3 Shortnose Sturgeon

All life stages of shortnose sturgeon are likely to be adversely affected by the 8-month delay in the completion of the fish passage at NSBLD. Since the fish passage will not be completed prior to completion of the inner harbor dredging, the increases in upstream spawning success due to access to habitat about NSBLD will not offset the losses in habitat downstream due to increases in salinity and reductions in DO. In the original Opinion, we determined that the habitat impacts from expansion of the navigation channel would result in adverse effects to juvenile shortnose sturgeon, and that the time-lag between channel expansion and fish passage implementation would result in reduced year class fitness until fish passage is completed. Based on USACE hydrodynamic modeling, we estimated that approximately 251 ac (7.6%) of available juvenile shortnose sturgeon habitat and 266 ac (6.9%) of available adult shortnose sturgeon habitat will be impacted by channel expansion. We believe it is reasonable to project that these habitat losses will adversely affect 7.6% of the adult population and 6.9% of the juvenile population of shortnose sturgeon in the action area. The time-lag between inner harbor dredging induced impacts and implementation of fish passage will extend these adverse effects over the same habitat area for another 8 months. Delay in fish passage implementation evaluated in this amendment will result in adverse effects to shortnose sturgeon by reductions in survival and maturation of an undetermined number of juveniles during the 8-month delay in fish passage implementation.

The adverse effects associated with habitat losses resulting from navigation channel expansion are expected to be sub-lethal for individual sturgeon of the existing population, and will not reduce their numbers, but may reduce the river's carrying capacity and its overall ability to provide suitable foraging habitat for shortnose sturgeon. We believe the additional delay will not result in lethal effects to individuals. NMFS also believes that shortnose sturgeon will use the remaining habitat (92.4% for juveniles and 93.1% for adults) prior to implementation of fish passage and should ultimately move to suitable foraging and resting habitats further upstream.

NMFS believes that the proposed action is not likely to cause a reduction in reproduction. Adult shortnose sturgeon will still be able to use the spawning habitat below NSBLD until fish passage is implemented. Based on the fact the NMFS does not believe the proposed action will result in a reduction in reproduction or numbers of shortnose sturgeon in the Savannah River, the proposed action will not result in a decrease in the species distribution. Based on this information, the proposed action will not appreciably reduce the likelihood of the shortnose sturgeon's survival in the Savannah River.

Recovery
The recovery plan for the shortnose sturgeon (NMFS 1998) lists 3 main objectives as recovery criteria for the species. Goals listed in the 1998 shortnose sturgeon recovery plan that could be affected by the proposed action include:

1) Ensure that all fish passageways permit adequate passage of shortnose sturgeon and do not alter migration or spawning behavior;
2) In each river, identify natural migration patterns of each life stage and any barriers to movement between habitats. Devise methods to pass shortnose sturgeon above/below existing barriers; and

The NSBLD fish passage will restore access to approximately 20 mi of historically important, high quality spawning access for shortnose sturgeon. Though completion of the fish passage will be delayed by 8 months, we believe this is not likely to appreciably reduce the likelihood that the SA DPS will recover in the wild. While delay in implementation will result in temporary adverse effects to juvenile Atlantic sturgeon, we believe that the current mandate under the WIIN Act to consider all alternatives for providing passage above NSBLD to sturgeon, including alternatives previously not considered, will ensure the best opportunity for successful sturgeon passage in the Savannah River.

8 CONCLUSION

After reviewing the current status of the species, the environmental baseline, the effects of the project’s offshore dredging action, and cumulative effects, it is NMFS’s Biological Opinion that the project’s offshore dredging is not likely to jeopardize the continued existence of the NA or SA DPS of green sea turtle, any of the 5 DPSs of Atlantic sturgeon, or the shortnose sturgeon.

9 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 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, USACE 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

This section of the Opinion summarizes the observed levels of green sea turtle and Atlantic sturgeon take estimated for hopper dredging of the Savannah Harbor entrance channel and the associated relocation trawling, based on new information from the first 2 years of the project. This section also establishes the use of habitat losses as a surrogate for takes of Atlantic and shortnose sturgeon resulting from habitat losses caused by expansion of the navigation channel and by delay in implementation of fish passage. The new ITS supersedes the previous 2011 and 2013 ITS for Atlantic and shortnose sturgeon and both green sea turtle DPSs. The ITSs of the original Opinion and the 2013 amendment remain in effect for all other species.

The take estimates in Table 10 represent the total anticipated lethal and non-lethal takes of green sea turtles and Atlantic sturgeon from hopper dredging and relocation trawling for the entire project. Table 11includes the levels of take that have already been observed, and that which is expected to be observed during the remaining dredging and relocation trawling. These observed take levels are to be used by USACE to determine if take estimates have been exceeded and reinitiation of ESA Section 7 consultation is necessary.

The take estimates in Table 12 represent our estimates of how much habitat supportive of Atlantic and shortnose sturgeon will be lost as a result of the expansion of the navigation channel. We are unable to reliably predict or estimate the specific number of individuals that may be adversely affected by habitat alternations resulting from channel deepening due to uncertainty regarding ecosystem/habitat response, limited information regarding current population estimates and habitat use distribution within the action area, and uncertainty regarding the response of individuals or populations to the habitat alterations. Use of habitat loss as a surrogate is based on the relationship between habitat needs of the species and available information regarding the habitat effects of the proposed action. Therefore, monitoring of habitat effects will be used to determine the extent of the effects to these species and to determine the need to reinitiate consultation.

Monitoring will include ensuring that habitat effects predicted by the USACE's modeling are not greater than expected. The monitoring will also be used to determine if prey species do colonize upriver habitats and how long it takes for such colonization to occur. Lastly, monitoring will determine if the sturgeon are using new habitat areas including those that we expect to eventually be newly colonized by prey species. If monitoring indicates that these predictions are not accurate and that the effects of the action are greater than expected, taking action through the adaptive management process will be required. Any future information regarding changes in the projected or actual habitat effects in Table 11 shall result in the need for reinitiation.

This amendment also serves as the permitting authority for take associated with handling, identifying, measuring, weighing, photographing, tagging (flipper tagging, PIT tagging), tissue sampling (e.g., fin clip of sturgeon), releasing incidentally taken sea turtles, 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 document. The authorized measures provide data necessary to monitor the anticipated incidental take and its effects on adversely affected species. The data collected helps ensure the action is not disproportionately affecting a portion of the population while also supporting recovery objectives.

Table 10. Green sea turtle takes resulting from SHEP dredging and relocation trawling

	Hopper Dredging	Relocation Trawling			Total Maximum Take		Grand Total[24]
	Lethal	Lethal (Max)	Non-lethal (Max)	Total[25]	Lethal	Non-lethal	
Green Sea Turtles (SA + NA DPS)	**23**	**1**	**5**	**5**	**24**	**5**	**28**
NA DPS	23	1	5	5	24	5	28
SA DPS	2	1	1	1	3	1	3

Table 11. Atlantic sturgeon takes resulting from SHEP dredging and relocation trawling

	Hopper Dredging	Relocation Trawling			Total Take		Grand Total
	Lethal	Lethal	Non-lethal	Total	Lethal	Non-lethal	
Atlantic Sturgeon (All DPSs)	**17**	**3**	**195**	**198**	**20**	**195**	**215**
Gulf of Maine DPS (11%)	2	1	22	23	3	22	25
New York Bight DPS (51%)	9	2	100	102	11	100	111
Chesapeake Bay DPS (13%)	3	1	26	27	4	26	30
Carolina DPS (2%)	1	1	4	5	2	4	6
South Atlantic DPS (22%)	4	1	43	44	5	43	48

[24] This column lists the total numbers of green sea turtles estimated to be taken, either lethally or non-lethally, during hopper dredging and relocation trawling. This number will not equal total maximum lethal takes plus the total maximum non-lethal take. See the next footnote for further explanation.

[25] This is the total number of green sea turtles we estimate will be captured during relocation trawling. There is a small likelihood (0.6%) that one of the captures could be lethal, though we expect all will likely be non-lethal (as has been the case during the project to date.) This table lists both the maximum lethal take and maximum non-lethal take estimated to occur during relocation trawling. The total numbers listed in this column will not equal the lethal plus the non-lethal take during relocation trawling.

