Endangered Species Act - Section 7 Consultation
Biological Opinion

Action Agency:	National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, Operations, Management, and Information Services Division; National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center; United States Fish and Wildlife Service
Activity:	Continued Authorization and Implementation of National Marine Fisheries Service's Integrated Fisheries Independent Monitoring Activities in the Southeast Region (SER-2009-07541)
Consulting Agency:	National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, Protected Species Division
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List of Frequently Used Acronyms

ACE	Ashepoo, Combahee, and Edisto Rivers Basin
ACFCMA	Atlantic Coastal Fisheries Cooperative Management Act
AFCA	Anadromous Fish Conservation Act
ASMFC	Atlantic States Marine Fisheries Commission
ASSRT	Atlantic Sturgeon Status Review Team
BOEM	Bureau of Ocean Energy Management
BSEE	Bureau of Safety and Environmental Enforcement
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CPUE	Catch Per Unit Effort
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DO	Dissolved Oxygen
DoD	Department of Defense
DPS	Distinct Population Segment
DWH	Deepwater Horizon
EEZ	Exclusive Economic Zone
ESA	Endangered Species Act
F/SER1	NMFS - Southeast Regional Office - Operations, Management, and Information Services Division
F/SER3	NMFS - Southeast Regional Office - Protected Resources Division
FERC	Federal Energy Regulatory Commission
FFWCC	Florida Fish and Wildlife Conservation Commission
FIM	Fisheries Independent Monitoring
FMP	Fishery Management Plan
FWRI	Florida Wildlife Research Institute
GADNR	Georgia Department of Natural Resources
GARFO-PRD	Greater Atlantic Regional Fisheries Office-Protected Resources Division
HMS	Highly Migratory Species
IJA	Interjurisdictional Fisheries Act
ISED	International Sawfish Encounter Database
ITS	Incidental Take Statement
MARMAP	Marine Resources Monitoring, Assessment, and Prediction
MMPA	Marine Mammal Protection Act
MRFSS	Marine Recreational Fishery Statistical Survey
NCDMF	North Carolina Division of Marine Fisheries
NEFOP	Northeast Fisheries Observer Program
NEFSC	Northeast Fisheries Science Center
NER	Northeast Regional Office
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NWA DPS	Northwest Atlantic Distinct Population Segment

PAH	Polychlorinated aromatic hydrocarbons
PSIGS	Pamlico Sound Independent Gillnet Survey
PCB	Polychlorinated biphenyls
ROV	Remotely Operated Vehicle
RPMs	Reasonable and Prudent Measures
SCDNR	South Carolina Department of Natural Resources
SCL	Straight Carapace Length
SEAMAP	Southeast Area Monitoring and Assessment Program
SEFSC	Southeast Fisheries Science Center
SER	Southeast Regional Office
SRP	Scientific Research Permit
STSSN	Sea Turtle Stranding and Salvage Network
T/C	Terms and Conditions
TED	Turtle Excluder Device
TCDD	Tetrachlorodibenzo-p-dioxin
TEWG	Turtle Expert Working Group
TPWD	Texas Parks and Wildlife Department
USACE	United States Army Corps of Engineers
YOY	Young-of-the-Year
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
USN	United States Navy
USVI	United States Virgin Islands
VTR	Vessel Trip Reports

1.0 Introduction

Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. § 1531 et seq.), requires each federal agency to ensure any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of any critical habitat of such species. When the action of a federal agency may affect an ESA-listed 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.

The action agency consults with NMFS on most listed marine species and their critical habitat. These consultations are concluded after NMFS has determined that an action is not likely to adversely affect listed species or designated critical habitat, or issues a Biological Opinion ("Opinion") evaluating whether the proposed action is likely to jeopardize the continued existence of a listed species, or destroy or adversely modify any critical habitat. If jeopardy or destruction or adverse modification is found to be likely, NMFS must identify reasonable and prudent alternatives to the action, if any, that would avoid jeopardizing any listed species and avoid destruction or adverse modification of any designated critical habitat. The Opinion establishes an incidental take statement (ITS) specifying the amount or extent of incidental take of the listed species that may occur, reasonable and prudent measures (RPMs) to reduce the effect of take, and may recommend conservation measures to further conserve the species. Notably, no incidental destruction or adverse modification of critical habitat can be authorized. Thus, there are no RPMs for critical habitat, only reasonable and prudent alternatives that must avoid destruction and adverse modification.

Each year the Southeast Fisheries Science Center (SEFSC) (F/SEC), state resource management agencies, USFWS, and academic institutions receive funding support from NMFS to collect fisheries independent data. This suite of independent but related activities collectively makes up NMFS's integrated fisheries independent monitoring (FIM) activities in the Southeast Region. A limited amount of incidental take of ESA-listed species has occurred during these FIM projects in the past. Previously, incidental takes occurring during FIM activities were either unauthorized or covered under ESA Section l0(a)(l)(A) permits if the principal investigators had one. However, policy changes within NMFS no longer allow such incidental takes to be covered under Section 10(a)(l)(A) permits. These permits authorize scientific research, including the directed capture of protected species, solely for studying ESA-listed species, not for the taking of listed species incidental to an otherwise lawful activity. Fishing conducted as part of NMFS's integrated FIM activities does not target ESA-listed species and is not scientific research on listed species.

FIM conducted by SEFSC is an action implemented by a federal agency subject to Section 7 consultation. NMFS's funding of FIM conducted by state resource management agencies, USFWS, and academic institutions is an action funded by a federal agency and is also subject to Section 7 consultation. The award conditions for all

NMFS-approved funding requests require the recipient to obtain all necessary permits and comply with other applicable law before the funded activity begins. However, in many of these cases the award of funds is the only federal action and the only opportunity for a project to receive Section 7 review. In accordance with Section 7 of the ESA, this document analyzes the effects to threatened and endangered species and designated critical habitat from FIM activities conducted directly by the SEFSC, as well as the federally-funded FIM activities carried out by state resource management agencies, USFWS, and academic institutions. This document constitutes NMFS's Opinion on the effects of NMFS's current integrated FIM activities in the Southeast Region. For the purposes of this consultation, National Oceanic and Atmospheric Administration (NOAA), NMFS, Southeast Regional Office (SER), Operations, Management, and Information Services Division (F/SER1); USFWS; and SEFSC are considered the action agencies and the consulting agency is NOAA/NMFS/SER, Protected Species Division (F/SER3). SEFSC and NMFS's Office of Protected Resources are also developing a separate but related Programmatic Environmental Assessment (PEA) to evaluate the effects of federally-funded FIM activities under the National Environmental Policy Act (NEPA).

This Opinion is based on information provided in the following: project descriptions submitted by state resource management agencies and the SEFSC; sea turtle recovery plans; past and current sea turtle research and population modeling efforts; information provided by researchers on adverse effects to ESA-listed species; smalltooth sawfish encounter database entries; the *Acropora* status review document (NMFS 2005a) and recovery plans; ESA-listed coral density estimates (Clark et al. 2015a; Clark et al. 2015b; Miller et al. 2007) past and current Atlantic, Gulf, and shortnose sturgeon research; the status review for the Central and Southwest Atlantic DPS of scalloped hammerhead shark (Miller et al. 2014) and other relevant scientific data and reports; consultation with NOAA research staff; and previous Opinions on other fisheries.

2.0 Description of the Proposed Action

FIM is a broad approach to evaluating marine communities and the species that comprise them. FIM also investigates habitat conditions for purposes of learning more about system-wide trends. FIM data are collected using statistically valid sampling techniques to supplement fisheries-dependent information obtained from anglers and commercial fishing operations. A variety of fishing gears and techniques ensure sampling of fisheries resources in a wide range of sizes and ages. Data collected includes species, size, sex, and number of individuals per species caught.

In previous Opinions on the continued authorization of federal fisheries (discussed in subsequent sections) the potential effects to listed species from the issuance of a limited number of scientific research permits (SRPs) to conduct FIM activities were analyzed. The proposed SRPs usually involved fishing by research vessels using fishing methods similar or identical to those used in the fishery being analyzed. In these cases, the types of adverse effects from fishing under an SRP were anticipated to be very similar or identical to the types of adverse effects occurring during commercial/recreational fishing,

and the magnitude of takes during fishing under an SRP were predicted to be a very small fraction of the take by the analogous fishery. As a result, any takes occurring under a particular SRP were covered by and counted against the take level authorized by the ITS issued for the appropriate fishery. For example, the effects of fishing under an SRP issued to collect reef fish in the Gulf of Mexico were considered likely be similar to those analyzed in the Opinion on the Gulf of Mexico reef fish fishery. In the past, any takes occurring during fishing under that SRP were counted against the ITS issued for the Gulf of Mexico reef fish fishery.

Given its scope and purpose, this Opinion is the most appropriate place to evaluate and monitor the impact to ESA-listed species from fishing associated with future research, and by extension, future SRPs. Biological Opinions on the following federal fisheries have included language to address the issuance of SRPs: Gulf of Mexico reef fish fishery; highly migratory species (HMS) pelagic longline fishery; HMS Atlantic shark and smoothhound fisheries; Caribbean spiny lobster fishery; Caribbean reef fish fishery; coastal migratory pelagics fishery; South Atlantic snapper-grouper fishery; and Gulf of Mexico/South Atlantic spiny lobster fishery. To avoid redundancy and potential confusion, this Opinion will supersede the above Opinions with regard to effects from any incidental take of ESA-listed species occurring during scientific research associated with those fisheries. This Opinion has no impact on any other portion of those Biological Opinions or the determination made therein. This Opinion directly addresses the potential effects from the fisheries-independent monitoring/research activities described in the subsequent sections. Any project not described below will require its own consultation to evaluate its potential impacts to listed species.

2.1 Authorities Under Which NMFS Supports FIM Projects

NMFS often seeks partnerships with state resource management agencies and academic institutions to increase its capacity to collect fisheries independent data. Authority to fund FIM projects comes from several different statutes, each with a different mandate. The following sections briefly describe the programs established under these authorities, or the types of research each Act supports.

Southeast Area Monitoring and Assessment Program (SEAMAP)
SEAMAP is a state/federal program designed to collect, manage, and disseminate fishery-independent data in the southeastern United States, authorized by the Fish and Wildlife Act. Three components currently collaborate with NMFS: SEAMAP-Gulf, SEAMAP-South Atlantic, and SEAMAP-Caribbean. Each component operates independently, planning and conducting surveys and disseminating information in accordance with cooperatively established administrative policies and guidelines. Table 2.1 identifies state/territorial and academic partners in each region.

Table 2.1. State, Territorial, and Academic Partners Conducting SEAMAP FIM Activities

SEAMAP Component	Administering Organization	Participating Agencies
SEAMAP-Gulf of Mexico (GOM)	Gulf States Marine Fisheries Commission	Alabama Department of Conservation and Natural Resources (ADCNR)
		Florida Fish and Wildlife Conservation Commission (FFWCC)
		Louisiana Department of Wildlife and Fisheries (LDWF)
		Mississippi Department of Marine Resources (MDMR)
		University of Southern Mississippi -Gulf Coast Research Laboratory (USM/GCRL)
		Texas Parks and Wildlife Department (TPWD)
		National Marine Fisheries Service/Southeast Fisheries Science Center (NMFS)
SEAMAP-South Atlantic (SA)	Atlantic States Marine Fisheries Commission	Florida Fish and Wildlife Conservation Commission (FFWCC)
		Georgia Department of Natural Resources (GADNR)
		North Carolina Department of Environment and Natural Resources (NCDENR)
		South Carolina Department of Natural Resources (SCDNR)
		Virginia Institute of Marine Science (VIMS)
		National Marine Fisheries Service/Southeast Fisheries Science Center (NMFS)
		U.S. Fish and Wildlife Service (USFWS)
SEAMAP-Caribbean (C)	Puerto Rico Sea Grant College Program	Puerto Rico Department of Natural and Environmental Resources (PR-DNER)
		Puerto Rico Sea Grant College Program
		Virgin Islands Division of Fish and Wildlife (USVI-DFW)
		National Marine Fisheries Service/Southeast Fisheries Science Center (NMFS)
		U.S. Fish and Wildlife Service (USFWS)

Congress has allocated SEAMAP funding since 1983. Support provided by NMFS via SEAMAP is noncompetitive, with funds allocated to the southeastern states for surveys and studies. SEAMAP cooperative agreements are multi-year, but funds are awarded annually. NMFS staff review and evaluate proposals based on technical merit, soundness of design, ability of the applicant to perform the proposed work, potential contribution of the project to national or regional goals, and appropriateness of proposed costs.

Marine Resources Monitoring, Assessment, and Prediction (MARMAP)

The MARMAP program is a cooperative fisheries project of the Marine Resources Research Institute of the South Carolina Department of Natural Resources (SCDNR), operating under the Unallied Management Program.[1] The program conducts reef fish

[1] The Unallied Management Program is authorized by the Department of Commerce Appropriation Act, Magnuson-Stevens Act, Fish and Wildlife Coordination Act, and the National Fisheries Research and Development Program.

assessment from North Carolina to northern Florida (between 27°N and 34°N). Although recent efforts of the South Carolina MARMAP program have concentrated on fishery-independent assessments of reef fish abundance and life history, the program began over 30 years ago as a plankton and groundfish survey of shelf and upper slope waters from Cape Fear to Cape Canaveral (SCDNR Website 2012).

Anadromous Fish Conservation Act

The Anadromous Fish Conservation Act was signed in 1965 and authorizes the Secretary of Commerce ("Secretary") to enter into cooperative agreements to protect anadromous and Great Lakes fishery resources. The Anadromous Fish Conservation Act projects in the Southeast Region are conducted to conserve, develop, and enhance anadromous fish and their habitat. Due to their complicated life histories and the many challenges to their survival, these species require special consideration. Information collected from this program is used to support management decisions at the state, interstate, and federal levels.

Atlantic Coastal Fisheries Cooperative Management Act (ACFCMA)

The ACFCMA was signed into law in December 1993. The Act authorizes the Secretary to provide financial assistance to support and enhance the development, implementation, and enforcement of effective interstate conservation and management of Atlantic Coastal resources. It presents a new and innovative approach to coordinated management of coastal migratory fisheries along the U.S. Atlantic coast. ACFCMA provides a mechanism to ensure Atlantic coastal state compliance with mandated conservation measures in Atlantic States Marine Fisheries Commission-approved fishery management plans. All Atlantic coast states that are included in a Commission fishery management plan must comply with certain conservation provisions of the plan to avoid a Secretary of Commerce-imposed moratorium in that state's waters for harvesting the species in question.

Interjurisdictional Fisheries Act (IJA)

The IJA, signed in 1986, authorizes the Secretary to allocate funds to states for projects carried out to gather information and conduct activities that support management of United States multijurisdictional fisheries. These projects respond to fishery research, habitat, and law enforcement needs under the Magnuson-Stevens Act, Atlantic Coastal Fisheries Cooperative Management Act, Great Lakes Fisheries Commission's Strategic Plan, and the individual multijurisdictional state and interstate marine fisheries commission's fisheries management planning programs.

Turtle Excluder Device (TED) Exemptions

Turtle excluder devices (TEDs) are required on any vessel capable of catching shrimp. 50 CFR 223.206(d)(2). This is generally considered by NMFS to be a vessel trawling a net with a mesh size of 4 inches or less; a number of the FIM-related trawling projects described in the following sections would fall into that category. However, our regulations provide a number of exemptions to the TED requirements. To receive an exemption a trawler must comply with alternative tow-time requirements *and* must meet 1 or more of the following criteria: (1) the vessel may not have a power or mechanical

advantage trawl retrieval system; (2) the trawler is a bait shrimper that retains all live shrimp under certain conditions; (3) the trawl is only a pusher-head trawl, skimmer trawl or wing net; (4) the trawler is operating in an area during a period when tow-time restrictions apply; or (5) the trawler is using a single test net (try net) with a headrope length of 12 ft or less, fished in the manner specified in the regulations (50 CFR 223.206(d)(2)(ii)). The threshold tow-time requirement to quality for an exemption as specified in the regulations is: tow-time measured from the time the codend enters the water until it is removed from the water may not exceed: (1) 55 minutes from April 1 through October 31; and (2) 75 minutes from November 1 through October 31.

The existing sea turtle conservation regulations provide 1 additional means for issuing exemptions to the TED requirements. The Southeast Regional Administrator of NMFS may issue authorization letters to allow fishery research that would otherwise be subject to the TED requirements, and to fishermen or researchers to develop modified or new TEDs, subject to any conditions and restrictions he deems appropriate (50 CFR 223.207(e)(2)). For authorizations to conduct fishery research without TEDs, these restrictions invariably include a requirement to limit tow times, often to less than the 55/75 minutes allowed for shrimpers. Reporting of any sea turtle mortality is required as a condition of these authorizations.

All FIM otter-trawling research is conducted without TEDS. Researchers must either meet the conditions for an exemption from the TED requirements outlined above, or they must apply for a permit from NMFS to conduct fishery research without a TED.

2.2 Description of Regional Fisheries Independent Research Projects

Since NMFS has the authority to provide assistance to non-federal entities and has a long record of doing so in the past, and in the case of SEFSC, actually conducts FIM activities, we believe the following FIM projects outlined below will occur in the future. The following sections outline specifics of the projects conducted by the SEFSC and other NMFS partners to collect fisheries independent data. Projects are described as proposed by the SEFSC or partner agencies. We assume any additional permits required to fish in the manners proposed have been received (e.g., TED exemptions). Since most research is conducted regionally and with a specific gear type, the projects have been grouped that way.

2.2.1 Hook-and-Line Gear Fisheries Independent Research Projects

2.2.1.1 South Atlantic

SEAMAP-SA Red Drum Bottom Longline Survey (NCDENR)
Sampling occurs monthly from July to October in state waters, primarily in Pamlico Sound (Figure 2.1). A limited number (approximately 50) of non-random (exploratory) sets are conducted from May through November time and weather permitting; approximately 72 stratified, random sets are conducted from July to October. All random sets occur from 1 hour before sunset until about 2 a.m. Non-random sets occur both day

and night. During random sampling, 2 sets are conducted at 36 locations for a total of up to 100 sets annually. Only 1 set is conducted at each of the approximately 30 non-random sampling sites. Depths at each station range from 3-40 ft, with most sets conducted between 15 and 20 ft. Bottom longline gear consists of approximately 5,000-ft mainline (500-pound [lb] test) with up to 100 gangions (approximately 2 ft, 200-lb test monofilament) with a 15/0 Mustad tuna circle hook (0° offset), and baited with readily available baitfish (e.g., menhaden, striped mullet, spot, croaker, and/or bluefish). Soak times are 30 minutes (L. Paramore, NCDENR, pers. comm. to A. Herndon, NMFS, June 2012).

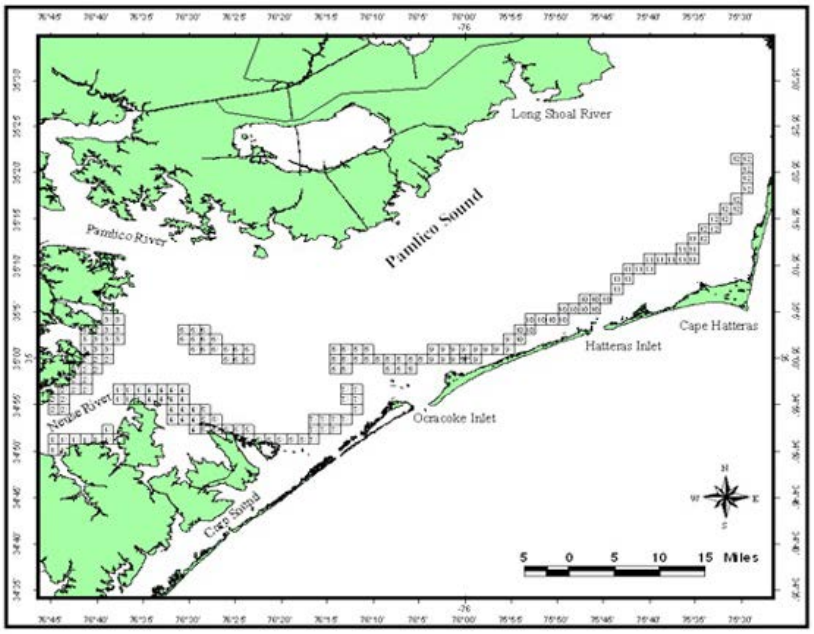

Figure 2.1. North Carolina Red Drum Longline Survey Area
(Source: http://www.seamap.org/NC%20red%20drum.html)

SEAMAP-SA Red Drum Bottom Longline Survey (SCDNR)

Sampling occurs in state and federal waters, primarily from August to December during 4 main sampling windows (May/June, July/Aug, Sept/Oct, Nov/Dec). The surveys generally occur from inside estuaries out 10 miles, in 4 core areas: Winyah Bay, Charleston Harbor, St. Helena Sound, and Port Royal Sound (Figure 2.2). During each sampling window, approximately 30 stations are selected randomly from a list of as many as 100 possible stations, for each of the 4 core areas, for a total of up to 360 stations annually. Those stations are then sampled over a 2-3 day period, with 1 set deployed at each station. Only daytime sets are used and each gear set lasts from 30 minutes after sunrise to 30 minutes before sunset. Depths at each station range from approximately 10 to 70 ft. Bottom longline gear consists of approximately 2,025-ft mainline (600-lb test) with up to 40 gangions (approximately 2 ft, 200-lb-test monofilament) with a 15/0 circle hook (0° offset), baited with spot croaker (*Leiostomus xanthurus*), Atlantic mackerel (*Scomber scomber*), or other readily obtainable baitfish. The mainline is weighted at both ends and large surface floats are attached to each end. Soak times are 30 minutes. This research is conducted on the R/V *Silver Crescent*, a 50-foot (ft), shallow-draft

vessel. The use of a chartered vessel may be required if scheduling conflicts arise with the use of the R/V *Silver Crescent* (E. Levesque, SCDNR, pers. comm. to A. Herndon, NMFS, July 2012).

