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

October 23, 2018

F/SER31:DMB
SER-2017-18882

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Ref.: SAW-2009-00293, Carteret County, Bogue Banks Master Beach Nourishment Plan, Carteret County, North Carolina

Dear Mr. Reusch and Ms. Hansen,

The enclosed Biological Opinion ("Opinion") was prepared by the National Marine Fisheries Service (NMFS) pursuant to Section 7(a)(2) of the Endangered Species Act (ESA). The Opinion considers the effects of a proposal by the Wilmington District of the U.S. Army Corps of Engineers (USACE) and the Bureau of Ocean Energy Management (BOEM) to authorize Carteret County, North Carolina, to implement a long-term beach and inlet management plan. We base this Opinion on project-specific information provided in the consultation package as well as NMFS's review of published literature. This Opinion analyzes the potential for the project to affect the following species: green sea turtle (North Atlantic and South Atlantic distinct population segments [DPSs]), hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, loggerhead sea turtle (Northwest Atlantic DPS), Atlantic sturgeon (Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs), giant manta ray, shortnose sturgeon, blue whale, fin whale, North Atlantic right whale, sei whale, and sperm whale. This Opinion also analyzes the potential for the project to have an effect on the following designated critical habitat: loggerhead sea turtle (Northwest Atlantic DPS) (Nearshore Reproductive Habitat, Unit N-03). Pursuant to 50 CFR 402.14(i)(5), any taking which is subject to an incidental take statement (ITS), and which is in compliance with the terms and conditions associated with the ITS, is not a prohibited taking under the ESA.

Please direct questions regarding this Opinion to Dana M. Bethea, Consultation Biologist, by phone at (727) 209-5974, or by email at Dana.Bethea@noaa.gov.

Sincerely,

STRELCHECK.ANDREW.J.1365863152
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for Roy E. Crabtree, Ph.D.
Regional Administrator

Enclosures:
Biological Opinion

File: 1514-22 F.1

Endangered Species Act - Section 7 Consultation
Biological Opinion

Action Agency:	U.S. Army Corps of Engineers, Wilmington District
Co-Action Agency:	Bureau of Ocean Energy Management
Applicant:	Carteret County, North Carolina Permit Number SAM-2009-00293
Activity:	Bogue Banks Master Beach Nourishment Plan
Consulting Agency:	National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, Protected Resources Division, St. Petersburg, Florida Consultation Number SER-2017-18882
Approved by:	STRELCHECK.ANDREW.J.1365863152 Digitally signed by STRELCHECK.ANDREW.J.1365863152 DN: c=US, o=U.S. Government, ou=DoD, ou=PKI, ou=OTHER, cn=STRELCHECK.ANDREW.J.1365863152 Date: 2018.10.23 14:41:19 -04'00' for Roy E. Crabtree, Ph.D., Regional Administrator NMFS, Southeast Regional Office St. Petersburg, Florida
Date Issued:	October 23, 2018

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Acronyms and Abbreviations

AIWW	Atlantic Intracoastal Waterway
APPS	NOAA Fisheries Authorizations and Permits for Protected Species
ASMFC	Atlantic States Marine Fisheries Commission
BOEM	Bureau of Ocean Energy Management
CFR	Code of Federal Regulations
DPS	Distinct Population Segment
DDT	Dichlorodiphenyltrichloroethane
DO	Dissolved oxygen
DTRU	Dry Tortugas Recovery Unit of loggerhead sea turtle
DWH	Deepwater Horizon oil spill of 2010
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
ESA	Endangered Species Act
FMP	Fishery Management Plan
FWC	Florida Fish and Wildlife Conservation Commission
FWRI	Fish and Wildlife Research Institute

FR	Federal Register
GADNR	Georgia Department of Natural Resources
GCRU	Greater Caribbean Recovery Unit of loggerhead sea turtle
HMS	Highly Migratory Species
IPCC	Intergovernmental Panel on Climate Change
ITS	Incidental Take Statement
LOP	Level of Protection
MCH	Morehead City Harbor
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NA DPS	North Atlantic DPS of green sea turtle
NEAMAP	Northeast Area Monitoring and Assessment Program
NCDENR	North Carolina Department of Environment and Natural Resources
NCWRC	North Carolina Wildlife Resources Commission
NGMRU	Northern Gulf of Mexico Recovery Unit of loggerhead sea turtle
NMFS	National Marine Fisheries Service
NOAA	National Ocean and Atmospheric Association
NRU	Northern Recovery Unit of loggerhead sea turtle
NWA DPS	Northwest Atlantic DPS of loggerhead sea turtle
ODMDS	Ocean Dredged Material Disposal Site
Opinion	Biological Opinion
PCB	Polychlorinated Biphenyls
PCE	Primary Constituent Elements
PCTS	Public Consultation Tracking System
PFRU	Peninsular Florida Recovery Unit of loggerhead sea turtle
PIT	Passive Integrated Transponder
PRD	NMFS Southeast Regional Office Protected Resources Division
RPM	Reasonable and Prudent Measure
SA DPS	South Atlantic DPS of green sea turtle
SARBO	South Atlantic Regional Biological Opinion
SCDNR	South Carolina Department of Natural Resources
STSSN	Sea Turtle Stranding and Salvage Network
T&C	Terms and Conditions
TED	Turtle Exclusion Device
U.S.	United States of America
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service
USN	U.S. Navy
YOY	Young-of-the-year

Units of Measurement

°C	degrees Celsius
cm	centimeter(s)
CPUE	catch per unit effort
EPR	eggs per recruit
°F	degrees Fahrenheit

ft	foot/feet
g	gram(s)
in	inch(es)
kg	kilogram(s)
km	kilometer(s)
kt	knot(s)
lb	pound(s)
lin ft	linear foot/feet
m	meter(s)
mm	millimeter(s)
MCY	million cubic yards
mi	mile(s)
mi^2	square mile(s)
mgd	million gallons per day
nmi	nautical mile(s)
SCL	straight carapace length
SSB/R	spawning stock biomass per recruit
yd	yard(s)
yd^3	cubic yard(s)

1 INTRODUCTION

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

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

This document represents NMFS's Opinion based on our review of the effects of a long-term beach and inlet management plan in Carteret County, North Carolina, on the following species (distinct population segments [DPSs]) and designated critical habitat in accordance with Section 7 of the ESA: green sea turtle (North Atlantic [NA] and South Atlantic [SA] DPSs), hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, loggerhead sea turtle (Northwest Atlantic [NWA] DPS), Atlantic sturgeon (Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs), giant manta ray, shortnose sturgeon, blue whale, fin whale, North Atlantic right whale, sei whale, sperm whale, and loggerhead sea turtle (NA DPS) designated critical habitat (Nearshore Reproductive Habitat, Unit N-03). NMFS has analyzed the information provided in the biological assessment and the effects on listed species under our purview in accordance with Section 7 of the ESA of 1973, as amended (16 U.S.C. 1531 et seq.). NMFS bases this Opinion on project information provided by the U.S. Army Corps of Engineers (USACE) and the Bureau of Ocean Energy Management (BOEM) as well as published literature and the best available scientific and commercial information.

2 CONSULTATION HISTORY

The following is the consultation history for Public Consultation Tracking System (PCTS) identifier number SER-2017-18882, Bogue Banks Master Beach Nourishment Plan.

- On September 11, 2017, NMFS received a request for formal consultation under Section 7 of the ESA from the USACE for permit SAM-2017-18882 in a letter dated September 8, 2017. Due to the complexity of the project and the overlapping Regulatory authorities between the

USACE and the BOEM, the request to initiate formal consultation is being conducted jointly by the 2 authorities.

- The USACE and BOEM determined that the proposed action may affect, but is not likely to adversely affect, North Atlantic right whale, hawksbill sea turtle, and shortnose sturgeon.
- The USACE and BOEM determined that the proposed action is likely to adversely affect green sea turtle (NA DPS), Kemp's ridley sea turtle, leatherback sea turtle, loggerhead sea turtle (NWA DPS), and Atlantic sturgeon (Carolina DPS).
- The USACE and BOEM also determined the proposed action may affect, but is not likely to adversely affect loggerhead sea turtle designated critical habitat.
- NMFS requested additional information on January 16, 2018, related to the project's location and on January 19, 2018, related to the details of the proposed action.
- NMFS held a conference call with the USACE and BOEM on January 23, 2018, to discuss project details and requested additional information regarding sea turtle take due to dredging in and near the action area. NMFS received response on February 6, 2018.
- On February 21, 2018, NMFS, USACE South Atlantic Division, and USACE Wilmington District decided to proceed with this Opinion as a stand-alone Opinion (i.e., not "stacked" on the current South Atlantic Regional Biological Opinion (NMFS 1997a)]).
- On March 13, 2018, NMFS, USACE South Atlantic Division, and USACE Wilmington District agreed that, unless a reinitiation trigger was met, this Opinion would cover the proposed action until the completion of the reintiated SARBO (SER-2008-5934). It is anticipated that the reinitiated SARBO will be drafted to cover all of the activities included in the proposed action. Upon completion of the SARBO, it is anticipated that this Opinion will be replaced by that Regional Biological Opinion.
- NMFS requested additional information on March 20, 2018, related to other dredging projects within and near the action area and received response on March 30, 2018.
- NMFS requested additional information related to relocation trawling data on March 30 and April 4, 2018, received response on April 4, 2018, and initiated consultation that day.
- During the review process, NMFS requested additional information on April 30, 2018, and received final response on May 10, 2018.
- NMFS provided the USACE and BOEM with a Draft Opinion on August 14, 2018.
- During the review of the Draft Opinion, NMFS requested additional information on August 30, 2018, and received response on September 7, 2018.
- NMFS provided the USACE and BOEM with a second, updated Draft Opinion on October 11, 2018.

3 DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA

3.1 Proposed Action

The USACE and BOEM propose to authorize Carteret County (the County), through an inter-local agreement with the island municipalities, to manage approximately 23 miles (mi) of beaches from Bogue Inlet to Atlantic Beach, North Carolina, through the implementation of a comprehensive 50-year beach nourishment and non-structural inlet management project. Atlantic Beach is also a party to the inter-local agreement; however, it is the on-going recipient of regular USACE placements of navigation-dredged material from the Morehead City Harbor (MCH) channels. The County's 50-year plan would provide for interim maintenance nourishment events along Atlantic Beach should USACE MCH placements cease. The County's 50-year plan would also provide storm-response nourishment for Atlantic Beach to address any storm-related needs in excess of the volumes placed by the USACE MCH project. The County projects the beaches will require maintenance placements totaling approximately 50.6 million cubic yards (MCY) over the 50-year life of the project. The County conservatively assumes for planning purposes that beach nourishment and channel alignment would require hopper dredging of approximately 26.7 MCY over the 50-year life of the project.

The USACE and BOEM have established protocols for delineating agency responsibilities for the proposed action in accordance with Section 7 of the ESA (Table 1). The division of responsibilities between the two agencies corresponds to the 3-nautical mile (nmi) diving line between state and federal waters.

Table 1. Lead Action Agency for Specific Activities within the Action Area for the Proposed Action

Lead Action Agency	Activity
BOEM	Hopper and/or cutterhead dredging outside of 3-nmi limit, Closed net (capture) relocation trawling
USACE	Hopper and/or cutterhead dredging inside of 3-nmi limit, Closed net (capture) relocation trawling
USACE	Cutterhead dredging within Bogue Inlet "Safe Box"
USACE	Placement of dredge material along oceanfront

3.1.1 Beach Nourishment

The 50-year beach nourishment plan would employ a regular and recurring cycle of nourishment events to continuously maintain beach profile sand volumes along 7 managed reaches (Bogue Inlet, Emerald Isle West, Emerald Isle Central, Emerald Isle East, Indian Beach/Salter Path, Pine Knoll Shores, and Atlantic Beach; Table 2).

Table 2. The Boundary Points of Each of the Proposed Placement Reaches (WSG-84 Map Datum)

Placement Reach		Latitude	Longitude
Bogue Inlet	Start	34.644014	-77.095811
	End	34.654532	-77.060167
Emerald Isle West	Start	34.654532	-77.060167
	End	34.667875	-77.001545
Emerald Isle Central	Start	34.667875	-77.001545
	End	34.676850	-76.950166
Emerald Isle East	Start	34.676850	-76.950166
	End	34.683493	-76.906960
Indian Beach/Salter Path	Start	34.683493	-76.906960
	End	34.689149	-76.864776
Pine Knoll Shores	Start	34.689149	-76.864776
	End	34.696737	-76.785998
Atlantic Beach	Start	34.696737	-76.785998
	End	34.694496	-76.699239

Nourishment events would be implemented according to 25-year level of protection (LOP) beach profile volumetric triggers, ranging 211-266 cubic yards per foot along various reaches of the approximately 23-mi project shoreline. Maintenance of the 25-year LOP beach profile volumes along the management reaches, which equates to protection for upland structures against a 25-year storm event, would involve: 1) regular recurring "maintenance" nourishment events to offset long-term, chronic background erosion (including hotspot erosion), and 2) periodic "storm response" nourishment events to offset sand losses incurred during hurricanes or major storm events. The individual management reaches are expected to require recurring maintenance sand placements at approximate intervals of 3 years (Emerald Isle East), 6 years (Pine Knoll Shores, Indian Beach/Salter Path, Bogue Inlet), and 9 years (Emerald Isle Central, Emerald Isle West) to offset chronic background erosion. Each individual nourishment event will be unique based on various factors; however, based on current projections and timelines, the range of days per event could be 50-250 days with most events being 100-150 days.

The majority of the beach volume will come from offshore borrow sites along Bogue Banks (Table 3). The proposed offshore borrow site sediments were analyzed for native beach compatibility and determined to be suitable for placement on Bogue Banks in accordance with the North Carolina Technical Standards for Beach Fill Projects [15A North Carolina Administrative Code (NCAC) 07H.0312]. Dredging operations at the offshore borrow sites would involve hopper dredges, but could also include the use of hydraulic cutterhead pipeline dredges. Excavation would not extend to or below the original underlying seafloor. The use of hopper dredges would involve sediment transport from the borrow sites to nearshore pump-out stations, where the material would be pumped from the dredge through a submerged pipeline leading to the recipient beach. Because each dredge has a different capacity and will be sailing a different distance based on placement reach, 3 to 6 dredge trips per day are estimated per dredge. Dredge companies may use up to 3 dredges at a time. Once the material is on the beach, bulldozers will likely be used to shape the beach to the target elevations.

Table 3. The Northwest Corner Point of Each of the Proposed Offshore Borrow Sites (WSG-84 Map Datum)

Offshore Borrow Sites	Latitude	Longitude
Old ODMDS	34.657715	-76.717213
Current ODMDS	34.641829	-76.749655
Area Y	34.635696	-77.060734

Additional volume of beach fill would be acquired from Atlantic Intracoastal Waterway (AIWW) disposal areas or upland sand mines. The proposed AIWW sources include 10 USACE Confined Disposal Facility (CDF) sites along the AIWW Bogue Inlet Crossing and adjoining AIWW channels behind Bogue Banks and Bear Island. These sites are active diked facilities that are used by the USACE for the disposal of dredged material from maintenance of the AIWW channels. Beach fill extraction from the 10 AIWW disposal sites would most likely involve pump-outs by a cutterhead dredge, with direct pipeline delivery to the beach or delivery via scows/barges and nearshore pump-out stations (Table 4). The proposed upland sources include 6 permitted sand mines located in Carteret (4), Craven (1), and Onslow Counties (1). The use of beach fill from the upland sites would involve delivery via dump trucks, with beach access via public access points. Because we do not anticipate direct or indirect routes of effects to species or critical habitat under NMFS jurisdiction due to the excavation of sand from the upland sand mines, we will not discuss that aspect of the project further.

Table 4. Proposed Atlantic Intracoastal Waterway Sand Sources (WSG-84 Map Datum)

Upland Borrow Sites	Latitude	Longitude
DA 22	34.875003	-76.689928
DA 26	34.853449	-76.688191
DA 60	34.670853	-77.091197
DA 61	34.671103	-77.100498
DA 62	34.673104	-77.104618
DA 64	34.676396	-77.111057
DA 65	34.679373	-77.116551
DA 82	34.655206	-77.157750
DA 88	34.644307	-77.174643
DA 94	34.631291	-77.202616

As detailed below, another source of beach fill would include compatible dredged material derived from realignments of the Bogue Inlet ebb channel.

3.1.2 Inlet Management

Bogue Inlet management would encompass periodic realignments of the ebb channel via dredging to a mid-inlet position approximately every 10 to 15 years, with corresponding placement of dredged material on the beaches of Emerald Isle. The initiation of realignment projects would be based on the position of the ebb channel relative to the boundaries of an established “Safe Box” within the inlet throat (Figure 1, Table 5). Based on the historical patterns, the “Safe Box” was established with boundaries corresponding to the location where acceleration of the ebb channel towards the west end of Emerald Isle has occurred in the past; the “Safe Box” is not necessarily within the previously approved channel limits. The ebb channel would be allowed to migrate freely so long as it remains within the boundaries of the “Safe Box”; however, migration beyond the eastern boundary (i.e., towards Emerald Isle) would trigger a preemptive ebb channel realignment event.

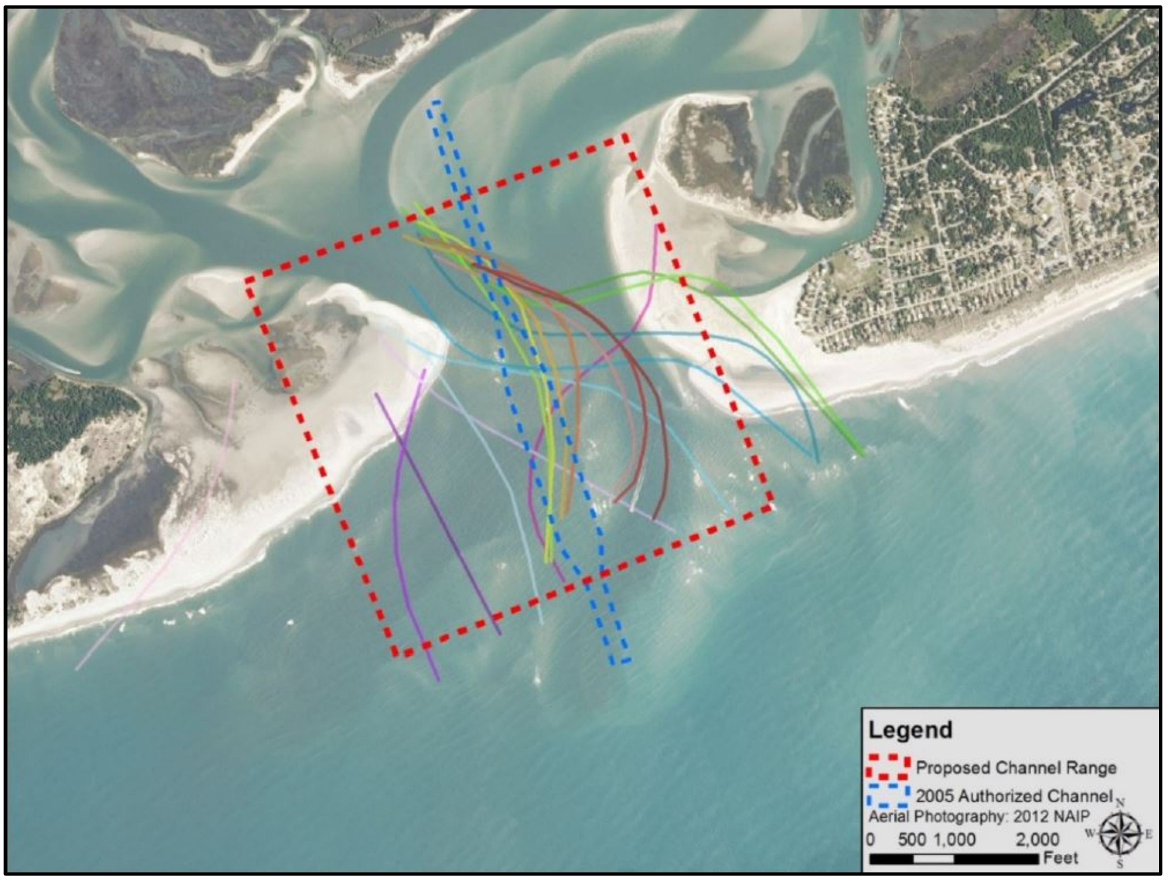

Figure 1. Proposed Bogue Inlet “Safe Box” with historical locations and 2005 ebb channel realignment footprint.

Table 5. Proposed Location of Bogue Inlet "Safe Box" (WSG-84 Map Datum)

"Safe Box"	Latitude	Longitude
Northwest Corner	34.647329	-77.120037
Northeast Corner	34.651840	-77.104904
Southeast Corner	34.639673	-77.099272
Southwest Corner	34.634968	-77.114293

Realignment events would entail the construction of a channel approximately 6,000-feet (ft)-long with bottom widths not to exceed 500 ft and project depths of approximately -16.5 ft North American Vertical Datum (not including overdredge). Relatively shallow inlet depths would require the use of a cutterhead dredge to excavate the new mid-inlet channel; however, a hopper dredge may be used. Based on the projected interval of 10 to 15 years, 3 to 5 realignment events would be expected over the 50-year life of the project. Using vibracores taken in 2012, the proposed channel footprint contains beach compatible material consisting of fine grained, poorly sorted quartz sand with less than 1% fines and gravel, and approximately 15% calcium carbonate in the form of shell hash.[1]

Due to the preemptive nature of realignment events, the need for a closure dike is generally not anticipated, as there would be sufficient time for the old channel to fill in before it presents a threat to Emerald Isle. However, in the event of extreme rapid ebb channel repositioning events (e.g., due to shoal breaching or hurricanes), the ebb channel could present an immediate threat to structures that would warrant the construction of a closure dike (like those shown in Figure 2) across the old channel to facilitate infilling. In such cases, it is anticipated that the dredged material from the new channel would be used to construct a closure dike across the old channel. Excavation would proceed inland from the seaward terminus of the new channel, with dredged material initially being pumped onto the Emerald Isle beaches. As work nears the inshore terminus of the new channel, disposal would be redirected to the designated dike construction area in the old channel.