Table 12. Total observed lethal and non-lethal takes, remaining observed lethal and non-lethal takes, and associated reinitiation triggers (remaining take) of green turtles and Atlantic sturgeon resulting from SHEP dredging and relocation trawling

	Hopper Dredging			Relocation Trawling					
Species	Total Observed Lethal	Already Observed (Lethal)	Reinitiation Trigger: Remaining Observed Take (lethal)	ITS: Total (Lethal)	Already Observed (Lethal)	Reinitiation Trigger: Remaining Lethal Take Allowed	ITS: Total (Non-Lethal)	Already Observed (Non-lethal)	Reinitiation Trigger: Remaining Non-Lethal Take Allowed
Green Sea Turtle (NA and SA DPSs)	15	7*	8	1	0	**1**	5	2	**3**
Atlantic Sturgeon (all 5 DPSs)	11	5	6	3	1	**2**	195	95	**100**

*Two of the turtles included as lethal takes have since been rehabilitated and released.

Table 13. ITS surrogate (habitat losses) resulting from channel expansion for Atlantic and shortnose sturgeon

Species	Adverse Effects	ITS
Atlantic sturgeon, juvenile, South Atlantic DPS	Reduced fitness of approximately 7.6% of juvenile population resulting from loss of 7.6% of suitable available forage and resting habitat	Annual loss of approximately 251 ac of winter foraging and resting habitat as defined by changes in salinity and DO concentrations. Habitat losses shall not exceed changes predicted through USACE hydrodynamic modeling, as represented in Figures 25 through 30 of the original Opinion and described in detail in the July, 2012 Final Environmental Impact Statement for the Savannah Harbor Expansions Project, Chatham County, Georgia and Jasper County, South Carolina.
Shortnose sturgeon, juvenile	Reduced fitness of approximately 7.6% of juvenile population resulting from loss of 7.6% of suitable available foraging and resting habitat	Annual loss of approximately 251 ac of winter foraging and resting habitat as defined by changes in salinity and DO concentrations. Habitat losses shall not exceed changes predicted through USACE hydrodynamic modeling, as represented in Figures 25 through 30 of the original Opinion and described in detail in the July, 2012 Final Environmental Impact Statement for the Savannah Harbor Expansions Project, Chatham County, Georgia and Jasper County, South Carolina
Shortnose sturgeon, adult	Reduced fitness of approximately 6.9% of adult population resulting from loss of 6.9% of suitable available foraging habitat	Annual loss of approximately 266 ac of winter foraging and resting habitat as defined by changes in salinity and DO concentrations. Habitat losses shall not exceed changes predicted through USACE hydrodynamic modeling represented in Figures 25 through 30 of the original Opinion and described in detail in the July, 2012 Final Environmental Impact Statement for the Savannah Harbor Expansions Project, Chatham County, Georgia and Jasper County, South Carolina

9.2 Effect of the Take

NMFS has determined the level of anticipated take associated with the project's offshore dredging is not likely to jeopardize the continued existence of the NA and SA DPS of green sea turtles. NMFS has also determined that anticipated take associated with habitat alterations in combination with effects of dredging and relocation trawling are not likely to jeopardize the continued existence of any of the 5 DPSs of Atlantic sturgeon. NMFS has also determined that anticipated take associated with habitat alterations is not likely to jeopardize the continued existence of shortnose sturgeon.

9.3 Reasonable and Prudent Measures

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

The RPMs and terms and conditions are specified as required, by 50 CFR 402.01(i)(1)(ii) and (iv), to document the incidental take by the proposed action and 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 the USACE in order for the protection of Section 7(o)(2) to apply. The USACE has a continuing duty to regulate the activity covered by this ITS. If the USACE fails to adhere to the terms and conditions through enforceable terms, and/or fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of Section 7(o)(2) may lapse.

9.3.1 Sea Turtles

NMFS has determined that the following RPMs are necessary and appropriate to minimize impacts of the incidental take of sea turtles during the proposed action. The RPMs that NMFS believes are necessary to minimize the impacts of the proposed hopper dredging have been discussed with the USACE in the past and are standard operating procedures, and include the use of intake and overflow screening, use of sea turtle deflector dragheads, observer and reporting requirements, and relocation trawling. The following RPMS and associated terms and conditions are established to implement these measures, and to document incidental takes. Only incidental takes that occur while these measures are in full implementation are authorized. Experience has shown that injuries sustained by sea turtles entrained in the hopper dredge dragheads are usually fatal. Current regional opinions for hopper dredging require observer monitoring requirements, deflector dragheads, and conditions and guidelines for relocation trawling, which NMFS believes are necessary to minimize effects of these removals on listed sea turtle species that occur in the action area.

9.3.1.1 Take Reporting: Observer Requirements and Dredged Material Screening

Qualified protected species observers monitor dredged material inflow and overflow screening baskets on many projects; however, screening is only partially effective and observed, documented takes provide only partial estimates of total sea turtle mortality. NMFS believes that some listed species taken by hopper dredges go undetected because body parts are forced through the sampling screens by the water pressure and are buried in the dredged material, or animals are crushed or killed but not entrained by the suction and so the takes may go unnoticed. The only mortalities that are documented are those where body parts either float, are large enough to be caught in the screens, and/or can be identified as from sea turtle species. However, this opinion estimates that with 4-in inflow screening in place, and 24 hour, 100 percent observer coverage will probably detect and record 67% of turtle mortality. Additionally, coordination with local sea turtle stranding networks can be a valuable adjunct monitoring method; not to directly monitor takes, but to help ensure that unanticipated impacts to sea turtles are not occurring.

9.3.1.2 Deflector Dragheads

V-shaped, sea turtle deflector dragheads prevent an unquantifiable yet significant number of sea turtles from being entrained and killed in hopper dredges each year. Without them, turtle takes during hopper dredging operations would unquestionably be higher. Draghead tests conducted in May-June 1993 by the USACE 's Waterways Experimental Station (WES), now known as the Engineering Research and Development Center (ERDC), in clear water conditions on the sea floor off Fort Pierce, Florida, with 300 mock turtles placed in rows, showed convincingly that the newly-developed WES deflector draghead "performed exceedingly well at deflecting the mock turtles." Thirty-seven of 39 mock turtles encountered were deflected, 2 turtles were not deflected, and none were damaged. Also, "the deflector draghead provided better production rates than the unmodified California draghead, and the deflector draghead was easier to operate and maneuver than the unmodified California flat-front draghead." The V-shape reduced forces encountered by the draghead, and resulted in smoother operation. V-shaped deflecting dragheads are now a widely accepted conservation tool, the dredging industry is familiar with them and their operation, and they are used by all USACE Districts conducting hopper dredge operations where turtles may be present.