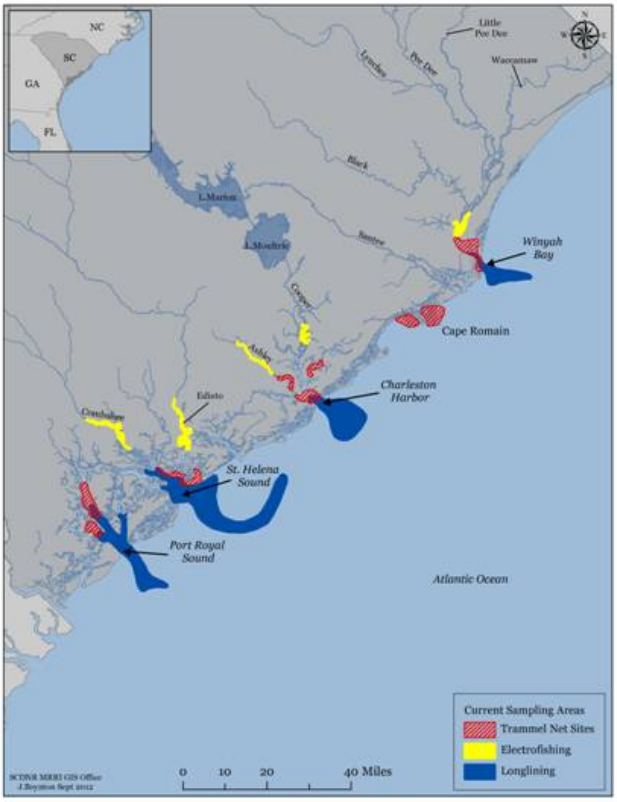

Figure 2.2. South Carolina Red Drum Longline Survey Area (Source: J. Boynton, SCDNR, 2012)

SEAMAP-SA Red Drum Bottom Longline Survey (GADNR)

Sampling occurs monthly from April to December in state and federal waters off the coast of Georgia and northeast Florida. The survey generally encompasses an area bounded by 32°05'N latitude to the north, 29°20'N latitude to the south, 80°30'W longitude to the east, and the coastline to the west. Current sampling occurs in a smaller area in waters off the Altamaha River drainage in Georgia to the St. Johns River drainage in Florida (Figure 2.3). From April to August, 25 stations are randomly sampled each month off southeast Georgia. From September to November, 35 stations are sampled each month, 10 in waters off northeast Florida. Florida sampling sites are randomly chosen. Three strata are delineated for the Georgia sampling sites (nearshore ; < 3nmi from the beach; offshore < 12 nmi), and sampling effort is temporally allocated. Because red drum migrate offshore in the winter the percentage of inshore versus offshore stations sampled each month changes. In September, 50% of stations are inshore, 50% are in the nearshore (0-3 nmi); October has effort split 25% inshore, 50% nearshore, and 25% offshore (3-12 nmi); November stations are 50% are nearshore, and 50% are offshore; and in December 25% of stations are nearshore, with 75% offshore. The number of sampling days per month ranges from 3 (during months with 25 stations) to 6 (during months with 35 stations). One bottom longline set is deployed at each station and all

sampling occurs during daylight hours. Depths at each station range from 13 to 66 ft. Bottom longline gear consists of approximately 3,000-ft mainline (660-lb test) with up to 60 gangions (approximately 1.5 ft of, 275-lb test monofilament) with either a 15/0 or a 12/0 circle hook (0° offset), depressed barbs, and baited with squid. The mainline is weighted at both ends (up to 50 lb), and large orange surface floats are attached to each end; soak times are 30 minutes (C. Belcher, GADNR, pers. comm. to A. Herndon, NMFS, July 2012).

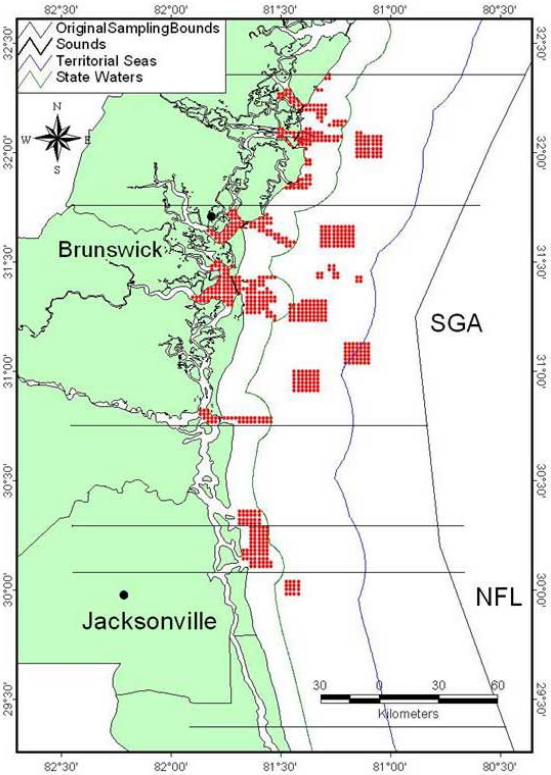

Figure 2.3. Georgia Red Drum Bottom Longline Survey Sampling Area (Source: GADNR 2009)

St. Lucie Rod-and-Reel Fish Health Study (NMFS)

Sampling occurs year round in the St. Lucie River estuarine system and adjacent inlet system (Jupiter or Ft. Pierce, Florida). Approximately 470 stations are sampled annually (3/day x 3 day/week). Twenty sampling stations are located in St. Lucie, 10 in Jupiter and 10 in the Ft. Pierce-Indian River Lagoon area. Sampling occurs at depths ranging from 6-25 ft and all sampling occurs during daylight hours. Hook-and-line gear uses 10- or 17-lb test monofilament with a 1-ft monofilament leader and a No.7 Mustad hook baited with shrimp. One line with 1 hook is fished at each station; lines soak for 30 minutes (J. Browder, NOAA, pers. comm. to A. Herndon, NMFS, July 2013).

HMS Chesapeake Bay and Coastal Virginia Bottom Longline Shark Survey (VIMS)

Sampling occurs in the Chesapeake Bay and the state and federal waters of Virginia. One survey is conducted each month starting in May or June through September or October. Sampling occurs at 8 stations, stratified by depth. Six of these stations occur in coastal waters and represent 3 depth strata, < 30 ft, 30-60 ft, and 60-100 ft; 2 of these stations

occur in the lower Chesapeake Bay. One set is conducted at each station and 50 sets are conducted annually; fishing occurs primarily during daylight hours. Bottom longline gear consists of a 1.25-nmi -long tarred nylon mainline (approximately 1,000-lb test), with 100-120 gangions consisting of 9/0 J-hooks or 12/0 circle hooks. Each hook is baited with one-third or one-half of an Atlantic menhaden (*Brevoortia tyrannus*). Soak time is 4 hours and fishing is conducted aboard the R/V *Bay Eagle* (K. Parsons, Virginia Institute of Marine Science, pers. comm. to A. Herndon, NMFS, June 2012).

MARMAP/SEAMAP-SA Reef Fish Survey (Rod-and-Reel) (SCDNR)
Vertical line sampling stations are selected opportunistically to collect life history information and occur near 1 of 2,600 stations in the South Atlantic Bight (between 27°N and 34°N). Sampling could occur in federal waters year round, but is conducted primarily from April through October. Up to 90 stations are sampled annually for an annual maximum of 400 sets. Stations are sampled during dawn and dusk, 1 hour before or after sunrise and sunset, respectively. Depths at each station are no greater than approximately 500 ft, but are generally shallower. Rods use 80-lb-test monofilament, with 3/0 or 6/0 hooks. Lines consist of a 30- or 50-lb test monofilament leader with three 2/0-5/0 hooks on each line. The top and bottom hooks are baited with cut squid, the middle hook is baited with a cut cigar minnow (*Decapterus* spp.); soak times are no more than 10 minutes per set. This research is conducted on R/V *Palmetto* (M. Reichert, SCDNR, pers. comm. to A. Herndon, NMFS, July 2012).

MARMAP/SEAMAP-SA Reef Fish Survey (Short Bottom Longline) (SCDNR)
This project is conducted simultaneously with the MARMAP/SEAMAP-SA Reef Fish Survey (Rod-and-Reel). Sampling locations are selected at random from 2,600 stations in the South Atlantic Bight (between 27°N and 34°N). Sampling occurs in federal waters, primarily from August through October. Stations are sampled during daylight hours. Depths at each station range from approximately 150 to 700 ft. Up to 6 bottom longlines may be deployed at each station, totaling no more than 200 lines annually. Bottom longline gear consists of an approximately 84-ft mainline with up to 20 gangions (approximately 2 ft, 200-lb-test monofilament), each with a Mustad 14/0 non-stainless steel circle hook, baited with whole squid. The mainline is weighted at both ends and a large surface float is attached to one end; soak times are approximately 90 minutes. This research is conducted on R/V *Palmetto* (M. Reichert, SCDNR, pers. comm. to A. Herndon, NMFS, July 2012).

MARMAP Reef Fish Survey (Long Bottom Longline) (SCDNR)
Sampling locations are selected in 15 geographical "blocks" (based on former LORAN coordinates) in the South Atlantic Bight (between 27°N and 34°N). Sampling occurs in federal waters, primarily from August to October. Stations are sampled during daylight hours. Depths at each station range from approximately 500 to 860 ft. Between 2 and 4 bottom longline sets are deployed at each station, totaling no more than 60 sets annually. The mainline is approximately 5,500 ft, with up to 100 gangions (approximately 2 ft, 200-lb-test monofilament), each with a Mustad 14/0 non-stainless steel circle hook, baited with whole squid. The mainline is weighted at both ends and a large surface float is attached to one end; soak times are approximately 90 minutes. This research is

conducted mostly from on the R/V *Lady Lisa* (M. Reichert, SCDNR, pers. comm. to A. Herndon, NMFS, July 2012).

Shark and Red Snapper Bottom Longline Survey (NMFS)

Surveys occur July through September from Cape Hatteras, North Carolina (35.15° N) to West Palm Beach, Florida (26.40°N), and the U.S. northern Gulf of Mexico from southwest Florida (25°N) to Brownsville, Texas (26°N). Between 240 and 280 stations are sampled in both state and federal waters. Sampling occurs in depths from approximately 30-1,200 ft. Most bottom longline sets are conducted parallel to depth contours unless survey conditions (i.e., current, sea state, wind) necessitates a different orientation. The number of randomly selected survey sites occupied within 60 nmi contiguous sampling zones is proportionally allocated based on the amount of continental shelf area within each of the depth strata. In the South Atlantic, 60% of stations are typically allocated between 30-180 ft and 40% between 180-600 ft. In the Gulf of Mexico, 50% of stations are allocated between 30-180 ft, 40% between 180-600 ft, and 10% are allocated between 600-1,200 ft (or at least 1 per sampling zone). One set is conducted at each station. Sampling occurs during the day and night. The bottom longline gear consists of a 1-nmi-long (1000-lb-test monofilament) mainline with 100 gangions. One 15/0 circle hook is attached to each gangion and baited with Atlantic mackerel; the mainline soaks for 1 hour. Research is conducted aboard NOAA ships *Oregon II*, *Gordon Gunter*, or *Pisces*, and the R/Vs *Caretta* and *Grayling* (B. Noble, NMFS Southeast Fisheries Science Center, pers. comm. to A. Herndon, NMFS, December 2014).

Pelagic Longline Survey (NMFS)

Surveys have occurred intermittently since 2004. Sampling occurs in the winter and spring (March through May) south of Cape Hatteras, North Carolina. Approximately 60 stations are sampled and all sampling occurs in federal waters. Sampling generally occurs in depths greater than 600 ft; 1 set is conducted at each station. Sampling occurs both day and night. Pelagic longline sampling gear consists of 5 nmi (5.75 statute miles) of mainline (4.0-mm-diameter monofilament, approximately 1,000- to 1,200-lb test) deployed between 2 high-flyers equipped with a poly buoy, radar reflector, and strobe lights. Gangions consist of 73 ft of 2.0-mm-diameter monofilament (approximately 400-lb test) followed by 2 ft of multistrand stainless steel fishing wire to which a single 18/0 non-offset circle hook, baited with Atlantic mackerel, is attached. Gangions are equipped with numeric tags and may be equipped with hook timers and temperature-depth recorders. Gangions are 110% in length of the float droplines to allow hooked animals to surface and breathe. The mainline soaks for 3 hours, determined from the time the last high-flyer is deployed until the first flyer is retrieved. Research is conducted aboard NOAA ships *Oregon II*, *Gordon Gunter*, and *Pisces*, and the R/Vs *Caretta* and *Grayling* (B. Noble, NMFS Southeast Fisheries Science Center, pers. comm. to A. Herndon, NMFS, December 2014).

2.2.1.2 Gulf of Mexico

HMS - Gulf of Mexico Shark Pupping and Nursery (GULFSPAN) Bottom Longline Survey (University of West Florida)

Surveys occur bimonthly between May and September from Perdido Bay at the Florida-Alabama border west to the far end of Choctawhatchee (including Big Lagoon, Pensacola Bay, East Bay, and Santa Rosa Sound). Up to 20 stations are sampled annually; 3 sets are conducted at each station. Sampling occurs during the day. The bottom longline gear consists of an approximately 5,000 ft (1,200-lb-test monofilament) mainline with 100 gangions. One circle hook (either a 10/0, 12/0, or 14/0 Mustad circle hook) is attached to each gangion and baited with Spanish mackerel (*Scomberomorus maculatus*); the mainline soaks for up to 1 hour (T. Daly-Engel, UWF, pers. comm. to A. Herndon, NMFS, May 2015).

HMS - GULFSPAN Bottom Longline Survey (Florida State University)

Surveys include fixed stations and randomly selected stations using a stratified, spatially balanced design. The fixed station survey includes two standard stations in St. George Sound that are sampled monthly (12 months per year). The randomized survey includes between 40 and 50 stations sampled between June and August from Alligator Point to Anclote Key, Florida. In total, up to 74 stations are sampled annually; 1 set is conducted at each station. Sampling occurs during the day. The bottom longline gear consists of an approximately 5,000 ft (900-lb-test monofilament) mainline with 100 gangions. One circle hook (either a 10/0, 12/0, 14/0, or 16/0 circle hook) is attached to each gangion and baited with Spanish mackerel (*Scomberomorus maculatus*); the mainline soaks for up to 1 hour (T. Daly-Engel, UWF, pers. comm. to A. Herndon, NMFS, May 2015).

SEAMAP-GOM Bottom Longline Survey (ADCNR)

Sampling is conducted during three sampling seasons (April-May, June-July, August-September). Up to 32 stations will be sampled annually with 1 set conducted at each station. Sampling depths will range from approximately 10 to approximately120 ft. Sampling occurs during daylight hours. The bottom longline gear consists of a one-mile-long (1200-lb-test monofilament) mainline with 100 gangions (700-lb-test monofilament) with No.15/0 circle hooks baited with Atlantic mackerel. The mainline soaks for 1 hour (J. Mareska, Alabama Department of Conservation and Natural Resources, pers. comm. to A. Herndon, NMFS, July 2012).

SEAMAP-GOM Vertical Line Survey (ADCNR)

Vertical line sampling will occur at 2 intervals, April/May, and July-September. One hundred and twenty stations are sampled during each interval, totaling 240 stations sampled annually. Sampling occurs in state and federal waters and only during daylight hours. Sampling depths range from 60 ft to no greater than approximately 500 ft. A 200-lb-test mainline is used. Attached to the end of the mainline is a weighted, 24-ft section of 400-lb-test clear monofilament "backbone." Ten gangions (100-lb-test clear monofilament) are attached to the backbone and 1 hook size (8/0, 11/0, or 15/0 Mustad) is attached to each gangion. Each backbone consists of only 1 hook size. All hooks are baited with Atlantic mackerel; soak times are 5 minutes (J. Mareska, Alabama

Department of Conservation and Natural Resources, pers. comm. to A. Herndon, NMFS, July 2012).

SEAMAP-GOM Bottom Longline Survey (USM/GCRL)

Sampling is conducted during 3 sampling seasons (April-May, June-July, August-September), in 3 regions (Mississippi Sound, south of the Mississippi Barrier Islands, Chandeleur and Breton Sound, and the area east of the Chandeleur Islands). The Mississippi Sound and South of Mississippi Barrier Islands sampling regions span a 342-km^2 (square kilometers) area extending from West Cat Island to East Petit Bois Island and 6.4 km (kilometers) to the north and south of the islands. Both regions are further sub-divided into 3 equal 114 km^2 areas. Up to 40 stations are sampled annually. Stations are randomly chosen within each area while giving consideration to the depth stratification (10-65 ft) of the region. Sampling occurs over a 2-day period during daylight hours, with 1 set conducted per station. The longline gear consists of a 1 mile (700-lb-test monofilament) mainline with 100 gangions (12 ft, 800-lb monofilament) outfitted with No. 15/0 circle hooks (0° offset) and baited with Atlantic mackerel. The mainline is weighted down with mid- and endpoint weights, and it soaks for 1 hour prior to retrieval. Radar high-flyer buoys are used to mark the longline locations at the water's surface. A hydraulic winch is used for setting and retrieving the mainline. This research is conducted on the University of Southern Mississippi's R/V *Tom McIlwain* (J. Hendon, USM/GCRL, pers. comm. to A. Herndon, NMFS, October 2012).

SEAMAP-GOM Bottom Longline Survey (LDWF)

Sampling is conducted during three sampling seasons (April-May, June-July, August-September). Up to 12 stations are sampled each month; no more than 96 stations are sampled annually. One set is conducted at each station. Sampling depths range from 12 to 600 ft. Sampling occurs during the daytime. The bottom longline gear consists of a 1-nmi-long (1000-lb-test monofilament) mainline with 100 gangions (700-lb-test monofilament) No.15/0 Mustad hooks and baited with Atlantic mackerel. The mainline soaks for 1 hour (M. Fischer, LDWF, pers. comm. to A. Herndon, NMFS, July 2012).

SEAMAP-GOM Vertical Line Survey (LDWF)

Sampling would occur quarterly west of the Mississippi river, across 3 depth strata (60-120 ft, 120-180 ft, and 180-360 ft). Sampling occurs in state and federal waters, and 20 stations are sampled in each depth strata each quarter; up to 240 stations are sampled annually. Stations are sampled during daylight hours. Sampling depths range from 60-360 ft. Bandit gear is used and 3 sets are fished at each station.[2] The bandit gear uses a 300-lb-test mainline. Attached to the end of the mainline is a weighted, 28-ft section of 400-lb-test clear monofilament ("backbone"). Ten gangions (200-lb-test clear

[2] Bandit gear is a type of hook-and-line gear that is attached to a boat's gunwale. This gear often consists of a fiberglass reel that holds the mainline or "backbone"; an L-bar or spreader that keeps the leaders/gangions from tangling with the mainline; a pulley to feed the line from the reel through the L-bar; a fiberglass arm; and an electronic or hydraulic reel motor. The gear is referred to a "bandit rig" because of its resemblance to a casino slot machine, which is often referred to as a "one-armed bandit."

monofilament) are attached to the backbone and 1 hook (a 9/0, 11/0, 13/0, or 15/0 Mustad 39960D) is attached to each gangion. All hooks are baited with Atlantic mackerel; soak times are 5 minutes (M. Fischer, LDWF, pers. comm. to A. Herndon, NMFS, July 2012).

SEAMAP-GOM Bottom Longline Survey (TPWD)

Sampling is conducted during three sampling seasons (April-May, June-July, August-September) in 2 areas within 15 miles of Aransas Pass and Bolivar Roads Ship Channel, exclusively in state waters (up to 9 nmi offshore). Up to 20 randomly selected stations are sampled; 1 set is conducted at each station. Sampling depths range from approximately 10 to approximately 65 ft. Sampling occurs between 7:00 a.m. and 5:00 p.m. The bottom longline gear consists of a 1-nmi-long (1000-lb-test monofilament) mainline with 100 gangions (700-lb-test monofilament); No.15/0 circle hooks and baited with Atlantic mackerel. The mainline soaks for 1 hour (F. Martínez-Andrade, TPWD, pers. comm. to A. Herndon, NMFS, July 2012).

Shark and Red Snapper Bottom Longline Survey (NMFS)

Surveys occur July through September from Cape Hatteras, North Carolina (35.15° N) to West Palm Beach, Florida (26.40°N), and the U.S. northern Gulf of Mexico from southwest Florida (25°N) to Brownsville, Texas (26°N). Between 240 and 280 stations are sampled in both state and federal waters. Sampling occurs in depths from approximately 30-1,200 ft. Most bottom longline sets are conducted parallel to depth contours unless survey conditions (i.e., current, sea state, wind) necessitate different orientation. The number of randomly selected survey sites occupied within 60 nmi contiguous sampling zones is proportionally allocated based on the amount of continental shelf area within each of the depth strata. In the South Atlantic, 60% of stations are allocated between 30-180 ft and 40% between 180-600 ft. In the Gulf of Mexico, 50% of stations are allocated between 30-180 ft, 40% between 180-600 ft, and 10% are allocated between 600-1,200 ft (or at least 1 per sampling zone). One set is conducted at each station. Sampling occurs during the day and night. The bottom longline gear consists of a 1-nmi-long (1000-lb-test monofilament) mainline with 100 gangions. One 15/0 circle hook is attached to each gangion and baited with Atlantic mackerel; the mainline soaks for 1 hour. Research is conducted aboard NOAA ships *Oregon II*, *Gordon Gunter*, and *Pisces*, and the R/Vs *Caretta* and *Grayling* (B. Noble, NMFS Southeast Fisheries Science Center, pers. comm. to A. Herndon, NMFS, December 2014).

Pelagic Longline Survey (NMFS)

Surveys have occurred intermittently since 2004. In the Gulf of Mexico, sampling primarily occurs in the winter and spring (February through May). Approximately 60 stations are sampled and all sampling occurs in federal waters. Sampling generally occurs in depths greater than 600 ft; 1 set is conducted at each station. Sampling occurs both day and night. Pelagic longline sampling gear consists of 5 nmi (5.75 statute miles) of mainline (4.0-mm-diameter monofilament, approximately 1,000- to 1,200-lb test) deployed between 2 high-flyers equipped with a poly buoy, radar reflector, and strobe lights. Gangions consist of 73 ft of 2.0-mm-diameter monofilament (approximately 400-lb test) followed by 2 ft of multistrand stainless steel fishing wire to which one 18/0 non-offset circle hook, baited with Atlantic mackerel, is attached. Gangions are equipped

with numeric tags and may be equipped with hook timers and temperature-depth recorders. Gangions are 110% in length of the float droplines to allow hooked animals to surface and breathe. The mainline soaks for 3 hours; time determined from the time the last high-flyer is deployed until the first flyer is retrieved. Research is conducted aboard NOAA ships *Oregon II*, *Gordon Gunter*, and *Pisces*, and the R/Vs *Caretta* and *Grayling* (B. Noble, NMFS Southeast Fisheries Science Center, pers. comm. to A. Herndon, NMFS, December 2014).

SEAMAP-GOM Reef Fish Survey (Vertical Line) (NMFS)
This project is conducted concurrently with the SEAMAP-GOM Reef Fish Survey (Fish Trap) (NMFS). Sampling occurs from April through July each year in association with topographic features (banks, ledges) located on the continental shelf of the Gulf of Mexico in the area from Brownsville, Texas, to Dry Tortugas, Florida. Since the survey area is large, a 2-stage sampling design is used to minimize travel time between sample stations. The first-stage, or primary sampling units (PSUs), are blocks 10 minutes of latitude by 10 minutes of longitude. The first-stage units are selected by stratified random sampling, with stratum boundaries defined by geographic region (4 regions: South Florida, Northeast Gulf, Louisiana-Texas Shelf, and South Texas), and by reef habitat area (blocks 20 km² reef, block > 20 km² reef); there are a total of 7 strata. A maximum of 120 stations are sampled at depths no greater than 500 ft and all sampling occurs during daylight hours with a camera array. Stations are sampled during daylight hours. The gear uses a 300-lb-test mainline. Attached to the end of the mainline is a weighted, 20-ft section of 300-lb-test clear monofilament ("backbone"). Ten gangions 100-lb-test clear monofilament) are attached to the backbone and 1 hook (a 8/0, 11/0 or 15/0) is attached to each gangion; up to 3 sets of 10 gangions may be fished at one time. All hooks are baited with mackerel; soak times are up to 5 minutes. Research is conducted aboard NOAA ships *Oregon II*, *Gordon Gunter*, and *Pisces*, and the R/Vs *Caretta* and *Grayling* (B. Noble, NMFS Southeast Fisheries Science Center, pers. comm. to A. Herndon, NMFS, December 2014).

2.2.1.3 Caribbean

SEAMAP-C Finfish Rod-and-Reel Survey (PR-DNER)
Sampling occurs year round off the west and east coast of Puerto Rico in territorial waters. Up to 120 stations are sampled at depths ranging from 15-300 ft and all sampling occurs during daylight hours. Hook-and-line gear uses 80-lb-test monofilament with a No.6 Mustad hook baited with squid. Three lines with 3 hooks per line are fished at each station; lines soak for 4 hours. This research is conducted from a 23-ft or 42-ft vessel (A. Rosario Jiménez, *PR-DNER*, pers. comm. to A. Herndon, NMFS, July 2012).