[1] Coastal Tech. 2013. Carteret County, North Carolina Sand Search Investigation, Final Geotechnical Report. Prepared by: Coastal Tech, Melbourne, FL. Prepared for: Moffatt & Nichol, Inc.

Figure 2. Example images of a closure dike (Images from the Carteret County Shore Protection Office [https://www.carteretcountync.gov/295/Shore-Protection])

3.1.3 Proposed Best Management Practices

a. The construction window for each sand placement and channel relocation event will occur November 16 – April 30 and will avoid the North Carolina sea turtle nesting and hatching season as defined by the North Carolina Wildlife Resource Commission (May 1 – November 15), thus minimizing the likelihood of direct impacts on nesting adult females, nests, and hatchlings.

b. All hopper dredging events will adhere to a November 16 – April 30 window, thus limiting operations to the colder months when most sea turtles have moved to warmer waters well seaward of the borrow sites.

c. Bogue Inlet ebb channel realignments would involve the use of a cutterhead dredge or hopper dredges to excavate a new mid-inlet channel. Cutterhead dredges may also be employed in borrow site operations. Cutterhead dredges are not known to entrain sea turtles or sturgeon.

3.1.4 *Minimization Measures that will be Required of the County by the USACE and BOEM*

a. All vessel operators will abide by NMFS's February, 2008, *Southeast Region Vessel Strike Avoidance Measures and Reporting for Mariners.*[2]

b. All in-water lines (rope, chain, and cable, including the lines to secure pipeline buoys) will be made of stiff, taut, and non-looping material. Examples of such lines are heavy metal chains or heavy cables that do not readily loop and tangle. Flexible in-water lines, such as nylon rope or any lines that could loop or tangle, will be enclosed in a plastic or rubber sleeve/tube to add rigidity and prevent the line from looping and tangling. In all instances, no excess line will be allowed in the water.

c. If a sea turtle or manta ray is observed within 100 yards (yd) of any operations, all appropriate precautions shall be implemented to ensure protection of the species, including cessation of operation if an animal moves within 50 ft of any moving equipment. All vessel operators will avoid collisions with swimming sea turtles, operate at "no wake/idle" speeds in the construction area, and report any collision with and/or injury to a sea turtle within 24 hours to NMFS's Protected Resources Division (takereport.nmfsser@noaa.gov) and the local sea turtle stranding/rescue organization.

d. All vessels greater than 65 ft will comply with the Right Whale Ship Strike Reduction Rule (50 CFR 224.105; compliance guide included as Appendix 1). Between November 1 and April 30, all dredge and attendant vessels greater than 65 ft will slow to 10 knots (kt) (or minimum safe speed) when a North Atlantic right whale is spotted within 15 nmi of the activity or transportation route within 24 hours, and one of the following conditions is present: poor visibility (e.g., fog, precipitation), Beaufort Sea State > 3, or at night. By law, all vessels operators shall maintain a 500-yd buffer between the vessel and any North Atlantic right whale (as required by Federal Regulation 50 CFR 224.103 (c)).

e. NMFS-approved protected species observers will live aboard the hopper dredges, monitoring all dredge loads for evidence of endangered and threatened species, as well as recording water temperatures, bycatch information, and any sightings of protected species in the area. Screening will be placed on all points of dredged material inflow into the hopper prior to work beginning, and protected species observers will monitor the screens for evidence of protected species interactions.

f. Hopper dredges will be required to have rigid turtle deflectors installed on all dragheads. The rigid deflector was developed under controlled conditions by the USACE's Waterways Experimental Station, now known as the Engineering Research and Development Center. V-shaped deflecting dragheads are a widely accepted conservation tool, the dredging industry is familiar with them and their operation, and they are used by all USACE Districts that conduct hopper dredge operations where sea turtles may be present. These dragheads

[2] NMFS. 2008. Vessel Strike Avoidance Measures and Reporting for Mariners, Revised February 2008. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, Protected Resources Division, Saint Petersburg, Florida.

prevent an unquantifiable yet significant number of sea turtles from being entrained and killed in hopper dredges each year. Additionally, to prevent impingement of protected species, particularly sea turtles or sturgeon, within the water column, every effort will be made to keep the dredge pumps disengaged when the hopper dredge dragheads are not firmly on the bottom and the rotating cutterhead will not be lifted from the sediment surface during operations.

g. Relocation trawling employs a capture-relocation technique and is targeted at the active dredging site within the borrow areas. Relocation trawling will be employed when water temperatures exceed 57 degrees Fahrenheit (°F) (13.8 degrees Celsius [°C]) beginning 24 hours prior to hopper dredging. Regardless of water temperature, if 1 sea turtle or sturgeon species is taken by a hopper dredge, trawlers will mobilize within 72 hours and 24-hour trawling will commence. If a second sea turtle or sturgeon species is taken by hopper dredge during the 72-hour mobilization period, dredging will cease until relocation trawling can begin. The applicant may choose to employ relocation trawling prior to meeting the above take triggers.

   During relocation trawling, 1 trawling vessel per dredge will operate 24 hours/day, 7 days/week. Tow times (i.e., the duration that the trawl net will be in the water and capable of capturing sea turtles or sturgeon) during relocation trawling will be strictly limited to less than 42 minutes total time. Trawling speeds will not exceed 3.5 kt. Protected species observers will live aboard the relocation trawlers, monitoring all tows for endangered and threatened species, as well as recording water temperatures, bycatch information, and any sightings of protected species in the area. Any sea turtle or sturgeon species captured during relocation trawling will be photographed, measured, biopsied for genetics, tagged, and relocated.

3.2 Action Area

The action area is defined by regulation as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action" (50 CFR 402.02). The action area encompasses approximately 41,957 acres; including the entire island of Bogue Banks from Bogue Inlet to Beaufort Inlet, portions of the adjacent islands of Shackleford Banks and Bear Island, and the ocean waters and seafloor offshore of Bogue Banks that comprise proposed borrow sites and potential sand transport routes (Tables 2-5 above, Figure 2 below). As stated above, bottom type within the action area is quartz sand and shell hash. Depth within the action area ranges from 3 to 36 ft in Bogue Inlet and 31 to 56 ft in each of the offshore borrow sites.

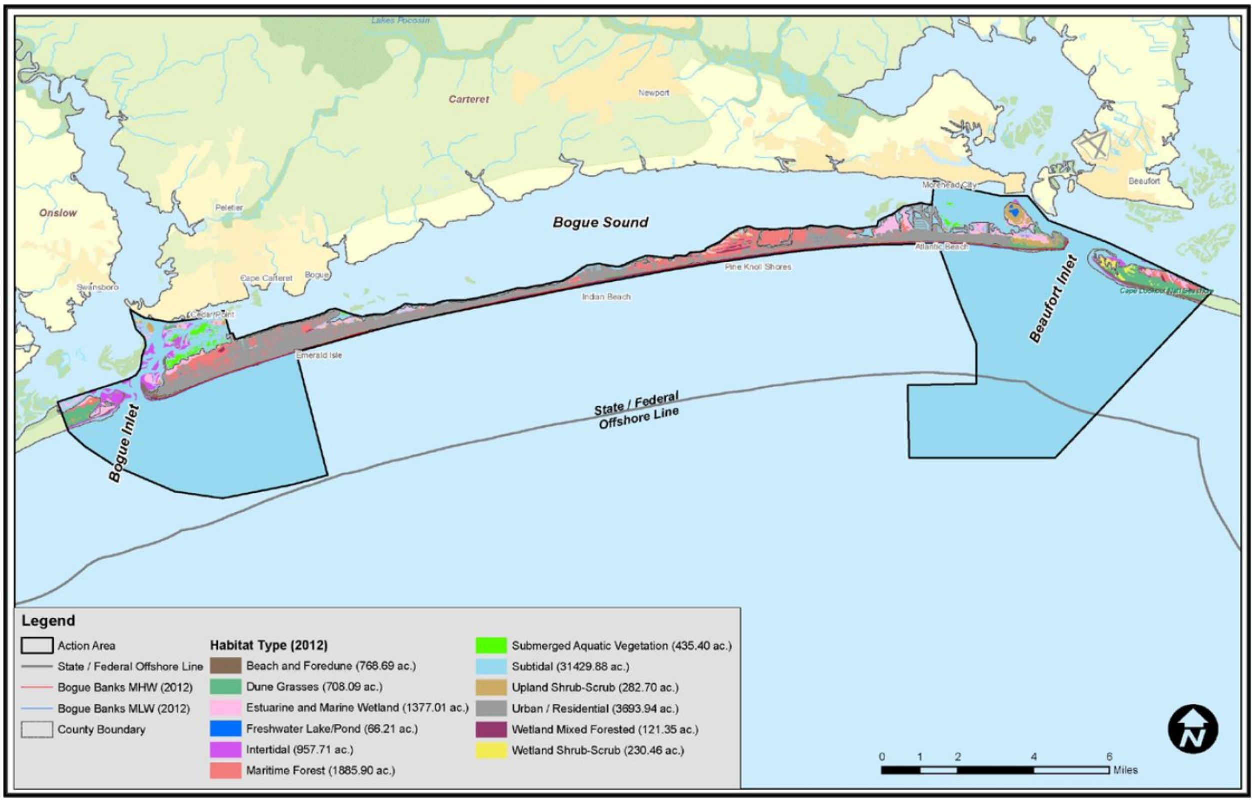

Figure 3. The action area outlined in black (Image supplied by USACE).

4 STATUS OF LISTED SPECIES AND CRITICAL HABITAT

Table 6 provides the effect determinations for ESA-listed species the USACE, BOEM, and/or NMFS believe may be affected by the proposed action.

Table 6. Effects Determinations for Species (DPSs) the Action Agencies and/or NMFS Believe May Be Affected by the Proposed Action

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

Because adult Atlantic sturgeon from all DPSs mix extensively in marine waters, we expect fish from all 5 DPSs (not just the Carolina DPS as proposed by USACE and BOEM; hereafter referred to as "All 5 DPSs") to be present in the action area.

Shortnose sturgeon are not expected be present in the areas where the proposed action is occurring. Prior assumptions were that shortnose sturgeon tended not to leave riverine waters (i.e., venture beyond the freshwater-saltwater interface); however, in a recent report by the South Carolina Division of National Resources (DNR) and Georgia DNR, the species was detected as far as 12.4 mi from the mouths of their spawning rivers in those states.[3] While spawning data is lacking for the rivers in North Carolina, the action area is located much greater than 12.4 mi from the mouth of any major river that may be used for spawning (i.e., nearshore Atlantic Ocean waters 67 mi south of the mouth of the Neuse River and 84 mi north of the mouth of the Cape Fear River). Therefore, we believe the proposed action will have no effect on shortnose sturgeon.

Table 7 provides the effects determinations for designated critical habitat occurring within the action area that the USACE and/or NMFS believe may be affected by the proposed action.

Table 7. Effects Determinations for Designated Critical Habitat the Action Agency and/or NMFS Believe May Be Affected by the Proposed Action

Species	Critical Habitat Unit	USACE Effect Determination	NMFS Effect Determination
Loggerhead sea turtle (NWA DPS)	Nearshore Reproductive, Unit N-03	NLAA	NE
NLAA = may affect, not likely to adversely affect; NE = No effect			

The proposed action is located within the boundary of loggerhead sea turtle designated critical habitat (Nearshore Reproductive Habitat, Unit N-03). Nearshore Reproductive Habitat is the portion of the nearshore waters adjacent to nesting beaches used by hatchlings to egress to the open-water environment as well as by nesting females to transit between beach and open water during the nesting season. The following primary constituent elements (PCEs) support this habitat:

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

Because the proposed action will avoid the North Carolina sea turtle nesting and hatching season (May 1 – November 15), and will not involve the placement of obstructions in the water during nesting season that would interfere with PCEs (ii) or (iii), we believe there is no effect to any of the PCEs of loggerhead sea turtle designated critical habitat (Nearshore Reproductive Habitat, Unit N-03).

4.1 Routes of Effect Not Likely to Adversely Affect Listed Species

[3] Temporal and spatial distribution of Atlantic sturgeon (*Acipenser oxyrinchus*) in U.S. Territorial waters off South Carolina and Georgia. Final (2013 to 2017) Report to the National Marine Fisheries Service National Oceanic and Atmospheric Administration. Prepared by: South Carolina Department of Natural Resources Marine Resources Division 217 Fort Johnson Road Charleston, South Carolina. December 22, 2017. Grant Number NA13NMF4720045.

4.1.1 Sea Turtles

The U.S. Fish and Wildlife Service (USFWS) and NMFS share jurisdiction for recovery and conservation of sea turtles listed under the ESA. NMFS is the lead for the conservation and recovery of sea turtles in the marine environment, and USFWS is the lead for the conservation and recovery of sea turtles on nesting beaches. Because responsibility for ESA consultation on the effects related to nesting beaches are under the purview of USFWS, those effects are not discussed in this Opinion.

In this section, we analyze potential routes of effect that are not likely to adversely affect listed sea turtles, and we conclude that the proposed action is not likely to adversely affect hawksbill or leatherback sea turtles. We discuss adverse effects to other listed sea turtles in Section 4.2.1.

Potential effects to sea turtles in the marine environment include the risk of interaction with non-hopper type dredging equipment (i.e., hydraulic cutterhead dredging) or material during dredging. NMFS has previously determined in dredging biological opinions that, while oceangoing hopper-type dredges may lethally entrain protected species, non-hopper type dredging methods, as proposed for this project, are slower and extremely unlikely to affect these species (NMFS 2007). Therefore, we conclude that the risk of injury to listed sea turtles from cutterhead dredging equipment associated with the proposed action is discountable.

The action area contains nearshore habitat that green (NA DPS and SA DPS), loggerhead (NWA DPS), and Kemp's ridley sea turtles may use for reproduction (i.e., ingress and egress for nesting and hatching). These species may avoid the use of the action area due to dredging and the in-water aspect of the placement of dredged material (i.e., "pump-outs" and direct pipeline delivery for beach nourishment and/or a temporary closure dike). The project will avoid the North Carolina sea turtle nesting and hatching season. Therefore, the effect to pregnant females and hatchlings from any disruption in use of the action area is highly unlikely and discountable. Any other sea turtle species-life stages (e.g., juveniles or adult males) in the action area will likely temporarily avoid the immediate project vicinity during in-water activities due to noise from vessels and machinery. We believe the effect of temporary avoidance of the action area to these sea turtle species-life stages will be insignificant given the availability of similar habitat nearby. Because these species-life stages are highly mobile, we expect that they will move away from these activities and use the adjacent open-water areas. Therefore, the effects to these 3 sea turtle species from the temporary loss of foraging or developmental habitat during dredging activities will be insignificant. The use of stiff, taut, and non-looping in-water lines to secure pipeline buoys will further reduce the risk of this aspect of the project to all sea turtle species-life stages in the action area.

Relocation trawling could affect nesting female sea turtles who may be en route to the nesting beach; however, we believe this effect is highly unlikely, and therefore, discountable. All dredging, and therefore all relocation trawling, will avoid the North Carolina sea turtle nesting and hatching season.

Vessels can strike sea turtles, leading to injury or death. Up to 3 dredges will make a maximum of 6 round trips per day to the borrow area during each nourishment event. However, weather events, equipment maintenance, and other operational procedures will likely mean that fewer than 6 trips per day are completed. There may also be hours or days between dredge trips to and from the area. If and when relocation trawling is triggered, up to 1 trawling vessel per dredge (maximum 3 total) will operate 24 hours/day, 7 days/week. Any vessel traffic in the area due to the proposed action will be temporary, occurring 50-250 days with most events being 100-150 days per year. Given the temporary and intermittent nature of increased vessel traffic and the implementation of minimization measures that have successfully been used to avoid vessel interactions in the past (i.e., slow vessel speeds, use of species observers on all vessels, and cessation of work if protected species are observed), NMFS believes that the effect to sea turtles from vessel strike will be highly unlikely, and therefore, discountable.

We believe the effect of the hopper dredging and relocation trawling components of the action on hawksbill and leatherback sea turtles are highly unlikely, and therefore, discountable, due to their infrequent use of the action area and our review of previous similar dredging projects in/near the action area. First, hopper dredging at the offshore borrow sites will occur in colder months when most sea turtles have moved to warmer waters. Second, these 2 species rarely nest in North Carolina; no nests of hawksbill or leatherback sea turtles have been recorded on Bogue Banks 2009-2017 (Seaturtle.org accessed by consulting biologist on March 19, 2018). Third, strandings of these 2 species along Bogue Banks are infrequent (2 hawksbill and 2 leatherback sea turtle strandings from 1976 to March 2018) and dredging was not the suspected reason for any reported strandings (Seaturtle.org accessed on March 19, 2018, by the consulting biologist). Further, examination of similar projects in close proximity to the action area (i.e., inshore and offshore), that employed hopper dredging and/or relocation trawling, and occurred during the time of year in which the proposed action will occur (Table 12 and 14), indicated no hawksbill or leatherback sea turtles have been taken (data provided directly to consultation biologist by USACE and BOEM on March 30, April 4, and September 7, 2018). Additionally, NMFS determined in the 1997 SARBO that leatherback sea turtles are not likely to be adversely affected by hopper dredging (NMFS 1997c; NMFS 2007), and we have not received any new information that would change the basis of this determination.

4.1.2 Atlantic Sturgeon

NMFS has analyzed the routes of effect Atlantic sturgeon from the proposed action. Potential routes of effect not likely to adversely affect sturgeon species include: physical injury from non-hopper type dredging equipment, vessel traffic, and avoidance of available habitat during dredging operations. We discuss adverse effects to Atlantic sturgeon in Section 4.2.2.

Potential effects not likely to adversely affect Atlantic sturgeon include the risk of interaction with non-hopper type dredging equipment (i.e., hydraulic cutterhead dredging) or material during dredging. Sturgeon are a highly mobile species and NMFS has previously determined in dredging biological opinions that, while oceangoing hopper-type dredges may lethally entrain protected species, non-hopper type dredging methods are slower and extremely unlikely to affect highly mobile species (NMFS 2007). Further, Dickerson (2011) summarized observed lethal take of Atlantic sturgeon from maintenance dredging of federal navigation channels conducted by the USACE along the U.S. Atlantic coast from 1990-2010 and none were reported from interactions with cutterhead dredges. Therefore, we conclude the risk of injury from cutterhead dredging equipment to Atlantic sturgeon is discountable.

Atlantic sturgeon are also susceptible to vessel strikes, as demonstrated by limited standing records that show both species have been struck by large shipping vessels in narrow channels in the Northeast. Narrow channels, combined with the deep drafts of shipping vessels, prevent sturgeon from being able to avoid interactions with the vessels. However, the action area does not contain narrow shipping channels that limit the species' ability to avoid vessels. In addition, navigational markers alert both recreational and commercial boaters to shallow areas in the action area, to prevent groundings. Because vessels are likely to rely on these markers to avoid shallow areas for safety reasons, there is little risk that the boats will be in shallow waters where they could interact with Atlantic sturgeon. Vessel interactions with Atlantic sturgeon are extremely unlikely, and therefore, discountable.

The action area contains offshore habitat that Atlantic sturgeon may use for foraging, reproduction, and/or migration and may be a mix of sturgeon from multiple DPSs. Atlantic sturgeon may avoid the use of the action area due to dredging activity. Because these species are mobile, we expect that they will move away from dredging activities and use the adjacent open-water areas with similar habitat. Additionally, the loss of habitat due to avoidance will be temporary and intermittent. Therefore, the effects to Atlantic sturgeon from the temporary loss of foraging habitat during dredging activities will be insignificant.

4.1.3 Marine Mammals

NMFS determined that potential effects on North Atlantic right whale, blue whale, fin whale, sei whale, and humpback whale from the proposed action include injury from potential interactions with a dredge vessel or a relocation trawler and temporary avoidance of the area during offshore dredge operation and relocation trawling.

Vessels can strike whale species, leading to injury or death. All dredge and attendant vessels greater than 65 ft will be required to abide by the Right Whale Ship Strike Reduction Rule (50 CFR 224.105) and follow the *Southeast Region Vessel Strike Avoidance Measures and Reporting for Mariners*. Dredge vessel collisions are not expected with any whale species due to the slow speed of the dredge (i.e., up to 3.5 kt while dredging), the avoidance behavior of whales to slow moving vessels, and the presence of NMFS-approved observers on board every dredge and relocation trawler. With implementation of these mandatory conservation measures, NMFS believes that the effect to North Atlantic right whale, blue whale, fin whale, sei whale, and humpback whale from vessel strike will be highly unlikely, and therefore discountable.

Whale species may be affected by the temporary loss of open water habitat due to dredging activities. North Atlantic right whales are most often present in coastal waters of North Carolina from November 1 to April 30 when dredging will occur. During this time, this species is generally migrating between their northern feeding and mating area and their southern calving area; however, any whale species could be present in the action area at any time. All whales will likely avoid the use of the action area due to dredging activity. Because these species are highly mobile, we expect that they will move away from dredging activities and use the adjacent open-water areas. We do not anticipate any other effects from the temporary loss of open water habitat to North Atlantic right whale mothers and/or calves as they move through this area. Therefore, the effect to any whale species from the temporary loss of habitat during offshore dredging activities will be insignificant.

Based on the above analysis, we conclude that all potential effects from the proposed action to North Atlantic right whale, blue whale, fin whale, sei whale, and humpback whale are discountable or insignificant; therefore these species will not be discussed further in this Opinion.