9.3.1.3 Relocation Trawling

Relocation trawling has proved to be a useful conservation tool in most dredging projects where it has been implemented. The September 22, 1995, Regional Biological Opinion (RBO) to the USACE's New Orleans and Galveston Districts on hopper dredging of channels in Texas and Louisiana included a conservation recommendation for relocation trawling which stated that "Relocation trawling in advance of an operating dredge in Texas and Louisiana channels should be considered if takes are documented early in a project that requires use of a hopper dredge during a period in which large number of sea turtles may occur." That RBO was amended by NMFS (Amendment No. 1, June 13, 2002) to change the conservation recommendation to a term and condition of the RBO. Overall, it is NMFS' opinion that the USACE Districts choosing to implement relocation trawling have benefited from their decisions. For example, in the Galveston District, Freeport Harbor Project (July 13-September 24, 2002), assessment and relocation trawling resulted in one loggerhead capture. In Sabine Pass (Sabine-Neches Waterway), assessment and relocation trawling in July-August 2002 resulted in five loggerhead and three Kemp's ridley sea turtle captures. One turtle was killed by the dredge; this occurred while the relocation trawler was in port repairing its trawl net (P. Bargo, pers. comm. 2002). In the Jacksonville District, sea turtles have been relocated out of the path of hopper dredges operating in Tampa Bay and Charlotte Harbor or their entrance channels. During St. Petersburg Harbor and Entrance Channel dredging in the fall of 2000, a pre-dredging risk assessment trawl survey resulted in capture, tagging, and relocation of two adult loggerheads and one subadult green turtle. In February 2002 during the Jacksonville District's Canaveral Channel emergency hopper dredging project for the Navy, two trawlers working around the clock captured and relocated 69 loggerhead and green turtles in seven days, and no turtles were entrained by the hopper dredge. In the Wilmington District's Bogue Banks Project in North Carolina, two trawlers successfully relocated five turtles in 15 days between March 13 and 27, 2003; one turtle was taken by the dredge. In 2003, Aransas Pass relocation trawling associated with hopper dredging resulted in 71 turtles captured and released (with three recaptures) in three months of dredging and relocation trawling. Five turtles were killed by the dredge. No turtles were killed after relocation trawling was increased from 12 to 24 hours per day (T. Bargo, pers. comm. to E. Hawk, October 27, 2003). In 2006, trawling associated with the dredging of the Houston-Galveston Navigation Channels resulted in 7 loggerheads relocated in 60 days of trawling (USACE Sea Turtle Data Warehouse; http://el.erdc.usace.army.mil/seaturtles/index.cfm). In Fiscal Year 2007, relocation trawling activities in USACE channel projects in the Gulf of Mexico resulted in the capture and relocation of 67 green, 42 Kemp's ridley, and 68 loggerhead sea turtles; in the South Atlantic, 18 loggerhead and 17 Kemp's ridley sea turtles were relocated (Ibid).

This opinion authorizes the use of turtle relocation trawling. NMFS believes the use of relocation trawling should be required during all proposed hopper dredging.

9.3.2 Sturgeon

We have determined the following RPMs are necessary and appropriate to minimize the impacts of future takes on sturgeon as the USACE conducts the dredging of the harbor and implements fish passage and other modifications in the project area.

9.3.2.1 Implement Safe and Effective Fish Passage in a Timely Manner

The implementation of fish passage at the New Savannah Bluff Lock and Dam is a measure that is expected to provide sturgeon access to upstream habitat. The delay in implementing fish passage will result in additional adverse effects beyond those anticipated in the original Opinion, including adverse effects to the year-class strength of both Atlantic and shortnose sturgeon over multiple years resulting from habitat changes. Reduction in year-class is a major consequence for the late-maturing, long-lived sturgeon that spawn infrequently. The constriction of habitat resulting from the effects of SHEP in the lower Savannah River adds further urgency to prompt fish passage implementation to restore access to habitat upstream that contains high quality spawning habitat and additional foraging habitat.

USACE estimates that analyses required by WIIN Act will be completed by August 2018. USACE will provide NMFS with final design and performance information for the selected fish passage alternative, including data on variance of velocity fields under different river flow scenarios. In order to consult with the other resource and sturgeon experts, NMFS will require a minimum of 30 days to provide a review of the final fish passage design.

Construction of the fish passage shall commence prior to January 2021 and be completed by October 2022. To reduce adverse effects to sturgeon during construction of the fish passage, special provisions for the protection of sturgeon shall be implemented (see below).

USACE shall initiate and complete fish passage land acquisition and design phase actions upon approval of the recommended alternative contained in the WIIN 2016 legislation. Construction of the fish passage shall commence following land acquisition, NEPA actions, additional permitting requirements, and the successful award of the feature construction contract. Additional lands must also be acquired to construct the rock ramp and for an access road to the site. The USACE shall initiate land acquisition prior to, or concurrent with, the start of dredging of the Savannah Harbor Entrance Channel.

USACE will coordinate the development of the final design of any fish passage alternative, either in-river or out-of-channel, with NMFS. The overall design goal of the fish passage alternative is to achieve at least 75 percent upstream passage effectiveness for both shortnose and Atlantic sturgeon, at least 85 percent downstream passage effectiveness, and cause no serious injury to sturgeon that come into contact with the passage or dam structures. The desired performance metrics for sturgeon tagged and monitored under the Monitoring and Adaptive Management Plan that reach the base of the structure are 90 percent upstream passage and 100 percent downstream passage. The fish passage must maintain velocities comparable to those found in the upstream habitat that the sturgeon are expected to access upon completion of the fish passage facility (at Augusta Shoals). USACE will retain these design parameters for the in-river design.

The USACE previously presented a fish passage design called an Off-Channel Rock Ramp which is expected to pass fish safely and effectively upstream and downstream. NMFS previously reviewed this design and its performance in detail and determined the proposed design would effectively pass sturgeon and other anadromous species.

The USACE will develop a Monitoring and Adaptive Management plan specifically for the fish passage as a part of the comprehensive Monitoring and Adaptive Management Plan for the project (included in RPM 3). The plan will identify detailed success criteria and triggers for passage modification. Atlantic sturgeon migrate to spawning habitat in spring/early summer and there is evidence suggesting that this species may also make a fall spawning run in some southern rivers. In contrast, shortnose sturgeon migrate to spawning habitat during late winter to early spring. Larval fish will also be beginning their movement downriver. To protect spawning sturgeon and their offspring, no in-water construction will be performed at the downstream entrance of the fish passage channel during the late winter/spring spawning period through the early summer larval period. In-water work and installation of sheet pile training walls (if necessary) may be performed upstream of the dam throughout the year. The USACE shall employ best management practices such as silt curtains to control turbidity throughout the construction of the fish passage facility. No drawdown of water levels can occur during the late winter/spring spawning period through the early summer larval period to facilitate construction. Normal flows must be maintained.

9.3.2.2 Protective Measures for Sturgeon during Construction in the SHEP Project Area

To reduce adverse effects to sturgeon during construction of the flow re-routing modifications and during the deepening, special provisions for the protection of sturgeon will need to be implemented. The area of the proposed flow re-routing modifications would be located in foraging and resting habitat for sturgeon and is especially important to juvenile shortnose sturgeon during the winter. A moratorium on specific in-water work associated with the flow re-routing modifications will be necessary to protect sturgeon. The timing of the moratorium is linked to the time of year when sturgeon are most likely to occur in the construction area.

9.3.2.3 Development of a Comprehensive Monitoring and Adaptive Management Plan for the Savannah River Project Area

To ensure appropriate monitoring and adaptive management is conducted within the entire Savannah River Project Area comprehensive monitoring and adaptive management plan shall be developed for assessing project effects associated with the deepening, the effectiveness of the fish passage, and for implementing corrective actions. The Plan shall contain details describing how sturgeon will be monitored. It must also address how adaptive management would be included during the construction phases. The Plan shall identify explicit success criteria and triggers. This would include a mechanism that would allow results from the monitoring to feed into decisions governing operation of the project activities and mitigation actions. If monitoring of sturgeon habitat indicates the loss of suitable habitat exceeds the amount determined by the USACE's models, or if the fish passage is not functioning as intended, and these impacts cannot be addressed through adaptive management, this would trigger re-initiation of consultation with NMFS. The USACE will coordinate with NMFS on development of the comprehensive plan to include measures to address these concerns.