SEAMAP-C Lane Snapper Bottom Longline Survey (PR-DNER)
Sampling occurs once per season (i.e., summer, winter, fall, spring), off the east, west, and south coasts of Puerto Rico in territorial waters (12 sampling trips annually). On each sampling trip, 5 non-aggregation sites and up to 10 aggregation sites are selected randomly. Over the course of a year, up to 180 stations are sampled at depths ranging from 15-300 ft and all sampling occurs between 5:30 and 7:30 in the evening. The

longline gear consists of a 300-ft mainline (130-lb-test monofilament) with 100 gangions (18 in of 20-lb test) containing a No.10 circle hook baited with squid. The mainline is weighted at both ends; the line soaks for 45 minutes (A. Rosario Jiménez, PR-DNER, pers. comm. to A. Herndon, NMFS, July 2012).

SEAMAP-C Yellowtail Snapper Rod-and-Reel Survey (PR-DNER)
Sampling occurs once per season (i.e., summer, winter, fall, spring), at the east, west, and south coasts of Puerto Rico in territorial waters (12 sampling trips annually). On each sampling trip, 10 yellowtail snapper spawning aggregation sites and 5 non-spawning-aggregation sites are selected randomly. Over the course of a year, up to 120 stations are sampled at depths ranging from 15-300 ft and all sampling occurs starting between 5:30 and 7:30 in the evening, depending on the season. Hook-and-line gear uses 80-lb-test monofilament with a No.6 Mustad hook baited with sardine. Three lines with 1 hook per line are fished at each station; lines soak for 4 hours. This research is conducted from a 23-ft or 42-ft vessel (A. Rosario Jiménez, PR-DNER, pers. comm. to A. Herndon, NMFS, July 2012).

Caribbean Reef Fish Survey (Bandit Gear) (NMFS)
This survey would be opportunistically completed every other calendar year. The objective of the cruise will be to determine the relative abundance of reef fish on the shelf waters of Puerto Rico and the United States Virgin Islands (USVI). The gear will be deployed at night and soak for 1 hour at sites selected by stratified sampling. The number of stations sampled annually is highly variable due to the opportunistic nature of the survey; however, no more than 300 vertical line sets are anticipated in any given year. The vertical line consists of a mainline with 10 gangions attached that is either deployed or attached to the vessel. One 8/0 or 11/0 circle hook is attached to each gangion and baited with Atlantic mackerel. The lines will soak for a maximum of 5 minutes. Research is conducted aboard the NOAA ships *Oregon II*, *Gordon Gunter*, and *Pisces*, and the R/Vs *Caretta* and *Grayling*. A Simrad ME70 Multi-Beam Echosounder and/or EK60 Multi-frequency Split-beam Echosounder to produce estimates of the abundance and distribution of marine organisms and estimate water depth are generally used continuously during a cruise. An Acoustic Doppler Current Profiler is also used continuously during cruises and measures the magnitude and direction of water currents as a function of depth (B. Noble, NMFS Southeast Fisheries Science Center, pers. comm. to A. Herndon, NMFS, February 2016).

2.2.2 Trawl Gear Fisheries Independent Research Projects

2.2.2.1 South Atlantic

SEAMAP-SA Coastal Trawl Survey (SCDNR)
Sampling cruises are generally conducted seasonally: spring (April-May), summer (July-August), and fall (October-November) in established strata between Cape Hatteras, North Carolina (35º13.2'N) and Cape Canaveral, Florida (28º30.0'N) (Figure 2.4). Sampling occurs in both state and federal waters. Up to 150 stations are sampled each season within 24 shallow-water strata delineated by the 15-ft to 30-ft depth contour. Stations are

randomly selected from a pool of stations within each stratum. The number of stations sampled in each stratum is determined each year based on specific design criteria. One trawl is conducted at each station. Sampling occurs exclusively during daylight hours (1 hour after sunrise to 1 hour before sunset). Two 75-ft mongoose-type Falcon trawl nets (otter trawls) without Turtle Excluder Devices (TEDs) or Bycatch Reduction Devices (BRDs) are used for sampling. The body of the trawl is constructed of No.15 twine with 1.875-in-stretch mesh. The cod end of the net is constructed of No. 30 twine with 1.625-in-stretch mesh and is protected by chafing gear of No. 84 twine with 4-in-stretch "scallop" mesh. A 300-ft 3-lead bridle is attached to each of a pair of wooden chain doors (10 ft by 40 in) and to a tongue centered on the headrope. The 86-ft headrope, excluding the tongue, has 1 large (60-cm) Norwegian "polyball" float attached top center of the net between the end of the tongue and the tongue bridle cable and two 9-in PVC foam floats located one-quarter of the distance from each end of the net webbing. A 1-ft chain dropback is used to attach the 89-ft footrope to the trawl door. A 0.25-in tickler chain, which is 3 ft shorter than the combined length of the footrope and dropback, is connected to the door alongside the footrope. Tow times are 20 minutes excluding wire-out and haulback time. Trawls are generally towed at a speed of 2.5 knots. Sampling is conducted by the R/V *Lady Lisa*, a 75-ft wooden-hulled, double-rigged, St. Augustine shrimp trawler (P. Webster, SCDNR, pers. comm. to A. Herndon, NMFS, August 2012).

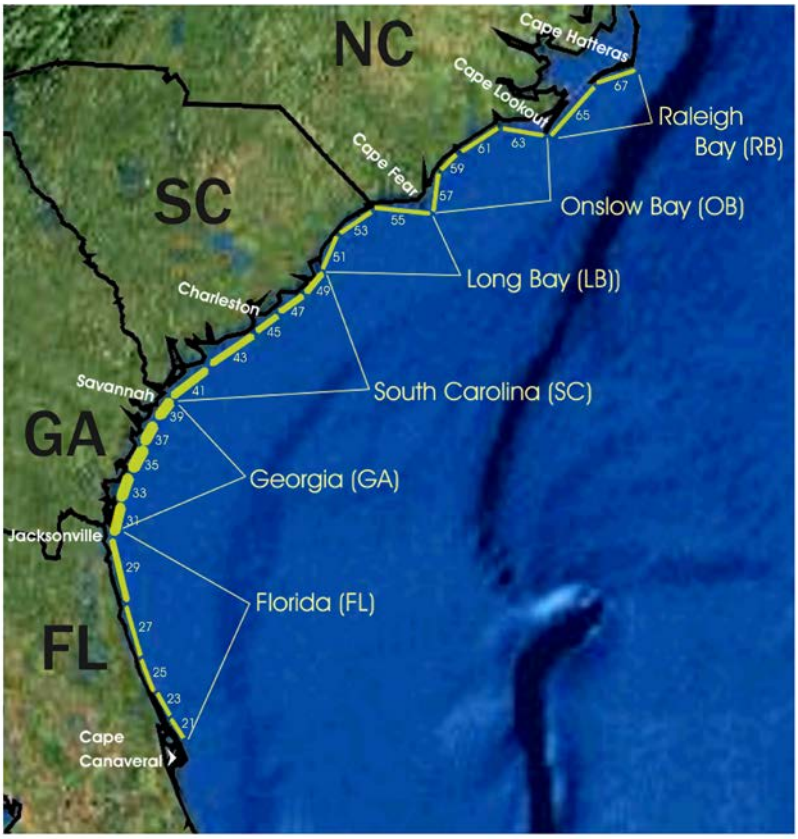

Figure 2.4. Areas Sampled by the SEAMAP-SA Coastal Trawl Survey (Source: SCDNR 2007)

SEAMAP-SA North Carolina Pamlico Sound Trawl Survey (NCDENR)
Sampling occurs in Pamlico Sound and the Pamlico, Pungo, and Neuse Rivers. Surveys occur during the middle 2 weeks in June and September. A total of 54 stations are sampled during each cruise, 1 in June and 1 in September, for a total of 108 stations annually. One trawl is conducted at each station, with 2 nets per trawl. Sampling occurs exclusively during daylight hours in waters 6 ft or shallower. Double rigged demersal mongoose trawls without TEDs or BRDs are used for sampling. The body of the trawl is constructed of No. 9 twine with 1.875-in-stretch (47.6-mm) mesh. The cod end of the net is constructed of No. 30 twine with 1.5-in-stretch (38.1-mm) mesh. The tail bag is 80 meshes around and 80 meshes long (approximately 10 ft). A 120-ft (36.58-m) 3-lead bridle is attached to each of a pair of wooden doors that measure 4 ft by 2 ft (1.22-m x 0.61-m) and to a tongue centered on the 30-ft (9.1-m) headrope. A 60-cm "poly ball" is attached between the end of the tongue and the tongue bridle cable. A 0.1875-in (4.76-mm) tickler chain that is 3.0 ft (0.9 m) shorter than the 34-ft (10.36-m) footrope is connected to the door next to the footrope. Tow times are 20 minutes excluding wire-out and haulback time. Trawls are generally towed at a speed of 2.5 knots. Sampling is conducted by the R/V Carolina Coast (J. Rock, NCDENR, pers. comm. to A. Herndon, NMFS, February 2013).

Atlantic Striped Bass Tagging Bottom Trawl Survey (USFWS)
Sampling is conducted by the USFWS aboard NMFS vessels. Sampling cruises are generally conducted during the winter (January-February), generally north of Cape Hatteras, North Carolina, in state and federal waters. Up to 350 stations may be sampled. Depending on the vessel, up to 2-in-wide trawl doors constructed of ½-in plywood with angle-iron framework and iron runners is used for sampling. Sampling occurs during the day and night. A 65-ft trawl net, 3.75-in-stretch nylon multifilament mesh cod end, with a 2-in mesh back section, a 4-in mesh mid-section, and an 8-in mesh front end, is used for sampling. Sampling depths range from 30-120 ft with tow times no more than 30 minutes. No BRDs/TEDs are used. Research is conducted aboard NOAA Ship *Oregon II* and R/V *Cape Hatteras* (W. Laney, USFWS, pers. comm. to A. Herndon, NMFS, July 2012).

2.2.2.2 Gulf of Mexico

SEAMAP-GOM Shrimp/Groundfish Trawl Survey (Summer) (FFWCC)
Surveying occurs during summer (June/July), in the eastern Gulf of Mexico from the Florida/Alabama border to Dry Tortugas, Florida. Sampling occurs in state and federal waters. Up to 160 stations are sampled during the course of a 20-day cruise. One 30-minute trawl tow is conducted at each station. Sampling occurs during the day and night. A 42-ft otter trawl (1½-in-stretch nylon multifilament mesh) with 96-in-long and 40-in-wide trawl doors, is pulled behind the vessel at a speed of 2.5 knots. No BRDs/TEDs are used (B. McMichael, FFWCC, pers. comm. to A. Herndon, NMFS, July 2012).

SEAMAP-GOM Shrimp/Groundfish Trawl Survey (Summer/Fall) (ADCNR)
Sampling occurs during summer (June, July) and fall cruises (October, November), in the state and federal waters off Alabama and Florida out to 360 ft. Eight to twelve stations are typically sampled per cruise. Cruises are divided into 2 legs to achieve all stations.

One trawl tow is conducted at each sampling site. Cruises occur during all hours for day and night stations. A single 42-ft otter trawl (1½-in-stretch mesh) is pulled behind the vessel at a speed of 2.5 knots for 30 minutes. No BRDs/TEDs are used (J. Mareska, ADCNR, pers. comm. to A. Herndon, NMFS, July 2012).

SEAMAP-GOM Plankton Trawls (ADCNR)

Plankton surveys are conducted around August/September to collect eggs and larvae of red drum, king mackerel, and other species. The survey encompasses the state waters off Alabama out to 360 ft deep. Currently there are 9 fixed stations near Mobile Bay, from which 3 are chosen randomly and 3 are fixed NMFS stations. One trawl tow of each net is conducted at each sampling site. Samples are collected primarily during daylight hours. The neuston net (Figure 2.5) has a 3- by 5-ft opening with very small mesh (i.e., microns), and is towed for 10 minutes through the surface waters for eggs and larvae. A fine-meshed bongo net (Figure 2.6), consisting of a 16-in opening on each of 2 cone-shaped nets attached to a single frame (resembling a figure-eight towed sideways), is also used at each station to sample at depth (360 ft) in the water column for eggs and larvae. No BRDs/TEDs are used (J. Mareska, ADCNR, pers. comm. to A. Herndon, NMFS, July 2012).

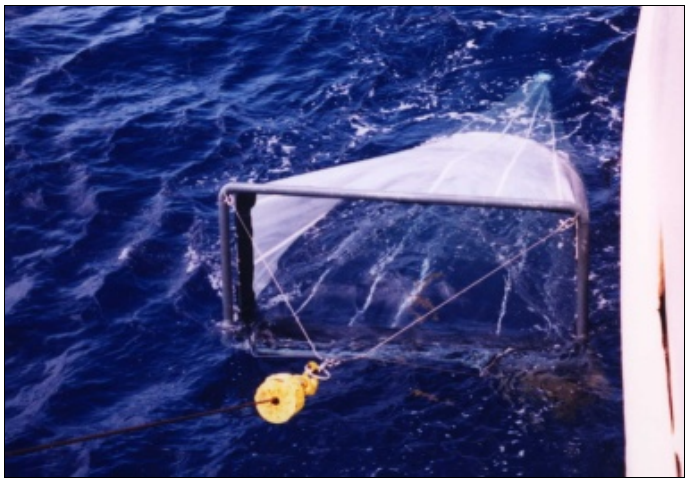

Figure 2.5. Example of Neuston Net (NOAA)

Figure 2.6. Example of Bongo Net (NOAA)

SEAMAP-GOM Shrimp/Groundfish Trawl Survey (Summer/Fall) (USM/GCRL)
Sampling occurs during the summer and fall (June and October, respectively), in the waters off Alabama, Mississippi, Louisiana, and Florida; cruises last 4-5 days. Approximately 60 stations (30 during the summer and 30 during the fall) are sampled annually across depths ranging from 6-200 ft. One trawl tow is conducted at each station. Sampling occurs during both daylight and nighttime hours. A 42-ft semi-balloon trawl, with 96-in-long and 40-in-wide trawl doors, constructed of 1-in Grade 1 yellow pine with angle-iron framework and iron runners, is used for sampling (without BRDs/TEDs). The body of the trawl is constructed of No. 24 twine with 1.5-in-stretch mesh. The cod end of the net is constructed of No. 42 twine with 1.625-in-stretch mesh. Tow time is 30 minutes bottom time (R. Hendon, USM/GCRL, pers. comm. to A. Herndon, NMFS, July 2012).

SEAMAP-GOM Plankton Trawls (USM/GCRL)
These surveys are conducted concurrently with the SEAMAP-GOM Shrimp/Groundfish (Summer/Fall) Trawl Survey (USM/GCRL). Plankton sampling occurs in the spring and fall (May and September, respectively), in the waters off Alabama, Mississippi, Louisiana, and Florida. Approximately 12 plankton stations are sampled. One neuston net and 1 bongo net are pulled at each station. Samples are collected both day and night. The neuston net has a 1- by 2-m opening with very small mesh (i.e., microns), and is towed for 10 minutes through the surface waters for eggs and larvae. A fine-meshed bongo net, consisting of a single frame with a pair of 0.5-m openings, each with a cone-shaped net attached, is also used at each station to sample at depth in the water column for eggs and larvae. Nets are deployed to within 2 m of the bottom and then immediately retrieved. Therefore, the total tow times vary depending upon depth; deeper sets require slightly longer total tow times than shallower sets. No BRDs/TEDs are used (J. Hendon, USM/GCRL, pers. comm. to A. Herndon, NMFS, May 2015).

SEAMAP-GOM Plankton Trawls (USM/GCRL)
While the previous plankton sampling survey occurred in conjunction with another trawl survey, this is a stand-alone sampling survey. Sampling occurs in the spring and fall (May and September, respectively), in the waters off Alabama, Mississippi, Louisiana, and Florida. A single 3-day sampling trip occurs during each sampling season. Approximately 20 plankton stations are sampled during the year (10 during each season). One neuston net and 1 bongo net are pulled at each station. Samples are collected both day and night. The neuston net has a 1- by 2-m opening with very small mesh (i.e., microns), and is towed for 10 minutes through the surface waters for eggs and larvae. A fine-meshed bongo net, consisting of a single frame with a pair of 0.5-m openings, each with a cone-shaped net attached, is also used at each station to sample at depth in the water column for eggs and larvae. Nets are deployed to within 2 meters (m) of the bottom and then immediately retrieved. Therefore, the total tow times vary dependent upon depth; deeper sets require slightly longer total tow times than shallower sets. No BRDs/TEDs are used (J. Hendon, USM/GCRL, pers. comm. to A. Herndon, NMFS, May 2015).

SEAMAP-GOM Shrimp/Groundfish Trawl Survey (Summer/Fall) (LDWF)
Surveying occurs once during the summer and fall (June and October, respectively). Sampling occurs at up to 25 randomly generated stations located in state and federal waters west of the Mississippi River. Approximately 50 trawl stations are sampled during the year (up to 25 during each cruise). One trawl tow is conducted at each station. Sampling occurs 24 hours a day. A 42-ft semi-balloon trawl, with 96-in-long and 40-in-wide trawl doors constructed of 1-in Grade 1 yellow pine with angle-iron framework and iron runners, is used for sampling. The body of the trawl is constructed of No. 24 twine with 1.5-in-stretch mesh. The cod end of the net is constructed of No. 42 twine with 1.625-in-stretch mesh. No BRDs/TEDs are used. Sampling occurs out to a depth of 120 ft with tow times of no more than 30 minutes (M. Fischer, LDWF, pers. comm. to A. Herndon, NMFS, July 2012).

SEAMAP-GOM Plankton Trawl Survey (LDWF)
This project is conducted concurrently with the SEAMAP-GOM Shrimp/Groundfish (Summer/Fall) Trawl Survey (LDWF). Plankton surveys occur during the summer and fall (June-July and October-November, respectively). Sampling occurs at up to 7 stations during each survey. Sampling is conducted in state and federal waters off the coast of central and eastern Louisiana. Approximately 14 trawl stations are sampled during the year. One neuston net and 1 bongo net are pulled at each station. Samples are collected 24 hours a day. The neuston net has a 3- by 6-ft opening with very small mesh (i.e., microns), and is towed for 10 minutes through the surface waters for eggs and larvae. A fine-meshed bongo net, consisting of a 16-in opening with 2 cone-shaped nets attached to a single frame, is also used at each station to sample at depth in the water column for eggs and larvae. No BRDs/TEDs are used (M. Fischer, LDWF, pers. comm. to A. Herndon, NMFS, July 2012).

SEAMAP-GOM Offshore Plankton Trawl Survey (LDWF)
Plankton surveys occur during the spring and fall (May and September, respectively). Sampling occurs at up to 10 stations during each survey. Sampling is conducted in federal waters off the coast of Louisiana. Approximately 25 plankton stations are sampled during the year. One neuston net and 1 bongo net are pulled at each station. Samples are collected 24 hours a day. The neuston net has a 3- by 6-ft opening with very small mesh (i.e., microns), and is towed for 10 minutes through the surface waters for eggs and larvae. A fine-meshed bongo net, consisting of a 16-in opening with 2 cone-shaped nets attached to a single frame, is also used at each station to sample at depth in the water column for eggs and larvae. No BRDs/TEDs are used (M. Fisher, LDWF, pers. comm. to A. Herndon, NMFS, July 2012).

SEAMAP-GOM Shrimp/Groundfish Trawl Survey (Summer/Fall) (TPWD)
Surveying occurs during the summer and fall (June to mid-July and November, respectively), in 5 specific sampling areas distributed along the Texas coast, from the border with Louisiana to the border with Mexico. Each area is located within 15 miles on either side of the following: Sabine Pass, Aransas Pass, Bolivar Pass, Matagorda Pass, and from the border with Mexico to 30 miles north (including Brazo Santiago Pass). Most sampling, with exception of the area east of Sabine Pass, occurs in state waters and

up to 9 nmi offshore. A total of 200 stations are sampled during the year: 120 during the summer and 80 during the fall. One trawl tow is conducted at each station. Sampling occurs between 8:00 a.m. and 6:00 p.m. A 20-ft otter trawl (1½-in-stretch nylon multifilament mesh), with 48-in-long and 20-in-wide trawl doors, constructed of ½-in plywood with angle-iron framework and iron runners, is used for sampling. No BRDs/TEDs are used. Sampling depths range from 6-98 ft with fixed tow times of 10 minutes (bottom time) (F. Martínez-Andrade, TPWD, pers. comm. to A. Herndon, NMFS, July 2012).

SEAMAP-GOM Shrimp/Groundfish Trawl Survey (Summer/Fall) (NMFS)
Sampling cruises are generally conducted seasonally during the summer (June-July) and fall (October-November). Sampling occurs from Brownsville, Texas to Key West, Florida. Sampling occurs in state and federal waters. Up to 670 stations are sampled during each season, 345 in summer and 320 in winter. One 30-minute trawl tow is conducted at each station. Sampling occurs during the day and night. A 42-ft semi-balloon shrimp trawl (1⅝-in-stretch nylon mesh cod end), with 8-ft-long and 40-in-wide trawl doors. Sampling depths range from 30-360 ft. No BRDs/TEDs are used. Research is conducted aboard NOAA ships *Oregon II*, *Gordon Gunter*, and *Pisces*, and the R/Vs *Caretta* and *Grayling* (B. Noble, NMFS Southeast Fisheries Science Center, pers. comm. to A. Herndon, NMFS, December 2014).

SEAMAP-GOM Summer and Fall Plankton Trawl Survey (NMFS)
Plankton surveys are conducted concurrently on the groundfish and small pelagics/shrimp trawls surveys. Sampling occurs seasonally during the summer (June-July) (110 bongo net trawls, 115 neuston net trawls) and fall (October-November) (75 bongo net trawls, 75 neuston net trawls), from Brownsville, Texas to Key West, Florida. Sampling occurs during the day and night. A neuston net has a 3- by 5-ft opening with very small mesh (i.e., .947 mm), and is towed for 10 minutes through the surface waters for eggs and larvae. A 61-cm bongo net frame, with 0.335 mm mesh net, may be used at each station and tow times are no more than 20 minutes. No BRDs/TEDs are used. Research is conducted aboard NOAA ships *Oregon II*, *Gordon Gunter*, and *Pisces*, and the R/Vs *Caretta* and *Grayling* (B. Noble, NMFS Southeast Fisheries Science Center, pers. comm. to A. Herndon, NMFS, December 2014).

SEAMAP-GOM Plankton Trawl Survey (Winter, Spring, and Fall) (NMFS)
Plankton specific surveys (i.e., not conducted in conjunction with groundfish/shrimp surveys) are conducted seasonally in the winter (February-March), spring (April-May), and fall (September). The winter and spring survey covers the entire U.S. Gulf of Mexico and the fall survey is an inshore survey in the Gulf of Mexico. Fall sampling is conducted at approximately 200 stations, winter sampling is conducted at approximately 115 stations, and approximately 140 stations are sampled in the spring. The winter survey assesses the occurrence, abundance, and geographical distribution of the early life stages of winter spawning fishes, especially grouper species and tilefish, from the continental shelf, the shelf edge, and deep Gulf waters. The spring survey targets bluefin tuna and covers the entire U.S. Gulf of Mexico. The fall survey assesses the occurrence, abundance and geographical distribution of the early life stages of fall spawning fishes,

especially king and Spanish mackerel, red drum, and snappers, Gulf-wide on the U.S. continental shelf. One tow of each net is conducted at each sampling site. Sampling occurs during the day and night. A neuston net has a 3- by 5-ft opening with very small mesh (i.e., 950 mm), and is towed for 10 minutes through the surface waters for eggs and larvae. A 61-cm bongo net frame, with 0.335 mm mesh net, may be used at each station and tow times are no more than 20 minutes. No BRDs/TEDs are used. Research is conducted aboard the NOAA ships *Oregon II, Gordon Gunter*, and *Pisces*, and the R/Vs *Caretta* and *Grayling* (B. Noble, NMFS Southeast Fisheries Science Center, pers. comm. to A. Herndon, NMFS, December 2014).