4.1.4 Giant Manta Ray

NMFS determined that potential effects on giant manta ray from the proposed action are limited to the following: physical injury from non-hopper type dredging equipment, injury from potential interactions with a dredge vessel or a relocation trawler, and temporary avoidance of the area during offshore dredge operation and relocation trawling.

Potential effects to the giant manta ray include the risk of interaction with non-hopper type dredging equipment (i.e., hydraulic cutterhead dredging) or material during dredging. Giant manta ray are a highly mobile species and NMFS has previously determined in dredging biological opinions that, while oceangoing hopper-type dredges may lethally entrain protected species, non-hopper type dredging methods are slower and extremely unlikely to affect highly mobile species (NMFS 2007), (NMFS 1997c). We believe that our previous conclusions regarding highly-mobile species can be appropriately applied to the giant manta ray, as we expect this highly-mobile species to exhibit a similar response to non-hopper type dredging equipment as other high-mobile species. We have no information indicating that giant manta rays are more susceptible to injury from non-hopper type dredging equipment than other similarly mobile species. Therefore, we conclude that the risk of injury from cutterhead dredging equipment to giant manta ray is discountable.

Vessels can strike manta rays, leading to injury or death. Dredge vessel collisions are not expected with any manta ray species due to the slow speed of the dredge (i.e., up to 3.5 kt while dredging), the avoidance behavior of manta rays to slow moving vessels, and the presence of NMFS-approved observers on board every dredge and relocation trawler to watch for ESA-listed species in the area. NMFS believes that the effect to giant manta ray from vessel strike will be highly unlikely, and therefore discountable. The implementation of the minimization measures stated above (i.e., slow vessel speeds, use of species observers on all vessels, and cessation of work if protected species are observed) will further reduce the risk of vessel interaction with giant manta ray.

We believe the effect of the hopper dredging and relocation trawling components of the action on giant manta ray is highly unlikely, and therefore, discountable, because we do not expect this species to be present during the time period when hopper dredging and relocation trawling are taking place. The proposed action will occur in the winter months (November to April) off the coast of North Carolina and the best available data indicates giant manta ray is likely seasonal, spending the winter months off the east coast of Florida (N. Farmer, NMFS Protected Resources Division [PRD], pers. comm. to consulting biologist on May 2, 2018).

Because all potential effects from the proposed action to giant manta ray were found to be discountable or insignificant, this species will not be discussed further in this Opinion.

4.2 Status of the Species Likely to Be Adversely Affected

The following subsections are synopses of the best available information on the statuses of the species that are likely to be adversely affected by one or more components of the proposed action, including species-specific information on the distribution, population structure, life history, abundance, and population trends, and threats; subsection 4.2.1d is a synopsis of general threats faced by all sea turtles. The biology and ecology of these species as well as their status and trends inform the effects analysis for this Opinion and will be discussed further in Section 8.

4.2.1 Sea Turtles

4.2.1a Green Sea Turtle (NA and SA DPSs)

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

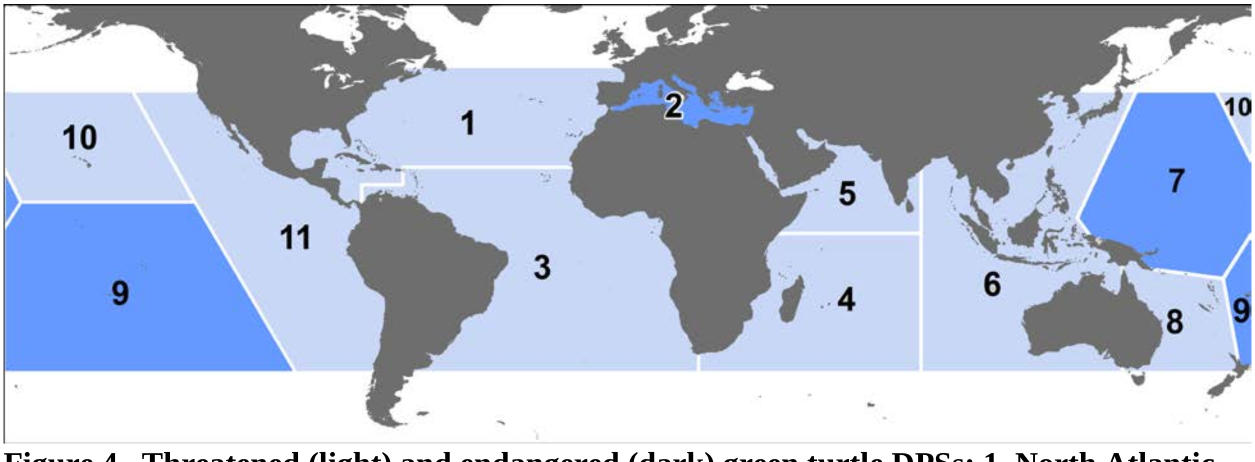

Figure 4. Threatened (light) and endangered (dark) green turtle DPSs: 1. North Atlantic, 2. Mediterranean, 3. South Atlantic, 4. Southwest Indian, 5. North Indian, 6. East Indian-West Pacific, 7. Central West Pacific, 8. Southwest Pacific, 9. Central South Pacific, 10. Central North Pacific, and 11.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

Species Description and Distribution

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

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

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

North Atlantic DPS Distribution

The NA DPS boundary is illustrated in Figure 4. 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 1991a). The vast majority of green sea turtle nesting within the southeastern United States occurs in Florida (Johnson and Ehrhart 1994; Meylan et al. 1995). Principal U.S. nesting areas for green sea turtles are in eastern Florida, predominantly Brevard south through Broward counties.

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

South Atlantic DPS Distribution

The SA DPS boundary is shown in Figure 1, and includes the U.S. Virgin Islands in the Caribbean. The SA DPS nesting sites can be roughly divided into four regions: western Africa, Ascension Island, Brazil, and the South Atlantic Caribbean (including Colombia, the Guianas, and Aves Island in addition to the numerous small, island nesting sites).

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

Carman et al. 2011; Lezama 2009; López-Mendilaharsu et al. 2006; Prosdocimi et al. 2012; Rivas-Zinno 2012).

Life History Information

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

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

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

Status and Population Dynamics

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

<u>North Atlantic DPS</u>

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

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

In the continental United States, green sea turtle nesting occurs along the Atlantic coast, primarily along the central and southeast coast of Florida (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 (up to tens of nests) (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 5). According to data collected from Florida's index nesting beach survey from 1989-2017, green sea turtle nest counts across Florida have increased dramatically, from a low of 267 in the early 1990s to a high of 38,954 in 2017. 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 5). Modeling by Chaloupka et al. (2008) using data sets of 25 years or more resulted in an estimate of the Florida nesting stock at the Archie Carr National Wildlife Refuge growing at an annual rate of 13.9% at that time. Increases have been even more rapid in recent years.

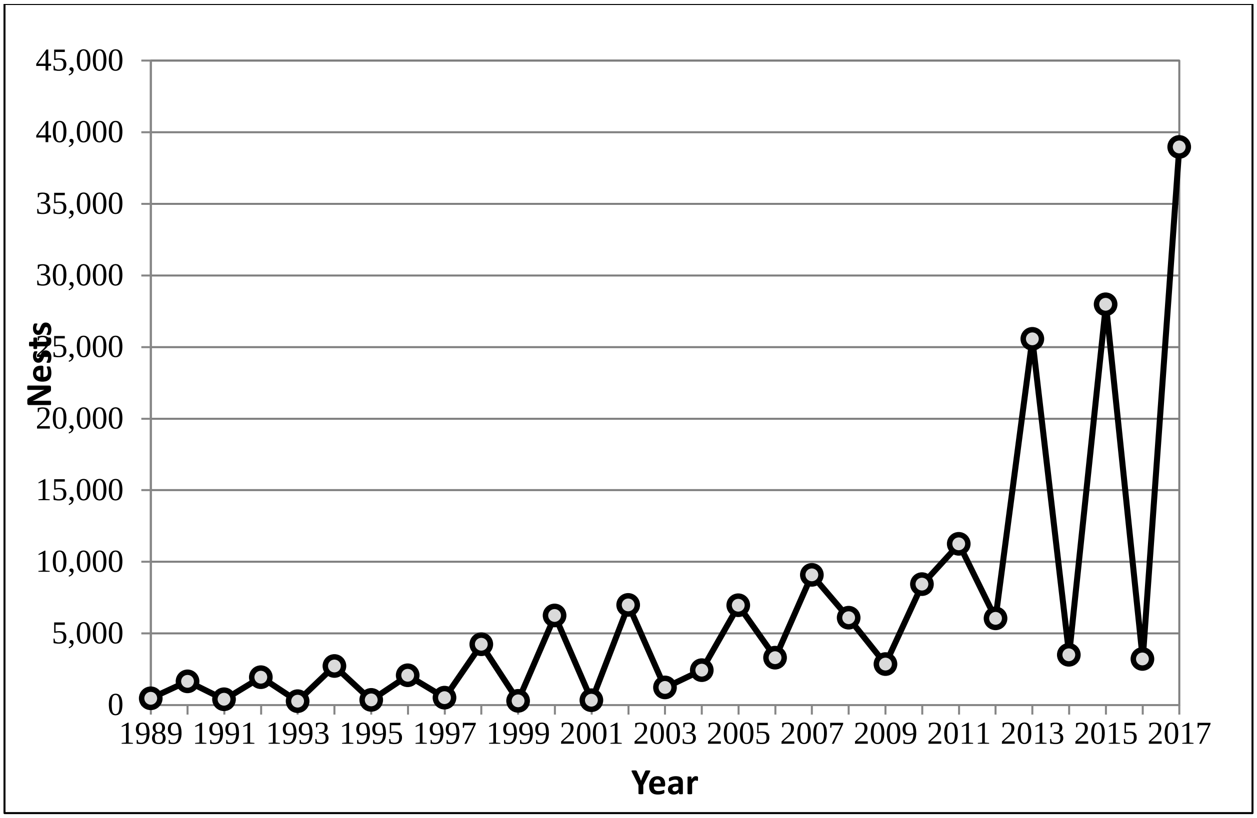

Figure 5. Green sea turtle nesting at Florida index beaches since 1989

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

<u>South Atlantic DPS</u>

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

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

Threats

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

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

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

Whereas oil spill impacts are discussed generally for all species in Section 4.2.1d, 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 2015b). Additional unquantified effects may have included inhalation of volatile compounds, disruption of foraging or migratory movements due to surface or subsurface oil, ingestion of prey species contaminated with oil and/or dispersants, and loss of foraging resources which could lead to compromised growth and/or reproductive potential. There is no information currently available to determine the extent of those impacts, if they occurred.

While green turtles regularly use the northern Gulf of Mexico, they have a widespread distribution throughout the entire Gulf of Mexico, Caribbean, and Atlantic, and the proportion of the population using the northern Gulf of Mexico at any given time is relatively low. Although it is known that adverse impacts occurred and numbers of animals in the Gulf of Mexico were reduced as a result of the Deepwater Horizon oil spill of 2010, 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 2015b).

4.2.1b Kemp's ridley Sea Turtle

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

Species Description and Distribution

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

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

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

Life History Information

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

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

Population Dynamics

Of the 7 species of sea turtles in the world, the Kemp's ridley has declined to the lowest population level. Most of the population of adult females nest on the beaches of Rancho Nuevo, Mexico (Pritchard 1969). When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand

1963). By the mid-1980s, however, nesting numbers from Rancho Nuevo and adjacent Mexican beaches were below 1,000, with a low of 702 nests in 1985. Yet, nesting steadily increased through the 1990s, and then accelerated during the first decade of the twenty-first century (Figure 8), which indicates the species is recovering.

It is worth noting that when the Bi-National Kemp's Ridley Sea Turtle Population Restoration Project was initiated in 1978, only Rancho Nuevo nests were recorded. In 1988, nesting data from southern beaches at Playa Dos and Barra del Tordo were added. In 1989, data from the northern beaches of Barra Ostionales and Tepehuajes were added, and most recently in 1996, data from La Pesca and Altamira beaches were recorded. Currently, nesting at Rancho Nuevo accounts for just over 81% of all recorded Kemp's ridley nests in Mexico. Following a significant, unexplained 1-year decline in 2010, Kemp's ridley nests in Mexico increased to 21,797 in 2012 (Gladys Porter Zoo 2013). From 2013 through 2014, there was a second significant decline, as only 16,385 and 11,279 nests were recorded, respectively. Recent data, however, indicates an increase in nesting. In 2015 there were 14,006 recorded nests, and in 2016 overall numbers increased to 18,354 recorded nests (Gladys Porter Zoo 2016). Preliminary information indicates a record high nesting season in 2017, with 24,570 nests recorded (J. Pena, pers. comm., August 31, 2017). At this time, it is unclear if future nesting will steadily and continuously increase, similar to what occurred from 1990-2009, or if nesting will continue to exhibit sporadic declines and increases as recorded in the past 8 years.

A small nesting population is also emerging in the United States, primarily in Texas, rising from 6 nests in 1996 to 42 in 2004, to a record high of 353 nests in 2017 (National Park Service data, http://www.nps.gov/pais/naturescience/strp.htm, http://www.nps.gov/pais/naturescience/current-season.htm). It is worth noting that nesting in Texas has paralleled the trends observed in Mexico, characterized by a significant decline in 2010, followed by a second decline in 2013-2014, but with a rebound in 2015.

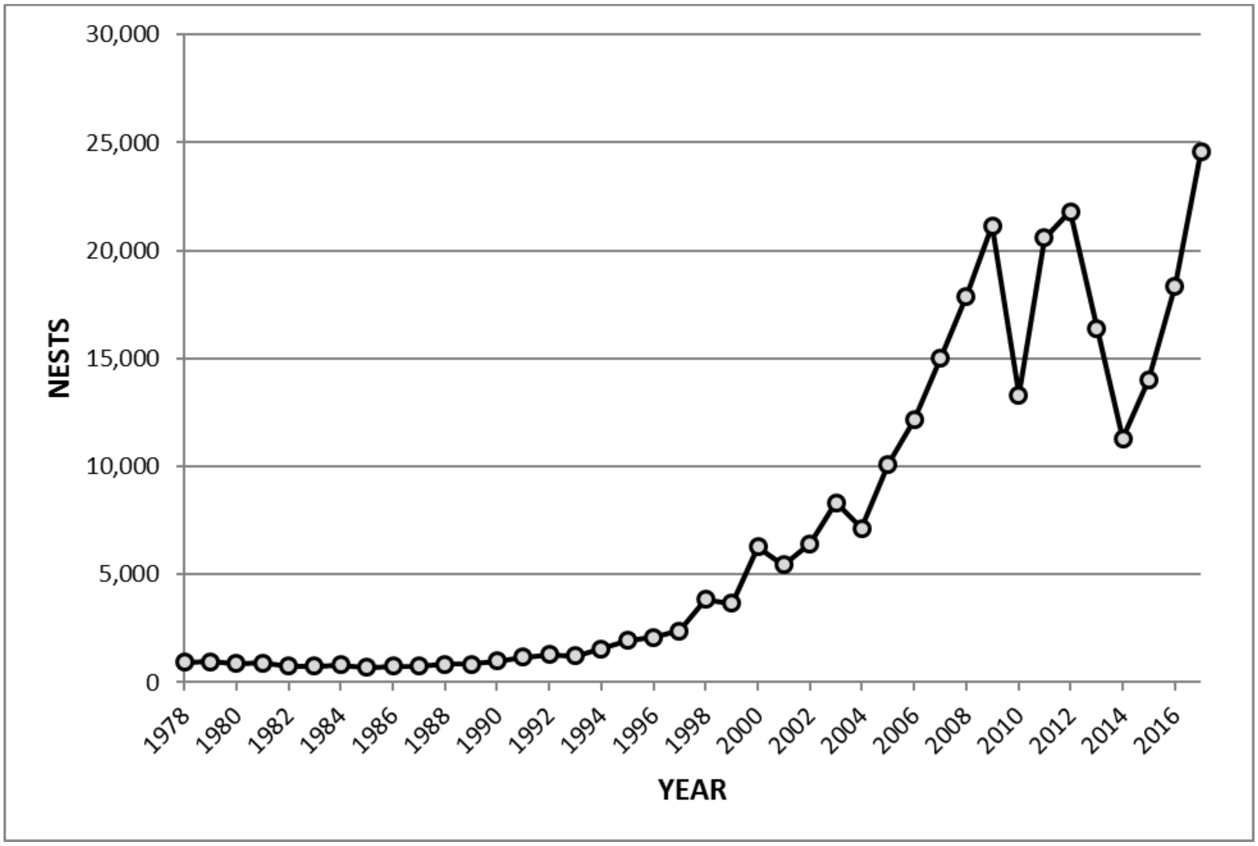

Figure 6. Kemp's ridley nest totals from Mexican beaches (Gladys Porter Zoo nesting database 2017)

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

Threats

Kemp's ridley sea turtles face many of the same threats as other sea turtle species, including destruction of nesting habitat from storm events, oceanic events such as cold-stunning, pollution (plastics, petroleum products, petrochemicals, etc.), ecosystem alterations (nesting beach development, beach nourishment and shoreline stabilization, vegetation changes, etc.), poaching, global climate change, fisheries interactions, natural predation, and disease. A discussion on general sea turtle threats can be found in Section 4.2.1d; the remainder of this section will expand on a few of the aforementioned threats and how they may specifically impact Kemp's ridley sea turtles.

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

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

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

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

species' preference for shallow, inshore waters coupled with increased population abundance, as reflected in recent Kemp's ridley nesting increases.

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

While oil spill impacts are discussed generally for all species in Section 4.2.1d, specific impacts of the DWH oil spill event on Kemp's ridley sea turtles are considered here. Kemp's ridleys experienced the greatest negative impact stemming from the DWH oil spill event of any sea turtle species. Impacts to Kemp's ridley sea turtles occurred to offshore small juveniles, as well as large juveniles and adults. Loss of hatchling production resulting from injury to adult turtles was also estimated for this species. Injuries to adult turtles of other species, such as loggerheads, certainly would have resulted in unrealized nests and hatchlings to those species as well. Yet, the calculation of unrealized nests and hatchlings was limited to Kemp's ridleys for several reasons. All Kemp's ridleys in the Gulf belong to the same population (NMFS et al. 2011a), so total population abundance could be calculated based on numbers of hatchlings because all individuals that enter the population could reasonably be expected to inhabit the northern Gulf of Mexico throughout their lives (DWH Trustees 2015b).

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

4.2.1c Loggerhead Sea Turtle (NWA DPS)

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

Species Description and Distribution

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

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

The majority of loggerhead nesting occurs at the western rims of the Atlantic and Indian Oceans concentrated in the north and south temperate zones and subtropics (NRC 1990a). For the NWA DPS, most nesting occurs along the coast of the United States, from southern Virginia to Alabama. Additional nesting beaches for this DPS are found along the northern and western Gulf of Mexico, eastern Yucatán Peninsula, at Cay Sal Bank in the eastern Bahamas (Addison

1997; Addison and Morford 1996), off the southwestern coast of Cuba (Moncada Gavilan 2001), and along the coasts of Central America, Colombia, Venezuela, and the eastern Caribbean Islands.

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

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

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

Life History Information

The Northwest Atlantic Loggerhead Recovery Team defined the following 8 life stages for the loggerhead life cycle, which include the ecosystems those stages generally use: (1) egg (terrestrial zone), (2) hatchling stage (terrestrial zone), (3) hatchling swim frenzy and transitional stage (neritic zone[5]), (4) juvenile stage (oceanic zone), (5) juvenile stage (neritic zone), (6) adult

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

stage (oceanic zone), (7) adult stage (neritic zone), and (8) nesting female (terrestrial zone) (NMFS and USFWS 2008b). Loggerheads are long-lived animals. They reach sexual maturity between 20-38 years of age, although age of maturity varies widely among populations (Frazer and Ehrhart 1985; NMFS 2001). The annual mating season occurs from late March to early June, and female turtles lay eggs throughout the summer months. Females deposit an average of 4.1 nests within a nesting season (Murphy and Hopkins 1984), but an individual female only nests every 3.7 years on average (Tucker 2010). Each nest contains an average of 100-126 eggs (Dodd Jr. 1988) which incubate for 42-75 days before hatching (NMFS and USFWS 2008b). Loggerhead hatchlings are 1.5-2 inches long and weigh about 0.7 ounce (20 g).

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

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

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

Offshore, adults primarily inhabit continental shelf waters, from New York south through Florida, the Bahamas, Cuba, and the Gulf of Mexico. Seasonal use of mid-Atlantic shelf waters, especially offshore New Jersey, Delaware, and Virginia during summer months, and offshore shelf waters, such as Onslow Bay (off the North Carolina coast), during winter months has also been documented (Hawkes et al. 2007)Georgia Department of Natural Resources, unpublished data; South Carolina Department of Natural Resources, unpublished data). Satellite telemetry has identified the shelf waters along the west Florida coast, the Bahamas, Cuba, and the Yucatán Peninsula as important resident areas for adult female loggerheads that nest in Florida (Foley et al. 2008; Girard et al. 2009; Hart et al. 2012). The southern edge of the Grand Bahama Bank is important habitat for loggerheads nesting on the Cay Sal Bank in the Bahamas, but nesting females are also resident in the bights of Eleuthera, Long Island, and Ragged Islands. They also reside in Florida Bay in the United States, and along the north coast of Cuba (A. Bolten and K. Bjorndal, University of Florida, unpublished data). Moncada et al. (2010) report the recapture of 5 adult female loggerheads in Cuban waters originally flipper-tagged in Quintana Roo, Mexico, which indicates that Cuban shelf waters likely also provide foraging habitat for adult females that nest in Mexico.