9.3.2.4 Ensure Appropriate Dissolved Oxygen Levels

The proposed expansion, deepening, and modification of the Savannah Harbor through dredging will have a significant effect on the habitat of sturgeon. The USACE is currently installing oxygen injection systems on the Savannah River above and within the project area to mitigate for expected impacts to dissolved oxygen caused by deepening the harbor. NMFS believes there is a high degree of uncertainty associated with the proposed use of an oxygen injection system. These systems, known as Speece cones, will be used during the summer months to inject oxygen into the river, as needed. These systems have not been previously used in a tidal system such as the Savannah River, so their efficacy cannot be thoroughly assessed before installation. Once operational, extensive monitoring of the river to determine effectiveness of the systems is proposed and modifications may be necessary as a part of a comprehensive monitoring and adaptive management plan to be developed for the project. Analysis of projected benefits of dissolved oxygen injection indicate that while there would be improvements in portions of the Front River and Middle River, the lower portion of the Back River would still have areas of unsuitable habitat for shortnose sturgeon. If the oxygen injection system does not perform as designed, impacts to sturgeon habitat from the harbor deepening could be greater than what has been estimated by the USACE's models. Contingency funding shall be included in the adaptive management plan to accommodate needed modifications to address low levels of dissolved oxygen. This measure is intended to ensure that impacts from SHEP are no worse than the USACE's predictions in the Environmental Impact Statement. Sturgeon have been shown to be impacted by low dissolved oxygen levels, and mortality of sturgeon can occur within hours of exposure to low dissolved oxygen (Campbell and Goodman 2004). The three-level dissolved oxygen criteria for shortnose sturgeon recommended by the interagency fisheries group and applied by the USACE to identify areas with suitable sturgeon habitat include rare (<1% of the time) excursions of summertime dissolved oxygen to less than 2 mg/Liter, infrequent excursions (<5%) to less than 3mg/Liter, and occasional excursions (<10%) below 4 mg/Liter. Thus, these are already relatively permissive standards that allow exposure of sturgeon to very depressed dissolved oxygen levels even in the areas designated as suitable habitat. Given the physiological threat posed to sturgeon from low dissolved oxygen combined with high thermal stress in the summer (water temperatures in the summer average 25°-28°C), monitoring and adaptive management of dissolved oxygen shall ensure that the oxygen injection systems perform as intended to offset impacts due to deepening the harbor and ensure the amount of suitable habitat identified as summer suitable habitat (see Figure 30 of the original Opinion) meet these established dissolved oxygen criteria.

9.3.2.5 Tissue Sampling, Tags and Reporting Take

Tissue samples taken of any sturgeon handled or stranded will be processed per Appendix C. All sturgeon encountered will need to be scanned for a PIT tag. The PIT tag reader should be able to read both 125 kHz and 134 kHz tags. The USACE will need to notify NMFS of any and all sturgeon injuries or mortality occurring during the dredging/construction activities within 24 hours of the take.

9.4 Terms and Conditions

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

Sea Turtles

1. Observers (RPM 9.3.1.1): The USACE shall arrange for qualified protected species observers to be aboard the hopper dredges to monitor the hopper bin, screening, and dragheads for sea turtles and their remains. Observer coverage sufficient for 100 percent monitoring (i.e., two observers) of hopper dredging operations is required aboard the hopper dredges throughout the proposed project.

2. Screening (RPM 9.3.1.1): 100 percent inflow screening of dredged material is required and 100 percent overflow screening is recommended. If conditions prevent 100 percent inflow screening, inflow screening may be reduced gradually, as further detailed in the following paragraph, but 100 percent overflow screening is then required.

    a. Screen Size: The hopper's inflow screens should have 4-in by 4-in screening. If the Savannah District (SAS), in consultation with observers and the draghead operator, determines that the draghead is clogging and reducing production substantially, the screens may be modified sequentially: mesh size may be increased, for example, to 6-in by 6-in, then 9-in by 9-in, then 12-in by 12-in openings. Other variations in screening size are allowed, with prior written approval by NMFS. Clogging should be greatly reduced with these flexible options; however, further clogging may compel removal of the screening altogether, in which case effective 100 percent overflow 4-in screening is mandatory. The USACE shall notify NMFS beforehand if inflow screening is going to be reduced or eliminated, and provide details of how effective overflow screening will be achieved.

b. Need for Flexible, Graduated Screens: NMFS believes that this flexible, graduated-screen option is necessary, since the need to constantly clear the inflow screens will increase the time it takes to complete the project and therefore increase the exposure of sea turtles to the risk of impingement or entrainment. Additionally, there are increased risks to sea turtles in the water column when the inflow is halted to clear screens, since this results in clogged intake pipes, which may have to be lifted from the bottom to discharge the clay by applying suction.

3. Dredging Pumps (RPM 9.3.1.1): Standard operating procedure shall be that dredging pumps shall be disengaged by the operator when the dragheads are not firmly on the bottom, to prevent impingement or entrainment of sea turtles within the water column. This precaution is especially important during the cleanup phase of dredging operations when the draghead frequently comes off the bottom and can suck in turtles resting in the shallow depressions between the high spots the draghead is trimming off.

4. Sea Turtle Deflecting Draghead (RPM 9.3.1.2): A state-of-the-art rigid deflector draghead must be used on all hopper dredges at all times. Alternate draghead designs shall not be used unless prior, written approval is given by NMFS.

5. Dredge Take Reporting and Final Report (RPM 9.3.1.1): Observer reports of incidental take by hopper dredges must be faxed to NMFS' Southeast Regional Office (phone: 727/824-5312, fax: 727/824-5309, and reported by electronic mail to: (**takereport.nmfsser@noaa.gov**) by onboard NMFS-approved protected species observers, the dredging company, or the USACE within 24 hours of any sea turtle or other listed species take observed.

A final report summarizing the results of the hopper dredging and any documented sea turtle or other listed species takes must be submitted to NMFS within 30 working days of completion of the dredging project. Reports shall contain information on project location (specific channel/area dredged), start-up and completion dates, cubic yards (yd^3) of material dredged, problems encountered, incidental takes and sightings of protected species, mitigative actions taken, screening type (inflow, overflow) utilized, daily water temperatures, name of dredge, names of endangered species observers, percent observer coverage, and any other information the SAS deems relevant.

6. Sea Turtle Strandings (RPM 9.3.1.1): The SAS representative shall notify the STSSN state representative (contact information available at: http://www.sefsc.noaa.gov/seaturtleSTSSN.jsp) of the start-up and completion of hopper dredging operations and bed-leveler dredging operations and ask to be notified of any sea turtle strandings in the project area that, in the estimation of STSSN personnel, bear signs of potential draghead impingement or entrainment, or interaction with a bed-leveling type dredge.

   Information on any such strandings shall be reported in writing within 30 days of project end to NMFS' Southeast Regional Office. Because the deaths of these turtles, if hopper dredge or bed-leveler dredge related, have already been accounted for in NMFS' jeopardy analysis, the strandings will not be counted against the USACE's take limit.

7. Reporting – Strandings (RPM 9.3.1.1): The USACE shall provide NMFS' Southeast Regional Office with a report detailing incidents, with photographs when available, of stranded sea turtles that bear indications of draghead impingement or entrainment and/or bed-leveler interactions.

8. Relocation Trawling (RPM 9.3.1.3)(if applicable): Prior to turtle relocation trawling, the USACE shall develop and submit to NMFS detailed specifications on the final selected turtle relocation trawling gear sufficiently ahead of planned dredging activities for NMFS to review and comment on the plans. NMFS fisheries gear specialists may be able to provide technical assistance in developing specifications. The use of relocation trawling will be required during all proposed hopper dredging during December 1 through April 15.

   Non-capture relocation trawling ("sweep trawling") may be used if prior, written approval is given by NMFS, after NMFS ensures that the proper net design and sweep trawling procedures will be used. Sweep-trawling trawl net design and trawling procedures are inherently and fundamentally different from capture-trawling trawl net design and procedures.

9. Relocation Trawling Report (RPM 9.3.1.3) (if applicable): The USACE shall provide NMFS' Southeast Regional Office with an end-of-project report within 30 days of completion of any relocation trawling. This report may be incorporated into the final report summarizing the results of the hopper dredging project.

10. Additional Relocation Trawler Requirements (RPM 9.3.1.3) (if applicable): Any capture-type or sweep-type relocation trawling conducted or contracted by the USACE to temporarily reduce or assess the abundance of these listed species during a hopper dredging project in order to reduce the possibility of lethal hopper dredge interactions, is subject to the following conditions as listed below. In the event that trawling does result in the capture of a sea turtle, the USACE or its contractors may employ a separate chase boat to relocate the turtle at a distance of no less than 3 mi from the centerline of the navigation channel at the capture site.

a. Handling: Sea turtles recovered by observers on modified relocation trawlers (e.g., turtles incidentally captured in modified trawl gear, injured turtles recovered on the surface, etc.) shall be handled in a manner designed to ensure their safety and viability, and shall be released over the side of the vessel, away from the propeller, and only after ensuring that the vessel's propeller is in the neutral, or disengaged, position (i.e., not rotating). Resuscitation guidelines are attached (Appendix B).

b. Captured Sea Turtle Holding Conditions: Sea turtles may be held up to 24 hours for the collection of important scientific measurements, prior to their release. Captured sea turtles shall be kept moist, and shaded whenever possible, until they are released.

c. Scientific Measurements and Data Collection: When safely possible, all turtles shall be measured (standard carapace measurements including body depth), tagged, weighed, and a tissue sample taken prior to release. Any external tags shall be noted and data recorded into the observer's log. Only NMFS-approved protected species observers or observer candidates in training under the direct supervision of a NMFS-approved protected species observer shall conduct the tagging/measuring/weighing/tissues sampling operations. External mounting of satellite tags, radio transmitters, data loggers, crittercams, etc., may be done under the authority of this opinion by NMFS-approved, trained personnel, after approval from NMFS SERO PRD (see Terms and Condition #10.g., Other Sampling Procedures).