Small Pelagics Trawl Survey (Fall) (NMFS)

Sampling cruises are generally conducted seasonally during the fall (October-November). Sampling occurs from Brownsville, Texas to Key West, Florida. Up to 200 stations are sampled in both state and federal waters. One 30-minute trawl tow is conducted at each station. Sampling occurs during the day and night. A 90-ft (headrope) high opening bottom trawl, with approximately 40-ft^2 trawl doors and cod-end mesh size of 1.75 in is used for sampling. Sampling depths range from approximately 150-1,500 ft. No BRDs/TEDs are used. A Simrad ME70 Multi-Beam Echosounder and/or EK60 Multi-frequency Split-beam Echosounder to produce estimates of the abundance and distribution of marine organisms and estimate water depth are generally used continuously during a cruise. An Acoustic Doppler Current Profiler is also used continuously during cruises and measures the magnitude and direction of water currents as a function of depth (B. Noble, NMFS Southeast Fisheries Science Center, pers. comm. to A. Herndon, NMFS, February 2016).

Juvenile Sport Fish Trawl Monitoring in Florida Bay (NMFS)

Sampling is conducted monthly, May through October or November in Florida Bay over 4-5 days. Approximately 500 stations are sampled annually. One trawl tow is conducted at each station. Sampling occurs during both daylight and nighttime hours. The trawl has an 11-ft head rope, 12.5-ft footrope equipped with a 3-mm galvanized tickler chain, 6-mm mesh in the body, and a 3-mm mesh tail bag. The mouth opening has an effective width of 7.1 ft. The trawl is towed at a speed of approximately 4 knots (to sample an area of about 500 m^2); tow time is 2 minutes. No BRDs/TEDs are used. The NMFS vessel *Whipray* is used in this sampling (J. Browder, NOAA, pers. comm. to A. Herndon, NMFS, July 2013).

Saint Andrew Bay Juvenile Reef Fish Trawl Survey (NMFS)

The study examines the variation of juvenile snapper and grouper densities in seagrass beds in St. Andrew Bay, Florida. Surveying occurs annually from May-November, once a week in St. Andrew Bay, Florida. Approximately 312 trawls are conducted annually; 13 trawls a week over 24 weeks. One trawl tow is conducted at each station. Sampling occurs during daylight hours. The trawl consists of an approximately 3-ft-wide, 10-inch-high metal frame, and a 2-mm mesh bag (approximately 9 ft long) sewn to the metal frame, is towed behind a boat for approximately 30 seconds to cover a distance of 165 ft (50 m). The trawl collects all epibenthic organisms living on or in the seagrass. A buoy is deployed to mark the beginning of each station so that the exact distance covered can

be measured with a laser range finder at the end of each trawl. The buoy is retrieved following the end of the trawl. No BRDs/TEDs are used. Sampling occurs out to a depth of 6 ft with tow times of no more than 30 seconds (A. David, NMFS, pers. comm. to A. Herndon, NMFS, January 2013).

Intraspecific Diversity in Pink Shrimp Trawl Survey (NMFS)

Sampling is conducted annually from June-August and occurs 4 times during that period. Sampling occurs in Florida Bay, Whitewater Bay, Fakahatchee Bay, Biscayne Bay, as well as the area of operation for the Sanibel and Tortugas shrimp fisheries. Within Biscayne Bay, Florida, sampling does not occur north of the Rickenbacker Causeway, in Miami Florida. Forty stations are sampled annually. Sampling occurs from 1-6 ft. One trawl tow is conducted at each station. Trawls target thick patches of *Thalassia* and *Halodule* seagrasses, where shrimp are most likely to occur. Sampling occurs only during daylight hours. The miniature roller-frame trawl consists of a 1,000 µm net that is 96 in long and attached to a rectangular frame of 1 in aluminum that forms the mouth of the trawl. The trawl mouth is 17 in high and 60 in wide. The trawl mouth is attached to, and supported on, a second bar of the same width as the bottom of the frame. A series of PVC "rollers" (10 in long, 2 in diameter) is attached to the support bar. The trawl is towed in an arc at a speed of 5 knots; tow times is approximately 5 minutes. No BRDs/TEDs are used (J. Browder, NOAA, pers. comm. to A. Herndon, NMFS 2013).

Environmental Influences on Pink Shrimp (Trawl) Survey (NMFS)

Sampling is conducted annually in June and August in Florida Bay and Whitewater Bay, Florida over 4-5 days. Forty stations are sampled per year; 1 trawl tow is conducted at each station. Sampling occurs during daylight hours. The trawl consists of a 1,000 µm net that is 96 in long and attached to a rectangular frame of 1-in aluminum that forms the mouth of the trawl. The trawl mouth is 17 in high and 60 in wide. The trawl mouth is attached to, and supported on, a second bar of the same width as the bottom of the frame. A series of PVC "rollers" (10 in length, 2 in diameter) is attached to the support bar. The trawl is towed in an arc at a speed of 5 knots; tow time is approximately 5 minutes. No BRDs/TEDs are used (J. Browder, NOAA, pers. comm. to A. Herndon, NMFS 2013).

IJA Inshore Finfish Trawl Survey (MDMR)

Surveying occurs during every month of the year in Mississippi's state waters from the upper reaches of Biloxi Back Bay, to an area approximately 2 miles south of the barrier islands outside of Dog Keys Pass in the Gulf of Mexico. Seventy-two stations are sampled annually (6 stations a month). One 10-minute trawl tow is conducted at each station. Sampling occurs during the day. A 16-ft otter trawl (¾-in-stretch nylon multifilament mesh, with a ¼-in mesh cod end), is used for sampling. Sampling depths range from 5-25 ft and no BRDs/TEDs are used (M. Brainard, MDMR, pers. comm. to A. Herndon, NMFS, October 2012).

IJA Oyster Dredge Monitoring Survey (MDMR)

Surveying occurs during every month of the year in Mississippi's state waters, at commercially important oyster reefs (Figure 2.7). Thirty-eight samples are taken during the year: 20 are taken on the Pass Christian Complex (Henderson Point, Pass Christian

Tonging and Dredging reefs), 4 samples on the Pass Marianne Reef, 4 on the Telegraph Reef, and 10 on the St. Joe Reef. Sampling occurs during the day. The oyster dredge has a 9-tooth bar and is approximately 20 in wide with teeth 4 in long and spaced 2 in apart, and dredge pulls are 1 minute long. Sampling depths range from 5-15 ft (M. Brainard, MDMR, pers. comm. to A. Herndon, NMFS, June 2012).

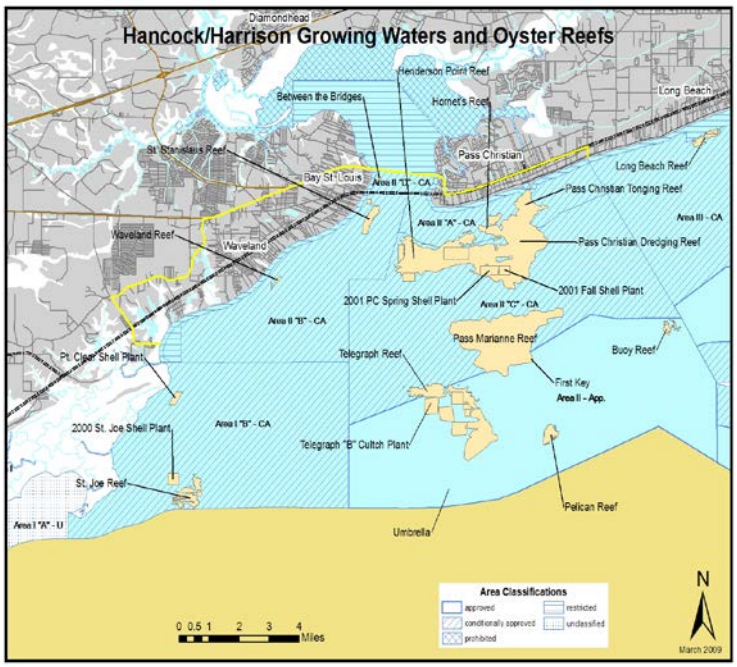

Figure 2.7. Commercially important oyster reefs
Source: Brainard 2009

IJA Biloxi Bay Beam Trawl Survey (MDMR)

Surveying occurs during every month of the year in Mississippi's state waters in Biloxi Bay. Up to 132 stations may be sampled annually, but samples are divided among the Mississippi IJA beach seine survey (see below), dependent upon station location and depth. One sweep is conducted at each station. Sampling occurs during the day. A 5-ft-wide beam trawl is pulled by hand to collect larvae samples. Trawl duration varies since it is pulled by hand, generally not more than 20 minutes. Sampling depths range from 1-5 ft and no BRDs/TEDs are used (M. Brainard, MDMR, pers. comm. to A. Herndon, NMFS, June 2012).

IJA Open Bay Shellfish Trawl Survey (TPWD)

Surveying occurs during every month of the year in Texas state waters in Galveston, Matagorda, Aransas, and Corpus Christi Bays and the lower Laguna Madre. Each bay system is divided into 2 strata - upper bay and lower bay - and one-half of the trawl samples is collected in each zone during each of the first half (1st-15th) and last half (16th-end) of each month. Sampling sites are selected at random. A total of 1,080 stations are sampled annually (90 stations a month). One 10-minute tow is conducted at each station. Sampling occurs during day. A 20-ft otter trawl (1½-in-stretch nylon multifilament mesh) with 48-in-long and 20-in-high trawl doors is used during sampling.

Sampling depths are 3-30 ft and no BRDs/TEDs are used (F. Martínez-Andrade, TPWD, pers. comm. to A. Herndon, NMFS, July 2012).

2.2.2.3 Caribbean

Caribbean Plankton Recruitment Experiment (Plankton Trawl) (NMFS)
Plankton surveys are conducted twice annually, in February and June to collect larvae for snapper, parrotfish, and grouper. The survey occurs in the U.S. Caribbean and Mexican waters out to about 330 ft. One trawl tow of each net is conducted at each sampling site and a maximum of 75 tows are conducted annually. Sampling is conducted both day and night. The bongo-towing frame consists of 2 circular frames, each 61 cm in diameter, connected by a central yoke to which the towing wire is attached. The towing frame is fitted with 2 cylindrical-conical fine mesh nets. Tow times are 30 minutes or less. Tows are conducted from the surface down to 300 ft with MOC samples collected approximately every 75 ft and surface tows at each station deeper than 75 m. No BRDs/TEDs are used. Research is conducted on the NOAA ship *Nancy Foster* (J. Lamkin, NMFS, pers. comm. to A. Herndon, NMFS, December 2012).

2.2.3 Net Gear Fisheries Independent Research Project

2.2.3.1 South Atlantic

ACFCMA American Shad Drift Gillnet Survey (SCDNR)
Surveying occurs from mid-January through mid-April, in multiple rivers in South Carolina including the Santee, Edisto, Waccamaw, and Combahee Rivers. Each week, 2-3 sampling trips are conducted during the sampling season, with 4 or 5 sets conducted during each trip, totaling about 120 sets annually. Sampling occurs during the day. A single gillnet of 5-in-stretch mesh, no longer than 450 ft in length and 22 ft deep, is deployed at each station. The net is set adrift, constantly tended, and soaks for 20 minutes. (A. Dukes, SCDNR, pers. comm. to A. Herndon, NMFS, October 2012).

RecFIN Red Drum Trammel Net Survey (SCDNR)
Sampling occurs every month in the coastal estuaries and rivers of South Carolina at depths 6 ft or less. The number of sets per station is variable, but 225 stations are sampled annually, with a maximum of 1,100 sets conducted annually. The gear is a trammel net made of 3 net panels. The center panel is 200 ft long and made of 2.5-in-stretched mesh. Two outer panels, each 200 ft long and made of 14-in-stretched mesh, flank the inner panel. All 3 panels are strung together and fished as a single gear. In total, the gear is 600 ft long and approximately 7 ft deep with a polyfoam float line and a lead core bottom line. The gear soaks for 10 minutes and is constantly tended. Sampling only occurs during the day (S. Arnott, SCDNR, pers. comm. to A. Herndon, NMFS, June 2013).

ACFCMA American Eel Fyke Net Survey (SCDNR)
Surveying occurs from February through April, at one sampling location in the Goose Creek Reservoir off the Cooper River, near Charleston, South Carolina. A single fyke

net is deployed at the sampling station (Figure 2.8). The net is left in the water for the entire sampling period (approximately 8 weeks). The station is sampled each day during the 8 week sampling period to collect a total of 40 samples every year. During the week, the end of the net is tied closed and sampled every 24 hours (i.e., once a day). No sampling occurs during the weekend and the net is untied to allow fish and eels to pass through. One end of the net is staked on the bank of the river, the net is stretched 2/3 of the way across the width of the river; the mesh is approximately ⅛ in. (Figure 2.9). The wings of the next are 18.8 ft x 9 ft funneling into 19-in diameter hoops leading to a codend. The headrope is 37.6 ft with a 700-micron mesh and 1-in^2 checkerboard grate over net opening. Sampling depths range from 1-7 ft (A. Dukes, SCDNR, pers. comm. to A. Herndon, NMFS, February 2012).

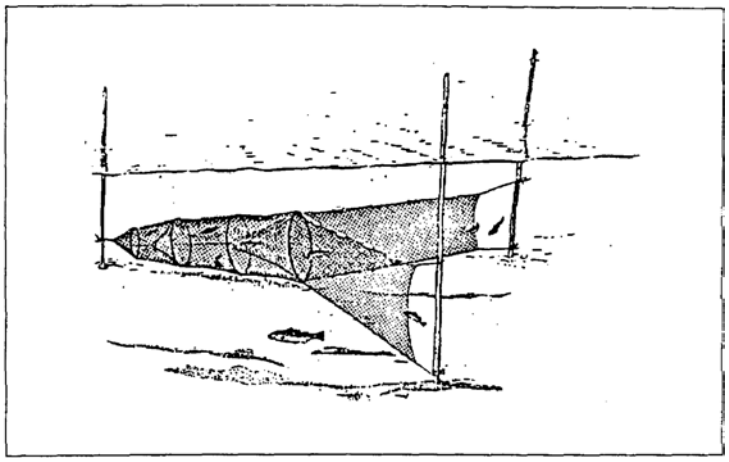

Figure 2.8. Example of a Fyke Net
Source: Nédélec and Prado 1990

Figure 2.9. Typical fyke net mesh size used in the American Eel Fyke Gillnet Survey
(Photo credit: B. Post SCDNR)

ACFCMA American Eel Fyke Net Survey (GADNR)

Surveying occurs from December through February and continues for 6 consecutive weeks once the first pulse of migrating young of year eels is detected. Sampling occurs in first order brackish water tributaries of the Altamaha Sound. Sampling is conducted 4 days a week for 6 weeks. During that period, a single fyke net is deployed at 2 sampling

stations. Both stations are sampled each day, for 48 samples every year. The net is left in the water for the entire sampling period (approximately 6 weeks). During the week, the end of the net is tied closed and sampled every 24 hours (i.e., once a day). No sampling occurs during the weekend and the net is untied to allow fish and eels to pass through. One end of the net is staked on the bank of the river, the net is stretched 2/3 of the way across the width of the river; the mesh is approximately 700 microns. The wings of the net are 18.8 ft by 9 ft funneling into 19-in diameter hoops leading to a codend. The headrope is 37.6 ft and 1-in^2 checkerboard grate over net opening. Sampling depths range from 1-8 ft (C. Belcher, GADNR, pers. comm. to A. Herndon, NMFS, January 2013).

2.2.3.2 Gulf of Mexico

HMS - GULFSPAN Gillnet Survey (University of West Florida)
This gillnet survey occurs in conjunction with the HMS - GULFSPAN Bottom Longline Survey (University of West Florida). Surveys occur bimonthly between May and September from Perdido Bay at the Florida-Alabama border west to the far end of Choctawhatchee Bay (including Big Lagoon, Pensacola Bay, East Bay, and Santa Rosa Sound). Up to 20 stations are sampled annually; 3 sets are conducted at each station. Sampling occurs during the day. The gear consists of 6 different stretched-mesh size panels, ranging from 3.0-5.5 in, in steps of 0.5 in. The 6 net panels are 3.0-, 3.5-, 4.0-, 4.5-, 5.0-, and 5.5-inch stretched mesh. All 6 panels are strung together and fished as a single gear. Each panel is 10 ft deep and 100 ft long. The gear is anchored with a large float on each end. The gear soaks for 30 minutes and is constantly tended (T. Daly-Engel, UWF, pers. comm. to A. Herndon, NMFS, May 2015).

HMS - GULFSPAN Gillnet Survey (Mote Marine Lab)
Sampling occurs in state waters off southwest Florida within Pine Island Sound in the Charlotte Harbor estuary. Sampling occurs yearly from May-September. Stations range in depth from approximately 2-15 ft, and all sampling is conducted during the day. Two different nets are used. The first consists of 6 different stretched-mesh size panels, ranging from 3.0-5.5 in, in steps 0.5 in. The 6 net panels are 3.0-, 3.5-, 4.0-, 4.5-, 5.0-, and 5.5-inch stretched mesh. All 6 panels are strung together and fished as a single gear. Each panel is 10 ft deep and 100 ft long. The second net is 4.5-in. stretched mesh, 10 ft deep and 1,200 ft long. Both sets of gear are anchored with 25-lb Danforth anchors with floats attached to the float line at 70-ft intervals. Up to 80 sets are conducted each year: 40 sets with each net and only 1 net is used during each set. Both nets soak for up to 1 hour and are constantly tended (B. Hueter, Mote Marine Lab, pers. comm. to A. Herndon, NMFS, June 2015).

HMS - GULFSPAN Gillnet Survey (USM/GCRL)
Sampling occurs during the day at 3 randomly generated stations each month (April to October), within the Mississippi Sound (Mississippi State waters only) in depths of approximately 3-30 ft. One set is conducted at each station for a maximum of 21 annually. The gear consists of 6 different stretched-mesh size panels, ranging from 3.0-5.5 in, in steps of 0.5 in. The 6 net panels are 3.0-, 3.5-, 4.0-, 4.5-, 5.0-, and 5.5-inch

stretched mesh. All 6 panels are strung together and fished as a single gear. Each panel is 10 ft deep and 100 ft long. The gear is anchored with a large float on each end. The gear soaks for 1 hour and is constantly tended (J. Hendon, USM/GCRL, pers. comm. to A. Herndon, NMFS, October 2012).

HMS - GULFSPAN Gillnet Survey (Florida State University)

Sampling occurs from Apalachicola Bay to Anclote Keys. The survey includes 2 fixed stations that are sampled monthly year-round and approximately 50 random stations sampled during summer; no more than 100 stations are sampled annually. The random stations are chosen using a spatially balanced sampling design based on the Generalized Random Tessellation Stratified method. Stations range in depth from approximately 3 to 30 ft, and all sampling is conducted during the day. The gear consists of 6 different stretched-mesh size panels, ranging from 3.0-5.5 in, in steps of 0.5 in. The 6 net panels are 3.0-, 3.5-, 4.0-, 4.5-, 5.0-, and 5.5-inch stretched mesh. All 6 panels are strung together and fished as a single gear. Each panel is 10 ft deep and 100 ft long. The gear is anchored with a large float on each end and the middle. The gear soaks for 1 hour and is constantly tended (D. Grubbs, Florida State University Coastal and Marine Laboratory, pers. comm. to A. Herndon, NMFS, November 2012).

HMS - GULFSPAN Gillnet Survey (NMFS)

Sampling occurs in 5 general areas along the panhandle of Florida: St. Andrew Bay, Crooked Island Sound, St. Joseph Bay, the Gulf of Mexico-side of St. Vincent Island, and Apalachicola Bay, Florida. The survey is conducted yearly from April to October, sampling once (up to 5 stations) in each area each month, or 150 stations annually. Stations are chosen in a random-haphazard design and range in depth from approximately 3-30 ft, and all sampling is conducted during the day. The gear consists of 6 different stretched-mesh size panels, ranging from 3.0-5.5 in, in steps 0.5 in. The 6 net panels are 3.0-, 3.5-, 4.0-, 4.5-, 5.0-, and 5.5-inch stretched mesh. All 6 panels are strung together and fished as a single gear. Each panel is 10 ft deep and 100 ft long. The gear is anchored with a large float on each end and the middle. The gear soaks from 15-30 minutes and is constantly tended (D. Bethea, NMFS Southeast Fisheries Science Center, pers. comm. to A. Herndon, NMFS, October 2012).

IJA Coastal Finfish Gillnet Survey (MDMR)

Surveying occurs during every month of the year in Mississippi's state waters. Four sampling stations are routinely sampled near the Pearl and Pascagoula Rivers, 2 samples are collected per station. One additional station is randomly sampled in 4 estuaries (Grand Bay National Estuarine Research Reserve, Biloxi Back Bay, St. Louis Bay, and Pascagoula River). Cumulatively, 8 stations are sampled each month with 96 sampled annually. Sampling occurs during the day. A single 750-ft-long, 6-ft-deep gillnet is deployed at each station. The gillnet consists of 5 panels, each with stretch-mesh sizes 2, 2½, 3, 3½, and 4 in, respectively; and each panel is 150 ft long. The net is anchored to shore and extends offshore; the last 50 ft of netting is curled back toward the beach to create a hook shape with the end of the net; the net soaks for 1 hr. Sampling depths range from 0-6 ft (M. Brainard, MDMR, pers. comm. to A. Herndon, NMFS, October 2012).

IJA Biloxi Bay Seine Survey (MDMR)
Surveying occurs during every month of the year in Mississippi's state waters in Biloxi Bay. Up to 132 stations are sampled annually (11 stations a month); sampling is divided with the Biloxi Bay Beam Trawl survey (see above) depending on location and depth. One pull is conducted at each station. Sampling occurs during the day. A 50-ft bag seine with ¼-in-bar mesh, 6-ft-deep lateral wings, and a 6-ft-wide central bag, is set by hand and pulled at various distances from the shoreline depending upon the topography of the bottom at each station. Sampling depths range from 1-5 ft and no BRDs/TEDs are used (M. Brainard, MDMR, pers. comm. to A. Herndon, NMFS, June 2012).

IJA Shoreline Shellfish Bag Seine Survey (TPWD)
Surveying occurs during every month of the year in Texas state waters in Galveston, Matagorda, Aransas, and Corpus Christi Bays and the lower Laguna Madre. One-half of the bag seine samples are collected in each bay during each of the first half (1st-15th) and last half (16th-end) of each month. Sampling sites are selected at random. A total of 1,200 stations are sampled annually (100 stations a month). One pull is conducted at each station. Sampling occurs during the day. A bag seine with 60-ft-long, 6-ft-deep lateral wings (½-in-stretch nylon multifilament mesh), with a 6-ft-wide central bag, is used for shoreline sampling. The net is extended and pulled 50 ft parallel to shore out to 40 ft offshore. Sampling depths range from 0-6 ft (F. Martínez-Andrade, TPWD, pers. comm. to A. Herndon, NMFS, July 2012).