Status and Population Dynamics

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

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

<u>Peninsular Florida Recovery Unit</u>

The Peninsular Florida Recovery Unit (PFRU) is the largest loggerhead nesting assemblage in the Northwest Atlantic. A near-complete nest census (all beaches including index nesting beaches) undertaken from 1989 to 2007 showed an average of 64,513 loggerhead nests per year, representing approximately 15,735 nesting females per year (NMFS and USFWS 2008b). The statewide estimated total for 2017 was 96,912 nests (FWRI nesting database).

In addition to the total nest count estimates, the Florida Fish and Wildlife Research Institute (FWRI) uses an index nesting beach survey method. The index survey uses standardized data-collection criteria to measure seasonal nesting and allow accurate comparisons between beaches and between years. This provides a better tool for understanding the nesting trends (Figure 6). FWRI performed a detailed analysis of the long-term loggerhead index nesting data (1989-2016; http://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead-trend/). Over that time period, 3 distinct trends were identified. From 1989-1998, there was a 24% increase that was followed by a sharp decline over the subsequent 9 years. A large increase in loggerhead nesting has occurred since, as indicated by the 71% increase in nesting over the 10-year period from 2007 and 2016. Nesting in 2016 also represented a new record for loggerheads on the core index beaches. FWRI examined the trend from the 1998 nesting high through 2016 and found that the decade-long post-1998 decline was replaced with a slight but nonsignificant increasing trend. Looking at the data from 1989 through 2016, FWRI concluded that there was an overall positive change in the nest counts although it was not statistically significant due to the wide variability between 2012-2016 resulting in widening confidence intervals (http://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead-trend/). Nesting at the core index beaches declined in 2017 to 48,033, which is still the 4th highest total since 2001.

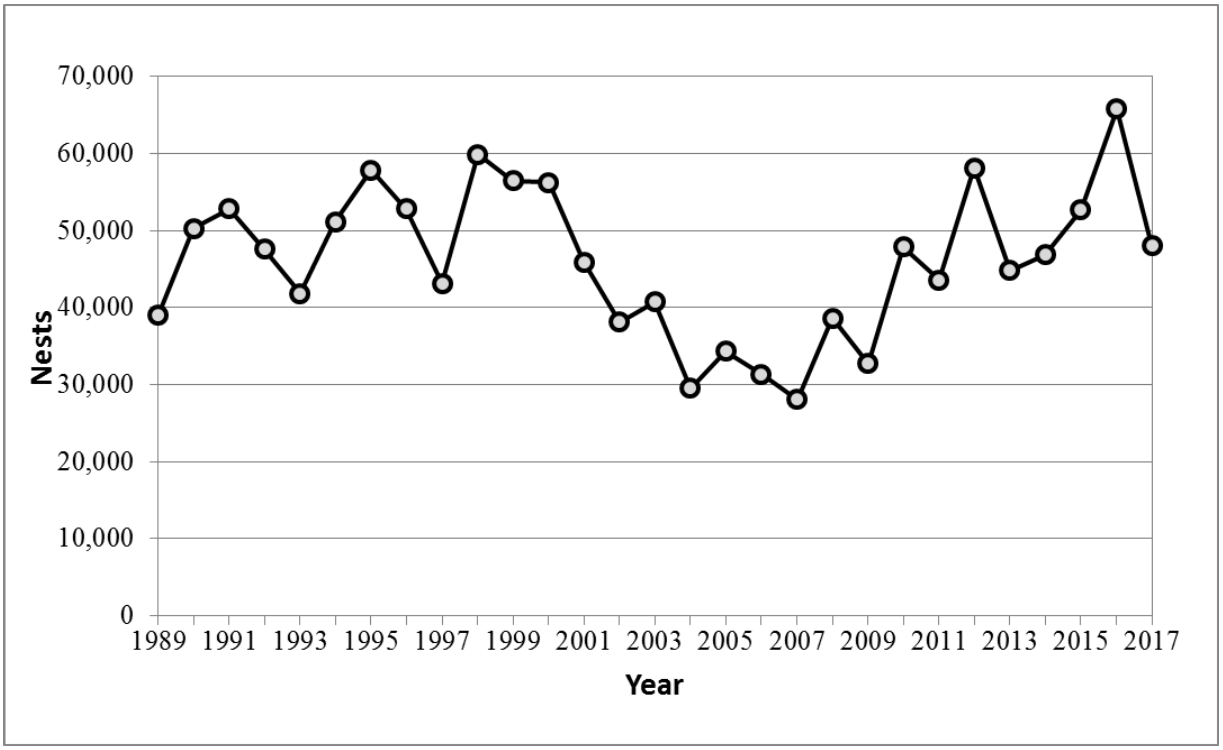

Figure 7. Loggerhead sea turtle nesting at Florida index beaches since 1989

<u>Northern Recovery Unit</u>

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

Data since that analysis (Table 8) are showing improved nesting numbers and a departure from the declining trend. Georgia nesting has rebounded to show the first statistically significant increasing trend since comprehensive nesting surveys began in 1989 (Mark Dodd, GADNR press release, http://www.georgiawildlife.com/node/3139). South Carolina and North Carolina nesting have also begun to shift away from the past declining trend. Loggerhead nesting in Georgia, South Carolina, and North Carolina all broke records in 2015 and then topped those records again in 2016. Nesting in 2017 declined relative to 2016, back to levels seen in 2013 and 2015.

Table 8. Total Number of NRU Loggerhead Nests (GADNR, SCDNR, and NCWRC nesting datasets compiled at Seaturtle.org)

Nests Recorded	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Georgia	1,649	998	1,760	1,992	2,241	2,289	1,196	2,319	3,265	2,155
South Carolina	4,500	2,182	3,141	4,015	4,615	5,193	2,083	5,104	6,443	5,232
North Carolina	841	302	856	950	1,074	1,260	542	1,254	1,612	1,195
Total	**6,990**	**3,472**	**5,757**	**6,957**	**7,930**	**8,742**	**3,821**	**8,677**	**11,320**	**8,582**

South Carolina also conducts an index beach nesting survey similar to the one described for Florida. Although the survey only includes a subset of nesting, the standardized effort and locations allow for a better representation of the nesting trend over time. Increases in nesting were seen for the period from 2009-2013, with a subsequent steep drop in 2014. Nesting then rebounded in 2015 and 2016, setting new highs each of those years. Nesting in 2017 dropped back down from the 2016 high, but was still the second highest on record (Figure 7).

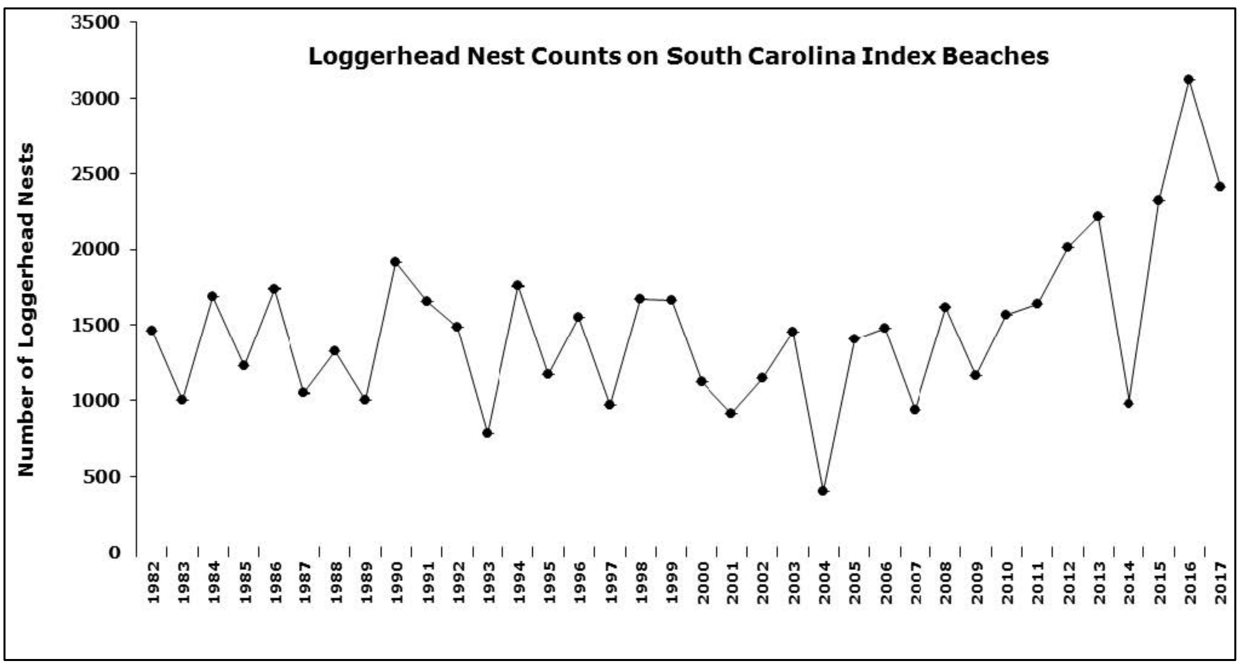

Figure 8. South Carolina index nesting beach counts for loggerhead sea turtles (from the SCDNR website: http://www.dnr.sc.gov/seaturtle/nest.htm)

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

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

In-water Trends

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

Population Estimate

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

Threats (Specific to Loggerhead Sea Turtles)

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

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

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

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

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

4.2.1d General Threats Faced by All Sea Turtle Species

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

Fisheries

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

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

Non-Fishery In-Water Activities

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

Coastal Development and Erosion Control

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

Environmental Contamination

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

The April 20, 2010, explosion of the Deepwater Horizon oil rig affected sea turtles in the Gulf of Mexico. An assessment has been completed on the injury to Gulf of Mexico marine life, including sea turtles, resulting from the spill (DWH Trustees 2015a). Following the spill, juvenile Kemp's ridley, green, and loggerhead sea turtles were found in *Sargassum* algae mats in the convergence zones, where currents meet and oil collected. Sea turtles found in these areas were often coated in oil and/or had ingested oil. The spill resulted in the direct mortality of many sea turtles and may have had sublethal effects or caused environmental damage that will impact other sea turtles into the future. Information on the spill impacts to individual sea turtle species is presented in the Status of the Species sections for each species.

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

Climate Change

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

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

The effects from increased temperatures may be intensified on developed nesting beaches where shoreline armoring and construction have denuded vegetation. Erosion control structures could potentially result in the permanent loss of nesting beach habitat or deter nesting females (NRC 1990a). These impacts will be exacerbated by sea level rise. If females nest on the seaward side of the erosion control structures, nests may be exposed to repeated tidal overwash (NMFS and USFWS 2007c). Sea level rise from global climate change is also a potential problem for areas with low-lying beaches where sand depth is a limiting factor, as the sea may inundate nesting sites and decrease available nesting habitat (Baker et al. 2006; Daniels et al. 1993; Fish et al. 2005). The loss of habitat as a result of climate change could be accelerated due to a combination of other environmental and oceanographic changes such as an increase in the frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion (Antonelis et al. 2006; Baker et al. 2006).

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

Other Threats

Predation by various land predators is a threat to developing nests and emerging hatchlings. The major natural predators of sea turtle nests are mammals, including raccoons, dogs, pigs, skunks, and badgers. Emergent hatchlings are preyed upon by these mammals as well as ghost crabs, laughing gulls, and the exotic South American fire ant (*Solenopsis invicta*). In addition to natural predation, direct harvest of eggs and adults from beaches in foreign countries continues to be a problem for various sea turtle species throughout their ranges (NMFS and USFWS 2008b).

Diseases, toxic blooms from algae and other microorganisms, and cold stunning events are additional sources of mortality that can range from local and limited to wide-scale and impacting hundreds or thousands of animals.

4.2.2 Atlantic Sturgeon (All 5 DPSs)

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

Species Descriptions and Distributions

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

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

Life History Information

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

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

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

Juvenile and adult Atlantic sturgeon occupy upper estuarine habitat where they frequently congregate around the saltwater/freshwater interface. Estuarine habitats are important for juveniles, serving as nursery areas by providing abundant foraging opportunities, as well as thermal and salinity refuges, for facilitating rapid growth. Some juveniles will take up residency in non-natal rivers that lack active spawning sites (Bain 1997). Residency time of young Atlantic sturgeon in estuarine areas varies between 1-6 years (Schueller and Peterson 2010; Smith 1985), after which Atlantic sturgeon start out-migration to the marine environment. Out-migration of adults from the estuaries to the sea is cued by water temperature and velocity. Adult Atlantic sturgeon will reside in the marine habitat during the non-spawning season and forage extensively. Coastal migrations by adult Atlantic sturgeon are extensive and are known to occur over sand and gravel substrate (Greene et al. 2009). Atlantic sturgeon remain in the marine habitat until the waters begin to warm, at which time ripening adults migrate back to their natal rivers to spawn.

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

Status and Population Dynamics

At the time Atlantic sturgeon were listed, the best available abundance information for each of the 5 DPSs was the estimated number of adult Atlantic sturgeon spawning in each of the rivers on an annual basis. The estimated number of annually spawning adults in each of the river populations is insufficient to quantify the total population numbers for each DPS of Atlantic sturgeon due to the lack of other necessary accompanying life history data. An attempt to estimate total ocean population numbers of adults and subadults was completed in 2012 using data from the Northeast Area Monitoring and Assessment Program (NEAMAP). NEAMAP trawl surveys were conducted from Cape Cod, Massachusetts, to Cape Hatteras, North Carolina, in nearshore waters to depths of 60 ft from fall 2007 through spring 2012. The results of these surveys, assuming 50% gear efficiency (i.e., assumption that the gear will capture some, but not all, of the sturgeon in the water column along the tow path, and the survey area is only a portion of Atlantic sturgeon habitat), are presented in Table 9. 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 9 currently represent the best available population abundance estimates for the 5 U.S. Atlantic sturgeon DPSs.

Table 9. 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 Sub-adults (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 Basins southward along the South Carolina, Georgia, and Florida coastal areas to the St. Johns River, Florida. Rivers known to have current spawning populations within the range of the South Atlantic DPS include the Combahee, Edisto, Savannah, Ogeechee, Altamaha, and Satilla Rivers. We determined spawning was occurring if young-of-the-year (YOY) were observed, or mature adults were present, in freshwater portions of a system. However, in some rivers, spawning by Atlantic sturgeon may not be contributing to population growth because of lack of suitable habitat and the presence of other stressors on juvenile survival and development.

Historically, both the Broad-Coosawatchie and St. Marys Rivers were documented to have spawning populations; there is also evidence that spawning may have occurred in the St. Johns

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

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

Carolina DPS

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

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

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

Chesapeake Bay DPS

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

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

New York Bight DPS

The New York Bight DPS includes all anadromous Atlantic sturgeon that spawn in the watersheds that drain into coastal waters from Chatham, Massachusetts, to the Delaware-Maryland border on Fenwick Island. The marine range of Atlantic sturgeon from the New York Bight DPS extends from the Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida.

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, and evidence of spawning was recently documented in the Connecticut River (ASSRT 2007; Savoy et al. 2017). 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, an estimate of the mean annual number of mature adults (863 total; 596 males and 267 females) was calculated for the Hudson River riverine population (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. At the time of listing, available data on abundance of juvenile Atlantic sturgeon in the Hudson River Estuary indicated 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. Standardized mean catch per net set from the NYSDEC juvenile Atlantic sturgeon survey have had a general increasing trend from 2006 – 2015, with the exception of a dip in 2013. 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 some years since 2009 shows that successful spawning is still occurring in the Delaware River. Based on the capture of juvenile Atlantic sturgeon in the Delaware River, researchers estimated estimate there were 3,656 (95% CI = 1,935–33,041) age 0-1 juvenile Atlantic sturgeon in the Delaware River subpopulation in 2014 (Hale et al. 2016). However, the relatively low numbers of captured adults suggest the existing riverine subpopulation is limited in size. For example, of the 261 adult-sized Atlantic sturgeon captured for scientific purposes off the Delaware Coast between 2009 and 2012, 100 were subsequently identified by genetics analysis to belong to the Hudson River subpopulation while only 36 belonged to the Delaware River subpopulation (Wirgin et al. 2015). 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 2017 Assessment determined the New York Bight DPS abundance is "depleted" relative to historical levels. It also determined there is a relatively high probability (75%) that the New York Bight DPS abundance has increased since the implementation of the 1998 fishing moratorium, and a 31% probability the New York Bight DPS is still subjected to mortality levels higher than determined acceptable in the 2017 assessment (ASMFC 2017).

The 2017 Assessment reported N_e for the Hudson and Delaware rivers in the New York Bight DPS. In the Hudson River, samples from 337 individuals collected from 1996-2015 produced an estimated N_e of 144.2 individuals (ASMFC 2017). In the Delaware River, 181 samples were collected from 2009-2015 and produced an estimated N_e of 56.7 individuals (ASMFC 2017). While not inclusive of all the spawning rivers in the New York Bight DPS, the estimates for the Hudson River suggests that spawning subpopulation may be large enough to avoid inbreeding depression ($N_e < 100$); however, the Delaware River spawning subpopulation may still be at risk. Both spawning subpopulations are likely at risk losing evolutionary potential ($N_e < 1000$). The NEAMAP model estimates a minimum ocean population for the entire DPS of 34,566 Atlantic sturgeon, of which 8,642 are adults.

Gulf of Maine DPS

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

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

Viability of Atlantic Sturgeon DPSs

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

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

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

Threats

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

Dams

Dams for hydropower generation, flood control, and navigation adversely affect Atlantic sturgeon by impeding access to spawning, developmental, and foraging habitat, modifying free-flowing rivers to reservoirs, physically damaging fish on upstream and downstream migrations, and altering water quality in the remaining downstream portions of spawning and nursery habitat (ASSRT 2007). Attempts to minimize the impacts of dams using measures such as fish passage have not proven beneficial to Atlantic sturgeon, as they do not regularly use existing fish passage devices, which are generally designed to pass pelagic fish (i.e., those living in the water column) rather than bottom-dwelling species, like sturgeon. Within the range occupied by the Carolina DPS, dams have restricted Atlantic sturgeon spawning and juvenile developmental habitat by blocking over 60% of the historical sturgeon habitat upstream of the dams in the Cape Fear and Santee-Cooper River systems. Water quality (velocity, temperature, and 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. Heavy industrial development and concentrated feeding operations 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 (mgd) 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 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 (NCDENR) 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 total population to bycatch mortality without suffering population declines. Mortality rates of Atlantic sturgeon taken as bycatch in various types of fishing gear range between 0% and 51%, with the greatest mortality occurring in sturgeon caught by sink gillnets. Currently, there are estimates of the number of Atlantic sturgeon captured and killed in sink gillnet and otter trawl fisheries authorized by Fishery Management Plans (FMPs) in the Northeast Region (Miller and Shepherd 2011). Those estimates indicate from 2006-2010, on average there were 1,548 and 1,569 encounters per year in observed gillnet and trawl fisheries, respectively, with an average of 3,118 encounters combined annually. Mortality rates in gillnet gear were approximately 20%, while mortality rates in otter trawl gear are generally lower, at approximately 5%. Atlantic sturgeon are particularly vulnerable to being caught in sink gillnets; therefore, fisheries using this type of gear account for a high percentage of Atlantic sturgeon bycatch. Atlantic sturgeon are incidentally captured in state and federal fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (ASMFC 2007; Stein et al. 2004). Little data exists on bycatch in the Southeast and high levels of bycatch underreporting are suspected. However, fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may access multiple river systems, they are subject to being caught in multiple fisheries throughout their range. In addition, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins and low DO). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality.

4.3 Status of the Species within the Action Area

We believe the hopper dredging and relocation trawling components of the proposed action are likely to adversely affect green sea turtle (NA and SA DPSs), Kemp's ridley sea turtle, loggerhead sea turtle (NWA DPS), and Atlantic sturgeon (All 5 DPSs). Effects to these species from these components of the action are discussed in Section 6. The following subsections are synopses of the best available information regarding the status of green sea turtle (NA & SA DPSs), Kemp's ridley sea turtle loggerhead sea turtle (NWA DPS), and Atlantic sturgeon (all 5 DPSs) within the action area.

4.3.1 Sea Turtles

Sea turtle nesting season in North Carolina occurs May 1 through September 15, peaking in mid-June through the end of July. As stated above, all components of the proposed action will occur November 16 – April 30 to avoid the North Carolina sea turtle nesting and hatching season. North Carolina's sounds and estuaries provide important developmental and foraging habitats for post-pelagic green, Kemp's ridley, and loggerhead sea turtles. Most of the information regarding the inshore distribution of sea turtles in North Carolina comes from studies in the Pamlico-Albemarle estuarine complex, which is north of the action area. In general, these sea turtle species move inshore during the spring and disperse throughout the sounds during the summer, then leave the sounds and move offshore during the late fall and early winter. (Epperly et al. 1995) reported the presence of sea turtles in back-barrier estuaries along the NC coast from April through December. (Goodman et al. 2007) reported the presence of sea turtles in Core and

Pamlico Sounds and the nearshore ocean waters of Raleigh Bay within 1 mi of shore from April through November.

Several studies have reported a strong relationship between sea turtle distribution and sea surface temperature. (Goodman et al. 2007) conducted aerial sea turtle surveys and sea surface temperature monitoring in Core Sound, Pamlico Sound, and adjacent nearshore ocean waters within 1 mi of shore from July 2004 to April 2006. All but 1 of the 92 sea turtle observations occurred in waters where sea surface temperatures were above 51.8 ^{o}F (11 °C). All sightings in the sounds occurred between April 16 and November 20 and all sightings in the nearshore ocean occurred between April 23 and November 27. The winter distribution of sea turtles offshore of Cape Hatteras also correlated with sea surface temperatures above 51.8 ^{o}F (11 °C) (Epperly et al. 1995c). In a similar study by (Coles and Musick 2000), sea turtle distribution offshore of Cape Hatteras (from shore to edge of Gulf Stream) was restricted to sea surface temperatures ≥55.9 °F (≥13.3 °C). While these studies occurred north of the action area, we feel it is prudent to use sea surface temperature of 51.8 ^{o}F (11 °C) as an indicator of when green sea turtle and loggerhead sea turtle may use the action area.