   NMFS-approved protected species observers may conduct more invasive scientific procedures (e.g., bloodletting, laparoscopies, external tumor removals, anal and gastric lavages, etc.) and partake in or assist in "piggy back" research projects but only if the observer holds a valid federal sea turtle research permit (and any required state permits) authorizing the activities, or the observer is acting as the duly-designated agent of the permit holder, and has first notified NMFS' Southeast Regional Office, Protected Resources Division.

d. Injuries: Injured sea turtles shall be immediately transported to the nearest sea turtle rehabilitation facility. Minor skin abrasions resulting from trawl capture are considered non-injurious. The USACE shall ensure that logistical arrangements and support to accomplish this are pre-planned and ready, and is responsible for ensuring that dredge vessel personnel comply with this requirement. The USACE shall bear the financial cost of sea turtle transport, treatment, rehabilitation, and release.

e. Flipper Tagging: All sea turtles captured by relocation trawling shall be flipper-tagged prior to release with external tags which shall be obtained prior to the project from the University of Florida's Archie Carr Center for Sea Turtle Research. This opinion serves as the permitting authority for any NMFS-approved protected species observer aboard these relocation trawlers to flipper-tag with external tags (e.g., Inconel tags) captured sea turtles. Columbus crabs or other organisms living on external sea turtle surfaces may also be sampled and removed under this authority.

f. PIT-Tag Scanning: This opinion serves as the permitting authority for any NMFS-approved protected species observer aboard a relocation trawler to PIT-tag captured sea turtles. PIT tagging of sea turtles is not required to be done if the NMFS-approved protected species observer does not have prior training or experience in said activity; however, if the observer has received prior training in PIT tagging procedures and is comfortable with the procedure, then the observer shall PIT tag the animal prior to release (in addition to the standard external tagging):

   Sea turtle PIT tagging must then be performed in accordance with the protocol detailed at NMFS' Southeast Fisheries Science Center's Web page: http://www.sefsc.noaa.gov/seaturtlefisheriesobservers.jsp. (See Appendix C on SEFSC's "Fisheries Observers" Web page);

   Unless otherwise approved in advance by NMFS SERO PRD, PIT tags used must be sterile, individually-wrapped tags to prevent disease transmission. PIT tags should be 125-kHz, glass-encapsulated tags–the smallest ones made. Note: If scanning reveals a PIT tag and it was not difficult to find, then do not insert another PIT tag; simply record the tag number and location, and frequency, if known. If for some reason the tag is difficult to detect (e.g., tag is embedded deep in muscle, or is a 400-kHz tag), then insert one in the other shoulder.

g. Other Sampling Procedures: All other tagging and external or internal sampling procedures (e.g., bloodletting, laparoscopies, external tumor removals, anal and gastric lavages, mounting of satellite or sonic transmitters, or similar tracking equipment, etc.) performed on live sea turtles are not permitted under this opinion unless the observer holds a valid sea turtle research permit authorizing the activity, either as the permit holder or a designated agent of the permit holder, or unless the observer (or person performing the procedure, in the case of piggy-back research by the USACE or other federal or state government agency or university personnel) receives prior, written approval by NMFS SERO after a thorough review by PRD of their credentials, experience, and training in the proposed procedures.

h. PIT-Tag Scanning and Data Submission Requirements: All sea turtles captured by relocation trawling or dredges shall be thoroughly scanned for the presence of PIT tags prior to release using a multi-frequency scanner powerful enough to read multiple frequencies (including 125-, 128-, 134-, and 400-kHz tags) and read tags deeply embedded in muscle tissue (e.g., manufactured by Trovan, Biomark, or Avid). Turtles whose scans show they have been previously PIT tagged shall nevertheless be externally flipper tagged. Sea turtle data collected (PIT tag scan data and external tagging data) shall be submitted to NOAA, National Marine Fisheries Service, Southeast Fisheries Science Center, Attn: Lisa Belskis, 75 Virginia Beach Drive, Miami, Florida 33149. All sea turtle data collected shall be submitted in electronic format within 60 days of project completion to Lisa.Belskis@noaa.gov and Sheryan.Epperly@noaa.gov. Sea turtle external flipper tag and PIT tag data generated and collected by relocation trawlers shall also be submitted to the

Cooperative Marine Turtle Tagging Program (CMTTP), on the appropriate CMTTP form, at the University of Florida's Archie Carr Center for Sea Turtle Research.

i. Handling Fibropapillomatose Turtles: NMFS-approved protected species observers are not required to handle viral fibropapilloma tumors if they believe there is a health hazard to themselves and choose not to. When handling sea turtles infected with fibropapilloma tumors, observers must maintain a separate set of sampling equipment for handling animals displaying fibropapilloma tumors or lesions.

11. Requirement and Authority to Conduct Tissue Sampling for Genetic and Contaminants Analyses: This opinion serves as the permitting authority for any NMFS-approved protected species observer aboard a relocation trawler or hopper dredge to tissue-sample live- or dead-captured sea turtles without the need for an ESA Section 10 permit.

All live or dead sea turtles captured by relocation trawling and hopper dredging (for both USACE-conducted and USACE-permitted activities) shall be tissue-sampled prior to release. Sampling shall continue uninterrupted until such time as NMFS determines and notifies the USACE in writing.

Sea turtle tissue samples shall be taken in accordance with NMFS' SEFSC procedures for sea turtle genetic analyses, and, as specified, for contaminants (e.g., heavy metals) analyses. Protocols for tissue sampling to be utilized in contaminants analyses are currently being developed by Dr. Dena Dickerson, ERDC. The USACE shall ensure that tissue samples taken during the dredging project are collected and stored properly and mailed every three months until completion of the dredging project to: NOAA, National Marine Fisheries Service, Southeast Fisheries Science Center, Attn: Lisa Belskis, 75 Virginia Beach Drive, Miami, Florida 33149.

12. Training - Personnel on Hopper Dredges: The USACE must ensure that all contracted personnel involved in operating hopper dredges (whether privately-funded or federally-funded projects) receive thorough training on measures of dredge operation that will minimize takes of sea turtles. It shall be the goal of the hopper dredging operation to establish operating procedures that are consistent with those that have been used successfully during hopper dredging in other regions of the coastal United States, and which have proven effective in reducing turtle/dredge interactions. Therefore, USACE Engineering Research and Development Center experts or other persons with expertise in this matter shall be involved both in dredge operation training, and installation, adjustment, and monitoring of the rigid deflector draghead assembly.

13. Dredge Lighting: All lighting aboard hopper dredges and hopper dredge pumpout barges operating within 3 nm of sea turtle nesting beaches shall be limited to the minimal lighting necessary to comply with U.S. Coast Guard and/or Occupational Safety and Health Administration requirements. All non-essential lighting on the dredge and pumpout barge shall be minimized through reduction, shielding, lowering, and appropriate placement of lights to minimize illumination of the water to reduce potential

disorientation effects on female sea turtles approaching the nesting beaches and sea turtle hatchlings making their way seaward from their natal beaches.

14. Best Management Practices: The USACE will be required to conduct activities in compliance with NMFS' March 23, 2006, *Sea Turtle and Smalltooth Sawfish Construction Conditions* (Appendix D), except that Condition "e" shall not apply to the hopper dredging operations as it is impracticable to require a hopper dredge to stop all forward movement whenever a sea turtle is sited closer than 50 feet on the surface.