Environmental Influences on Pink Shrimp (Seine) Survey (NMFS)
This project is conducted concurrently with the Environmental Influences on Pink Shrimp (Trawl) Survey (NMFS); 40 stations are sampled annually. One pull is conducted at each station. Sampling occurs during the day. The main net is 5-ft high by 16.5-ft wide with a 5-ft-long PVC pole at each end. The "sock" is located at the center of the net and is 9-ft long with a 50-inch diameter mouth that tapers down to a 10-in diameter at the tail (tied close, cod end). All parts of the net use 1,000 μm mesh. The bottom of the net is weighted with an enclosed leadline; the top is adorned with 10 evenly spaced 4-in-diameter floats. The net is set by hand and pulled at various distances from the shoreline depending upon the topography of the bottom at each station. Sampling depths range from 1-5 ft and no BRDs/TEDs are used (J. Browder, NOAA, pers. comm. to A. Herndon, NMFS 2013).

Intraspecific Diversity in Pink Shrimp (Seine) Survey (NMFS)
This project is conducted concurrently with the Intraspecific Diversity in Pink Shrimp (Trawl) Survey (NMFS); 40 stations are sampled annually. One pull is conducted at each station. Sampling occurs during the day. The main net is 5 ft high by 16.5 ft wide with a 5-ft-long PVC pole at each end. The "sock" is located at the center of the net and is 9 ft long with a 50-in-diameter mouth that tapers down to 10 in diameter at the tail (tied close cod end). All parts of the net use 1,000 μm mesh. The bottom of the net is weighted with an enclosed leadline; the top is adorned with 10 evenly spaced 4-in-diameter floats. The net is set by hand and pulled at various distances from the shoreline depending upon the topography of the bottom at each station. Sampling depths range from 1-5 ft and no

BRDs/TEDs are used (J. Browder, NOAA, pers. comm. to A. Herndon, NMFS, June 2015).

2.2.3.3 Caribbean

NONE

2.2.4 Fish Trap & Underwater Camera Fisheries Independent Research Projects

2.2.4.1 South Atlantic

MARMAP/SEAMAP-SA Reef Fish Survey (Fish Trap) (SCDNR)
This project is conducted simultaneously with the other MARMAP/SEAMAP-SA Reef Fish Surveys. Sampling locations are selected at random from 2,600 stations in the South Atlantic Bight (between 27°N and 34°N). Sampling occurs from April through October at stations at depths of approximately 300 ft; sampling occurs during daylight hours. Chevron traps (approximately 5 ft by 5.5 ft by 2 ft) with 1 funnel entrance are baited with clupeids (e.g., menhaden) and soak for 90 minutes. Up to 6 traps are set at each station and each trap has a single vertical line with a buoy attached, totaling no more than 600 trap deployments annually. This research is conducted almost exclusively on R/V *Palmetto* (M. Reichert, SCDNR, pers. comm. to A. Herndon, NMFS, July 2012).

MARMAP/SEAMAP-SA Reef Fish Survey (Underwater Still and Video Cameras) (SCDNR)
The underwater video camera is used opportunistically to investigate bottom habitat and verify habitat type in the South Atlantic Bight (between 27°N and 34°N). Underwater video recordings are made using an Outland Technology's pan and tilt (Model UWC-185/c) color camera mounted on an underwater camera sled frame during daylight hours. The framed camera is tethered to the vessel using a wire cable and is lowered to approximately 3-15 ft off the sea floor. The sled is towed by drifting with small speed and direction changes while under vessel engine power. In addition, a Nikon S210 or S220 camera housed in an Ikelite underwater housing and a Canon video camera in an underwater housing are mounted on the top of Chevron traps during sampling. The still cameras produce a sequence of shots, obtained at 5-minute intervals, utilizing the camera's time-elapse photo feature. The video camera makes a recording during the soaking of the gear. Sampling occurs from April through October at all MARMAP chevron trap stations (see description above). A Nikon S210 or S220 camera housed in an Ikelite underwater housing is mounted on the top outside edge of the Chevron trap, facing the trap's entrance funnel. A sequence of shots is obtained at 5-minute intervals utilizing the camera's time-elapse photo feature. This research is conducted on R/V *Palmetto* (M. Reichert, SCDNR, pers. comm. to A. Herndon, NMFS, July 2012).

Southeast Fishery-Independent Survey (SEFIS) Reef Fish Trap with Camera Survey (NMFS)

Sampling occurs from Cape Hatteras, North Carolina, to St. Lucie Inlet, Florida; approximately 900 stations are sampled annually on average, with a maximum of 1,200 stations. Sampling occurs from April through October at depths between 50 and 300 ft, with most at depths between 100 and 180 ft; traps are only deployed during daylight hours. One trap is deployed at each station and each trap has a single vertical line with 2 buoys attached. Chevron traps (approximately 6 ft by 6 ft by 2 ft) with 1 funnel entrance (approximately 6 in wide) are baited with menhaden and soak for 90 minutes. One Canon high-definition video camera is attached to the top of the trap and faces outward over the mouth of the trap. An additional GoPro camera is also attached to the trap and faces the other direction. This research is conducted on R/V *Savannah* and the NOAA ship *Pisces*. A Simrad ME70 Multi-Beam Echosounder and/or EK60 Multi-frequency Split-beam Echosounder to produce estimates of the abundance and distribution of marine organisms and estimate water depth are generally used continuously during a cruise. An Acoustic Doppler Current Profiler is also used continuously during cruises and measures the magnitude and direction of water currents as a function of depth (B. Noble, NMFS Southeast Fisheries Science Center, pers. comm. to A. Herndon, NMFS, February 2016).

IBBEAM - Integrated Biscayne Bay Ecological Assessment and Monitoring Project (Fish Trap) (NMFS)

This visual and fish "throw-trap" survey occurs twice annually from May-October and November-April along the western shoreline of Biscayne Bay (from Shoal Point to Turkey Point), Florida. A maximum of 140 stations are sampled annually. For the visual survey, divers with snorkels and masks swim along established visual belt-transects (60 m^2 sampled) recording the fish species encountered over the course of 100 dives annually. A SEFSC small boat (either the *Privateer* or the *Polar*) is used for this activity.

The fish "throw-trap" is used in open water less than 3 ft deep. Up to 372 casts are conducted annually. An open-ended, solid-sided square aluminum box measuring 1-m^2 by 45-cm tall (1 m^2 throw-trap) tossed from a boat entraps small fish and macroinvertebrates living on or near a bottom usually vegetated with seagrass or macroalgae but sometimes bare. Panels of 3-mm stretched mesh attached to opposite sides of the frame are used to cover the top in water greater than 45 cm deep. Samples are removed from the trap with 4 sweeps of a seine (also 3-mm stretched mesh) on a frame that closely fits the throw-trap width. The 3 throw-trap samples are retained separately and returned to the lab for sorting, identification, and data entry. Organisms primarily sampled include penaeid and caridean shrimps, crabs, and small fishes. The SEFSC vessel *HMS Miller*, a shallow-draft, wide-beamed catamaran is employed for this activity (J. Browder, NMFS, pers. comm. to A. Herndon, NMFS, January 2013).

2.2.4.2 Gulf of Mexico

SEAMAP-GOM Reef Fish Monitoring Survey (Underwater Camera) (FFWCC)
Surveys occur during May-October. This survey is conducted along the west-central Florida shelf between the Alabama border and the Dry Tortugas, Florida. A stratified-random sample design is employed to select sample sites from NMFS statistical zones 2 (Gulf of Mexico side only) - 10 (Figure 2.10). Approximately 75 stations are sampled in each statistical zone, with no more than 750 stations sampled annually. Habitat types are identified using side-scan sonar. If hard corals are identified via sonar, the gear is deployed in sand patches adjacent to reef habitat. Sampling depths range from approximately 15-350 ft and all sampling occurs during daylight hours. Two stationary camera arrays are deployed at each station. Each array measures approximately 2.2- by 2.2-ft and consists of 2 stationary imaging system units consisting of a custom-milled aluminum housing containing a PC-104 form factor custom-built computer connected to 2 remote black and white stereo video camera heads placed at a baseline spacing 20 cm. Each array is also equipped with a light sensor, compass, and water quality datasonde to record environmental data. At 1 end of the housing are 3 glass lens plates: 1 for a color video camera (KT&C KPC-650CHQ), the other 2 for a black-and-white stereo still camera (Videre STH-MDCS) containing 2 lenses separated by 9 cm. On the opposite end of the housing are a SEACON 4-pin power and 6-pin data connectors. The array is lowered to the bottom and is attached to a float by line; each array is also equipped with an emergency pop-up buoy in case the line is cut. Arrays generally soak for 1 hour. (T. Switzer, FFWCC, pers. comm. to A. Herndon, NMFS, April 2016).

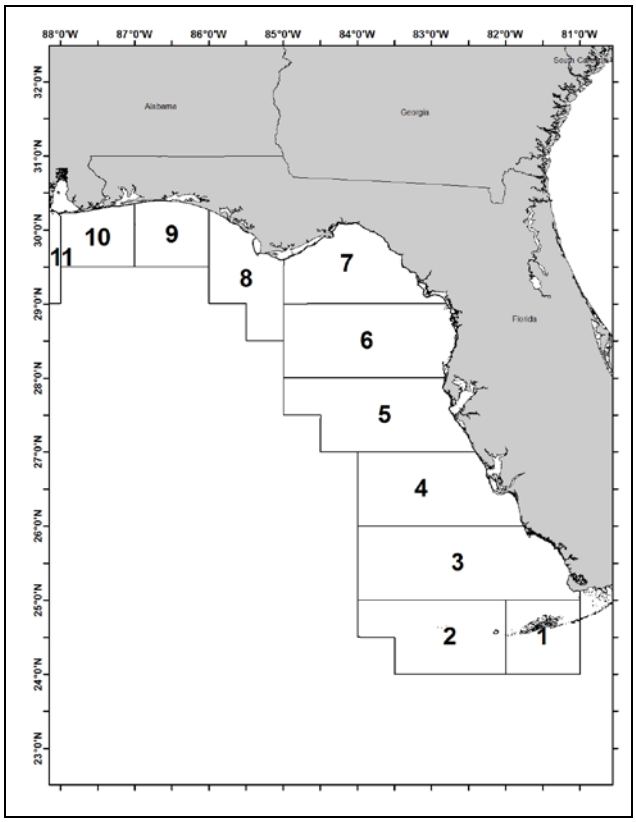

Figure 2.10 NMFS Statistical Zones

SEAMAP-GOM Reef Fish Monitoring Survey (Fish Trap) (FFWCC)
This project is conducted concurrently with the SEAMAP-GOM Reef Fish Survey (Underwater Camera) (FFWCC). Surveys occur during May - October. This survey is conducted along the west-central Florida shelf between the Alabama border and the Dry Tortugas, Florida. Sampling occurs at stations ranging in depth from approximately 15-350 ft, and all sampling occurs during daylight hours. Chevron traps with 1 funnel entrance or Z-traps with 2 funnel entrances (both types are approximately 5 ft by 5.5 ft by 2 ft) are baited with Atlantic mackerel, and soak for 90 minutes. Up to 3 traps are set at each station and each trap has a single vertical line with a buoy attached, totaling approximately 150 stations annually. All traps are equipped with a timed-release blow-out panel to prevent ghost fishing should the trap be lost. This research is conducted on R/Vs *Weatherbird II* or *Belows* (T. Switzer, FFWCC, pers. comm. to A. Herndon, NMFS, April 2016).

SEAMAP-GOM Reef Fish Survey (Fish Trap) (NMFS)
Sampling occurs from April through July each year in association with topographic features (banks, ledges) located on the continental shelf of the Gulf of Mexico in the area from Brownsville, Texas, to Dry Tortugas, Florida. Since the survey area is large, a 2-stage sampling design is used to minimize travel time between sample stations. The first-stage, or PSUs, are blocks 10 minutes of latitude by 10 minutes of longitude. The first-stage units are selected by stratified random sampling, with stratum boundaries defined by geographic region (4 regions: South Florida, Northeast Gulf, Louisiana-Texas Shelf, and South Texas), and by reef habitat area (blocks 20 km^2 reef, block > 20 km^2 reef); there are a total of 7 strata. Approximately 100 stations are sampled, annually, and up to 2 traps are deployed at each station, at depths ranging from 15-300 ft and all sampling occurs during daylight hours. A chevron (or arrow) 6- by 6-ft fish trap with 1.5-in vinyl-clad mesh is used to capture fish. An approximately 1.5-ft by 1-ft escape panel is placed on 1 side and kept closed using 7-day magnesium releases. Traps are baited with squid or mackerel and soak for 1 hour. A Simrad ME70 Multi-Beam Echosounder and/or EK60 Multi-frequency Split-beam Echosounder to produce estimates of the abundance and distribution of marine organisms and estimate water depth are generally used continuously during a cruise. An Acoustic Doppler Current Profiler is also used continuously during cruises and measures the magnitude and direction of water currents as a function of depth (B. Noble, NMFS Southeast Fisheries Science Center, pers. comm. to A. Herndon, NMFS, February 2016).

SEAMAP-GOM Reef Fish Survey (Underwater Camera) (NMFS)
This project is conducted concurrently with the SEAMAP-GOM Reef Fish Survey (Fish Trap) (NMFS). Sampling occurs from April through July each year in association with topographic features (banks, ledges) located on the continental shelf of the Gulf of Mexico in the area from Brownsville, Texas, to Dry Tortugas, Florida. Since the survey area is large, a 2-stage sampling design is used to minimize travel time between sample stations. The first-stage, or PSUs, are blocks 10 minutes of latitude by 10 minutes of longitude. The first-stage units are selected by stratified random sampling, with stratum boundaries defined by geographic region (4 regions: South Florida, Northeast Gulf,

Louisiana-Texas Shelf, and South Texas), and by reef habitat area (blocks # 20 km² reef, block > 20 km² reef). There are 7 strata. A maximum of 600 stations are sampled at depths no greater than 500 ft and all sampling occurs during daylight hours with a camera array. The camera array consists of 4 cylindrical pressure housings positioned orthogonally and center mounted at a height of 51 cm above the bottom of the array. Each housing consists of 4 color MPEG cameras with paired black-and-white Videre stereo cameras. The array, 63 inches in diameter and 33 inches tall, is lowered to the bottom and is attached to a float by line. It is baited with squid and soaks for 30 minutes. A Simrad ME70 Multi-Beam Echosounder and/or EK60 Multi-frequency Split-beam Echosounder to produce estimates of the abundance and distribution of marine organisms and estimate water depth are generally used continuously during a cruise. An Acoustic Doppler Current Profiler is also used continuously during cruises and measures the magnitude and direction of water currents as a function of depth (B. Noble, NMFS Southeast Fisheries Science Center, pers. comm. to A. Herndon, NMFS, February 2016).

Northeast Gulf of Mexico Marine Protected Area (MPA) Abundance Survey (Underwater Camera) (NMFS)

The survey is conducted within the boundaries of Madison-Swanson and Steamboat Lumps Marine Protected Areas, and a control area on the west Florida shelf known as the Twin Ridges to document the relationship between habitat and species assemblages and track changes in reef fish abundance and distribution over time. A stratified-random sample design is employed to select sample sites within each MPA. Sites at Twin Ridges are selected randomly. A maximum of 200 stations are sampled at depths no greater than 500 ft, and all sampling occurs during daylight hours with a camera array. The camera array consists of 4 cylindrical pressure housings positioned orthogonally and center mounted at a height of 51 cm above the bottom of the array. Each housing consists of 4 color MPEG cameras with paired black-and-white Videre stereo cameras. The array is lowered to the bottom and is attached to a float by line. It is baited with squid and soaked for 30 minutes. Research is conducted aboard the R/Vs *Carretta, Harold B,* and *Grayling* (B. Noble, NMFS Southeast Fisheries Science Center, pers. comm. to A. Herndon, NMFS, December 2014).

Panama City Laboratory Reef Fish Survey (Video) (NMFS)

Sampling occurs from May through September each year near rocky reefs and live bottom in inner and mid-shelf waters from Destin, Florida, to Cedar Key, Florida. A maximum of 200 stations annually are sampled at depths from 8-50 m and all sampling occurs during daylight hours with a camera array. The camera array consists of 4 cylindrical pressure housings positioned orthogonally and center mounted at a height of 51 cm above the bottom of the array. Each housing consists of 4 color MPEG cameras with paired black-and-white Videre stereo cameras. The array has a diameter of 63 in and is 33 in tall. It is lowered to the bottom and attached to a float by line. The array is baited with Atlantic mackerel and soaks for 30 minutes. Research is conducted aboard the NOAA R/Vs *Harold B* and *Caretta* (D. Devries, NMFS, pers. comm. to A. Herndon, NMFS, December 2012).

Panama City Laboratory Reef Fish Survey (Fish Trap) (NMFS)
This project is conducted concurrently with the Panama City Laboratory Reef Fish Survey (Video) (NMFS). Sampling occurs from May through September each year near rocky reefs and live bottom in inner and mid-shelf waters from Destin, Florida, to Cedar Key, Florida. A maximum of 100 stations are sampled annually, and up to 4 traps are deployed daily (1 per station) at depths ranging from 8-50 m, and all sampling occurs during daylight hours. A 6- by 6-ft chevron (or arrow) fish trap with 1.5-in vinyl-clad mesh and a single oval opening that is 7.5 in wide and 11.5 in tall is used to capture fish. An approximately 1.5-ft by 1-ft escape panel is placed on 1 side and kept closed using 7-day magnesium releases. Traps are baited with 3 Atlantic mackerel and soaked for 1.5 hours. Each trap is attached to 1 large (16-in-diameter) polyball buoy with a smaller (8-in-diameter) trailing polyball buoy. Research is conducted aboard the NOAA R/Vs *Harold B* and *Caretta* (D. Devries, NMFS, pers. comm. to A. Herndon, NMFS, December 2012).

Panama City Laboratory Remotely Operated Vehicle (ROV) Reef Fish Survey (NMFS)
Sampling occurs annually in October and November in the Northeast Gulf of Mexico on the inner to mid-shelf off Panama City, Florida. A maximum of 17 stations are sampled at depths from 25-50 m and all sampling occurs during daylight hours with a mini-ROV. The ROV is attached to a heavy weight deployed directly below the stern of the vessel. The ROV is attached to the weight by a 300-ft tether and is constantly monitored. An operator aboard the vessel controls the mini-ROV, which uses a color video camera and scaling lasers to count and measure fish. Per reef, 2-4 transect surveys are conducted, followed by a 30-minute random search for cryptic and rare species and to collect size data using the scaling lasers. The ROV is never baited and usually soaks 1 hour (D. Devries, NMFS, pers. comm. to A. Herndon, NMFS, December 2013).

2.2.4.3 Caribbean

Caribbean Reef Fish Survey (Underwater Camera) (NMFS)
This project is conducted concurrently with the other portions of the Caribbean Reef Fish Survey (NMFS). This survey would be opportunistically completed every other calendar year. The objective of the cruise is to determine the relative abundance of reef fish on the shelf waters of Puerto Rico and United States Virgin Islands (USVI). A maximum of 400 stations are sampled at depths no greater than 550 ft. The camera array is baited with squid and consists of 4 cylindrical pressure housings positioned orthogonally and center mounted at a height of 51 cm above the bottom of the array. Each housing consists of 4 color MPEG cameras with paired black-and-white Videre stereo cameras. The array, 63 inches in diameter and 33 in tall, is lowered to the bottom and is attached to a float by line. Underwater camera sampling would occur only during daylight hours, with the first gear deployment 1 hour after sunrise and the last gear retrieval 1 hour prior to sunset. The camera array would soak for 30 minutes. A Simrad ME70 Multi-Beam Echosounder and/or EK60 Multi-frequency Split-beam Echosounder to produce estimates of the abundance and distribution of marine organisms and estimate water depth are generally used continuously during a cruise. An Acoustic Doppler Current Profiler is also used continuously during cruises and measures the magnitude and direction of water currents

as a function of depth (B. Noble, NMFS Southeast Fisheries Science Center, pers. comm. to A. Herndon, NMFS, February 2016).

Caribbean Reef Fish Survey (Fish Trap) (NMFS)
This project is conducted concurrently with the other portions of the Caribbean Reef Fish Survey (NMFS). This survey would be opportunistically completed every other calendar year. The objective of the cruise will be to determine the relative abundance of reef fish on the shelf waters of Puerto Rico and USVI. The gear will be deployed at night and soak for 1 hour at sites selected by stratified sampling. The number of stations sampled annually is highly variable due to the opportunistic nature of the survey; however, no more than 100 traps will be deployed in any given year. A 6- by 6-ft chevron (or arrow) fish trap with 1.5-in vinyl-clad mesh and a single oval opening that is 7.5 in wide and 11.5 in tall is baited with squid or Atlantic mackerel and is used to capture fish. An approximately 1.5-ft by 1-ft escape panel is placed on 1 side and kept closed using 7-day magnesium releases. A Simrad ME70 Multi-Beam Echosounder and/or EK60 Multi-frequency Split-beam Echosounder to produce estimates of the abundance and distribution of marine organisms and estimate water depth are generally used continuously during a cruise. An Acoustic Doppler Current Profiler is also used continuously during cruises and measures the magnitude and direction of water currents as a function of depth (B. Noble, NMFS Southeast Fisheries Science Center, pers. comm. to A. Herndon, NMFS, February 2016).

2.2.5 Visual Survey Fisheries Independent Monitoring Projects

2.2.5.1 South Atlantic

NONE

2.2.5.2 Gulf of Mexico

IJA Oyster Visual Monitoring Survey (MDMR)
Surveying occurs during the month before and after the close of the Mississippi season, which opens in September/October and runs through April/May of the following year. Twenty sampling stations are randomly selected from reefs in Mississippi State waters. Divers using SCUBA gear conduct sampling during the day. All sampling occurs in waters at 5-15 ft depth (M. Brainard, MDMR, pers. comm. to A. Herndon, NMFS, June 2012).

Reef Fish Visual Census Survey – Dry Tortugas, Florida (NMFS)
Surveying occurs annually from May-September near the Dry Tortugas in the Gulf of Mexico, in waters less than 100 ft deep; no resources are extracted. SCUBA divers with meter sticks, 30-cm rulers, and digital cameras visually collect data on the abundance and size of reef fish, and habitat features. Up to 300 stations are sampled annually, at randomly selected 15-m-diameter plots (J. Bohnsack, NMFS, pers. comm. to A. Herndon, NMFS, November 2013).

Reef Fish Visual Census Survey – Florida Keys/SE Florida Shelf (NMFS)
Surveying occurs annually from May through September in the Florida Keys and Florida Shelf, in waters less than 100 ft deep; no resources are extracted. SCUBA divers with meter sticks, 30-cm rulers, and digital cameras visually collect data on the abundance and size of reef fish, and habitat features. Up to 300 stations are sampled annually, at randomly selected 15-m-diameter plots (J. Bohnsack, NMFS, pers. comm. to A. Herndon, NMFS, November 2013).

Florida/Dry Tortugas Coral Reef Benthic Survey (NMFS)
Surveying occurs quarterly to annually and may occur at any time of year though it is more likely in May-October. Survey area encompasses federal and state waters in Florida from the Dry Tortugas to Martin County. SCUBA divers use transect tapes and/or measurement rods and hand-held photography to collect data on the abundance and size of reef fish, and habitat features. Occasionally, benthic samples are collected (e.g., algae, coral biopsies) by divers with hand tools for vouchers, genotyping, condition assessment, etc. Divers use care to minimize contact with sensitive benthic organisms. Maximum days of sampling is 100 per year; 300 stations are sampled annually. Sampling is conducted during daylight hours. Sampling is conducted from a range of vessel types, primarily NOAA small boats, but also includes contract vessels and other agency small boats (e.g., state/territory, National Park Service, and/or NGO partners) (M. Miller, NMFS, pers. comm. to A. Herndon, NMFS, December 2012).