The following subsections contain sea turtle species-specific nesting and stranding data for the action area.

4.3.1a Green Sea Turtle (NA and SA DPSs)

Green sea turtle nesting and stranding data in the action area has occurred sporadically and in small numbers in recent years. A total of 7 green sea turtle nests were reported along Bogue Banks from 2009-2017 (Table 10; Seaturtle.org accessed by consulting biologist on March 19, 2018). A total of 69 green sea turtles have stranded on Bogue Banks from 1976 through March 19, 2018 (Seaturtle.org accessed by consulting biologist on March 19, 2018).

Table 10. Green Sea Turtle Nesting on Bogue Banks (2009-2017)

Year	Atlantic Beach	Emerald Isle	Ft. Macon State Park	Indian Beach/Salter Path	Pine Knoll Shores	Total
2009	0	0	0	0	0	**0**
2010	0	1	0	0	1	**2**
2011	0	0	0	0	0	**0**
2012	0	1	0	0	0	**1**
2013	0	0	0	0	0	**0**
2014	0	0	0	0	0	**0**
2015	0	2	0	1	0	**3**
2016	0	0	0	0	1	**1**
2017	0	0	0	0	0	**0**
Total	**0**	**4**	**0**	**1**	**2**	**7**

4.3.1b Kemp's ridley Sea Turtle

A total of 3 Kemp's ridley sea turtle nests were reported along Bogue Banks from 2009-2017: all 3 were on Indian Beach/Salter Path (1 in 2014 and 2 in 2017; Seaturtle.org accessed by consulting biologist on March 19, 2018). A total of 60 Kemp's ridley sea turtles have stranded on Bogue Banks from 1976 through March 19, 2018 (Seaturtle.org accessed by consulting biologist on March 19, 2018).

4.3.1c Loggerhead Sea Turtle (NWA DPS)

A total of 366 loggerhead sea turtle nests were recorded along Bogue Banks from 2000-2017 (Table 11). Approximately 55% (n=200) were located on the beaches of Emerald Isle. A total of 95 loggerhead sea turtles have stranded on Bogue Banks from 1976 through March 19, 2018 (Seaturtle.org accessed by consulting biologist on March 19, 2018).

Table 11. Loggerhead Sea Turtle Nesting on Bogue Banks (2009-2017)

Year	Atlantic Beach	Emerald Isle	Ft. Macon State Park	Indian Beach/Salter Path	Pine Knoll Shores	Total
2009	4	16	6	5	4	**35**
2010	4	28	5	5	10	**52**
2011	4	17	4	3	No Data	**28**
2012	1	29	2	6	0	**38**
2013	9	10	5	3	9	**36**
2014	0	16	0	1	1	**18**
2015	6	13	7	1	6	**33**
2016	9	52	2	6	10	**79**
2017	9	19	6	3	10	**47**
Total	**46**	**200**	**37**	**33**	**50**	**366**

4.3.2 Atlantic Sturgeon (All 5 DPSs Combined)

Atlantic sturgeon were historically abundant in most North Carolina coastal rivers and estuaries. Because adult Atlantic sturgeon from all DPSs mix extensively in marine waters, we expect fish from all 5 DPSs (not just the Carolina DPS as proposed by USACE and BOEM) to be present in the action area. However, only the Carolina DPS is expected to spawn near the action area. The Cape Fear River (84 mi south of the action area) and the Neuse River (67 mi north of the action area) contain current spawning populations of Atlantic sturgeon within the range of the Carolina DPS. When not spawning, coastal migrations by adult Atlantic sturgeon are extensive and are known to occur over sand substrate (Greene et al. 2009). When adult Atlantic sturgeon reside in the marine habitat, they forage extensively on mollusks, gastropods, amphipods, isopods, and small fishes, especially sand lances (*Ammodytes* sp.). Atlantic sturgeon from Georgia to Chesapeake Bay remain in the marine and estuarine habitat until they migrate back to their natal rivers to spawn (i.e., late summer and fall). Because adult Atlantic sturgeon migrate along the coast when not spawning and tend to use estuaries, the timing of the proposed action means that it is more likely that Atlantic sturgeon may be present in the action area. NMFS believes that no individual sturgeon is likely to be a permanent resident of the nearshore or offshore waters of Bogue Banks, North Carolina, although some individuals may be present in any portion of the action area at any given time. Based on their foraging and spawning habitat preferences, Atlantic sturgeon may be affected by activities occurring in the inshore, nearshore, and offshore marine environment and, therefore, the status of the 5 Atlantic sturgeon DPSs in the action area, as well as the threats to these DPSs, are considered to be the same as those discussed in Section 4.2.2.

5 ENVIRONMENTAL BASELINE

This section is a description of the effects of past and ongoing human and natural factors leading to the current status of the species, their habitat (including designated critical habitat), and ecosystem, within the action area. The environmental baseline does not include the effects of the action under review in this Opinion.

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 well as the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

Focusing on the impacts of the activities in the action area specifically, allows us to assess the prior experience and state (or condition) of the endangered and threatened individuals, and areas of designated critical habitat that occur in an action area, and that will be exposed to effects from the action under consultation. This is important because, in some phenotypic states or life history stages, 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. The same is true for localized populations of endangered and threatened species: the consequences of changes in the fitness or performance of individuals on a population's status depends on the prior state of the population.

The following subsections are synopses of the actions and the effects these actions have had or are having on green sea turtle, Kemp's ridley sea turtle, loggerhead sea turtle, and Atlantic sturgeon within the action area.

5.1 Federal Actions

5.1.1 ESA Section 10 Permits

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

NOAA Fisheries Authorizations and Permits for Protected Species (APPS) database by the consulting biologist on July 10, 2018, there were 5 active Section 10(a)(1)(A) scientific research permits applicable to green, Kemp's ridley, and loggerhead sea turtles within the action area. These permits allow the capture, handling, sampling, and release of these turtle species (all life stages except hatchlings) and range in purpose from reducing bycatch in commercial fisheries to gaining better scientific knowledge. Per a search of the NOAA Fisheries APPS database by the consulting biologist on July 10, 2018, there are 3 active Section 10(a)(1)(A) scientific research permits applicable to Atlantic sturgeon within the action area. These permits allow federal and state agency personnel to collect, necropsy, sample, and/or salvage dead any Atlantic sturgeon found beached, sunken, or floating. U.S. facilities authorized to hold captive bred sturgeon are also authorized to collect, necropsy, and sample under this permit, should a captive Atlantic sturgeon need to be euthanized. Opportunistic research such as this may be useful for scientific and educational purposes.

5.1.2 Other Actions under the ESA

Status reviews of the green sea turtle were completed on August 31, 2007, and March 30, 2015. Each review determined that no delisting or reclassification of a species status (i.e., threatened or endangered) was warranted at the time.

A draft bi-national recovery plan for Kemp's ridley sea turtle was published on March 6, 2010 (75 FR 12496). A 5-year review was completed in July 2015 and determined that no delisting or reclassification of a species status (i.e., threatened or endangered) was warranted at the time.

A revised recovery plan for the loggerhead sea turtle was completed December 8, 2008 (NMFS and USFWS 2008a). Status reviews of the loggerhead sea turtle were completed on August 11, 2009, and August 31, 2007. Each review determined that no delisting or reclassification of a species status (i.e., threatened or endangered) was warranted at the time.

A recovery plan for Atlantic sturgeon has not yet been developed.

5.1.3 Vessel Activity and Operations

Potential sources of adverse effects from federal vessel activity and operations in the action area include operations of the United States Navy (USN) and United State Coast Guard (USCG). Through the Section 7 process, where applicable, NMFS has and will continue to establish conservation measures for all these agency vessel operations to avoid or minimize adverse effects to listed species. Refer to the Biological Opinions for the USCG (NMFS 1995; NMFS 1996) and the USN (NMFS 1996; NMFS 1997b; NMFS 2013) for details on the scope of vessel operations for these agencies and conservation measures implemented as standard operating procedures.

5.1.4 Dredging

The construction and maintenance of federal navigation channels and sand mining sites ("borrow areas") conducted by the USACE has been identified as a source of sea turtle mortality. Hopper dredges have been known to entrain and kill sea turtles as the suction dragheads of the advancing dredge. Entrainment events most likely occur when hopper dredge dragheads approach an animal that is oriented on the bottom and either resting or foraging and moving at minimal speed. In most cases, the entrainment scenario occurs when the operating environment presents challenges for the turtle deflector to operate as designed and the operator is not able to keep the draghead(s) fixed on the bottom. Similarly, entrainment can occur when a sea turtle burrows into the substrate or is within a hole/trench/depression that the draghead moves over. Entrained sea turtles rarely survive.

Hopper dredging can also affect Atlantic sturgeon through environmental effects and direct capture. Environmental effects of dredging that could also affect 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. Dickerson (2011) summarized observed lethal take of 21 sturgeon from maintenance dredging of federal navigation channels conducted by the USACE along the U.S. Atlantic coast from 1990-2010: 6 shortnose, 11 Atlantic, and 1 unidentified due to decomposition. Of the 11 Atlantic sturgeon lethal takes, 1 was due to interaction with a mechanical dredge, 0 were from a cutterhead dredge, and 10 were from a hopper dredges. Notably, reports include only those trips when an observer was on board to document capture.

NMFS completed a regional Biological Opinion on the impacts of USACE's South Atlantic coast hopper-dredging operations in 1997 for dredging in the USACE's South Atlantic Division (NMFS 1997c). The regional Biological Opinion on South Atlantic hopper dredging (SARBO) of navigational channels and borrow areas determined that hopper dredging would not adversely affect leatherback sea turtles in the South Atlantic Division (i.e., coastal states of North Carolina through Key West, Florida). The Opinion determined hopper dredging in the South Atlantic Division would adversely affect 4 sea turtle species (i.e., green, hawksbill, Kemp's ridley, and loggerhead), but it would not jeopardize their continued existence. Atlantic sturgeon were not included in the 1997 SARBO. As stated above, reinitiation of consultation on the 1997 SARBO has been triggered for a number of reasons, including listing of new species and designation of critical habitat that may be affected by these dredging activities. Outside projects covered by SARBO, there have been no other dredging Opinions for sea turtles or Atlantic sturgeon within the action area as per a review of the NMFS PRD's completed consultation database and a search of PCTS records by the consulting biologist on April 23, 2017.

5.1.5 Beach Nourishment

The USACE issues Clean Water Act permits for disposal of material in navigable waters of the United States, including beach nourishment. The activity of beach nourishment, particularly when impacts include the loss of nearshore hard bottom habitat along the east coast of Florida, has been documented to result in injury and death of juvenile green sea turtles. Juvenile green turtles are known to utilize these high-energy, dynamic habitats for foraging and as refuge, and show a preference for this habitat even when abundant deeper-water sites are available. The loss of such limited habitat, especially when considering the cumulative loss as a result of beach nourishment activities occurring along the entire range of the habitat and continually over time, is expected to result in loss of foraging opportunities and protective refuge. The stresses are also expected to contribute to mortality of individuals already in poor condition as a result of disease or other factors. Beach nourishment permitted by the USACE also often involves use of a hopper dredge to collect nourishment material, thus posing another route of adverse effects to sea turtles. There are no beach nourishment Opinions within the action area as per a review of the NMFS PRD's completed consultation database and a search of PCTS records by the consulting biologist on April 23, 2017.

5.1.6 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. NMFS issued an Opinion on the continued authorization and implementation of these projects on May 9, 2016 (SER-2009-07541). The Opinion determined the continued authorization and implementation of these projects would adversely affect ESA-listed sea turtle species and Atlantic sturgeon (all 5 DPSs), but it would not jeopardize their continued existence.

5.1.7 Federally Managed Fisheries

Sea turtles are adversely affected by fishing gears used throughout the continental shelf of the action area. Hook-and-line gear, trawl, and pot fisheries have all been documented as interacting with sea turtles. Atlantic sturgeon are adversely affected by fishing gears used throughout the action area. While a number of different gears are used (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 use gear known to adversely affect listed sea turtle species and Atlantic sturgeon. A brief summary of each fishery is provided below, but more detailed information can be found in the respective Opinions.

<u>5.1.7a Finfish Fisheries</u>

In February 2012, NMFS issued an Opinion on the continued authorization of the Atlantic dolphin-wahoo fishery (SER-2012-00410). The Opinion concluded the fishery may adversely affect, but would not jeopardize the continued existence of any ESA-listed sea turtle species. NMFS concluded that this fishery was not likely to adversely affect Atlantic sturgeon.

In 2012, NMFS issued an Opinion on the continued authorization of Highly Migratory Species Atlantic shark fisheries (NMFS 2012a). This commercial fishery uses bottom longline and gillnet gear. The recreational sector of the fishery uses only hook-and-line gear. To protect declining shark stocks, the proposed action seeks to greatly reduce the fishing effort in the commercial component of the fishery. These reductions are likely to greatly reduce the interactions between the commercial component of the fishery and sea turtles. The Opinion concluded that ESA-listed sea turtle species may be adversely affected by operation of the fishery but that the proposed action was not expected to jeopardize the continued existence of any of these species. NMFS (2012a) was the first formal consultation that evaluated the potential adverse effects of these fisheries on all 5 DPSs of Atlantic sturgeon. 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 anticipate the capture of Atlantic sturgeon in shark and smoothhound gillnet gear, but concluded the proposed action was not likely to jeopardize the continued existence of the species.

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 ESA-listed sea turtle species or any DPS of Atlantic sturgeon.

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 in 2015 (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 ESA-listed sea turtles species or any DPS of Atlantic sturgeon.

NOAA Fisheries Service completed an Opinion on the South Atlantic snapper-grouper fishery entitled: "The Continued Authorization of Snapper-Grouper Fishing in the U.S. South Atlantic Exclusive Economic Zone (EEZ) as Managed Under the Snapper-Grouper Fishery Management Plan of the South Atlantic Region (SGFMP), including Amendment 16 to the SGFMP" (SER-2016-17768) in 2016. The Opinion concluded the continued authorization of the fishery is not likely to jeopardize the continued existence of any ESA-listed sea turtles. The Opinion concluded the continued authorization of the fishery is not likely to adversely affect any DPS of Atlantic sturgeon.

<u>5.1.7b Southeastern Shrimp Trawl Fisheries</u>

Southeastern U.S. shrimp fisheries target primarily brown, white, and pink shrimp in inland waters and estuaries through the state-regulated territorial seas and in federal waters of the EEZ. As sea turtles rest, forage, or swim on or near the bottom, these species are captured by shrimp trawls that are pulled along the bottom. In 1990, the National Research Council concluded that the southeastern U.S. shrimp trawl fisheries affected more sea turtles than all other activities combined and was the most significant anthropogenic source of sea turtle mortality in the U.S. waters, in part due to the high reproductive value of turtles taken in this fishery (NRC 1990b).

On May 9, 2012, NMFS completed an Opinion that analyzed the continued implementation of the sea turtle conservation regulations and the continued authorization of the Southeast shrimp fisheries in federal waters under the Magnuson-Stevens Act (MSA) (NMFS 2012b). The Opinion also considered a proposed amendment to the sea turtle conservation regulations that would 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 these vessels to use TEDs. The Opinion concluded that the proposed action would not jeopardize the continued existence of any sea turtle species. The Opinion requires NMFS to minimize the impacts of incidental takes through monitoring of shrimp effort and regulatory compliance levels, conducting TED training and outreach, and continuing to research the effects of shrimp trawling on listed species. Subsequent to the completion of this opinion, NMFS withdrew the proposed amendment to require TEDs in skimmer trawls, pusher-head trawls, and wing nets. 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 southeastern U.S. shrimp fisheries in federal waters under the MSA was not likely jeopardize the continued existence of any ESA-listed sea turtle species. Information considered in the Opinion also 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, North Carolina Division of Marine Fisheries, pers. comm., via public comment on the proposed rule to list Atlantic sturgeon, 2010). The Opinion concluded that the proposed action was likely to adversely affect Atlantic sturgeon, but would not jeopardize the continued existence of any DPS of Atlantic sturgeon.

5.2 State or Private Actions

5.2.1 Maritime Industry

Private and commercial vessels, including fishing vessels, operating in the action area 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) include many records of vessel interaction with sea turtles where there are high levels of vessel traffic. The extent of the problem is difficult to assess because we cannot know whether the majority of sea turtles are struck pre- or post-mortem. 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 or predation. NMFS and the USCG have completed several formal consultations on individual marine events that may affect sea turtles. We do not expect any effect to Atlantic sturgeon from vessel collision due to the species' primarily benthic nature.

5.2.2 Coastal Development

Beachfront development, lighting, and beach erosion control all are ongoing activities along the North 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.

5.2.3 Fishery Independent Monitoring

The NCDENR 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 North Carolina. Due to the use of trawls and nets, Atlantic sturgeon have been taken during the studies. The USFWS provides funding for these studies and is in the process of reinitiating consultation with NMFS (SER-2015-16821) on the potential effects to Atlantic sturgeon from the sampling program titled "*North Carolina Striped Bass Monitoring*" funded through grant award NC-F-F16AF01316 (F-56-25).

5.2.4 State Fisheries

Recreational fishing as regulated by the State of North Carolina can affect protected species or their habitats within the action area. Pressure from recreational fishing in and adjacent to the action area is likely to continue. Observations of state recreational fisheries have shown that loggerhead sea turtles are known to bite baited hooks and frequently ingest the hooks. Hooked sea turtles have been reported by the public fishing from boats, piers, and beach, banks, and jetties and from commercial anglers fishing for reef fish and for sharks with both single rigs and bottom longlines (NMFS 2001). Additionally, lost fishing gear such as line cut after snagging on rocks, or discarded hooks and line, can also pose an entanglement threat to sea turtles in the area. A detailed summary of the known impacts of hook-and-line incidental captures to Kemp's ridley and loggerhead sea turtles can be found in the TEWG reports (1998; 2000). While information on sturgeon caught via recreational hook-and-line is sparse, hook-and-line gear (including bottom longline gear) is considered not likely to adversely affect Atlantic sturgeon. There have been no fishing pier biological opinions within the action area as per a review of the NMFS

PRD's completed consultation database and a search of PCTS records by the consulting biologist on April 23, 2017.

In August of 2007, NMFS issued a regulation (72 FR 43176, August 3, 2007) to require any fishing vessels subject to the jurisdiction of the United States to take observers upon NMFS's request. The purpose of this measure is to learn more about sea turtle interactions with fishing operations, to evaluate existing measures to reduce sea turtle takes, and to determine whether additional measures to address prohibited sea turtle takes may be necessary.

Atlantic sturgeon are also known to be adversely affected by gillnets and otter trawls. In fact, given these gear types are used most frequently used in state waters, state fisheries may have a greater impact on Atlantic sturgeon than federal fisheries using these same gear types. Descriptions of Atlantic sturgeon captured in the South Atlantic shrimp fisheries operating in both federal and state waters is described previously. In North Carolina, commercial large-mesh gillnet fisheries targeting southern flounder, striped bass, American shad, hickory shad, and catfishes are known to capture Atlantic sturgeon. Likewise, small-mesh gillnet fisheries targeting spot, striped mullet, bluefish, spotted seatrout, weakfish, Atlantic menhaden, Spanish mackerel, white perch, and kingfishes are also known to capture Atlantic sturgeon. North Carolina Division of Marine Fisheries manages both types of gillnet fisheries via regulations include mandatory gear attendance, net length limits, soak-time restrictions, net shot limits, net height tie-down requirements, closed areas, mesh size restrictions, minimum distance between fishing operations, marking and permitting requirements, and observer requirements.

North Carolina applied for, and received, an Incidental Take Permit from NOAA NMFS Office of Protected Resources to authorize the capture of Atlantic sturgeon in their gillnet fisheries from NMFS in 2014. The biological opinion relied on modeling to estimate future interactions. The Opinion determined the continued operation of the fisheries was likely to adversely affect Atlantic sturgeon DPSs but would not jeopardize their continued existence.

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

5.2.5 Fishery Independent Monitoring

The NCDENR 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 North Carolina. Due to the use of trawls and nets, Atlantic sturgeon have been taken during the studies. The USFWS provides funding for these studies and is in the process of reinitiating consultation with NMFS (SER-2015-16821) on the potential effects to Atlantic sturgeon from the sampling program titled "*North Carolina Striped Bass Monitoring*" funded through grant award NC-F-F16AF01316 (F-56-25). Over the past 7 years, this study has taken approximately 229 Atlantic sturgeon (200 non-lethal, 29 lethal).

5.3 Marine Debris and Acoustic Impacts

A number of activities that may affect ESA-listed sea turtle species and Atlantic sturgeon in the action area include anthropogenic marine debris and acoustic effects. The effects from these activities are difficult to measure. Where possible, conservation actions are being implemented to monitor or study the effects to sea turtles from these sources.

5.4 Marine Pollution and Environmental Contamination

Sources of pollutants along the coastal areas include atmospheric loading of PCBs, stormwater runoff from coastal towns and cities into rivers and canals emptying into bays and the ocean, and groundwater and other discharges (Vargo et al. 1986). Nutrient loading from land-based sources such as coastal community discharges is known to stimulate plankton blooms in closed or semi-closed estuarine systems (Bowen and Valiela 2001; Rabalais et al. 2002). The effects on larger embayments are unknown. Although pathological effects of oil spills have been documented in laboratory studies of marine mammals and sea turtles (Vargo et al. 1986), the impacts of many other anthropogenic toxins have not been investigated.