Sturgeon

The following Terms and Conditions implement the RPMs above, which are designed to minimize the adverse impacts of the expected take from the proposed action, and to provide for monitoring and validation of the impacts associated with the proposed action, and must be collectively implemented.

Develop a Plan for Safe and Effective Fish Passage (RPM 9.3.2.1): The final design, selection of preferred alternative and implementation of a safe and effective fish passage shall be coordinated by the USACE in consultation with NMFS, USACE will coordinate directly with NMFS and NMFS will need a minimum of 30 days to review the final fish passage design. USACE will provide NMFS with final design and performance information for the selected fish passage alternative, including data on variance of velocity fields under different river flow scenarios. The proposed final design shall require NMFS' final review to validate the design meets the requirements specified in the Biological Opinion. The overall design goal of the fish passage alternative is to achieve at least 75 percent upstream passage effectiveness for both shortnose and Atlantic sturgeon, at least 85 percent downstream passage effectiveness, and cause no serious injury to sturgeon that come into contact with the passage or dam structures. The desired performance metrics for sturgeon tagged and monitored under the Monitoring and Adaptive Management Plan that reach the base of the structure are 90 percent upstream passage and 100 percent downstream passage. The fish passage must maintain velocities comparable to those found in the upstream habitat that the sturgeon are expected to access upon completion of the fish passage facility (at Augusta Shoals).

1. Timeline for Construction of the Fish Passage (RPM 9.3.2.1): USACE estimates that analyses required by WIIN Act will be completed by August 2018. Construction of the fish passage shall commence prior to January 2021 and be completed within 3 years. To reduce adverse effects to sturgeon during construction of the fish passage, special provisions for the protection of sturgeon shall be implemented.

2. Land for Fish Passage (RPM1): The USACE or project sponsor shall purchase any additional land necessary for construction of the fish passage and for an access road to the site. The land acquisition process must be initiated prior to, or concurrent with, commencement of entrance channel dredging actions.

3. Fish Passage Construction Guidelines (RPM 9.3.2.1): To minimize effects to spawning sturgeon and their offspring, no in-water fish passage construction downstream of the NSBLD shall occur between August 15 and April 15 of any year. In-water construction of the fish passage may be performed downstream of the dam between April 16 and August 14 of any year, and upstream of the dam throughout the year.

   The original Opinion included a Term and Condition prohibiting in-water work downstream of the NSBLD between February 1 and May 31 of any year. That Term and Condition has been revised in this amendment based on emerging information regarding seasonal migration patterns of Atlantic sturgeon, including results from telemetry tagging investigations completed through the SHEP Monitoring and Adaptive Management Plan (Post et al. 2016). This revised Term and Condition extends the no-work window from four months to eight months each year allowing only four months each year for in-water work conducted downstream of NSBLD. This expanded no-work period could affect both the total duration of fish passage construction as well as the cost of such work, however because we do not know which alternative will be selected, we are unable to determine how the revised no-work window will ultimately affect the overall fish passage construction timeline. While the no-work window is intended to avoid and minimize potential effects to individual sturgeon that may be in close physical proximity to the NSBLD work area, timely and full implementation of fish passage is also a significant consideration because such passage minimizes potential effects to sturgeon populations in the Savannah River resulting from SHEP by allowing access to alternative habitats for both spawning and larval development. Moreover, passage at NSBLD is a pivotal component of NMFS's conservation and recovery efforts for both Atlantic and shortnose sturgeon. As such, upon USACE's selection of the preferred passage alternative, NMFS may re-evaluate trade-offs between potential short term effects associated with in-water work and potential loss of benefits to spawning, larval and young juvenile sturgeon resulting from additional delay of full fish passage implementation that might result from the expanded in-water work prohibition.

4. In-water Work During Construction of the Fish Passage (RPM 9.3.2.1): The USACE shall adhere to the following protective measures during construction of the fish passage.

   a. Appropriate erosion and turbidity controls shall be utilized wherever necessary to limit sediments from entering the water.

   b. Dredging and construction shall be conducted with minimum environmental impact.

   c. No construction debris shall be allowed to enter the water.

   d. To ensure passage throughout the habitat, adequate pathways must be provided at all times so that fish can migrate between foraging habitat and spawning habitat; no blocking of the channel is allowed.

   e. Normal water flows must be maintained throughout the construction areas.

f. The USACE shall not reduce flows during spring/early summer to aid in the construction of the fish passage.

5. Fish Passage Effectiveness Monitoring and Adaptive Management (RPM 9.3.2.1): The USACE shall develop a Monitoring and Adaptive Management Plan specifically for the fish passage that will, to the maximum extent practicable, ensure the performance criteria described in sturgeon term and condition no.1 above will be achieved. The plan will also identify detailed triggers for passage modification. Post-construction monitoring shall be designed and conducted to assess the effectiveness of the fish passage in safely passing sturgeon upstream and downstream. The USACE shall consult with NMFS and the other federal and state resource agencies in the completion of the Plan within 6 months of receiving all environmental approvals to implement the project. NMFS shall have final review of such plan. If it is determined that sturgeon are not safely and effectively passing upstream and downstream through the fish passage, measures shall be taken to identify the source of the problem, and corrective actions approved by NMFS shall be taken to rectify the problem.

6. Timing of Construction of the Flow Re-routing Modifications (RPM 9.3.2.2): The construction of the diversion structure associated with the flow re-routing modifications has the potential to cause injury to sturgeon. The impact to sturgeon shall be minimized by constructing the diversion structure while most sturgeon are congregated upstream of the construction area between May 15 and November 1.

7. Protection of Sturgeon during In-water Construction in the Lower Savannah River (RPM 9.3.2.2): The USACE shall adhere to the following measures to protect sturgeon during deepening of the harbor and widening of the channel; and during the modifications associated with the flow re-routing, which include plugging Rifle Cut, filling the Sediment Basin, closing the lower arm of McCoy Cut, construction of a flow diversion structure at McCoy Cut, and the dredging of the upper Middle and Back River.

   a. Appropriate erosion and turbidity controls shall be utilized wherever necessary to limit sediments from entering the water.

   b. Dredging and construction shall be conducted with minimum environmental impact.

   c. No construction debris shall be allowed to enter the water.

   d. No blocking of the channel is allowed, except where included as part of the flow re-routing modifications.

8. Ensure Appropriate Monitoring and Adaptive Management within the Lower Savannah River Project Area (RPM 9.3.2.3): A comprehensive monitoring and adaptive management plan shall be developed for assessing project effects associated with the deepening, the flow re-routing modifications, the injection of dissolved oxygen, and for implementing corrective actions. The USACE shall coordinate with NMFS and other federal and state resource agencies in the completion of the Plan within 6 months of receiving all environmental approvals to implement the project. NMFS shall have final

review of such plan. The Plan shall include monitoring to determine whether the predicted amount of habitat loss, as determined by the USACE's models, is being exceeded. If the monitoring indicates that habitat loss to any species within NMFS' ESA authority is being exceeded, this will trigger re-initiation of consultation with NMFS. Preconstruction monitoring would begin in time to allow one year of work to be complete before dredging occurs in the inner harbor. USACE shall conduct post-construction monitoring of dissolved oxygen concentrations and salinity in the Savanah River to confirm the extent of sturgeon habitat losses estimated through hydrodynamic modeling. This monitoring will support verification of the magnitude and geographic extent of the projected changes in DO and salinity depicted in Figures 25 – 30 of the original Opinion and described in detail in the July, 2012 Final Environmental Impact Statement for the Savannah Harbor Expansions Project, Chatham County, Georgia and Jasper County, South Carolina.