Tortugas Ecological Reserve Survey (NMFS)
Surveying occurs biennially in June or July in the Tortugas Ecological Reserve in the Gulf of Mexico; no resources are extracted. SCUBA divers swim transects to identify and count all species of snapper/grouper/other predators seen on the transect swim out. Transects are conducted at 16 stations with each sampled up to 3 times; transects are 30 m (M. Burton, NMFS, pers. comm. to A. Herndon, NMFS, 2012).

2.2.5.3 Caribbean

SEAMAP-C Queen Conch Visual Surveys (PR-DNER)
Surveying occurs from July to November, on the east, west, and south coast platforms of Puerto Rico. One hundred sampling stations are selected at random: 40 are located on the west platform, 40 on the east platform, and 20 on the south platform. Surveys are conducted during the day by divers using SCUBA gear and underwater scooters. Sampling occurs primarily in territorial waters at depths of 10-90 ft, though some sampling occurs in federal waters (A. Rosario Jimenez, PR-DNER, pers. comm. to A. Herndon, NMFS, July 2012).

SEAMAP-C Queen Conch Visual Surveys (USVI-DFW)
Surveying occurs during the conch seasonal closure period (June 1-October 31) at historically surveyed sites; no queen conch are extracted. Up to 62 surveys are conducted annually, during the day by divers using SCUBA gear and underwater scooters. Sampling occurs in territorial waters and the exclusive economic zone (EEZ) at 20-90 ft depth (R. Pemberton, USVI-DFW, pers. comm. to A. Herndon, NMFS, October 2012).

Caribbean Coral Reef Benthic Survey (NMFS)
Surveying occurs annually to triennially and may occur at any point during the year but will most likely occur from May through October. Sampling occurs in the territorial waters around Puerto Rico, USVI, and Navassa, in waters 100 ft deep or less. SCUBA divers use transect tapes and/or measurement rods and hand-held photography. Occasionally, benthic samples are collected (e.g., algae, coral biopsies) by divers with hand tools for vouchers, genotyping, condition assessment, etc. Divers use care to minimize contact with sensitive benthic organisms. Sampling is conducted during daylight hours. No more than 30 days of sampling would occur with a maximum of 300 stations sampled annually. Sampling is conducted from a range of vessel types, primarily NOAA boats, but also including contract vessel and other agency small boats (e.g. state/territory, National Park Service, and or NGO partners). (M. Miller, NMFS, pers. comm. to A. Herndon, NMFS, December 2012).

Reef Fish Visual Census Survey - Caribbean (NMFS)
Surveying occurs annually from May through September in Puerto Rico and USVI, in waters less than 100 ft deep; no resources are extracted. SCUBA divers with meter sticks, 30-cm rulers, and digital cameras visually collect data on the abundance and size of reef fish, and habitat features. Up to 300 stations are sampled annually, at randomly selected 15-m-diameter plots (J. Bohnsack, NMFS, pers. comm. to A. Herndon, NMFS, November 2012).

2.2.5 Other Gear Fisheries Independent Research Projects

2.2.5.1 South Atlantic

SEAMAP-SA Juvenile Grouper (Gag) Ingress Study (SCDNR)
Survey uses juvenile fish collectors (Witham collectors). Sampling (examination of the collectors) occurs 2-3 times per week from mid-March through mid-June, occasionally until the end of June. The surveys occur at a number of locations in Georgia, South Carolina, and North Carolina (see Table 2.2). At each site, 4 Witham collectors are deployed in intertidal creeks, approximately 100 ft apart, totaling 60 collectors in the entire region. Witham collectors consist of air conditioner filter material (Precisionaire hoghair) folded over a PVC frame of size roughly 18 in by 18 in. Collectors are floated off the bottom and anchored with a single line to the bottom in tidal creeks that are about 3 ft deep at low tide. A variety of small boats (17-25 ft) with outboard engines are used for deployment, sampling and retrieval of the Witham collectors (M. Reichert, SCDNR, pers. comm. to A. Herndon, NMFS 2013).

Table 2.2. Juvenile Grouper (Gag) Ingress Study Sites

Geographic Location	Site Location	Location Coordinates
Swansboro, NC	Burden Channel	34º 66.873 N, 77º 08.772 W
	Hammock Beach	34º 64.373 N, 77º 13.363 W
Wilmington, NC	Hewlett Creek	34º 10.56 N, 77º 50.18 W
	Motts Creek	34º 12.32 N, 77º 48.30 W
Georgetown, SC	Baruch A	33º 21.1 N, 79º 10.8 W
	Baruch B	33 21.0 N, 79 10.8 W
Charleston, SC	Conch Creek	32º 47.0 N, 79º 50.3 W
	Inlet Creek	32º 47.4N, 79º 49.7 W
	Price Creek	32º 52.6 N, 79º 42.3W
Beaufort, SC	Station Creek A	32º 16.8 N, 80º 37.5 W
	Station Creek B	32º 17.6 N 80º 37.6 W
Savannah, GA	Newell Creek	31º 74.843 N, 81º 16.638 W
	Ossabaw Island	31º 73.938 N, 81º 14.426 W
Brunswick, GA	Barbour River	31º 56.099 N, 81º 23.773 W
	Todd River	31º 56.361 N, 81º 21.854 W

U.S. South Atlantic Marine Protected Area (MPA) Mapping Survey (NMFS)
The survey maps 5 Marine Protected Areas off the southeast coast between Jacksonville, Florida and Cape Fear, North Carolina. These MPAs are located on or near the continental shelf edge and cover benthic habitats at depths between 260 and 1,950 ft. One survey is conducted annually; generally, these occur during summer months (May-August), but may vary depending on vessel availability. Survey duration is normally 14 days at sea aboard NOAA ships *Nancy Foster* or *Pisces*, or a chartered vessel. The mapping is done via ROVs and acoustic equipment. The ROV is a Phantom S2; it is attached to a piece of equipment deployed to measure water characteristics with a 100-ft tether. Once at depth, the ROV is deployed from this piece of equipment and conducts transects over high relief bottom, staying within 15 ft of the bottom. Approximately 40 ROV deployments occur in a given year. Generally, 2-3 dives are conducted per day with each dive lasting 2-3 hours. No baits are ever used (A. David, NMFS Southeast Fisheries Science Center, pers. comm. to A. Herndon, NMFS, February 2013).

Acoustic equipment is also used to map benthic habitats and detect mid-water fish assemblages. The acoustic survey equipment consists of a Simrad ME70 Multi-Beam Echosounder and/or EK60 Multi-frequency Split-beam Echosounder. The frequencies used during the surveys are 18, 38, 70, 120, and 200 kilohertz (kHz). The transducers for the acoustic equipment are mounted to the hull of a vessel. The vessel then runs parallel tracks over the bottom, trying to achieve approximately 25% overlap with the previous track. Mapping occurs during the night when the vessel is not transiting between stations (generally every other night). During the course of a 14-day cruise, acoustic gear is deployed no more than 25 times and for a period ranging from 6-12 hours. No baits are ever used (A. David, NMFS Southeast Fisheries Science Center, pers. comm. to A. Herndon, NMFS, February 2013).

Beaufort Bridgenet Plankton Survey (NMFS)
Sampling generally occurs from November to May, but in some years occurs year round. Sampling occurs at up to 7 stations during each survey. Sampling occurs from a fixed platform attached to the Pivers Island Bridge in Beaufort, North Carolina. Sampling occurs once weekly during the nighttime flood tide (i.e., between ~ 8 pm and 5 am) and samples are collected from the surface waters (i.e., 0-3 ft). The collection gear is a 2-m^2 rectangular plankton net with 1 mm mesh, fitted with a flow meter. No BRDs/TEDs are used (T. Kellison, NMFS, pers. comm. via M. Cook, NMFS, to A. Herndon, NMFS, November 2012).

RecFIN Red Drum Electrofishing Survey (SCDNR)
Sampling occurs every month in the coastal estuaries and rivers of South Carolina at depths 6 ft or less. One set is conducted per station and up to 360 stations are sampled annually (30 per month). An 18-ft Smith-Root electrofishing boat is used to conduct the sampling. The boat operates at approximately 3000 watts pulsed direct current. The electric field extends less than 20 ft horizontally and approximately 6 ft vertically from the electrofishing vessel and is influenced by environmental factors (conductivity of water, water temperature, salinity, etc.). The boat drifts with the current or operates at idle speed along the river bank (Figure 2.11). The electricity is turned on for 15 minutes at a time and sampling only occurs during the day. Stunned fish are collected via dip nets, measured, and returned to the river. A small subset of fish collected is retained for aging and reproductive studies (S. Arnott, SCDNR, pers. comm. to A. Herndon, NMFS, August 2015).

Figure 2.11 Example of Electrofishing
(Photo credit: S. Arnott, SCDNR)

2.2.5.2 Gulf of Mexico

Environmental Influences on Pink Shrimp (Dip Net) Survey (NMFS)
This project is conducted concurrently with the Environmental Influences on Pink Shrimp (Trawl) Survey (NMFS). This project is conducted concurrently with the Environmental Influences on Pink Shrimp (Trawl) Survey (NMFS). Up to 40 stations are sampled annually, during the day. Dip nets consist of a long pole with a 19-in-diameter net at the end, made of ¼-inch mesh. A researcher generally stands at the bow or stern of the boat and lowers the net into the water to collect a sample. Sampling depths range from generally range from 1-5 ft and no BRDs/TEDs are used (J. Browder, NOAA, pers. comm. to A. Herndon, NMFS 2013).

Intraspecific Diversity in Pink Shrimp (Dip Net) Survey (NMFS)
This project is conducted concurrently with the Intraspecific Diversity in Pink Shrimp (Trawl) Survey (NMFS). Up to 40 stations are sampled annually, during the day. Dip nets consist of a long pole with a 19-in-diameter net at the end made of ¼-inch mesh. A researcher generally stands at the bow or stern of the boat and lowers the net into the water to collect a sample. Sampling depths generally range from 1-5 ft and no BRDs/TEDs are used (J. Browder, NOAA, pers. comm. to A. Herndon, NMFS, June 2015).

2.2.5.3 Caribbean

SEAMAP-C Spiny Lobster Artificial Habitat Surveys (PR-DNER)
Surveying occurs monthly, on the west coast platform of Puerto Rico. Ten shelters are deployed at each of 6 permanent stations for a total of 60 (Figure 2.12). Shelters are deployed in a line approximately 100 ft apart. Each shelter is 16 cement blocks; 8 of the blocks are placed on the sea floor forming a square shape, 2 cement blocks per side. The other 8 blocks are placed on top of the first layer of blocks (Figure 2.13). The blocks are tied to each other with nylon rope. Sampling is done monthly between the full and the new moon. During sampling, divers inspect each shelter once a month and count the number of juvenile lobsters in the shelter. Lobsters are measured using a measuring stick. All habitat building materials are carried to the sampling locations and assembled by divers on seagrass habitats. All sampling occurs in territorial waters at 10-90 ft depth. Sampling occurs during the day (Jiménez 2009).

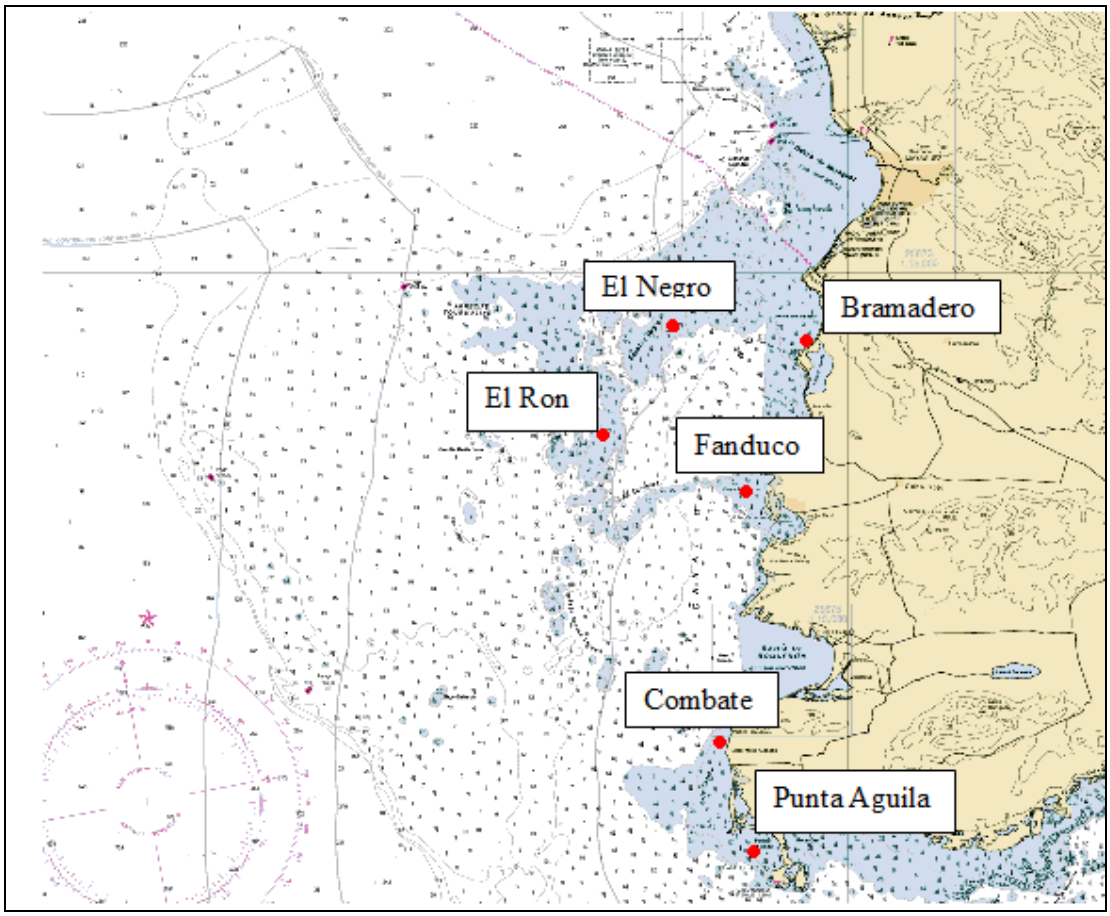

Figure 2.12. Location of spiny lobster artificial habitats (Jiménez 2009).

Figure 2.13. Typical array for spiny lobster artificial habitat surveys
(Photo credit: V.S. Matos)

SEAMAP-C Spiny Lobster Artificial Habitat Surveys (USVI-DFW)

Surveying occurs monthly, in territorial waters and the EEZ of the contiguous USVI. Two sets of 10 shelters are deployed, 1 set on St. Thomas/St. John and 1 set on St. Croix, for a total of 20. Shelters are deployed on flat substrate sites, preferably in seagrass area blowout holes near mangrove areas, in water depths between approximately 6-10 ft. Each shelter is 16 cement blocks; 8 of the blocks are placed on the sea floor forming a

square shape, 2 cement blocks per side. The other 8 blocks were placed on top of the first layer of blocks (same as in Figure 2.9). The blocks are tied to each other with nylon rope. Sampling is done monthly between the full and the new moon. During sampling, divers inspect each shelter once a month and count the number of juvenile lobsters in the shelter. Lobsters are measured using a measuring stick. All habitat building materials are carried to the sampling locations and assembled by divers. Sampling occurs during the day (R. Pemberton, USVI-DFW, pers. comm. to A. Herndon, NMFS, October 2012).

2.3 Action Area

The action area for a Biological Opinion is defined as the area affected, directly or indirectly, by the action and not merely the immediate area where the action occurs. FIM can occur anywhere in federal or state/territorial waters depending on the targeted species, sampling design, and the purpose of the research. Some limited sampling has even occurred on the high seas between the United States and Mexico. Researchers often refer to study areas as Large Marine Ecosystems (LMEs), which are defined in Figure 2.14. In Table 2.3, we describe how we will refer to each LME throughout the document. Therefore, the action area of this consultation includes all of the U.S. South Atlantic, Gulf of Mexico, and Caribbean region, as well as the adjacent state/territorial waters.

Table 2.3. Naming Convention for LMEs in the Biological Opinion

Large Marine Ecosystem	Biological Opinion Reference
Gulf of Mexico	Gulf of Mexico Region
Northeast U.S. and Southeast U.S. Continental Shelf	U.S. South Atlantic or South Atlantic Region
Caribbean Sea	Caribbean Region

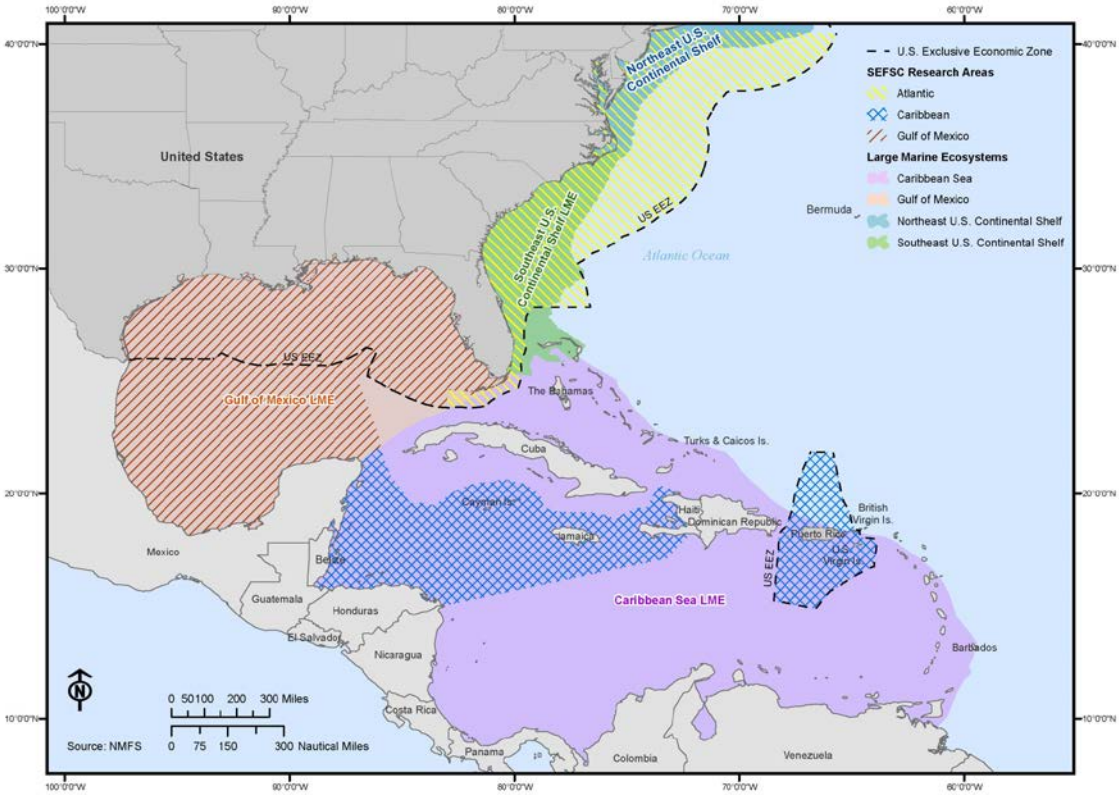

Figure 2.14. Map of LMEs where FIM activities may occur (Source: NMFS, Esri et al., 2014)

3.0 Species and Critical Habitat That Occur in the Action Area

Species That Occur in the Action Area

Marine Mammals		**Status**
Blue whale	*Balaenoptera musculus*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
North Atlantic right whale	*Eubalaena glacialis*	Endangered
Sea Turtles		
Green sea turtle	*Chelonia mydas*	Threatened[3]
Hawksbill sea turtle	*Eretmochelys imbricata*	Endangered
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Leatherback sea turtle	*Dermochelys coriacea*	Endangered
Loggerhead sea turtle	*Caretta caretta*	Threatened[4]
Invertebrates		
Elkhorn coral	*Acropora palmata*	Threatened
Staghorn coral	*Acropora cervicornis*	Threatened
Rough cactus coral	*Mycetophyllia ferox*	Threatened
Pillar coral	*Dendrogyra cylindrus*	Threatened
Lobed star coral	*Orbicella annularis*	Threatened
Mountainous star coral	*Orbicella faveolata*	Threatened
Boulder star coral	*Orbicella franksi*	Threatened
Fish		
Smalltooth sawfish	*Pristis pectinata*	Endangered[5]
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	Threatened
Shortnose sturgeon	*Acipenser brevirostrum*	Endangered
Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*	Endangered/Threatened[6]
Scalloped hammerhead	*Sphyrna lewini*	Threatened[7]

[3] The North Atlantic Distinct Population Segment (DPSs) and the South Atlantic DPS.
[4]The NW Atlantic DPS
[5] The United States DPS
[6]The New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs are listed as endangered, the Gulf of Maine DPS is listed as threatened; all can occur in the action area.
[7] Central and Southwest Atlantic DPS

Critical Habitat That Occurs in the Action Area

Designated Critical Habitat for	Region Designated In
North Atlantic right whale	South Atlantic
Elkhorn and staghorn coral ("*Acropora*")	South Atlantic/Caribbean
Green sea turtle	Caribbean
Hawksbill sea turtle	Caribbean
Leatherback sea turtle	Caribbean
Gulf sturgeon	Gulf of Mexico
Smalltooth sawfish	Gulf of Mexico
Northwest Atlantic DPS loggerhead sea turtle	Gulf of Mexico/South Atlantic

3.1 Species Not Likely to be Adversely Affected

FIM uses 8 different gear types or techniques to collect FIM data: visual surveys, fish traps, underwater cameras, artificial habitat aggregation devices, gillnets, seines, trawl gear (bottom and plankton), and hook-and-line gear (bottom longline and vertical line). NMFS determined that none of these gear types when used as described in Section 2.0 are likely to adversely affect the following species listed under the ESA: blue whales, sei whales, sperm whales, fin whales, humpback whales, North Atlantic right whales, gulf sturgeon and all listed corals in the action area. These species are excluded from further analysis and consideration in this Opinion. Table 3.1 indicates the effects determinations for each species.