Coastal runoff, marina and dock construction, dredging, aquaculture, oil and gas exploration and extraction, increased under water noise and boat traffic can degrade marine habitats used by sea turtles and sturgeon (Colburn et al. 1996). The development of marinas and docks in inshore waters can negatively impact nearshore habitats. An increase in the number of docks built increases boat and vessel traffic. 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 analyzed in this Opinion travel between near shore and offshore habitats and may be exposed to and accumulate these contaminants during their life cycles.

There are studies on organic contaminants and trace metal accumulation in green and leatherback sea turtles (Aguirre et al. 1994; Caurant et al. 1999; Corsolini et al. 2000). McKenzie et al. (1999) measured concentrations of PFCs and organochlorine pesticides (such as DDT) in sea turtle 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). Dietary preferences were likely the main differentiating factor among species. Decreasing lipid contaminant burdens with turtle size were observed in green turtles, most likely attributable to a change in diet with age. Storelli et al. (1998) analyzed tissues from 12 loggerhead sea turtles stranded along the Adriatic Sea (Italy) and found that characteristically, mercury accumulates in sea turtle livers while cadmium accumulates in their kidneys, as has been reported for other marine organisms like dolphins, seals and porpoises (Law et al. 1991a).

5.5 Stochastic Events

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

5.6 Conservation and Recovery Actions Benefiting

NMFS has implemented a number 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 Atlantic Highly Migratory Species (HMS) and Gulf of Mexico reef fish fisheries, and TED requirements for the southeastern shrimp fisheries. Sea turtles and Atlantic sturgeon benefit from the use TEDs. TEDs and bycatch reduction device requirements may reduce sea turtle and 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 ESA-listed sea turtle species and 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.

6 EFFECT OF THE ACTION ON LISTED SPECIES

NMFS believes that the hopper dredging and relocation trawling components of the proposed action are likely to adversely affect green sea turtle (NA and SA DPSs), Kemp’s ridley sea turtle, loggerhead sea turtle (NWA DPS), and Atlantic sturgeon (all 5 DPSs).

6.1 Hopper Dredging

As stated above, the management reaches are projected to require maintenance placements totaling approximately 50.6 MCY over the 50-year life of the project. It is conservatively assumed for planning purposes that beach nourishment and channel alignment would require hopper dredging of approximately 26.7 MCY over the 50-year life of the project.

A typical hopper dredge vessel operates with 2 trailing, suction dragheads simultaneously, 1 on each side of the vessel. Sand will be dredged from the borrow areas and transported to the nearshore waters adjacent to the beach. There it will be dispersed via pump and pipeline from the hopper dredge. Because each dredge has a different capacity and will be sailing a different distance based on placement reach, 3 to 6 dredge trips per day are estimated per dredge. Dredge companies may use up to 3 dredges at a time. Based on current projections and timelines, the days per event could be up to 250 days (8 months) with most events occurring up to 150 days (5 months).

During dredging operations, protected species observers will live aboard the dredge, monitoring every load, 24 hours a day, for evidence of dredge-related impacts to protected species, particularly sea turtles and sturgeon. When the dredge is transiting, observers will maintain a bridge watch for protected species and keep a logbook noting the date, time, location, species, number of animals, distance and bearing from dredge, direction of travel, and other information, for all sightings. During all phases of dredging operations, the applicant will abide by the minimization measures stated in section 3.1.4.

6.1.1 Effects of Hopper Dredging

Previous NMFS Opinions have determined that hopper dredges may adversely affect green sea turtle, Kemp's ridley sea turtle, loggerhead sea turtle, and Atlantic sturgeon through crushing and/or entrainment by the dredge's suction dragheads. NMFS has also previously determined that dredged material screening is only partially effective at detecting entrained turtles, and observed interactions likely provide only partial estimates of total mortality. NMFS believes that ESA-listed species 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 interactions may go unnoticed. Mortalities are only noticed and documented when body parts float, are large enough to be caught in the screens, and can be identified as sea turtle or sturgeon parts. Body parts that are forced through the suction dragheads' 4-in (or greater) inflow screens by the suction-pump pressure and that do not float are unlikely to be observed, since they will sink to the bottom of the hopper and not be detected by the overflow screening. The majority of sea turtles killed by hopper dredges are immediately crushed or dismembered by the heavy suction dragheads and/or by the force of the hopper dredges' powerful, high-velocity dredge pumps. Very few sea turtles (over the years, a fraction of a percent) survive entrainment in hopper dredges; these are usually smaller juveniles that are sucked through the pumps without being dismembered or badly injured. Often they will appear uninjured only to die later of unknown internal injuries while in rehabilitation. We have very little data for hopper dredge-entrained Atlantic sturgeon; however, we know that this species has been lethally taken in hopper dredge activities in spawning rivers in Georgia. Therefore, we are conservatively predicting that all entrainment events by hopper dredges will be lethal for the green sea turtle, Kemp's ridley sea turtle loggerhead sea turtle, and Atlantic sturgeon.

6.1.2 Estimated Mortality from Hopper Dredging

We used data from previous hopper dredging projects to determine the effects to green sea turtles, Kemp's ridley sea turtle, loggerhead sea turtles, and Atlantic sturgeon. We selected these projects based on proximity to the action area (i.e., inshore and offshore), similarity of dredge type (i.e., hopper dredging), and time of year (i.e., November to April). We include hopper-dredging projects from 1997 to 2018 because NMFS last revised the SARBO in 1997 to include requirements and recommendations for dredging activities, similar to what will be required of the proposed action. We believe that the projects in Table 12 represent the best available data to help us determine potential lethal take of these species from hopper dredging due to the proposed action.

Hopper dredging in and around the action area during this time generated approximately 20,270,955 cubic yards (yd^3) of material (Table 12). Observed take during these projects amounted to 2 green, 3 Kemp's ridley, and 17 loggerhead sea turtles sea turtles. This equates to a catch-per-unit-effort (CPUE) of 0.000000099 green sea turtles per yd^3 dredged (2 green sea turtles ÷ 20,270,955 total yd^3 dredged), 0.000000148 Kemp's ridley sea turtles per yd^3 dredged (3 Kemp's ridley sea turtles ÷ 20,270,955 total yd^3 dredged), and 0.000000839 loggerhead sea turtles per yd^3 dredged (17 loggerhead sea turtles ÷ 20,270,955 total yd^3 dredged).

Table 12. Material Removed and Observed Take of Sea Turtle Species from Hopper Dredging Projects in and around Carteret County, NC, 1997-2017 (*Data taken from Piatkowski 2007[6]; **Data provided by USACE and BOEM)

Project Name (Authority)	Start Date (Month-Year)	Quantity Dredged (yd^3)	Green Sea Turtle Take	Kemp's Ridley Sea Turtle Take	Loggerhead Sea Turtle Take
Ocean Bar (USACE)*	Apr-97	267,655	0	0	6
Ocean Bar (USACE)*	Nov-98	2,240,267	0	0	1
Ocean Bar (USACE)*	Nov-99	952,364	0	0	3
Ocean Bar (USACE)*	Jan-00	1,793,378	0	0	0
Ocean Bar (USACE)*	Jan-01	523,358	0	0	0
Bogue Banks Phase I - PKS and IB (USACE)*	Nov-01	1,869,390	0	3	2
Ocean Bar (Range A; Cutoff) (USACE)*	Feb-02	62,160	0	0	0
Bogue Banks Phase II - Emerald Isle (USACE)*	Feb-03	989,895	0	0	1
Morehead City Ocean Bar/Indian Beach Salter Path 993 (USACE)*	Feb-04	789,998	0	0	0
Bogue Banks Phase II (USACE)*	Mar-04	243,076	0	0	0
Ocean Bar (USACE)*	Feb-05	285,119	0	0	0

[6] Piatkowski, Doug (2007) Annual Sea Turtle Monitoring Report, Wilmington District, Maintenance Dredging – Fiscal Year 2006

Project Name (Authority)	Start Date (Month-Year)	Quantity Dredged (yd^3)	Green Sea Turtle Take	Kemp's Ridley Sea Turtle Take	Loggerhead Sea Turtle Take
Ocean Bar (USACE)*	Jan-06	1,004,410	0	0	0
Morehead City Harbor Ocean Bar (USACE)**	Jan-07	853,958	0	0	1
Wilmington Harbor Ocean Bar (USACE)**	Dec-07	429,091	1	0	0
Morehead City Ocean Bar (USACE)**	Jan-08	466,127	0	0	0
Morehead City Inner Harbor (USACE)**	Mar-08	133,652	0	0	0
Wilmington Harbor Ocean Bar (USACE)**	Jan-09	948,477	0	0	0
Morehead City Inner and Outer Bars (USACE)**	Feb-09	621,561	0	0	0
Wilmington Harbor Outer Ocean Bar (USACE)**	Feb-10	1,004,359	0	0	0
Carolina Beach, Kure Beach and Ocean Isle Beach Nourishment (USACE)**	Mar-10	446,967	0	0	0
Wilmington Harbor Ocean Bar (USACE)**	Dec-10	857,726	0	0	0
Wilmington Harbor Ocean Bar & Mid-River Channel (USACE)**	Jan-12	327,483	0	0	0
Morehead City Harbor - Cutoff Channel & Range A (USACE)**	Jan-12	435,034	0	0	0
Wilmington Harbor Ocean Bar and Mid River Channels (Emergency Dredging) (USACE)**	Mar-12	83,849	0	0	0
Carteret County, North Carolina, Post-Irene (BOEM)**	Feb-13	1,042,417	0	0	0
Holden Beach, North Carolina (Private)**	Jan-17	1,279,283	1	0	1
Wilmington Harbor (USACE)**	Mar-17	319,901	0	0	2
Total Take by Species			2	3	17
Total Quantity Dredged (yd^3)			20,270,955		
CPUE			0.000000099	0.000000148	0.000000839

The final rule listing Atlantic sturgeon became effective April 6, 2012 (77 FR 5914; 77 FR 5879). Therefore, to estimate mortality for Atlantic sturgeon, we truncated the above table and used only hopper dredging data in and around the action area from the effective date of the final listing rule to present. Hopper dredging in and around the action area during this time generated approximately 2,641,601 yd^3 of material (Table 13). Observed take during these projects was 1 Atlantic sturgeon. This equates to a CPUE of 0.000000379 Atlantic sturgeon per yd^3 dredged (1 Atlantic sturgeon ÷ 2,641,601 total yd^3 dredged).

Table 13. Material Removed and Observed Take of Atlantic Sturgeon from Hopper Dredging Projects in and around Carteret County, NC, 2012-2017 (Data provided by USACE)

Project Name (Authority)	Start Date (Month-Year)	Quantity Dredged (yd^3)	Atlantic Sturgeon
Carteret County, North Carolina, Post-Irene (BOEM)**	Feb-13	1,042,417	0
Holden Beach, North Carolina (Private)	Jan-17	1,279,283	0
Wilmington Harbor (USACE)	Mar-17	319,901	1
	Total Take	1	
	Total Quantity Dredged (yd^3)	2,641,601	
	CPUE	0.000000379	

As stated above, approximately 26,700,000 yd^3 over the 50-year life of the project will be obtained by hopper dredge. Using the CPUEs for sea turtle species from Table 12, we estimate that the hopper dredging portion of the proposed action will result in the observed take of 3 green sea turtles (0.000000099 × 26,700,000 yd^3 dredged = 2.6, rounded up to 3), 4 Kemp's ridley sea turtles (0.000000148 × 26,700,000 yd^3 dredged), and 23 loggerhead sea turtles (0.000000839 × 26,700,000 yd^3 dredged = 22.4, rounded up to 23) over the 50-year life of the project. Using the CPUE for Atlantic sturgeon from Table 13, we can estimate that the hopper dredging portion of the proposed action will result in the observed take of approximately 11 Atlantic sturgeon (0.000000379 × 26,700,000 yd^3 dredged = 10.1, rounded up to 11). We note here that we round up to the next whole number when estimating take in sections 6.1 and 6.2 because it is not possible to take a fraction of an animal.

It is not known how many sea turtles or Atlantic sturgeon are taken, but unobserved, by hopper dredges. Therefore, because we have no new information, and to be conservative to all species, we apply our longstanding assumption that observed interactions constitute only 50% of total takes.[7] 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 a trigger for some of the reasonable and prudent measures, and for potential reinitiation of consultation if actual observed take exceeds the anticipated/authorized number of observed take.

[7] November 19, 2003 Regional Biological Opinion on hopper dredging issued to the U.S. Army Corps of Engineers for their Gulf of Mexico District's (i.e., Jacksonville, Mobile, New Orleans, and Galveston) maintenance dredging and beach nourishment operations.

However, our jeopardy analysis will account for total take (observed take plus unobserved take). Based on a 50% detection rate of hopper dredge-entrained species, NMFS estimates total lethal take of green sea turtle, Kemp's ridley sea turtle, loggerhead sea turtle, and Atlantic sturgeon over the 50-year life of the project as listed in Table 14 below.

Table 14. Anticipated Amount of Lethal Take due to Hopper Dredging over the 50-year Life of the Project

Species	Observed Hopper Dredge Lethal Take	Unobserved Hopper Dredge Lethal Take	Total Hopper Dredge Lethal Take
Green sea turtle (NA and SA DPS, combined)	3	3	6
Kemp's ridley sea turtle	4	4	8
Loggerhead sea turtle (NWA DPS)	23	23	46
Atlantic sturgeon (all 5 DPSs, combined)	11	11	22

6.2 Relocation Trawling

As stated above, relocation trawling will be employed when water temperatures exceed 57 ^{o}F (13.8 ^{o}C) beginning 24 hours prior to hopper dredging. Regardless of water temperature, if 1 sea turtle or Atlantic sturgeon is taken by a hopper dredge, trawlers will mobilize within 72 hours and 24-hour trawling will commence.

During relocation trawling, 1 trawling vessel per dredge will operate 24 hours/day, 7 days/week. Tow times (i.e., the duration that the trawl net will be in the water and capable of trapping sea turtles or sturgeon) will be strictly limited to less than 42 minutes total time. Trawling speeds will not exceed 3.5 kt.

Protected species observers will live aboard the relocation trawlers, monitoring all tows for endangered and threatened species, as well as recording water temperatures, bycatch information, and any sightings of protected species in the area. Any sea turtle or Atlantic sturgeon captured during relocation trawling will be photographed, measured, biopsied for genetics, tagged, and relocated at least 3 nmi away. During all phases of relocation trawling, the applicant will abide by the harm avoidance and minimization measures stated in section 3.1.4.

6.2.1 Effects of Relocation Trawling

Relocation trawling is a proven method of reducing the density of sea turtles and sturgeon in front of an advancing hopper dredge and very likely results in reduced lethal take from hopper dredging(NMFS 2007). Relocation trawling is conducted only when it can be done safely. The effects of relocation trawling are mostly nonlethal and non-injurious to captured sea turtles and sturgeon species.

Dickerson et al. (2007) evaluated the effectiveness of relocation trawling for reducing interactions with sea turtles by analyzing incidental interactions recorded in endangered species observer reports, relocation trawling reports, and hopper dredging project reports from 1995 through 2006. They found that 358 dredging-related sea turtle interactions were reported (Regions: Gulf = 147 sea turtles; Atlantic = 211 sea turtles) in the 319 hopper dredging projects throughout the Gulf of Mexico (n = 128) and Atlantic Ocean (n = 191) that used endangered species monitoring. In the 70 projects that used relocation trawling, 1,239 sea turtles were reported (Gulf Regions = 844; Atlantic Region = 395). Loggerhead sea turtle was the predominant species for both dredge interactions and relocation trawling interactions. Kemp's ridley sea turtle ranked second. Green turtles were captured in trawls only during December through March in the Gulf of Mexico. Relocation data for Atlantic sturgeon is sparse; however, we know that relocation trawling is effective for reducing interactions between hopper dredges and Atlantic sturgeon. As of January 18, 2017, recent operations in Savannah Harbor, Chatham County, Georgia, have resulted in over 121 Atlantic sturgeon relocated in advance of dredging operations, while only 8 Atlantic sturgeon have been observed as lethally taken by hopper dredging.

There is a remote possibility that sea turtles could be injured by the trawl doors; 5 (0.4%) of 1,216 sea turtles captured by relocation trawlers from October 1, 2006, to June 14, 2011, during USACE dredging projects resulted in immediate mortality (USACE Sea Turtle Data Warehouse 2014). Therefore, we will account for the potential of lethal take due to relocation trawling below. No lethal interactions with Atlantic sturgeon as a result of relocation trawling have been reported. All ESA-listed species captured via relocation trawling will be released unharmed in a nearby area that contains the same habitat as the areas where the trawling will occur; thus, any habitat displacement effects associated with the relocation trawling capture are expected to be insignificant.

6.2.2 Estimated Take from Relocation Trawling

We used data from previous hopper dredging projects that employed relocation trawling in and around the action area during the same time of year as the proposed action to determine the effects of relocation trawling to sea turtles and Atlantic sturgeon. There have not been many projects that employ relocation trawling near the action area, because relocation trawling is not authorized under the 1997 SARBO. Relocation trawling in and around the action area between 1998 and 2013 relocated 7 loggerhead sea turtles and 0 green or Kemp's ridley sea turtles (Table 15). The total amount of material dredged during relocation trawling effort was 2,910,143 yd^3. This equates to a CPUE of 0.000001115 loggerhead sea turtles relocated per yd^3 dredged (7 loggerhead sea turtles ÷ 6,280,159 total yd^3 dredged). Based on the best available data, we do not expect any green sea turtles or Kemp's ridley sea turtles to be captured via relocation trawl.

Table 15. Observed Take of Sea Turtle Species from Relocation Trawling during Hopper Dredging Projects in and around Carteret County, NC, 1997-2017 (*Data taken from Piatkowski 2007[8]; **Data provided by USACE Wilmington and BOEM)

Project Name (Authority)	Start Date (Month -Year)	Quantity Dredged (yd^3)	Green Sea Turtle Take	Kemp's ridley Sea Turtle Take	Loggerhead Sea Turtle Take
Ocean Bar (USACE)*	Apr-97	267,655	0	0	2
Bogue Banks Phase I - PKS and IB (USACE)*	Nov-01	1,869,390	0	0	0
Bogue Banks Phase II - Emerald Isle (USACE)*	Feb-03	989,895	0	0	0
Bogue Banks Phase II (USACE)*	Mar-04	243,076	0	0	0
Bogue Banks Beach Nourishment (Phase II) (USACE)**	Mar-04	1,867,726	0	0	5
Carteret County, North Carolina, Post-Irene (BOEM)**	Feb-13	1,042,417	0	0	0
		Total Take by Species	0	0	7
		Total Quantity Dredged (yd^3)	6,280,159		
		CPUE	0	0	0.000001115

The observed take of Atlantic sturgeon from relocation trawling during hopper dredging projects is listed in Table 16. Using the best available data, 79 Atlantic sturgeon have been relocated. The total amount of material dredged during relocation trawling effort was 2,492,417 yd^3. This equates to a CPUE of 0.000031696 Atlantic sturgeon per yd^3 dredged (79 Atlantic sturgeon ÷ 2,492,417 total yd^3 dredged).

[8] Piatkowski, Doug (2007) Annual Sea Turtle Monitoring Report, Wilmington District, Maintenance Dredging – Fiscal Year 2006

Table 16. Observed Take of Atlantic sturgeon from Relocation Trawling during Hopper Dredging Projects (Data provided by USACE and BOEM)

Project Name (Authority)	Start Date (Month-Year)	Quantity Dredged (yd^3)	Atlantic Sturgeon
Carteret County, North Carolina, Post-Irene (BOEM)	Feb-13	1,042,417	0
Brunswick County, Georgia (USACE)	Jan-18	1,450,000	79
		Total Take	79
		Total Dredged	2,492,417
		CPUE	0.000031696

While the Brunswick County, Georgia, project is outside the action area, it represents the best available relocation trawling data with the closest proximity and similar time of year to the proposed action. We note here that the Brunswick County, Georgia, project occurred in very close proximity to the mouth of two known spawning rivers for Atlantic sturgeon in Georgia (i.e., the Satilla River is approximately 9 mi to the south and the Altamaha River is approximately 15.5 mi to the north) where hopper dredging for the proposed action occurs farther offshore at a much greater distance from known spawning rivers in North Carolina (i.e., at offshore ODMDS sites approximately 67 mi south of the mouth of the Neuse River and 84 mi north of the mouth of the Cape Fear River). Therefore, we acknowledge that the number of Atlantic sturgeon captured by relocation trawl in the Brunswick County, Georgia, project is likely an over-estimation of relocation take that may occur in the proposed action. As stated above, we are limited in the number of projects from which to choose because relocation trawling is not allowed under the 1997 SARBO.

We conservatively assume that 26,700,000 yd^3 over the 50-year life of the project will be obtained by hopper dredge. A conservative estimate would assume all hopper dredging would require relocation trawling. Therefore, we estimate that the proposed action will result in the relocation (non-lethal take) of 30 loggerhead sea turtles (0.000001115 × 26,700,000 yd^3 dredged = 29.8, rounded up to 30; Table 15) and 847 Atlantic sturgeon (0.000031696 × 26,700,000 yd^3 dredged = 846.3, rounded up to 847; Table 16) over the 50-year life of the project.

As stated above, 0.4% of sea turtles captured by relocation trawlers from October 1, 2006, to June 14, 2011, during USACE dredging projects resulted in immediate mortality (USACE Sea Turtle Data Warehouse 2014). We apply this rate to the number of non-lethal captures estimated from the proposed action and estimate that relocation trawling may lead to 1 lethal take of a loggerhead sea turtle over the 50-year life of the project (30 non-lethal takes × 0.4% = 0.1, rounded up to 1). So far, we have no information indicating that any Atlantic sturgeon have been injured or killed during relocation trawling; therefore, we do not anticipate lethal take of this species due to relocation trawling. We anticipate all take due to relocation trawling will be observed.