9. Ensure Appropriate Dissolved Oxygen Levels (RPM 9.3.2.4): Monitoring and adaptive management for dissolved oxygen levels shall ensure that the oxygen injection systems perform as intended to offset impacts due to deepening the harbor and ensure the amount of suitable habitat as predicted in the USACE's modeling of the three-level summer habitat suitability criteria for sturgeon (Table 7) are not reduced. During the monitoring and adaptive management period if dissolved oxygen excursions below minimal levels in the modeled river cells are longer in duration than specified in the criteria, corrective action will be taken immediately, if practicable, for example by increasing or adjusting the operation of the Speece Cone system or cessation of dredging in the area of concern. If short-term responses are not practicable, potential engineering solutions shall be identified and implemented as soon as possible, and not later than July 1, following discovery of the poor oxygen levels.

10. Tissue Sampling (RPM 9.3.2.5): A tissue sample shall be taken of any sturgeon handled or stranded per Appendix C; samples shall be shipped to the address provided in Appendix C within one month.

11. PIT Tag Scanning (RPM 9.3.2.5): All sturgeon encountered shall be scanned for a PIT tag; codes shall be included in the take report submitted to NMFS. The PIT tag reader shall be able to read both 125 kHz and 134 kHz tags. Any untagged sturgeon will be fitted with a PIT tag. PIT tagging of sturgeon is not required to be done if the NMFS-approved protected species observer does not have prior training or experience in said activity; however, if the observer has received prior training in PIT tagging procedures and is comfortable with the procedure, then the observer shall PIT tag the animal prior to release (in addition to the standard external tagging).

12. Lethal Take (RPM 9.3.2.5): If a lethal take occurs, USACE shall arrange for contaminant analysis of the carcass. The carcass should be frozen and NMFS contacted immediately to provide instructions for shipping and preparation.

13. Take Reporting (RPM 9.3.2.5): Observer reports of incidental take by hopper dredges and relocation trawls must be faxed to NMFS' Southeast Regional Office (phone:

727/824-5312, fax: 727/824-5309), and reported by electronic mail to: (**takereport.nmfsser@noaa.gov)** by onboard NMFS-approved protected species observers, the dredging company, or the USACE within 24 hours.

10 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authority 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.

10.1 Sea Turtles

Pursuant to Section 7(a)(1) of the ESA, the following conservation recommendations are made to assist the USACE in contributing to the conservation of sea turtles by further reducing or eliminating adverse impacts that result from dredging.

1. Draghead Modifications and Bed-Leveling Studies: The USACE should supplement other efforts to develop modifications to existing dredges to reduce or eliminate take of sea turtles, and develop methods to minimize sea turtle take during "cleanup" operations when the draghead maintains only intermittent contact with the bottom. Some method to level the "peaks and valleys" created by dredging would reduce the amount of time dragheads are off the bottom. NMFS is ready to assist the USACE in conducting studies to evaluate bed-leveling devices and their potential for interaction with sea turtles, and develop modifications if needed.

2. Draghead Evaluation Studies and Protocol: Additional research, development, and improved performance is needed before the V-shaped rigid deflector draghead can replace seasonal restrictions as a method of reducing sea turtle captures during hopper dredging activities. Development of a more effective deflector draghead or other entrainment-deterring device (or combination of devices, including use of acoustic deterrents) could potentially reduce the need for sea turtle relocation or result in expansion of the winter dredging window. NMFS should be consulted regarding the development of a protocol for draghead evaluation tests. NMFS recommends that USACE coordinate with ERDC, the Association of Dredge Contractors of America, and dredge operators (Manson, Bean-Stuyvesant, Great Lakes, Natco, etc.) regarding additional reasonable measures they may take to further reduce the likelihood of sea turtle takes.

2. Continuous Improvements in Monitoring and Detecting Takes: The USACE should seek continuous improvements in detecting takes and should determine, through research and development, a better method for monitoring and estimating sea turtle takes by hopper dredge. Observation of overflow and inflow screening is only partially effective and provides only partial estimates of total sea turtle mortality.

3. <u>Overflow Screening</u>: The USACE should encourage dredging companies to develop or modify existing overflow screening methods on their company's dredge vessels for maximum effectiveness of screening and monitoring. Horizontal overflow screening is preferable to vertical overflow screening because NMFS considers that horizontal overflow screening is significantly more effective at detecting evidence of protected species entrainment than vertical overflow screening.

4. <u>Preferential Consideration for Horizontal Overflow Screening</u>: The USACE should give preferential consideration to hopper dredges with horizontal overflow screening when awarding hopper dredging contracts for areas where new materials, large amounts of debris, or clay may be encountered, or have historically been encountered. Excessive inflow screen clogging may in some instances necessitate removal of inflow screening, at which point effective overflow screening becomes more important.

5. <u>Section 10 Research Permits, Relocation Trawling, Piggy-Back Research, and 50 CFR Part 223 Authority to Conduct Research on Salvaged, Dead Specimens</u>: NMFS recommends that USACE ERDC apply to NMFS for an ESA Section 10 research permit to conduct endangered species research on species incidentally captured during traditional relocation trawling. SERO shall assist the USACE with the permit application process.

   NMFS also encourages the USACE to cooperate with NMFS' scientists, other federal agencies' scientists, and university scientists holding appropriate research permits to make fuller use of turtles taken or captured by hopper dredges and relocation trawlers pursuant to the authority conferred by this opinion. NMFS encourages "piggy-back" research projects by duly-permitted or authorized individuals or their authorized designees.
   Important research can be conducted without a Section 10 permit on salvaged dead specimens. Under current federal regulations (see 50 CFR 223.206 (b): Exception for injured, dead, or stranded [threatened sea turtle] specimens), "Agents…of a Federal land or water management agency may…salvage a dead specimen which may be useful for scientific study." Similar regulations at 50 CFR 222.310 provide "salvaging" authority for endangered sea turtles.

6. <u>Draghead Improvements - Water Ports</u>: NMFS recommends that the USACE require or at least recommend to dredge operators that all dragheads on hopper dredges contracted by the USACE for dredging projects be eventually outfitted with water ports located in the top of the dragheads to help prevent the dragheads from becoming plugged with sediments. When the dragheads become plugged with sediments, the dragheads are often raised off the bottom by the dredge operator with the suction pumps on in order to take in enough water to help clear clogs in the dragarm pipeline, which increases the likelihood that sea turtles in the vicinity of the draghead will be taken by the dredge. Water ports located in the top of the dragheads would relieve the necessity of raising the draghead off the bottom to perform such an action, and reduce the chance of incidental take of sea turtles.

NMFS supports and recommends the implementation of proposals by ERDC and USACE personnel for various draghead modifications to address scenarios where turtles may be entrained during hopper dredging (Dickerson and Clausner 2003). These include: (1) An adjustable visor; (2) water jets for flaps to prevent plugging and thus reduce the requirement to lift the draghead off the bottom; and (3) a valve arrangement (which mimics the function of a "Hoffer" valve used on cutterhead type dredges to allow additional water to be brought in when the suction line is plugging) that will provide a very large amount of water into the suction pipe thereby significantly reducing flow through the visor when the draghead is lifted off the bottom, reducing the potential to take a turtle.

7. Economic Incentives for No Turtle Takes: The USACE should consider devising and implementing some method of significant economic incentives to hopper dredge operators such as financial reimbursement based on their satisfactory completion of dredging operations, or X number of yd^3 of material moved, or hours of dredging performed, without taking turtles. This may encourage dredging companies to research and develop "turtle friendly" dredging methods; more effective, deflector dragheads; pre-deflectors; top-located water ports on dragarms; etc.

8. Sodium Vapor Lights on Offshore Equipment: On offshore equipment (i.e., hopper dredges, pumpout barges) shielded low-pressure sodium vapor lights are highly recommended for lights that cannot be eliminated.

10.2 Atlantic Sturgeon

USACE 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 evaluation of potential effects to sturgeon populations, assessments of interactions and sturgeon migratory and feeding behavior.

10.3 Shortnose Sturgeon

USACE should support future research on the biology and life history of shortnose sturgeon throughout the Savannah River.

Recommended research includes:

1. Estimating population size and structure.

2. Identification of spawning sites and substrate.

3. Assessment of areas upstream NSBLD as spawning habitat.

4. Effects of regulated flow on spawning habitat.

5. Effects of water quality changes on shortnose sturgeon and their resting and foraging habitats.

Specific research should include:

1. A study to examine prey composition and availability in the Savannah River would improve knowledge of the distribution of preferred foraging habitat of sturgeon.