Table 3.1. Species Not Likely to be Adversely Affected

	Gear Type					
Species	**Bottom Longline**	**Vertical Line**	**Bottom Trawl**	**Plankton Trawl**	**Gillnets**	**Seines**
Blue whale	NE	NE	NE	NE	NE	NE
Sei whale	NE	NE	NE	NE	NE	NE
Fin whale	NE	NE	NE	NE	NE	NE
Sperm whale	NE	NE	NE	NE	NE	NE
Humpback whale	NLAA	NLAA	NLAA	NLAA	NE	NE
North Atlantic right whale	NE	NE	NLAA	NE	NE	NE
Elkhorn coral	NE or NLAA	NE or NLAA	NE or NLAA	NE	NE	NE
Staghorn coral	NE or NLAA	NE or NLAA	NE or NLAA	NE	NE	NE
Rough cactus coral	NE or NLAA	NE or NLAA	NE or NLAA	NE	NE	NE
Pillar coral	NE or NLAA	NE or NLAA	NE or NLAA	NE	NE	NE
Lobed star coral	NE or NLAA	NE or NLAA	NE or NLAA	NE	NE	NE
Mountainous star coral	NE or NLAA	NE or NLAA	NE or NLAA	NE	NE	NE
Boulder star coral	NE or NLAA	NE or NLAA	NE or NLAA	NE or NLAA	NE	NE
Johnson's Seagrass	NE	NE	NLAA	NE	NE	NE
Gulf sturgeon	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA

	Gear Types							
Species	**Fish Traps**	**U/W Cameras**	**Visual Surveys**	**Artificial Habitat**	**Dip Net**	**ROVs**	**Acoustic Equip.**	**Electrofishing**
Blue whale	NE	NE	NE	NE	NE	NE	NE	NE
Sei whale	NE	NE	NE	NE	NE	NE	NE	NE
Fin whale	NE	NE	NE	NE	NE	NE	NE	NE
Sperm whale	NE	NE	NE	NE	NE	NE	NE	NE
Humpback whale	NLAA	NLAA	NLAA	NLAA	NE	NE	NE	NE
North Atlantic right whale	NE	NE	NE	NE	NE	NE	NE	NE
Elkhorn coral	NE or NLAA	NE or NLAA	NLAA	NE	NE	NE	NE	NE
Staghorn coral	NE or NLAA	NE or NLAA	NLAA	NE	NE	NE	NE	NE
Rough cactus coral	NE or NLAA	NE or NLAA	NLAA	NE	NE	NE	NE	NE
Pillar coral	NE or NLAA	NE or NLAA	NLAA	NE	NE	NE	NE	NE
Lobed star coral	NE or NLAA	NE or NLAA	NLAA	NE	NE	NE	NE	NE
Mountainous star coral	NE or NLAA	NE or NLAA	NLAA	NE	NE	NE	NE	NE
Boulder star coral	NE or NLAA	NE or NLAA	NLAA	NE	NE	NE	NE	NE
Johnson's seagrass	NE	NE	NE	NE	NE	Ne	NE	NE
Gulf sturgeon	NE	NE	NE	NE	NE	NE	NE	NE

3.1.1 Blue, Sei, Sperm, and Fin Whales

We believe the proposed action will not affect blue, sei, or sperm whales. All 3 species are predominantly found seaward of the continental shelf in deeper waters (CETAP 1982; NMFS 2011i; Waring et al. 2010; Waring et al. 2013; Wenzel et al. 1988) . In the North Atlantic, blue whales are most frequently sighted in the Gulf of St. Lawrence from April to January (Sears 2002) and are considered rare off the East Coast. NMFS's annual marine mammal stock assessment reports (SAR) last reported on blue whales in 2010, stating "[t]he blue whale is best considered as an occasional visitor in US Atlantic EEZ waters, which may represent the current southern limit of its feeding range(CETAP 1982; Wenzel et al. 1988). Pike et al. (2009) conducted ship surveys in the Central and Northeast Atlantic in 1987, 1989, 1995, and 2001. Blue whales were most commonly sighted off western Iceland, and to a lesser extent northeast of Iceland. They were very rare or absent in the Northeast Atlantic (Waring et al. 2010). Sightings of sperm whales are almost exclusively in the continental shelf edge and continental slope areas (Scott and Sadove 1997). Most sperm whales are found in very deep waters (> 1,000 m). Since these species occur most consistently in waters much deeper than those FIM-related sampling is likely to occur in, therefore we believe all FIM-related gears/techniques, or vessel operations, will have no effect on blue, sei, or sperm whales. None of these species is found in the U.S. Caribbean where FIM-related activities may occur, so those activities will not affect these species.

Fin whales are generally found along the 100-m isobath with sightings also spread over deeper water including canyons along the shelf break and are found north of Cape Hatteras, North Carolina (Waring et al. 2012). Fin whales do not occur in the Gulf of Mexico or U.S. Caribbean where FIM-related activities may occur. The dip net, gillnet, and seine sampling occurring in the South Atlantic will not affect fin whales because they occur in riverine, estuary, or inshore bay environments where the species does not occur. Acoustic equipment, ROV deployment, hook-and-line sampling (bottom longline and vertical line), trawling (bottom and plankton), underwater camera deployments, electrofishing, and fish trap deployments will either occur shallower than where fin whales are found or south of Cape Hatteras, North Carolina, and will not affect them. No visual surveys are conducted and no artificial habitat aggregation devices are deployed in the South Atlantic region where the fin whale occurs. Therefore, we believe all FIM-related gears/techniques, and vessel operations, will have no effect on fin whales, either.

3.1.2. North Atlantic Right Whales

The proposed action is not likely to adversely affect North Atlantic right whales. North Atlantic right whales generally occur south of Virginia from November 1-April 30. Some have been sighted as far as about 30 nmi offshore Pabst et al. 2009); however, mom and calf pairs are much more common (i.e., greater than 90%) in shallower water (i.e., 10-30 m) and within a relatively narrow sea surface temperature range (Keller et al. 2012). North Atlantic right whales do not occur in the Gulf of Mexico or the U.S. Caribbean. Therefore, the FIM-related activities occurring in those areas will not affect them.

Hook-and-Line, Fish Traps, Underwater Cameras, Gillnet/Seine, Electrofishing, Dip Net, Visual Survey, Artificial Habitat Aggregation Devices, and Plankton Trawl Gear

None of the hook-and-line sampling or fish traps deployments proposed in the South Atlantic region will affect North Atlantic right whales. All proposed sampling of hook-and-line gear or fish traps either occurs during a time of year when the species will not be in the action area, or occurs at depths seaward of where this species occurs in the Southeast. Similarly, the use of underwater cameras in the South Atlantic will not affect them because that sampling only occurs with the MARMAP/SEAMAP-SA Reef Fish Survey and only from May-September, when the species is not present in the action area. The dip net, gillnet, electrofishing, and seine sampling occurring in the South Atlantic will not affect North Atlantic right whales because it occurs in riverine, estuary, or inshore bay environments where the species does not occur. Additionally, no visual surveys are conducted, no artificial habitat aggregation devices are deployed, and no plankton trawling occurs in the South Atlantic region where the species occur; thus, these gears/techniques will not affect these species either.

Bottom Trawling Gear

Bottom trawling is not likely to adversely affect North Atlantic right whales. There has never been a known interaction between this species and bottom trawling gear. Amendments to the MMPA in 1994 required NMFS to annually prepare SAR for each stock of marine mammals that occurs in U.S. waters. Each SAR is required to include a description of the commercial fisheries that interact with a stock, including the level of incidental mortality and serious injury of the stock by each, among other things. Since 1995, NMFS has been monitoring the status North Atlantic right whales and reporting interactions between the species and commercial fisheries in its annual SAR. Those reports indicate that based on information going back as far as 1975, there has never been a known interaction between bottom trawl gear and North Atlantic right whales anywhere along the East Coast (Blaylock et al. 1995; Waring et al. 2006; Waring et al. 2010; Waring et al. 2014; Waring et al. 2003; Waring et al. 1999; Waring et al. 1997; Waring et al. 2001). Because some unknown number of interactions between North Atlantic right whales and commercial fisheries likely occur but go unaccounted for, the SARs represent a minimum accounting of all the known interactions. Some species of whale may be more likely to interact with bottom trawl gear because they could be attracted to trawling activities that make their prey species easier to catch (Fertl and Leatherwood 1997). However, North Atlantic right whales only feed on krill, which is not a species that can be captured by the types of bottom trawls used during FIM-related activities. For these reasons, we believe any adverse effects from FIM-related bottom trawling on North Atlantic right whales are extremely unlikely to occur and are discountable.

ROV and Acoustic Equipment

ROV deployment will also not affect North Atlantic right whales because it occurs from May-August when the species is not present in the South Atlantic region. All of the projects using acoustic equipment in the South Atlantic occur during times of year (April-October) when the species is not present in the region. Therefore, these pieces of equipment will have no effect on North Atlantic right whales.

Vessel Operations
We anticipate that most FIM-related activities will occur at a time of year when North Atlantic right whales will not be present in the action area, or projects will occur seaward of where the species is found when they are in the action area. Because of the low likelihood of FIM-related sampling even occurring near North Atlantic right whales, it is not surprising there has never been a documented interaction with FIM-related vessels. Most research vessels are relative small (i.e., 65 feet or less) and operate at slow speeds. For example, while actively sampling vessels go no more than 5 knots, usually operating at 2-3 knots. When transiting between sampling stations, research vessels could travel up to 14 knots. However, research vessel captains and crew watch for protected species (including North Atlantic right whales) while underway and take necessary actions to avoid them. Additionally, information regarding the location of North Atlantic right whales is reported via the Right Whale Early Warning System. North Atlantic right whale sightings are reported in near real time from aerial surveys, shipboard surveys, whale watch vessels, and opportunistic sources (USCG, commercial ships, fishing vessels, and the general public) and the information is disseminated to mariners within a half hour of a sighting. This reduces the likelihood of collisions between vessels and North Atlantic right whales by alerting mariners to the presence of the whales in near real time. Vessels are unlikely to even operate at a location or time of year when they may overlap spatially with North Atlantic. Even then, research vessels tend to operate are relative slow speeds and receive information regarding any North Atlantic right whales nearby via the early warning system. The lack of any documented interaction in the past, in combination with these other factors, leads us to believe that it is extremely unlikely an interaction will occur in the future. Thus, we believe any adverse effects to North Atlantic right whales from FIM-related vessel operations is extremely unlikely to occur and is discountable.

3.1.3 Humpback Whales

The proposed action is not likely to adversely affect humpback whales. In the western North Atlantic ocean, humpback whales feed during spring, summer, and fall over a range that encompasses the eastern coast of the United States (including the Gulf of Maine), the Gulf of St. Lawrence, Newfoundland/Labrador, and western Greenland. In their summer foraging areas and winter calving areas, humpback whales tend to occupy shallower, coastal waters. During their seasonal migrations, humpback whales disperse widely in deep, pelagic waters and tend to avoid coastal waters (Winn and Reichley 1985). In winter, whales from the Gulf of Maine mate and calve primarily in the West Indies. Animals appear to leave these areas in late October and likely arrive on the breeding grounds in the Caribbean in mid-late November. Those animals then likely depart the breeding/calving grounds for the summer feeding grounds in mid-to-late March (A. Machernis, NMFS, pers. comm. to A. Herndon, NMFS, September 2015).

Not all humpback whales migrate to the West Indies every winter, and significant numbers of animals are found in mid- and high-latitude regions at this time, including off North Carolina. Humpback whales may be found off North Carolina year-round (Clapham et al. 1993; Swingle et al. 1993) and a number of wintertime humpback sightings have occurred in the southeastern United States (NMFS unpublished data; New England Aquarium, Georgia Department of Natural Resources, and Florida Fish and Wildlife Conservation Commission unpublished data). Data extracted by us from the OBIS-SEAMAP database report 187 records (222 animals) of

humpback whales between the North Carolina/Virginia border and the east coast of Florida from 1913-2014.[8] A large gap in the time series appears, with no records reported between 1914 and 1965. From 1966-1999, 43 records were reported (52 animals) and from 2000-2014, 129 records were reported (155 whales) (Canadian Wildlife Service 1992; CETAP 1982; Halpin et al. 2009; Jochens et al. 2008; Jochens et al. 2006; NMFS 1992; NMFS 1998a; UNCW 2006; UNCW 2008; UNCW 2010)). Those more recent data support the indication that humpbacks occur from North Carolina/Virginia to Florida year round, with at least 1 record in every month; those data also indicate seasonality. Records (n = 116) and number of animals (n =139) reported were greatest from January through April, accounting for 90%. The number of records (n = 17) and animals reported (n = 21) were much lower from April through October, accounting for only 13%. The species does not occur in the Gulf of Mexico. Therefore, the FIM-related activities occurring in those areas will not affect the species.

Dip Net, Gillnet/Seine, Electrofishing, Visual Surveys, Artificial Habitat Aggregation Devices, and Plankton Trawl Gear

The dip net, gillnet, electrofishing, and seine sampling occurring in the South Atlantic will not affect humpback whales because this sampling is implemented in riverine, estuary, or inshore bay environments where the species does not occur.

There may be some overlap (i.e., November) in periods of time when humpbacks occur in the Caribbean and divers are conducting visual surveys. It is unclear what effect these surveys might have on humpback whales because no information on the effects from divers to humpback whales is currently available. However, Bettridge et al. (2015) do report on information regarding humpback behavioral responses to whale-watching boats. The authors indicate there was increased swimming speed during exposure but little evidence of significant effects on inter-breath intervals and blow rates (Weinrich et al. 2008). Passive acoustic monitoring and localization of humpback whale songs in the presence of whale-watching boats on Brazilian breeding grounds also found that whales moved away from the boat in the majority of cases (68.4% of the time when boats were less than 2.5 miles distant, (Sousa-Lima and Clark 2009)). Additionally, the humpback whale biological review team's evaluation of the existing evidence on the impacts of whale-watching to humpbacks indicated they were likely to have negligible impacts, and the BRT determined they were a low threat (Bettridge et al. 2015). While not specific to visual census surveys, this information suggests relatively minor behavioral changes when exposed to whale watching vessels. FIM-related visual census surveys will be likely be far less intrusive given small vessels and presence of only a few divers in the water at any time. There are also no reports of humpback whales suffering adverse effects of any kind during visual surveys. Therefore, we believe any adverse effects from visual surveys would be insignificant.

Artificial habitat aggregation structures could adversely affect humpback whales via entrapment. We believe entrapment is extremely unlikely to occur and is discountable. These habitats are unbaited and attract reef fish and invertebrates because of the shelter they provide. Trained scientists construct the habitats underwater, in very shallow water (6-10 ft), after carrying all the

[8] We queried the available data sets by asking for all available records of humpback whales from approximately the North Carolina/Virginia border south to the Florida Keys. The data was queried in December 2014.

building materials to the sites by hand. Once in place, the habitats are stationary with no entangling gear attached (i.e., netting, hooks, or lines). The spaces between the blocks used to create these habitats are too narrow (approximately 4.5-in wide x 6-in high) for a humpback whale (or calf) to enter and get caught. For these reasons, the likelihood of artificial habitats used in association with FIM adversely affecting this species is extremely unlikely to occur.

FIM plankton sampling in the Caribbean could adversely affect humpback whales, via entanglement in nets or contact with other portions of the gear (e.g., trawl frames). We believe these routes of effects are extremely unlikely to occur and are discountable. Caribbean plankton trawling occurs in February and June; 75 tows are split across the 2 sampling seasons. Only February sampling may occur when humpback whales are expected in the region. Plankton trawl sampling uses fine-mesh (i.e., microns) bongo and neuston nets, measuring 5 ft or less, trawled for a maximum of 30 minutes to collect fish larvae samples. No interactions with humpback whales during plankton sampling (in any region) have ever been reported. Because of short tow times and limited number of tows conducted during the times of year when humpback whales may be present, we believe it is extremely unlikely that this gear will capture this species, even over the course of several years.

ROV and Acoustic Equipment

ROV deployments will not affect humpbacks. Only one ROV project occurs in the South Atlantic, usually during the summer (May-August). The ROV is attached to a piece of equipment deployed to measure water characteristics with a 100-ft tether. Once at depth, the ROV is deployed from this piece of equipment and conducts transects over high-relief bottom, staying within 15 ft of the bottom. Entanglement risk is low because of a combination of factors: the camera is tended, the cable between the vessel and camera is taut and not coiling or floating loosely, there is only a single system in use from North Carolina through Florida, and the tether is short. Consequently, we believe any adverse effects from ROVs are extremely unlikely to occur and are discountable.

The acoustic equipment associated with the proposed action is not likely to adversely affect humpback whales. The acoustic equipment uses frequencies ranging from 18-333 kHz (Table 3.2). Helweg et al. (2000) produced a mathematical model of a humpback whale's hearing sensitivity based on the anatomy of the whale's ear. Based on that model, they concluded that humpback whales would be sensitive to sound in frequencies ranging from 0.7-10 kHz, with a maximum sensitivity between 2 and 6 kHz. Since no FIM-related acoustic equipment use frequencies that humpback whales can detect, this equipment will not affect them.

Table 3.2. Acoustic Equipment and Frequencies Used During FIM Projects

Equipment	Frequencies Used
Simrad ME70 Multi-Beam Echosounder	70,000-120,000 Hz (70-120 kHz)
EK 60 Multi-Frequency Single-Beam Active Acoustics	18,000 Hz; 38,000 Hz; 70,000 Hz; 120,000 Hz; 200,000 Hz (18, 38, 70, 120, 200 kHz)
Acoustic Doppler Current Profiler	333,000 Hz (333 kHz)

Hook-and-Line Gear

Humpback whales are known to occasionally interact with hook-and-line fisheries (Waring et al. 2014). However, we believe any adverse effects to this species from FIM-related hook-and-line fishing in the South Atlantic or Caribbean regions is extremely unlikely to occur and discountable. The best available information on humpback whale and hook-and-line fishing interactions indicates that in 2012, there were 7 documented entanglements between humpback whales and hook-and-line gear, in 2013 there were 3 documented interactions; none resulted in serious injury or mortality (Morin and Kenney 2012; Morin and Kenney 2013). Whether a commercial fishery was responsible for those interactions could not be determined. In 2012, 2 entanglements were associated with recreational fishing (Morin and Kenney 2012); none were attributed to recreational fishing in 2013 (Morin and Kenney 2013). The last documented interaction between a commercial hook-and-line fishery and a humpback whale was in 2001, with the Gulf of Maine, U.S. Mid-Atlantic tuna, shark and swordfish hook-and-line/harpoon fishery (79 FR 77919; January 28, 2015). No interactions between a humpback whale and bottom longline gear have been reported. This is likely because the gear is set on the bottom, away from the surface where humpback whales spend most of their time.

In the South Atlantic, bottom longline gear accounts for the vast majority (i.e., 81%) of hook-and-line effort. Pelagic longline (up to 18,000 hook-hours; 18%) and vertical line gear (370 hook-hours; up to 1%) account for the rest. Pelagic longline sampling occurs from March-May, south of Cape Hatteras, North Carolina. During this time of year we anticipate most humpbacks will be north of the sampling area on their summer feeding grounds. Most of the fishing effort in the South Atlantic is conducted with gear (i.e., bottom longline) that is unlikely to interact with humpbacks. Even in instances when pelagic longline sampling occurs, it usually takes place during a time of year when humpbacks are less likely to be in areas sampled. Additionally, interactions between humpback whales and commercial hook-and-line fisheries using millions of hook-hours annually appear rare; FIM sampling in the South Atlantic uses less than 100,000 hook-hours annually. For all of these reasons, we believe any adverse effects to humpback whales from FIM-related hook-and-line fishing in the South Atlantic are extremely unlikely to occur and are discountable.

Hook-and-line fishing effort in the Caribbean is far below that of the South Atlantic, only 44,000 hook-hours. Bottom longline gear accounts for 54% (23,500 hook-hours) and vertical line gear accounts for the rest (19,950 hook-hours). For reasons similar to those explained for the South Atlantic, we believe any adverse effects to humpback whales in the Caribbean region are extremely unlikely to occur and discountable. Humpbacks are likely only in the Caribbean region from mid-to-late November through mid-to-late March. The hook-and-line fishing effort occurring during that period would be approximately 21,465 hook-hours. This amount of fishing effort is tiny compared (i.e., 1-2%) to commercial hook-and-line fisheries, which use millions of hook-hours annually. As described above, interactions between these commercial fisheries using millions of hook-hours a year and humpback whales are very rare. For these reasons, we believe any adverse effects to humpback whales from FIM related hook-and-line fishing in the South Atlantic are extremely unlikely to occur and are discountable.

Fish Trap Gear
Fish traps are also not likely to adversely affect humpback whales. According to the OBIS-SEAMAP data we queried, only 13% of records (n = 17) and animals reported (n = 21) were observed from April through October from 2001-2014, from North Carolina/Virginia to Florida. While clearly a minimum number, this does indicate humpbacks are much more common during the period of time when traps are not used in the South Atlantic. During FIM-related fish trap sampling, a maximum of 9 fish traps would be deployed a day, at random sampling locations from North Carolina to Florida, during that April-October time period. Those traps are only deployed during the day, soak for a maximum of 90 minutes, and are always within direct line of sight. For these reasons and because humpbacks are uncommon in the fish trap sampling area, we believe any adverse effects are extremely unlike to occur and are discountable.

Underwater Cameras
Underwater cameras are also not likely to adversely affect humpback whales. The OBIS-SEAMAP data we queried, only 13% of records (n = 17) and animals reported (n = 21) were observed from April through October from 2001-2014, from North Carolina/Virginia to Florida. While clearly a minimum number, this does indicate humpbacks are much more common during the period of time when traps are not used in the South Atlantic. Underwater cameras are suspended from a vessel either drifting with the wind or current or towed at low speeds (necessary for visual inspection/mapping efforts) by a taut metal cable. Entanglement risk to humpback whales from the cable attaching the mobile camera to the vessel is extremely low because of a combination of factors: the camera is tended, the cable between the vessel and camera is taut, and the mobile camera is used only during daylight. For these reasons, we believe any adverse effects from underwater cameras to humpback whales are extremely unlikely to occur and are discountable.

Bottom Trawling Gear
As with North Atlantic right whales, we do not believe bottom trawling will adversely affect humpback whales. There has never been a known interaction between this species and bottom trawling gear. Since 1995, NMFS has also been monitoring on the status humpback whales and reporting interactions between the species and commercial fisheries in its annual SAR. Those reports indicated that based on information going back as far as 1975 there has never been a known interaction between bottom trawl gear and humpback whales (Blaylock et al. 1995; Waring et al. 2006; Waring et al. 2010; Waring et al. 2014; Waring et al. 2003; Waring et al. 1999; Waring et al. 1997; Waring et al. 2001). Because some unknown number of interactions between humpback whales and commercial fisheries likely occur but go unaccounted for, the SARs represent a minimum accounting of all the known interactions.

Some species of whale may be more likely to interact with bottom trawl gear because they could be attracted to trawling activities that make their prey species easier to catch. Fertl and Leatherwood (1997), report 2 such instances of humpback whales feeding behind trawl gear. However, they also indicate the number of cetaceans captured in mid-water trawls is greater than in bottom trawls. For this difference, they cite Northridge (1988a); (Northridge 1988b) as describing likely reasons: (1) mid-water nets generally target small pelagic fish species, which are often the same species preyed upon by marine mammals; (2) mid-water gear is generally towed at relatively high speeds; and (3) mid-water trawls are generally much larger than most

demersal trawls. Only 1 FIM-related bottom trawl project (USFWS striped bass) operates in a depth range that might also include humpback whales. However, we believe it is extremely unlikely this project will interact with a humpback whale. The project conducts a maximum of 350 tows total across January and February (6 trawls a day on average), and those tows are constantly monitored and last a maximum of 30 minutes. Humpbacks feed primarily on tiny crustaceans (mostly krill), plankton, and small fish, not striped bass; thus, are not likely to be drawn to trawlers targeting striped bass. For these reasons, we believe any adverse effects from FIM-related bottom trawl gear to humpback are extremely unlikely to occur and are discountable.

Vessel Operations

There has never been a reported vessel strike between any FIM-related research vessel and humpback whales, during sampling at over 192,320 stations. Most research vessels are relative small (i.e., 65 feet or less) and operate at slow speeds. For example, while actively sampling vessels go no more than 5 knots, usually operating at 2-3 knots. When transiting between sampling stations, research vessels could travel more quickly. However, research vessel captains and crew watch for protected species (including humpback whales) while underway and take necessary actions to avoid them. For these reasons, and because there has never been a documented interaction with FIM-related vessels and humpback whales, we believe any adverse effects from these vessels is extremely unlikely to occur and is discountable.

3.1.4 ESA-Listed Corals

Seven species of coral are listed under the ESA: elkhorn coral (*Acropora palmata*), staghorn coral (*Acropora cervicornis*), rough cactus coral (*Mycetophyllia ferox*), pillar coral (*Dendrogyra cylindrus*), lobed star coral (*Orbicella annularis*), mountainous star coral (*Orbicella faveolata*), and boulder star coral (*Orbicella franksi*). The gear types and techniques used during FIM research (i.e., hook-and-line or trawl sampling, fish traps, underwater cameras, visual surveys, dip nets, seines/gillnets, electrofishing, or artificial habitat aggregation devices) will not adversely affect ESA-listed corals. Because of the number of species, project types, and regions considered in this section, Table 3.9 summarizes the effects determination for each species and FIM-related gear type.