Table 17. Anticipated Amount of Take due to Relocation Trawling over the 50-year Life of the Project

Species	Relocation Non-lethal Take	Relocation Lethal Take	Total Relocation Take
Green sea turtle (NA & SA DPS, combined)	0	0	0
Kemp's ridley sea turtle	0	0	0
Loggerhead sea turtle (NWA DPS)	30	1	31
Atlantic sturgeon (all 5 DPSs, combined)	847	0	847

7 CUMULATIVE EFFECTS

Cumulative effects include the effects of *future* state, tribal, or local private actions— i.e., that are not already in the baseline—that are reasonably certain to occur in the action area considered in this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA (50 CFR 402.14). Actions that are reasonably certain to occur would include actions that have some demonstrable commitment to their implementation, such as funding, contracts, agreements or plans.

Coastal development, channel dredging, and boating activities have degraded or modified sea turtle habitats throughout the southeastern United States. Dams, dredging, and poor water quality have modified and restricted the extent of suitable habitat for Atlantic sturgeon spawning and nursery habitat. These threats were discussed above for each species. While the degradation and modification of habitat is not likely the primary reason for the decline of sea turtles and Atlantic sturgeon abundance or distribution, it has likely been a contributing factor. No future actions with effects beyond those already described are reasonably certain to occur in the action area.

8 JEOPARDY ANALYSIS

The analyses conducted in the previous sections of this Opinion provide the basis on which we determine whether the proposed action would be likely to jeopardize the continued existence of green sea turtle, loggerhead sea turtle, and Atlantic sturgeon. In the effect of the action section, we outlined how the proposed action would affect these species at the individual level and the magnitude of those effects based on the best available data. Next, we assessed each of these species' response to the effects of the proposed action in terms of overall population effects and whether those effects will jeopardize their continued existence in the context of the status of the species, the environmental baseline, and the cumulative effects.

It is the responsibility of the action agency to "insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species…" (ESA Section 7(a)(2)). Action agencies must consult with and seek assistance from the NMFS to meet this responsibility. NMFS must ultimately determine in a Biological Opinion whether the action jeopardizes listed species. To *jeopardize the continued existence of* is defined as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). The following jeopardy analysis first considers the effects of the action to determine if we would reasonably expect the action to result in reductions in reproduction, numbers, or distribution of green sea turtle, loggerhead sea turtle, and Atlantic sturgeon. The analysis next considers whether any such reduction would in turn result in an appreciable reduction in the likelihood of survival of these species in the wild, and the likelihood of recovery of these species in the wild.

8.1 Green Sea Turtle (NA and SA DPSs)

As discussed in the effects of the action section, within U.S. waters green sea turtles from both the NA and SA DPSs can be found on foraging grounds. While there are currently no in-depth studies available to determine the percent of NA and SA DPS individuals in any given location, an analysis of green sea turtles on the foraging grounds off Hutchinson Island, Florida (Atlantic Ocean-side), found approximately 95% of the turtles sampled came from the NA DPS. While is it highly likely green sea turtles found in or near the action area will be from the NA DPS, we cannot rule out that they may also be from the SA DPS. Therefore, to analyze effects in a precautionary manner, we will conduct 2 jeopardy analyses, one for each DPS (i.e., assuming up to 5% could come from the SA DPS).

8.1.1 NA DPS

The proposed action may result in the lethal take of up to 6 green sea turtles from the NA DPS over the 50-year life of the project. We do not expect any green sea turtles to be captured via relocation trawling based on the best available data.

<u>8.1.1a Survival</u>

The lethal take of 6 green sea turtles from the NA DPS by hopper dredging over the 50-year life of the project is a reduction in numbers. A lethal take could also result in a potential reduction in future reproduction, assuming the individual would be female and would have survived to reproduce in the future. For example, as discussed above, an adult green sea turtle can lay 3-4 clutches of eggs every 2-4 years, with approximately 110-115 eggs/nest, of which a small percentage is expected to survive to sexual maturity. The anticipated lethal take is expected to occur in a discrete action area (i.e., where hopper dredging will be occurring) and green sea turtles in the NA DPS generally have large ranges; thus, no reduction in the distribution is expected from the take of these individuals.

Whether the reductions in numbers and reproduction of this species would appreciably reduce its likelihood of survival depends on the probable effect the changes in numbers and reproduction would have relative to current population sizes and trends. In the Status of Species of this Opinion, we presented the status of the DPS, outlined threats, and discussed information on estimates of the number of nesting females and nesting trends at primary nesting beaches. In the

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

Seminoff et al. (2015) estimated that there are greater than 167,000 nesting green sea turtle females in the NA DPS. The nesting at Tortuguero, Costa Rica, accounts for approximately 79% of that estimate (approximately 131,000 nesters), with Quintana Roo, Mexico, (approximately 18,250 nesters; 11%), and Florida, USA (approximately 8,400 nesters; 5%), also accounting for a large portion of the overall nesting (Seminoff et al. 2015). At Tortuguero, Costa Rica, the number of nests laid per year from 1999 to 2010 increased, despite substantial human impacts to the population at the nesting beach and at foraging areas (Campell and Lagueux 2005; Troëng 1998; Troëng and Rankin 2005). Nesting locations in Mexico along the Yucatan Peninsula also indicate the number of nests laid each year has deposited, but by 2000 this increased to over 1,500 nests/year (NMFS and USFWS 2007d). 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, FFWCC, pers. comm., 2013). As described in the Section 4.2.1a, nesting has increased substantially over the last 20 years and peaked in 2015 with 27,975 nests statewide.

In summary, green sea turtle nesting at the primary nesting beaches within the range of the NA DPS has been increasing over the past 2 decades, against the background of the past and ongoing human and natural factors (i.e., the environmental baseline) that have contributed to the current status of the species. We believe these nesting trends are indicative of a species with a high number of sexually mature individuals. Since the abundance trend information for NA DPS green sea turtles is clearly increasing, we believe the potential lethal take of 6 green sea turtles from the NA DPS over the 50-year life of the project will not have any measurable effect on that trend. After analyzing the magnitude of the effects of the proposed action, in combination with the past, present, and future expected impacts to the DPS discussed in this Opinion, we believe the proposed action is not reasonably expected to cause an appreciable reduction in the likelihood of survival of the green sea turtle NA DPS in the wild.

8.1.1b Recovery

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

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

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

According to data collected from Florida's index nesting beach survey from 1989-2016, green sea turtle nest counts across Florida have increased approximately ten-fold from a low of 267 in the early 1990s to a high of 27,975 in 2015 (http://myfwc.com/research/wildlife/sea-turtles/nesting/green-turtle/; reviewed by consulting biologist on June 28, 2017), indicating that the first listed recovery objective is currently being met. 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 also increased, consistent with the criteria of the second listed recovery objective.

The potential lethal take of 6 green sea turtles from the NA DPS over the 50-year life of the project will result in a reduction in numbers when it occurs, but it is unlikely to have any detectable influence on the recovery objectives and trends noted above, even when considered in the context of the of the Status of the Species, the Environmental Baseline, and Cumulative Effects discussed in this Opinion. Based on the best available data, we do not anticipate any non-lethal take of NA DPS green sea turtles due to relocation trawling. Thus, the proposed action will not impede achieving the recovery objectives above and will not result in an appreciable reduction in the likelihood of NA DPS green sea turtles' recovery in the wild.

<u>8.1.1c Conclusion</u>

The lethal take of green sea turtles from the NA DPS associated with the proposed action are not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the NA DPS of green sea turtle in the wild. We do not expect any green sea turtles to be captured via relocation trawling based on the best available data.

8.1.2 SA DPS

Until we have an analysis with a larger sample size across more of the Atlantic by the NMFS Southwest Fisheries Science Center genetics lab and because we do not anticipate any impacts to nesters or hatchlings, we use 5% as the best estimate of the percent of SA DPS individuals that could be taken by a project in waters of the Atlantic Ocean. We find that the proposed action may result in the lethal take of 1 green sea turtle from the SA DPS over the 50-year life of the project (6 total lethal takes × 5% = 0.3, rounded up to 1). As stated above, we do not expect any green sea turtles to be captured via relocation trawling based on the best available data.

<u>8.1.2a Survival</u>

The lethal take of 1 green sea turtle from the SA DPS by hopper dredging is a reduction in numbers. As discussed above, lethal interactions would also result in a potential reduction in future reproduction, assuming the individual would be female and would have survived otherwise to reproduce. While the project will occur over 50 years, the anticipated lethal take is expected to occur in a discrete action area (i.e., where hopper dredging is occurring) and green sea turtles in the SA DPS generally have large ranges; thus, no reduction in the distribution is expected from the take of these individuals.

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

In Section 4.2.1a, we summarized available information on number of nesters and nesting trends at SA DPS beaches. Seminoff et al. (2015) estimated that there are greater than 63,000 nesting females in the SA DPS, though they noted the adult female nesting abundance from 37 beaches could not be quantified. The nesting at Poilão, Guinea-Bissau, accounted for approximately 46% of that estimate (approximately 30,000 nesters), with Ascension Island, United Kingdom, (approximately 13,400 nesters; 21%), and the Galibi Reserve, Suriname (approximately 9,400 nesters; 15%) also accounting for a large portion of the overall nesting (Seminoff et al. 2015).

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

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

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

In summary, nesting at the primary nesting beaches for the SA DPS has been increasing over the past 3 decades, against the background of the past and ongoing human and natural factors (as contemplated in the Status of the Species and Environmental Baseline sections) that have contributed to the current status of the species. We believe these nesting trends are indicative of a species with a high number of sexually mature individuals. Since the abundance trend information for green sea turtles is clearly increasing, we believe the potential lethal take of 1 green sea turtle from the SA DPS over the 50-year life of the project will not have any measurable effect on that trend. After analyzing the magnitude of the effects of the proposed action, in combination with the past, present, and future expected impacts to the DPS discussed in this Opinion, we believe the proposed action is not reasonably expected to cause an appreciable reduction in the likelihood of survival of the green sea turtle SA DPS in the wild.

8.1.2b 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 1991b) does exist. Since the animals within the SA DPS all occur in the Atlantic Ocean and would have been subject to the recovery actions described in that plan, we believe it is appropriate to continue using that Recovery Plan as a guide until a new plan, specific to the SA DPS, is developed. In our analysis for the NA DPS, we stated that the Atlantic Recovery Plan lists the following relevant recovery objectives over a period of 25 continuous years:

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

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

The nesting recovery objective is specific to the NA DPS, but demonstrates the importance of increases in nesting to recovery. As previously stated, nesting at the primary SA DPS nesting beaches has been increasing over the past 3 decades. There are currently no estimates available specifically addressing changes in abundance of individuals on foraging grounds. Given the clear increases in nesting and in-water abundance, however, it is likely that numbers on foraging grounds have increased.

The potential lethal take of 1 green sea turtle from the SA DPS over the 50-year life of the project will result in a reduction in numbers when it occurs, but it is unlikely to have any detectable influence on the trends noted above, even when considered in context with the Status of the Species, the Environmental Baseline, and Cumulative Effects discussed in this Opinion. Based on the best available data, we do not anticipate any non-lethal take of NA DPS green sea turtles due to relocation trawling. Thus, the proposed action will not impede achieving the recovery objectives above and will not result in an appreciable reduction in the likelihood of the SA DPS of green sea turtles' recovery in the wild.

8.1.2c Conclusion

The potential lethal take of 1 SA DPS green sea turtle associated with the proposed action is not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the SA DPS of green sea turtle in the wild. We do not expect any green sea turtles to be captured via relocation trawling based on the best available data.

8.2 Kemp's ridley Sea Turtle

The proposed action may result in the take of up to 8 Kemp's ridley sea turtles over the 50-year life of the project (8 lethal from hopper dredging). We do not expect any Kemp's ridley turtles to be captured via relocation trawling based on the best available data.

8.2.1 Survival

The potential lethal take of up to 8 Kemp's ridley sea turtle over the 50-year life of the project would reduce the species' population compared to the number that would have been present in the absence of the proposed action, assuming all other variables remained the same. The Turtle Expert Working Group (TEWG 1998b) estimates age at maturity from 7-15 years. Females return to their nesting beach about every 2 years (TEWG 1998b). The mean clutch size for Kemp's ridley sea turtle is 100 eggs/nest, with an average of 2.5 nests/female/season. Lethal takes could also result in a potential reduction in future reproduction, assuming at least one of these individuals would be female and would have survived to reproduce in the future. The loss of 8 Kemp's ridley sea turtle could preclude the production of thousands of eggs and hatchlings, of which a fractional percentage would be expected to survive to sexual maturity. Thus, the death of any females would eliminate their contribution to future generations, and result in a reduction in sea turtle reproduction. The anticipated lethal takes are expected to occur in a small, discrete action area (i.e., where hopper dredging is occurring) and Kemp's ridley sea turtle generally have large ranges; thus, no reduction in the distribution is expected from the take of these individuals.

In the absence of any total population estimates for Kemp's ridley sea turtle, nesting trends are the best proxy for estimating population changes. Following a significant, unexplained 1-year decline in 2010, Kemp's ridley sea turtle nests in Mexico reached a record high of 21,797 in 2012 (Gladys Porter Zoo nesting database 2013). There was a second significant decline in Mexico nests 2013 through 2014; however, nesting in Mexico has increased 2015 through 2017 (Gladys Porter Zoo 2016).

A small nesting population is also emerging in the United States, primarily in Texas, rising from 6 nests in 1996 to 42 in 2004, to a record high of 353 nests in 2017 (National Park Service data, http://www.nps.gov/pais/naturescience/strp.htm, http://www.nps.gov/pais/naturescience/current-season.htm). It is worth noting that nesting in Texas has paralleled the trends observed in Mexico, characterized by a significant decline in 2010, followed by a second decline in 2013-2014, but with a rebound in 2015-2017.

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

We believe this long-term increasing trend in nesting is evidence of an increasing population, as well as a population that is maintaining (and potentially increasing) its genetic diversity. We believe these nesting trends are indicative of a species with a high number of sexually mature individuals. Since the abundance trend information is clearly increasing, we believe the potential lethal take of 8 Kemp's ridley sea turtles over the 50-year life of the project attributed to the proposed action will not have any measurable effect on that trend. After analyzing the magnitude of the effects of the proposed action, in combination with the past, present, and future expected impacts to the DPS discussed in this Opinion, we believe the proposed action is not reasonably expected to cause an appreciable reduction in the likelihood of survival of Kemp's ridley sea turtles in the wild.

8.2.2 Recovery

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

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

The recovery plan states the average number of nests per female is 2.5; it sets a recovery goal of 10,000 nesting females associated with 25,000 nests. The 2012 nesting season recorded approximately 22,000 nests. Yet, in 2013 through 2014, there was a second significant decline, with only 16,385 and 11,279 nests recorded, respectively, which would equate to 6,554 nesting females in 2013 (16,385 / 2.5) and 4,512 in 2014 (11,279 / 2.5). Nest counts increased in the last three years, but they did not reach 25,000 by 2017; however, it is clear that the population has increased over the last 2 decades. The increase in Kemp's ridley sea turtle nesting is likely due to a combination of management measures including elimination of direct harvest, nest protection, the use of TEDs, reduced trawling effort in Mexico and the United States, and possibly other changes in vital rates (TEWG 1998a; TEWG 2000).

The lethal take of up to 8 Kemp's ridley sea turtles over the 50-year life of the project will result in a reduction in numbers and reproduction, but it is unlikely to have any detectable influence on the nesting trends noted above. Given a nesting population in the thousands, the projected loss is not expected to have any discernable impact to the species.

8.2.3 Conclusion

The lethal take of 8 Kemp's ridley sea turtles associated with the proposed action are not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of Kemp's ridley sea turtle in the wild. We do not expect any Kemps' ridley sea turtles to be captured via relocation trawling based on the best available data.

8.3 Loggerhead Sea Turtle (NWA DPS)

The proposed action may result in the take of 77 loggerhead sea turtles from the NWA DPS over the 50-year life of the project (30 non-lethal [from relocation trawling], 47 lethal [46 from hopper dredging, 1 from relocation trawling]).

8.3.1 Survival

Generally, we assume that one clutch of eggs (one nest) is lost for each adult female that is relocated during nesting season; however, hopper dredging (and thus, relocation trawling) will avoid the North Carolina sea turtle nesting and hatching season. Thus, the potential non-lethal relocation of 30 loggerhead sea turtles from the NWA DPS over the 50-year life of the project is not expected to have any measurable impact on the overall population and reproduction due to the potential loss of clutches. Sea turtles captured in the trawling efforts will be released in nearby areas soon after capture. Interactions with vessels and/or relocation trawlers may elicit startle or avoidance responses and the effects of the proposed action may result in temporary changes in behavior of sea turtles (minutes to hours) over small areas, but are not expected to change the distribution of any sea turtles in the action area. The lack of any lasting impact to animals encountered in relocation trawls indicates that the activity is not likely to have any effect on the species' reproduction or population numbers. Additionally, given the wide spread distribution of loggerhead sea turtles, and the fact that these animals have large ranges, the capture and release of sea turtles in nearby areas is not expected to have any effect on loggerhead sea turtle (NWA DPS) distribution.

The lethal take of 47 loggerhead sea turtles over the 50-year life of the project (46 by hopper dredging, 1 by relocation trawling) is a reduction in numbers. A lethal take could also result in a potential reduction in future reproduction, assuming the individual would be female and would have survived to reproduce in the future. For example, an adult female loggerhead sea turtle can lay approximately 4 clutches of eggs every 3 years, with 100-126 eggs per clutch. Thus, the loss of 1 adult female could preclude the production of thousands of eggs and hatchlings of which a small percentage would be expected to survive to sexual maturity. To be conservative, we assume that all the loggerhead sea turtles that will be taken by hopper dredge will be adult females, with a higher potential impact on the species relative to take of other stages. However, a reduction in the distribution of loggerhead sea turtles is not expected from lethal takes attributed to the proposed action. The anticipated lethal take is expected to occur in a discrete action area (i.e., where hopper dredging will be occurring) and loggerhead sea turtles in the NWA DPS generally have large ranges; thus, no reduction in the distribution is expected from the take of these individuals.

Whether or not the reductions in loggerhead sea turtle numbers and reproduction attributed to the proposed action would appreciably reduce the likelihood of survival depends on what effect these reductions in numbers and reproduction would have on overall population sizes and trends (i.e., whether the estimated reductions, when viewed within the context of the environmental baseline and status of the species, are of such an extent that adverse effects on population dynamics are appreciable). In Section 4.2.1c, we reviewed the status of this species in terms of nesting and female population trends and several recent assessments based on population modeling (i.e., Conant et al. 2009b; NMFS-SEFSC 2009b). Below we synthesize what that information means both in general terms and the more specific context of the proposed action.

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

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

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

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

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

The proposed action could lethally take 47 loggerhead sea turtles over the 50-year life of the project. We do not expect this loss to result in a detectable change to the population numbers or increasing trends. The non-lethal capture of 30 loggerhead sea turtles over the 50-year life of the project would not affect the adult female nesting population or number of nests per nesting season, particularly because the proposed action will occur outside of sea turtle nesting season. After analyzing the magnitude of the effects of the proposed action, in combination with the past, present, and future expected impacts to the DPS discussed in this Opinion, we believe the proposed action is not reasonably expected to cause an appreciable reduction in the likelihood of survival of the loggerhead sea turtle NWA DPS in the wild.

8.3.2 Recovery

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

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

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

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

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

Nesting trends have been increasing over several years. As noted previously, we believe the future takes predicted will be similar to the levels of take that has occurred in the past and those past takes did not impede the positive trends we are currently seeing in nesting during that time. We also indicated that the lethal take of 47 loggerhead sea turtles over the 50-year life of the project is so small in relation to the overall population, that it would not impede achieving recovery objectives, even when considered in the context of the Status of the Species, the Environmental Baseline, and Cumulative Effects discussed in this Opinion. We believe this is true for both nesting and juvenile in-water populations. For these reasons, we do not believe the proposed action will impede achieving the recovery objectives or overall recovery strategy.

8.3.3 Conclusion

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

8.4 Atlantic Sturgeon (All 5 DPSs)

Five DPSs of Atlantic sturgeon are listed under the ESA, 4 as endangered and 1 as threatened. Because Atlantic sturgeon mix extensively in the marine waters, individuals from all 5 DPSs could occur in action area. The proposed action may result in the take of 869 Atlantic sturgeon from any DPS over the 50-year life of the project (847 non-lethal from relocation trawling and 22 lethal from hopper dredging).

Because subadult and adult Atlantic sturgeon mix extensively in the marine and estuarine environments, individuals from all 5 Atlantic sturgeon DPSs could occur within the action area. Therefore, we must determine from which DPSs the takes will occur. Unfortunately, data is quite limited regarding the distributions of Atlantic sturgeon DPSs when mixed in marine or estuarine waters. To date, there is only 1 report available which examines the distributions of the individual DPSs in offshore environments – NMFS's Greater Atlantic Regional Fisheries Office (GARFO) PRD's Mixed Stock Analysis (MSA) (Damon-Randall et al. 2013). The report is an analysis of the composition of Atlantic sturgeon stocks along the East Coast, using tag-recapture data and genetic samples that identify captured fish back to their DPS of origin. Atlantic sturgeon can be assigned to their DPS based on genetic analyses with 92-96% accuracy (ASSRT and NMFS 2007), though some fish used in the MSA could not be assigned to a DPS. Data from NEFOP and the At Sea Monitoring (ASM) programs were used in the MSA to determine the percentage of fish from each of the DPSs at the selected locations along the coast. This report is the best available information, and we will use this to assign the Atlantic sturgeon takes to the 5

DPSs.