2. As the implementation of fish passage at the New Savannah Bluff Lock and Dam would trigger implementation of fish passage at the dams located upstream, it would be useful to acquire data identifying the best design for fish passage at these facilities. Accommodating passage of sturgeon at these dams would restore access to additional former spawning habitat and assist in the recovery of the species.

3. USACE should support future research that evaluates the relationship between flow, water temperature, and sturgeon migration. Additional information on this relationship would provide a better indicator of conditions that cue and successfully initiate sturgeon spawning movement. USACE could apply this information to determine future adequate flow rates within Savannah River and the geographic range of the species. The Nature Conservancy (TNC) has taken an active role in shortnose sturgeon research and restoration in the South. In the Savannah River, TNC is working with the USACE to identify effects of water release on sturgeon spawning habitat; shortnose sturgeon implanted with ultrasonic transmitters are being tracked to assess impacts of flow and identify spawning areas. The USACE should continue to support and encourage more of this type of research.

4. USACE should develop and coordinate a basin-wide research plan to obtain better results in understanding sturgeon population dynamics and movement. A basin-wide flow regimen should be developed to ensure adequate water quality for the sturgeon during drought, and a conservative approach to storing excess water for later use.

11 REINITIATION OF CONSULTATION

This concludes the reinitiated formal consultation on the SHEP project. 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 ITS 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 amendment; (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, USACE must immediately request reinitiation of formal consultation.

12 LITERATURE CITED

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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	Cod End	Ground Gear
material type	material type	length (ft) ______
mesh size (in) ______ (stretched)	mesh size (in) ______ (stretched)	size (in) ______

Doors	Lazy Line
type	material type
length (ft) ______ height (ft) ______	

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) ______

Page 1 of 4

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)

Location	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)

Location	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 ______

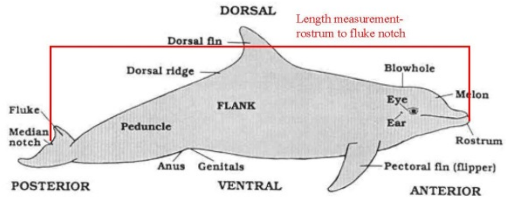
Mitigation Measures in place at time of capture:

Additional Comments:

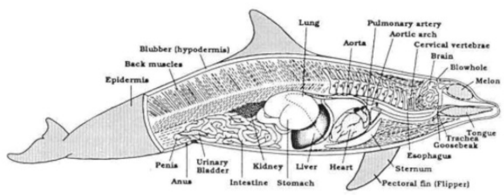
Print Form Reset Form

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

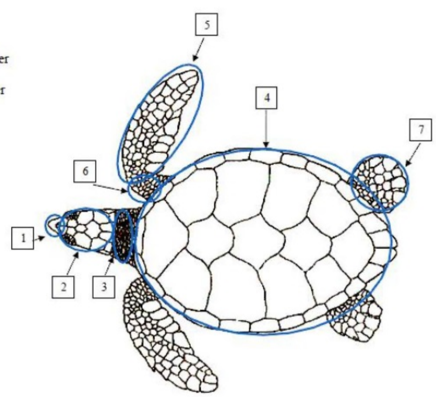


Basic Internal Anatomy

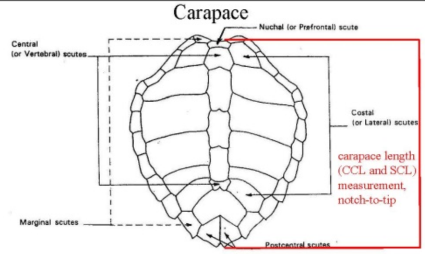
Sea Turtles

External hardshell:

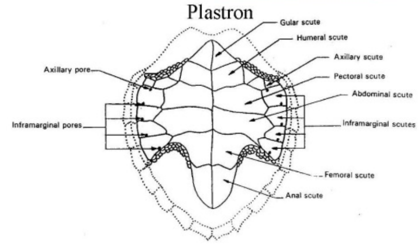
1) Beak
2) Head
3) Neck
4) Carapace
5) Front Flipper
6) Shoulder
7) Rear Flipper



Carapace

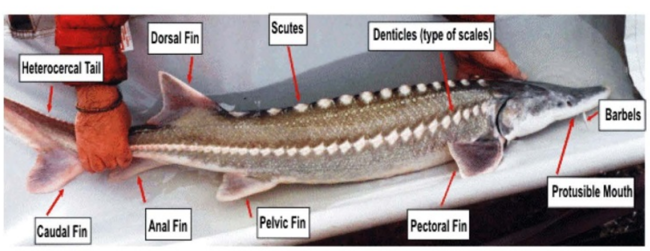


Plastron

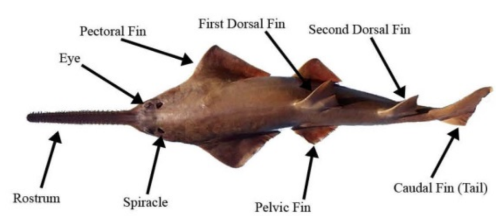


Finfish

Sturgeon



Sawfish



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.

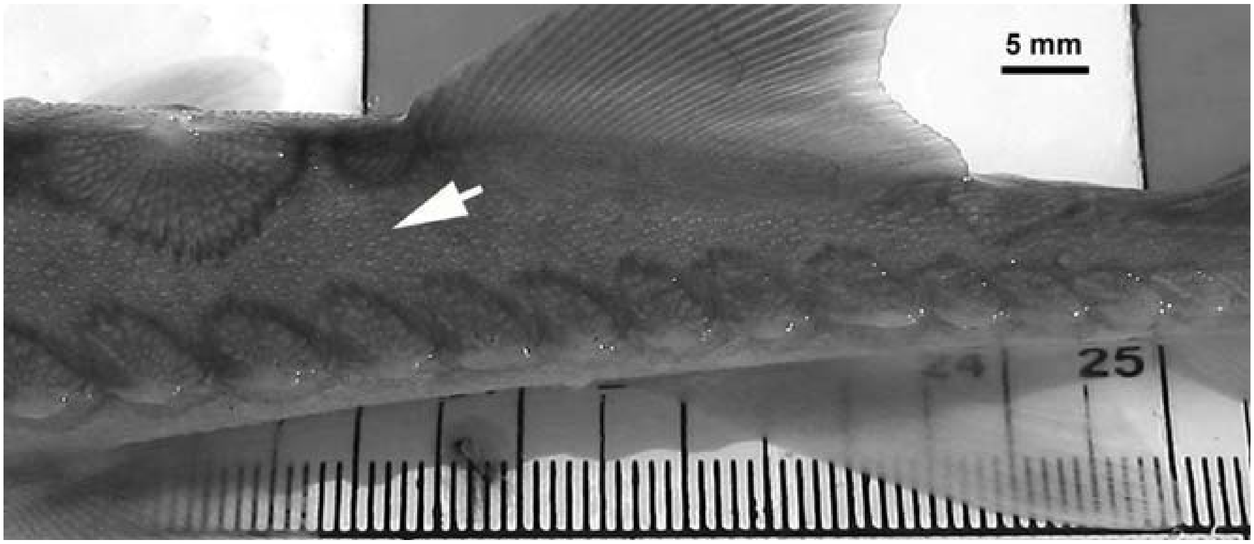


Figure E1. Standardized Location for PIT Tagging all Gulf, Atlantic, and shortnose sturgeon
(Photo Credit: J. Henne, USFWS)

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 non-lethal	4-Lethal or non-lethal	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 non-lethal	1-Lethal or non-lethal	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
USFWS-Funded GADNR studies of Rec Fish	5 Years	8 non-lethal	None	14 non-lethal	11 NA DPS non-lethal; 2 SA DPS non-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)				
USFWS-Funded GADNR studies of Rec Fish	5 years	9 –No more than 2 lethal adults/A.E.s	35 –No more than 3 lethal adults/A.E.s	11 –No more than 2 lethal adults/A.E.s	3 –No more than 2 lethal adults/A.E.s	16 –No more than 2 lethal adults/A.E.s

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