Damon-Randall et al. (2013) reported the composition of Atlantic sturgeon residing in the Carolinian marine ecoregion, which extends from Cape Hatteras, North Carolina, south to Cape Canaveral, Florida (http://www.marineregions.org/gazetteer.php?p=details&id=22003), as 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 is 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 in this Opinion. Removing the contribution of those fish means that the average composition numbers below do not sum to 100; however, it does not change our analysis because the percentage contribution of that population is negligible.

Table 18 shows the breakdown of anticipated lethal take by DPS over the 50-year life of the project given the above percent compositions in the Carolinian marine ecoregion.

Table 18. Anticipated Take by DPS Over the 50-year Life of the Project

DPS	Total Anticipated Lethal Take (All DPSs combined)	Percent Composition in Carolinian Marine Ecoregion	Take by DPS (rounded up to nearest whole number)
South Atlantic	22	22%	5
Carolina	22	2%	1
Chesapeake Bay	22	13%	3
New York Bight	22	51%	12
Gulf of Maine	22	11%	3

8.4.1 Survival

A conservative approach assumes that all lethal captures would occur in any one year of the 50-year project. A worst-case scenario assumes all lethal capture would occur in the first year of the 50-year project. Thus, if all lethal captures happened in the first year, the reduction in the total population of each DPS would range from 0.03% to 0.07% (Table 19).

Table 19. Percentage of Take by DPS for the Ocean Population of Atlantic Sturgeon Assuming the Total Lethal Take in Any 1 Year

DPS	Anticipated Lethal Take by DPS	Estimated Ocean Population Abundance (from Table 9)	Take of Total Population (%)
South Atlantic	5	14,911	0.03
Carolina	1	1,356	0.07
Chesapeake Bay	5	8,811	0.03
New York Bight	12	34,566	0.03
Gulf of Maine	3	7,455	0.04

All of these values are far below the estimated 5% mortality rate Boreman (1997) believed a sturgeon population could likely withstand annually and not decline. Therefore, although the potential lethal take of Atlantic sturgeon in any 1 year (as stated in Table 18 & 19) will cause a reduction in numbers of each of the DPSs, we do not believe this reduction will appreciably reduce the likelihood that any of the 5 DPSs will survive in the wild.

For each of the 5 DPSs to remain stable over generations, a certain amount of spawning must occur to offset the deaths within the population. We measure spawning potential in 2 ways: spawning stock biomass per recruit (SSB/R) and eggs per recruit (EPR). EPR_{max} refers to the maximum number of eggs produced by a female Atlantic sturgeon over the course of its lifetime assuming no fishing mortality. Similarly, SSB/R_{max} is the expected contribution an adult individual 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 an adult individual 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. Since the EPR_{max} or SSB/R_{max} for each adult 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) suggested 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) indicated that since stock biomass and egg production are typically linearly correlated (i.e., larger females generally produce more eggs than smaller females) 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 maintain an EPR of at least 20% of EPR_{max} (i.e., to remain stable). We believe evaluating the total lethal take of the proposed action against the fishing mortality associated with maintaining an EPR of at least 20% of EPR_{max} (i.e., fishing mortality = 14%) is the appropriate approach for evaluating the potential impacts of the proposed action on the likelihood any of the DPSs will survive in the wild. For this analysis, we assume that all the Atlantic sturgeon that will be lethally taken by hopper dredge will be spawning adults, which has a higher potential for impact on the population relative to take of other stages. While this assumption is highly unlikely, it is the approach most conservative to each of the DPSs. Thus, if all lethal captures happened in any one year, the reduction in the population of spawning adults in each DPS would range from 0.16% to 0.29% (Table 20).

Table 20. Percentage of Lethal Take by DPS for the Ocean Population of Adult Atlantic Sturgeon Assuming the Total Lethal Take in Any 1 Year

DPS	Anticipated Lethal Take by DPS	Estimated Ocean Population of Adults (from Table 9)	Take of Adult Population (%)
South Atlantic	5	3,728	0.13
Carolina	1	339	0.29
Chesapeake Bay	5	2,203	0.14
New York Bight	12	8,642	0.14
Gulf of Maine	3	1,864	0.16

All of these values are far below the 14% fishing mortality threshold suggested by Boreman (1997) that would allow a population to remain stable. Additionally, the anticipated lethal take of Atlantic sturgeon associated with the proposed action, over the 50-year life of the project, is expected to occur in a discrete action area in the marine environment (i.e., where hopper dredging will be occurring) where all DPSs mix extensively. Because Atlantic sturgeon generally have large ranges, no reduction in the distribution of any of the DPSs is expected from the lethal take of these individuals. Therefore, although the potential lethal take Atlantic sturgeon associated with the proposed action will cause a reduction in numbers of reproducing individuals in that DPS, we do not believe this reduction will appreciably reduce the likelihood that any of the 5 DPSs will survive in the wild. The non-lethal take of 847 Atlantic sturgeon by relocation trawling is not expected to have any measurable impact on the reproduction, numbers, or distribution of animals from any of the 5 DPSs because the individuals captured and released are expected to fully recover, and individuals will be released in proximity to where they were captured. We therefore believe the proposed action is not reasonably expected to cause an appreciable reduction in the likelihood of survival of any of the 5 DPSs in the wild.

8.4.2 Recovery

A recovery plan for Atlantic sturgeon has not yet been developed any DPS; however, the first step in recovering a species is to reduce identified threats; only by alleviating threats can lasting recovery be achieved. An increase in the population to a size that maintains a steady recruitment of individuals representing all life stages would provide population stability and enable the population to sustain itself even in the event of unforeseen and unavoidable impacts. The major threats affecting the 5 Atlantic sturgeon DPSs were summarized in the final listing rules and include: dams, dredging, water quality, climate change, and overutilization for commercial purposes. While the proposed action includes dredging, which is considered one of the major threats to Atlantic sturgeon, we believe relocation trawling will reduce the overall level of lethal take associated with the proposed project, providing clear conservation benefit to the species when compared to hopper dredging without relocation trawling. We do not believe the proposed action will affect the recovery of any Atlantic sturgeon DPS, by exacerbating effects of any of the major threats identified in the final listing rules. The lethal take of Atlantic sturgeon over the 50-year life of the project is not likely to appreciably reduce population numbers of any DPS over time due to current population sizes and expected recruitment. Therefore, we conclude the proposed action will not appreciably diminish the likelihood of recovery for any of the 5 DPSs of Atlantic sturgeon.

8.4.2 Conclusion

The lethal and nonlethal take of Atlantic sturgeon associated with the proposed action is not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of any of the 5 Atlantic sturgeon DPSs in the wild.

9 CONCLUSION

Using the best available data, we analyzed the effects of the proposed action in the context of the status of the species, the environmental baseline, and cumulative effects and we determined that the proposed action is not likely to jeopardize the continued existence of green sea turtle (NA or SA DPS), loggerhead sea turtle (NWA DPS), and Atlantic sturgeon (all 5 DPSs). These analyses focused on the impacts to, and population responses of, these species. Because the proposed action will not appreciably reduce the likelihood of survival and recovery of these species, it is our Opinion that the proposed action is also not likely to jeopardize the continued existence of any of these species.

10 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulation pursuant to Section 4(d) of the ESA prohibit take of endangered and threatened species, respectively, without special exemption. *Take* is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. *Incidental take* is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement (ITS). NMFS must estimate the extent of take expected to occur from implementation of the proposed action to frame the limits of the take exemption provided in the Incidental Take Statement. These limits set thresholds that, if exceeded, would be the basis for reinitiating consultation. Per the Terms and Conditions, the USACE will notify NMFS when 75% of any of the observed 50-year take limits are reached to discuss if reinitiation is necessary. The following section describes the extent of take that NMFS anticipates will occur as a result of the proposed action.

NMFS anticipates the total lethal take (observed plus unobserved) over the 50-year life of the project will consist of up to 6 green sea turtles (NA and SA DPSs combined) (6 from hopper dredging, 0 from relocation trawling), 8 Kemp’s ridley sea turtles (8 from hopper dredging, 0 from relocation trawling), 47 loggerhead sea turtles (NWA DPS) (46 from hopper dredging and 1 from relocation trawl), and 22 Atlantic sturgeon (All 5 DPSs combined) (from hopper dredging). NMFS also anticipates the non-lethal incidental take, by relocation trawling, of up to 30 loggerhead sea turtles and 847 Atlantic sturgeon over the 50-year life of the project. Based on the best available data, we do not anticipate any non-lethal take of green or Kemp’s ridley sea turtles.

As discussed above, we believe only half of the takes associated with hopper dredging will be observed because unexploded ordinance screens will not be used. Therefore, take exceedance shall be accounted for based on observed takes. We believe all the lethal and non-lethal takes associated with relocation trawling will be observed. The ITS statement for the 50-year life of the project is located in Table 21.

Table 21. Incidental Take Statement over the 50-Year Life of the Project

Species	Observed Lethal Take	Observed Non-lethal Take
Green sea turtle (NA and SA DPSs combined)	3 (all hopper dredging)	0
Kemp's ridley sea turtle	4 (all hopper dredging)	0
Loggerhead sea turtle (NWA DPS)	24 (23 hopper dredging, 1 relocation trawl)	30 (all relocation trawling)
Atlantic sturgeon (All 5 DPSs combined)	11 (all hopper dredging)	847 (all relocation trawling)

11 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 reasonable and prudent measures (RPMs) necessary to minimize the impacts of take and the terms and conditions (T&Cs) to implement those measures, must be provided and must be followed to minimize those impacts. Only incidental take by the federal agency that complies with the specified T&Cs is authorized.

The RPMs and T&Cs 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 RPMs and T&Cs are nondiscretionary, and must be implemented by the USACE and BOEM in order for the protection of Section 7(o)(2) to apply. The USACE and BOEM have a continuing duty to regulate the activity covered by this incidental take statement. If the USACE or BOEM fail to adhere to the T&Cs through enforceable terms, and/or fails to retain oversight to ensure compliance with these T&Cs, the protective coverage of Section 7(o)(2) may lapse.

NMFS has determined that the following RPMs must be implemented by the USACE and BOEM (directly or through mandatory conditions of its authorization for the action):

1. The USACE and BOEM will have measures in place to monitor and report all interactions with any protected species resulting from the proposed action.

2. Relocation trawling will be employed when water temperatures exceed 57°F (13.8°C) beginning 24 hours prior to hopper dredging. Regardless of water temperature, if 1 sea turtle or sturgeon species is taken by a hopper dredge, trawlers will mobilize within 72 hours and 24-hour trawling will commence. If a second sea turtle or sturgeon species is taken during the 72-hour mobilization period, dredging will cease until relocation trawling can begin. The

applicant may choose to employ relocation trawling prior to meeting the temperature or take trigger; however, voluntary relocation trawling does not change the number of allowable take in this Opinion.

3. The USACE and BOEM shall implement best management practices, including the use sea turtle deflector dragheads, intake, and overflow screening to reduce the risk of injury or mortality of listed species and lessen the number of sea turtles killed by the proposed action.

4. The USACE and BOEM will require NMFS-approved observers to monitor dredged material inflow and overflow screening baskets on the hopper dredge.

12 TERMS AND CONDITIONS

In order to be exempt from the prohibitions of Section 9 of the ESA, the USACE, BOEM, and/or the County are required to comply with the T&Cs that implement the RPMs. The following T&Cs are nondiscretionary. The USACE and BOEM shall condition the County to require the following terms and conditions to minimize the effects of take on green sea turtle, Kemps' ridley sea turtle, loggerhead sea turtle, and Atlantic sturgeon:

1. An annual project report summarizing the results of the dredging, the relocation trawling (if any), and the take (if any) must be submitted to NMFS within 30 working days of completion of that year's activities (RPM 1).

    a. Annual reports shall contain information on project location, start-up and completion dates, cubic yards of material dredged, problems encountered, incidental takes (include photographs, if available), sightings of protected species, mitigating actions taken (if relocation trawling, the total number of tows, location of capture/release, and number and species of turtles and sturgeon relocated), screening type (inflow, overflow) utilized, daily water temperatures, name of dredge, names of endangered species observers, percent observer coverage, and any other information the USACE, BOEM, and/or contractor deems relevant. This report must reference the present Opinion by NMFS identifier number (SER-2017-18882), title (Bogue Banks Master Beach Nourishment Plan), and issuance date, and be provided to NMFS's Protected Resources Division at: takereport.nmfsser@noaa.gov.

    b. Information regarding all USACE hopper dredging and relocation trawling contained in the annual report will be uploaded to the USACE's Operations and Dredging Endangered Species System (ODESS).

2. Due to the longevity of the proposed action, the USACE and BOEM shall notify NMFS when 75% of any of the species take limits in Table 21 (i.e., observed lethal or non-lethal) are reached to discuss whether reinitiation might be necessary.

3. The USACE and BOEM project manager 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 ask to be notified of any sea turtle or sturgeon stranding in the project area that, in the estimation of the STSSN personnel, bear signs of potential draghead impingement or entrainment. Information on any such stranding shall be reported in writing within 30 working days of completion of that year's activities to NMFS's Southeast Regional Office (address provided in RPM No. 1 above), or included in the project report (RPM 1).

4. If/when relocation trawling in triggered, all non-lethal relocation trawl take reports shall be submitted to NMFS weekly at: takereport.nmfsser@noaa.gov. All lethal take reports shall be submitted within 24 hours (RPM 2) to the same address. These reports shall reference the present Opinion by NMFS identifier number (SER-2017-18882), title (Bogue Banks Master Beach Nourishment Plan), and issuance date.

5. The following conditions must be observed during relocation trawling (RPM 2, following minimization measure 3.1.4f):

   c. *Trawl Time.* Trawl tow-time duration shall not exceed 42 minutes (doors in-doors out) and trawl speeds shall not exceed 3.5 kn.

   d. *Handling During Trawling.* Sea turtles captured pursuant to relocation trawling shall be handled in a manner designed to ensure their safety and viability by implementing the measures below. See Appendix 2: Requirements for Handling Incidentally Taken Sturgeon and Collecting Genetic Samples for sturgeon-specific conditions. Use Appendix 3: Sturgeon Genetic Sample Submission Sheet when recording data for any sturgeon capture via relocation trawling.

      i. *Holding Conditions.* Captured sea turtles shall be kept moist, and shaded whenever possible, until they are released. They may be held for up to 24 hours if opportunistic, ancillary, "piggy-back" data gathering (e.g., opportunistic satellite tagging) is proposed. This Opinion provides the authority to NMFS-approved observers to satellite tag captured sea turtles.

      ii. *Measurements, Sampling, and Tagging.* This Opinion serves as the permitting authority for any NMFS-approved endangered species observers aboard relocation trawlers or hopper dredge to weigh, measure, collect a tissue sample, and tag captured sea turtles and sturgeon without the need for an ESA Section 10 permit. Only NMFS-approved observers or observer candidates in training under the direct supervision of a NMFS-approved observer shall conduct the measuring/weighing/tissue sampling/tagging operations.

         1. <u>Measurements.</u> All sea turtles shall be measured (standard carapace measurements including body depth) and weighed prior to release when safely possible.

         2. <u>Tissue Sampling.</u> All sea turtles captured by relocation trawling shall be tissue-sampled prior to release, according to the protocols described in the October 29, 1997, SARBO, as revised through Revision No. 2. Tissue samples shall be sent

within 60 days of capture to: NOAA, National Marine Fisheries Service, Southeast Fisheries Science Center, Attn: Lisa Belskis, 75 Virginia Beach Drive, Miami, Florida 33149. All data collected shall be submitted in electronic format within 60 working days to Lisa Belskis at the following email address: Lisa.Belskis@noaa.gov. A copy of the Protected Species Incidental Take Form should accompany the sample.

3. Tagging. All sea turtles captured by relocation trawling shall be flipper-tagged prior to release with external tags that shall be obtained prior to the project from the University of Florida's Archie Carr Center for Sea Turtle Research. Columbus crabs or other organisms living on external sea turtle surfaces may also be sampled and removed under this authority. All sea turtles captured by relocation trawling or dredges shall be thoroughly scanned for the presence of passive integrated transponder (PIT) tags prior to release using a scanner powerful enough to read dual frequencies (125 and 134 kilohertz) and read tags deeply embedded deep in muscle tissue (e.g., manufactured by Biomark or Avid). Sea turtles which have been previously PIT tagged shall nevertheless be externally flipper-tagged. PIT-tagging may only be conducted by observers with PIT-tagging training or experience. The 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 data collected shall be submitted in electronic format within 60 working days to Lisa Belskis at the following email address: Lisa.Belskis@noaa.gov. All data generated and samples 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.

iii. *Take and Release Time During Trawling.* Sea turtles shall be kept no longer than 24 hours prior to release and shall be released not less than 3 nmi from the dredge site. Recaptured turtles shall be released not less than 5 nmi away 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). If it can be done safely, turtles may be transferred onto another vessel for transport to the release area to enable the relocation trawler to keep sweeping the dredge site without interruption.

iv. *Injuries and Incidental Take Quota.* Any protected species injured or killed in federal or state waters during or as a consequence of relocation trawling shall count toward the incidental take quota. Minor skin abrasions resulting from trawl capture are considered non-injurious. Injured sea turtles shall be immediately transported by Carteret County or its contractor at its own expense to the nearest sea turtle rehabilitation facility; all rehabilitation costs and sea turtle transportation costs shall be borne by Carteret County or its contractor. If it is determined that the turtle cannot be released, NMFS and the rehabilitation facility will determine the best course of action along with a cost estimate for continued care.

6. For the proposed action, 100% shipboard observer monitoring of inflow screens is required year-round. If conditions disallow 100% inflow screening, inflow screening can be reduced gradually. But effective, 100% overflow screening is then required, and an explanation must be included in the annual project report, and NMFS notified beforehand.

   If the dredge is not using UXO screening, then the hopper's inflow screens should initially have 4-in by 4-in screening, for effective screening and capture of entrained protected species body parts. NMFS believes this is workable for sand mining operations where a minimum of debris is expected to be encountered. However, if the USACE or BOEM, in consultation with observers and the draghead operator, determine that the draghead is clogging and reducing production substantially, the mesh size may be increased after prior consultation with and approval by NMFS, to 8-in by 8-in; if this still clogs, then 16-in by 16-in openings. NMFS believes that this flexible, graduated-screen option is prudent since the need to constantly clear the inflow screens will increase the time it takes to complete the project; therefore, it will increase the exposure of sea turtles and sturgeon to the risk of impingement or entrainment. Inflow screen clogging should be greatly reduced with these flexible options; however, further clogging (e.g., as when encountering heavy clay or debris) may compel removal of the inflow screening altogether, in which case *effective* 100% overflow screening is mandatory.

   The USACE and BOEM shall notify and get approval from NMFS *beforehand* if inflow screening is going to be reduced or eliminated, and provide details of how effective overflow screening will be achieved. NMFS, in consultation with the dredging company, the USACE, and BOEM, shall determine what constitutes effective overflow screening (RPM 3).

7. The USACE and BOEM will require the use of rigid sea turtle deflectors on all hopper dragheads. The hopper dredge's sea turtle deflector draghead is to be inspected prior to startup of hopper dredging operations. In addition, the USACE and BOEM shall ensure that all contracted personnel involved in operating hopper dredges receive thorough training on measures of dredge operation that will minimize sea turtle and sturgeon take (RPM 3, following minimization measure 3.1.4e).

8. The USACE and BOEM shall arrange for NMFS-approved protected species observers to be aboard the hopper dredge to monitor the hopper bin, screening, and dragheads for sea turtles, sturgeon, and their remains. For the proposed action, 100% observer monitoring is required. Beach observers cannot be used in place of shipboard observers for hopper dredging of borrow areas (RPM 4, following minimization measure 3.1.4d).

9. The USACE and BOEM shall arrange for NMFS-approved protected species observers to maintain watch on the bridge of all hopper dredges and relocation trawlers for protected species and keep a logbook noting the date, time, location, species, number of animals, distance and bearing from dredge, direction of travel, and other information, for all sightings when the dredge vessel is transiting (following minimization measure 3.1.4d). NMFS-protected species observer sighting reports shall be included in the annual project summary report (T&C 1).

13 CONSERVATION RECOMMENDATIONS

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

NMFS believes the following conservation recommendations further the conservation of listed sea turtle species and sturgeon. NMFS strongly recommends that these measures be considered and implemented, and requests to be notified of their implementation.

1. To the extent practicable, the USACE and BOEM should schedule dredging operations at times of year when listed species are least likely to be present in the borrow areas.

2. Whenever possible, the USACE and BOEM should outfit any hopper dredge with a rigid deflector draghead as designed by the USACE Engineering Research and Development Center. Or if that is unavailable, a rigid sea turtle deflector should be attached to the draghead.

3. To the extent practicable, the USACE and BOEM should minimize the use of hopper dredges in favor of cutterhead dredges.

4. The USACE and BOEM should conduct studies in conjunction with cutterhead dredging where disposal occurs on the beach to assess the potential for improved screening to: (1) establish the type and size of biological material that may be entrained in the cutterhead dredge, and (2) verify that monitoring the disposal site without screening is providing an accurate assessment of entrained material.

5. The USACE and BOEM should support studies to determine the effectiveness of using a sea turtle deflector to minimize the potential entrainment of sturgeon during hopper dredging.

6. The USACE and BOEM should explore alternative means for monitoring for interactions with listed species when UXO screening is in place including exploring the potential for video or other electronic monitoring and consider designing pilot studies to test the efficiency of innovative monitoring and screening techniques.

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

14 REINITIATION OF CONSULTATION

This concludes NMFS's formal consultation on the proposed action. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where 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 incidental take is exceeded, (2) new information reveals effects of the agency action on listed species or designated critical habitat in a manner or to an extent not considered in this Opinion, (3) the agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitat not considered in this Opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action. Pursuant to 50 CFR 402.14(i)(5), any taking which is subject to an incidental take statement and which is compliance with the terms and conditions is not a prohibited taking under the ESA.

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