The status review for the ESA-listed coral species (SSR) identified the potential threats to corals from fishing. The SSR indicated corals may be affected by: (1) trophic effects, (2) human-induced physical damage, and (3) destructive fishing practices (Brainard et al. 2011). Threats from trophic effects refer to the removal of herbivorous fish by fisheries that alter trophic interactions that are particularly important in structuring coral reef ecosystems (e.g., herbivorous fish constraining the spread of macroalgae). Human-induced physical damage identified in the SSR refers primarily to things like vessel groundings, coastal construction, and increased coastal erosion/turbidity resulting from these construction activities. The SSR generally refers to destructive fishing practices as those that may damage coral - for example, physical damage from fishing gear like dredges, trawls, or traps as well as the use of toxic chemicals or explosives. We do not believe the FIM-related bottom trawl and hook-and-line projects occurring within the range of ESA-listed corals will result in any adverse effects, as discussed below.

Artificial Habitat Aggregation Structure, Plankton Trawl, ROVs, Acoustic Equipment, Dip Net, Electrofishing, Seines, and Gillnet Gear

Projects using artificial habitat aggregation structures, plankton trawls, ROVs, acoustic equipment, dip net, seines, and gillnets, will have no effect on ESA-listed corals regardless of where the projects occur. Artificial habitat aggregation structures are constructed on seagrass habitats, and dip nets and electrofishing are used in habitats that do not support coral colonies; thus, these gear types will not affect any ESA-listed coral species. Similarly, plankton trawling and ROV deployments will not affect ESA-listed corals because the gears do not interact with the benthos. Acoustic equipment will have no effect on ESA-listed corals because these species cannot hear. All seine and gillnet projects, regardless of their region, are conducted outside the habitats of ESA-listed corals.

Visual Surveys

Visual surveys are only conducted by trained divers with scientific backgrounds, which makes any interaction between them and ESA-listed corals colonies extremely unlikely to occur and discountable.

Fish Trap and Underwater Camera Gear

Fish traps and underwater cameras are not likely to adversely affect ESA-listed corals. Table 3.3 displays the fish trap and underwater camera projects that occur within the range of some of the ESA-listed corals; no fish traps and underwater cameras are used in the South Atlantic. Fish traps and underwater cameras may cause abrasion or fragmentation if they contact colonies, but they are lowered to the bottom (not dropped) and are not intentionally deployed directly atop of known reef habitat. In addition, traps are only left unattended to soak for one hour, so trap movement potentially affecting corals is not a potential issue for this activity.

The SEAMAP-GOM Reef Fish Monitoring Survey-FFWCC project would deploy up to 75 camera/traps annually in an area where any *Orbicella* may occur (i.e., NMFS statistical zone 2). However, when sampling in these areas, the FFWCC uses side-scan sonar to identify habitat types. When areas of hard coral are identified the gear is deployed in sand next to those habitats. Since FWC camera/traps are only deployed on sand habitat that does not support coral growth, we believe any adverse effects from these gear deployments are extremely unlikely to occur and are discountable.

NMFS conducts 2 trap/camera projects in the Gulf of Mexico and U.S. Caribbean that could potentially affect ESA-listed corals. In the Gulf of Mexico, the NMFS project deploys cameras and fish traps anywhere within 4 monitoring areas across the Gulf of Mexico (South Florida, the Northeastern Gulf of Mexico, the Louisiana-Texas shelf, and South Texas) and those sites are selected at random. Only 50 of the sampling stations in the South Florida region occur within the range of the ESA-listed species, primarily in the area around the Dry Tortugas and Tortugas Bank, Florida (B. Noble, NMFS Southeast Fisheries Science Center, pers. Comm. to A. Herndon, NMFS, December 2014). If we make the conservative, and unlikely, assumption that of all the stations available from the South Florida region, all 50 potentially occurring within the range of ESA-listed corals are selected, we can estimate the maximum amount of bottom habitat affected annually by adding up the footprints of all the trap deployed. NMFS deploys a

maximum of 2 fish traps (36 ft^2 each) and 1 camera array (21 ft^2) at each station. Two fish traps deployed at each station and 1 camera array at each station means 100 fish traps and 50 camera traps might be deployed annually. Based on the footprint of each trap/camera reported in Table 3.3 these projects would affect a maximum of 4,650 ft^2 (432 m^2) of bottom annually.[9] In the U.S. Caribbean NMFS's camera/trap project occurs in the shelf waters of Puerto Rico and USVI. A maximum of 100 fish traps (36 ft^2 each) and 400 camera arrays (21 ft^2) could be deployed annually in the U.S. Caribbean; affecting up to 12,206 ft^2 (1,134 m^2) of bottom.[10]

Table 3.3 Trap/UW Camera Projects Occurring in the Range of ESA-Listed Corals

Region	Trap/UW Camera Project	Number of Traps/Arrays	Trap/Array Footprint (ft^2)	Total Footprint (ft^2)	Total Footprint (ac)
Gulf of Mexico	SEAMAP-GOM Reef Fish Monitoring (FFWCC) (Trap)	1 yr = 450	27.5	12,375	0.284
		5 yrs = 2,250		61,875	1.420
	SEAMAP-GOM Reef Fish Monitoring (FFWCC) (UW Camera Array)	1 yr = 150	4.84	726	0.017
		5 yrs = 750		3,630	0.083
	SEAMAP-GOM Reef Fish Survey (NMFS) (Trap)	1 yr = 200	36	7,200	0.165
		5 yrs = 1,000		36,000	0.826
	SEAMAP-GOM Reef Fish Survey (NMFS) (UW Camera Array)	1 yr = 600	21.65	12,990	0.298
		5 yrs = 3,000		64,950	1.491
Caribbean	Caribbean Reef Fish Survey (NMFS) (Trap)	1 yr = 100	36	3,600	0.083
		5 yrs = 500		18,000	0.413
	Caribbean Reef Fish Survey (NMFS) (UW Camera Array)	1 yr = 400	21.65	8,660	0.199
		5 yrs = 2,000		43,300	0.994
Total All Projects		1 yr = 1,900		45,551	1.046
		5 yrs = 9,500		227,755	5.227

Relatively large areas in the Gulf of Mexico and the U.S. Caribbean contain hardbottom habitat that could potentially support corals. Yet, only a fraction of that area is likely to actually support ESA-listed corals due to their depressed abundances and because local physical and biological conditions are not conducive to their growth. Trap/camera sampling in these regions also samples hardbottom habitats that could support coral, but the footprint from those projects is tiny compared to the amount of coral supporting habitat (CSH). Taken together, we believe the probability that a trap/camera would be deployed on top of an ESA-listed coral is extremely unlikely to occur, and any adverse effects are discountable.

We assume that trap/camera deployments would only cause adverse effects to corals if they contacted them. To determine the likelihood of that occurring, we estimated the probability of overlap between the footprint of deployed traps/cameras and ESA-listed corals. When 2 or more

[9] 100 fish traps annually x 3.34 m^2 (36 ft^2) trap footprint = 334 m^2 trap impacts annually; 50 cameras annually x 2 m^2 (21.65 ft^2) camera footprint = 100 m^2 camera impacts annually; 334 m^2 trap impacts annually + 100 m^2 camera impacts annually = 434 m^2 trap/camera impacts annually.

[10] 100 fish traps annually x 3.34 m^2 (36 ft^2) trap footprint = 334 m^2 trap impacts annually; 400 cameras annually x 2 m^2 (21.65 ft^2) camera footprint = 800 m^2 camera impacts annually; 334 m^2 trap impacts annually + 100 m^2 camera impacts annually = 1,134 m^2 trap/camera impacts annually.

events could occur together, the probability of them occurring simultaneously is calculated by multiplying the individual probability of 1 occurring by the individual probability of the other occurring. A trap/camera and an ESA-listed coral could occur in the same place at the same time. This means we can estimate the probability that they will occur in the same place at the same time. To estimate this, we multiply the probability that a trap/camera will be deployed on CSH by the probability an ESA-listed coral is also on the CSH.[11]

For purposes of this analysis, to estimate the probabilities of each, we started by determining the amount of CSH in the U.S. Caribbean (NMFS unpublished data) and the area around the Dry Tortugas, Florida, (Waara et al. 2011).[12] The next step was to identify the CSH in both areas that might be affected by traps. By dividing the total trap footprint by the total CSH in each region, we could determine the probability that a given area of CSH would be affected by traps/cameras in a given year; Table 3.4 reports those calculations.

Table 3.4 Probability an Area of Coral Supporting Habitat is Affected by Camera/Traps

Region	Total Area of Coral Supporting Habitat (m^2)	NMFS Trap Footprint (m^2)	Probability Coral Supporting Habitat Affected by Traps
Florida	92,140,000	432	0.000005
Caribbean	855,040,000	1,134	0.000001

We followed a similar approach to determine the probability that an area of CSH supported an ESA-listed coral. This portion of the analysis required 2 steps. Information from the National Coral Reef Monitoring Program (NCRMP) indicates that ESA-listed corals are only seen in a subset of their total benthic habitat sampling; Table 3.6 reports the percentage of the area sampled by NCRMP in each region where at least 1 colony of an ESA-listed coral was identified. In other words, the probability an ESA-listed species would be identified occur in the area they sampled.

[11] Probability that a trap/camera is deployed on habitat supporting coral x Probability that an ESA-listed coral occurs on habitat supporting coral = Probability a trap/camera is deployed on habitat supporting coral that also supports ESA-listed coral.

[12] In the U.S. Caribbean, the best available information indicated CSH included: Colonized Bedrock, Colonized Pavement ,Colonized Pavement w/Sand Channels, Linear Reef, Patch Reef (Aggregated), Patch Reef (Individual), Reef Rubble, Scattered Coral/Rock in Unconsolidated Sediment, Spur and Groove Reef, Uncolonized Bedrock, Uncolonized Pavement, Uncolonized Pavement with Sand Channel. In Florida, Warra et al. (2011) reports a number of different habitat types. Our estimate included Aggregate Patch Reefs, Reef Terrace (high profile), Remnant (low profile), Individual Patch Reef, Pavement, Reef Rubble, Patchy Coral/or Rock in Unconsolidated Sediment, High Relief Spur and Groove, Low Relief Spur and Groove habitat types.

Table 3.5 Probability of an ESA-Listed Corals Being Identified During NCRMP Survey

Species	Percentage of Area Surveyed by NCRMP Where a Species was Identified	Probability an Area Surveyed by NCRMP had this Species
	Florida	
Staghorn	6.77%	0.0677
Elkhorn	1.20%	0.0120
Pillar	0.00%	0
Rough cactus	1.99%	0.0199
Lobed star	3.98%	0.0398
Mountainous star	31.08%	0.3108
Boulder star	34.66%	0.3466
	Caribbean	
Staghorn	4.8%	0.048
Elkhorn	3.2%	0.032
Pillar	3.2%	0.032
Rough cactus	1.9%	0.019
Lobed star	29.4%	0.294
Mountainous star	41.6%	0.416
Boulder star	31.6%	0.316

NCRMP is only capable of surveying a small portion of the total CSH in the 2 regions. By dividing the total area surveyed by NCRMP by the total CSH in each region, we determined the proportion of all CSH surveyed; Table 3.6 reports those calculations.

Table 3.6 Proportion of Total Coral Supporting Habitat Surveyed by NCRMP

Region	Total Area of Coral Supporting Habitat (m^2)	Area Surveyed by NCRMP (m^2)	Proportion of Coral Supporting Habitat Surveyed
Florida	92,140,000	22,590	0.000245
Caribbean	855,040,000	27,882	0.000033

Since NCRMP randomly samples areas potentially supporting coral, they are unlikely to consistently sample areas with relatively high or low coral cover. Thus, we believe it is reasonable to assume the probability of occurrence of ESA-listed corals reported during the NCRMP surveys can be applied to our estimate of CSH. Under that assumption, if we multiply the ESA-listed coral probability of occurrence (Table 3.5), by the proportion of all CSH surveyed (Table 3.6), we can determine the probability that an ESA-listed coral will occur on CSH; Table 3.7 reports the results of those calculations.

Table 3.7 Probability an ESA-Listed Coral Occurs on Coral Supporting Habitat

Species	Probability an Area Surveyed by NCRMP had this Species	Proportion of Coral Supporting Habitat Surveyed	Probability Coral Supporting Habitat Has Species
Florida			
Staghorn	0.0677	0.000245	0.0000166
Elkhorn	0.0120		0.0000029
Pillar	0		0
Rough cactus	0.0199		0.0000049
Lobed star	0.0398		0.0000098
Mountainous star	0.3108		0.0000762
Boulder star	0.3466		0.0000850
Caribbean			
Staghorn	0.048	0.000033	0.0000016
Elkhorn	0.032		0.0000011
Pillar	0.032		0.0000011
Rough cactus	0.019		0.0000006
Lobed star	0.294		0.0000096
Mountainous star	0.416		0.0000136
Boulder star	0.316		0.0000103

Thus far, we estimated the probability that CSH would be affected by traps, and the probability that an ESA-listed coral will occur on CSH. As noted previously, we can determine the probability those 2 things will occur together, by multiplying their individual probabilities by each other. So the final step of our effects analysis determines the probability that a trap/camera deployed on CSH would encounter an ESA-listed coral species on that same habitat; Table 3.8 reports those estimates.[13] Because the probability of interaction is so low, we believe any adverse effects are extremely unlikely to occur and are discountable.

[13] Thought of in a different way, multiplying these probabilities by 100, would give you the percent chance that a given area of CSH has an ESA-listed coral on it, and would be affected by traps. For example, there is a 0.000000008% chance that a trap would be deployed on top of a staghorn coral in Florida during a given year.

Table 3.8 Probability that Coral Supporting Habitat With Each ESA-Listed Coral May Be Affected by Cameras/Traps

Species	Probability Coral Supporting Habitat Has Species	Probability Coral Supporting Habitat Affected by Traps	Probability Area With Species Will be Affected by Traps
Florida			
Staghorn	0.0000166	0.000005	0.00000000008
Elkhorn	0.0000029		0.00000000001
Pillar	0		0
Rough cactus	0.0000049		0.00000000002
Lobed star	0.0000098		0.00000000005
Mountainous star	0.0000762		0.00000000036
Boulder star	0.0000850		0.00000000040
Caribbean			
Staghorn	0.0000016	0.000001	0.000000000002
Elkhorn	0.0000011		0.000000000001
Pillar	0.0000011		0.000000000001
Rough cactus	0.0000006		0.000000000001
Lobed star	0.0000096		0.000000000013
Mountainous star	0.0000136		0.000000000018
Boulder star	0.0000103		0.000000000014

Bottom Trawl Gear

The South Atlantic bottom trawling projects occur outside the range of ESA-listed coral and will not affect them; no bottom trawling occurs in the Caribbean. Only 2 bottom-trawling projects occur in the Gulf of Mexico within the range of ESA-listed coral species; neither target herbivorous fish. These projects will not cause any measurable trophic effects potentially harmful to ESA-listed corals located where these projects may occur.

Vessel groundings associated with these projects are possible, but we believe these events are extremely unlikely to occur. The captains of the vessels used during these projects have years of experience operating vessels. Likewise, the vessels have high-quality depth gauges and GPS units which allows the captains to detect bottom features and calculate vessel position in relation to mapped coral structures. Experience and the use of technology greatly reduce the likelihood of vessels' groundings.

While bottom trawl gear can be damaging to corals in general, we do not believe these FIM-related bottom trawling will adversely affect ESA-listed coral species occurring within the range of those projects. FIM-related bottom trawl gears are used away from reefs, generally in mudflats or seagrass beds where ESA-listed corals do not occur. Sampling in these locations increases the likelihood of capturing the target species (i.e., shrimp and groundfish) while simultaneously minimizing the potential impacts to gear trawled along the bottom. For all these reasons, we believe the likelihood of FIM-related bottom trawl gear causing adverse effects ESA-listed coral species likely to occur in the Gulf of Mexico are extremely unlikely to occur.

Hook-and-Line Gear

Similar to bottom trawl gear, we evaluated the potential threat FIM-related hook-and-line sampling might pose to ESA-listed corals based on the information provided in the SSR and the final listing rule (79 FR 53852, Sept. 10, 2014). Hook-and-line sampling in the South Atlantic does not occur within the range of ESA-listed corals. None of the projects in the Gulf of Mexico or Caribbean that occur within the range of ESA-listed corals target herbivorous fish. Additionally, because dead fish are used as bait, they are very unlikely to accidentally capture herbivorous fish. These projects will not cause any measurable trophic effects potentially harmful to ESA-listed corals. We also believe the same rationale described previously for why bottom trawl sampling is not likely to cause human-induced physical damage applies to FIM-related hook-and-line sampling.

The SSR does not indicate that hook-and-line fishing is a major concern for ESA-listed corals. The SSR does identify hook-and-line fishing as a potential threat to corals in a general sense, but indicates the threat is largely effort-dependent. The information in Chiappone et al. (2005) suggests that the level of hook-and-line fishing effort needed to impact coral is very high. They report, that while lost hook-and-line fishing gear was ubiquitous in the Florida Keys, it was estimated that <0.2% of the milleporid hydrocorals, stony corals, and gorgonians in the habitats studied showed injury (e.g., colony abrasions and partial mortality) as a result of hook-and-line gear interactions.

In Monroe County, Florida (i.e., the Florida Keys), the number of angler trips reporting landings of finfish (i.e., species likely to be targeting with hook-and-line gear) was 32,751 (https://public.myfwc.com/FWRI/PFDM/ReportCreator.aspx) for the year that Chiappone et al. (2005) conducted their study. This suggests that fishing effort of 32,751 sets per year, likely affected less than 0.2% of the milleporid hydrocorals, stony corals, and gorgonians.

In the Gulf of Mexico, a maximum of 50 bottom longline sets and 150 vertical line sets would occur each year.[14] The maximum number of lines/set during any given year in Puerto Rico is 900 among 3 projects (SEAMAP-C Finfish Rod-and-Reel Survey, SEAMAP-C Lane Snapper Bottom Longline Survey, SEAMAP-C Yellowtail Snapper Rod-and-Reel Survey).[15] The anticipated amount of FIM-related hook-and-line sampling in a given year is well below the level that caused damage in less than 0.2% milleporid hydrocorals, stony corals, and gorgonians. For these reasons, we believe any adverse effects to ESA-listed corals from FIM hook-and-line sampling is extremely unlikely to occur and are discountable.

[14] 50 sites annually x 1 bottom longline set/site = 50 bottom longline set annually; 50 sites annually x up to 3 vertical line sets/site = 150 vertical line sets annually

[15] Finfish R&R = 120 stations annually x 3 vertical line sets/site = 360 vertical line sets annually; Lane Snapper BLL = 180 sites annually x 1 bottom longline set/site = 180 bottom longline set annually; Yellowtail R&R = 120 stations annually x 3 vertical line sets/site = 360 vertical line sets annually; All Effort = 360 + 120 + 360

Table 3.9 Effects Determination Summary for ESA-Listed Corals

Gear Type	Region	Species						
		Elkhorn Coral	Staghorn Coral	Rough Cactus Coral	Pillar Coral	Lobed Star Coral	Mountainous Star Coral	Boulder Star Coral
Artificial Habitat Aggregation Structures	GOM	NE	NE	NE	NE	NE	NE	NE
	SA	NE	NE	NE	NE	NE	NE	NE
	Carib	NE	NE	NE	NE	NE	NE	NE
Plankton Trawl	GOM	NE	NE	NE	NE	NE	NE	NE
	SA	NE	NE	NE	NE	NE	NE	NE
	Carib	NE	NE	NE	NE	NE	NE	NE
ROV	GOM	NE	NE	NE	NE	NE	NE	NE
	SA	NE	NE	NE	NE	NE	NE	NE
	Carib	NE	NE	NE	NE	NE	NE	NE
Acoustic Equipment	GOM	NE	NE	NE	NE	NE	NE	NE
	SA	NE	NE	NE	NE	NE	NE	NE
	Carib	NE	NE	NE	NE	NE	NE	NE
Seine	GOM	NE	NE	NE	NE	NE	NE	NE
	SA	NE	NE	NE	NE	NE	NE	NE
	Carib	NE	NE	NE	NE	NE	NE	NE
Gillnet	GOM	NE	NE	NE	NE	NE	NE	NE
	SA	NE	NE	NE	NE	NE	NE	NE
	Carib	NE	NE	NE	NE	NE	NE	NE
Dip Net	GOM	NE	NE	NE	NE	NE	NE	NE
	SA	NE	NE	NE	NE	NE	NE	NE
	Carib	NE	NE	NE	NE	NE	NE	NE
Visual Surveys	GOM	NE	NE	NE	NE	NLAA	NLAA	NLAA
	SA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
	Carib	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Fish Traps	GOM	NE	NE	NE	NE	NLAA	NLAA	NLAA
	SA	NE	NE	NE	NE	NE	NE	NE
	Carib	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Underwater Cameras	GOM	NE	NE	NE	NE	NLAA	NLAA	NLAA
	SA	NE	NE	NE	NE	NE	NE	NE
	Carib	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Bottom Trawl	GOM	NE	NE	NE	NE	NLAA	NLAA	NLAA
	SA	NE	NE	NE	NE	NE	NE	NE
	Carib	NE	NE	NE	NE	NE	NE	NE
Hook-and-Line	GOM	NE	NE	NE	NE	NLAA	NLAA	NLAA
	SA	NE	NE	NE	NE	NE	NE	NE
	Carib	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Electrofishing	GOM	NE	NE	NE	NE	NE	NE	NE
	SA	NE	NE	NE	NE	NE	NE	NE
	Carib	NE	NE	NE	NE	NE	NE	NE

GOM = Gulf of Mexico; SA = South Atlantic; Carib = Caribbean; NE = No effect; NLAA = Not Likely to Adversely Affect

3.1.5 Johnson's Seagrass

We believe the proposed action is not likely to adversely affect Johnson's seagrass. Johnson's seagrass is found between Sebastian Inlet (27°51'N, 80°27'W) and north Biscayne Bay (25°45'N, 80°07'W) Florida (Durako et al. 2003), to depths of 10-13 ft (3-4 m) (Hammerstrom et al. 2006; Kenworthy 2000). Johnson's seagrass is a pioneer species, quickly recruiting to locally uninhabited patches, moving out once conditions become unfavorable. This attribute allows Johnson's seagrass to compete effectively in periodically disturbed areas sparsely or completely devoid of other seagrass. However, as patches become more densely populated with other seagrass species Johnson's seagrass is eventually out-competed (Durako et al. 2003). Johnson's seagrass does not occur in the Gulf of Mexico or Caribbean region. Three projects (SEFIS, IBBEAM, and Intraspecific Diversity in Pink Shrimp) occur in the South Atlantic between Sebastian Inlet and Biscayne Bay, Florida. The SEFIS project occurs at depths of 50-300 ft, deeper than the range of Johnson's seagrass; this project will not affect the species. Similarly, the IBBEAM project does not overlap with the range of the species. While it occurs in Biscayne Bay, sampling does not occur north of Shoal Point, Florida (25°38.3562'N, 80°16.3364'W); the southernmost range of Johnson's seagrass stops at Virginia Key, Florida (25°43.8197'N, 80°9.88259'W). Since the project does not operate within the known range of the species, it will not affect it. The Intraspecific Diversity in Pink Shrimp project does have some sampling effort that overlaps the range and depth of Johnson's seagrass. However, the research targets shrimp in thick patches of *Thalassia* and *Halodule*. Johnson's seagrass is frequently outcompeted by larger, wider-blade seagrass species. For that reason, it prefers being a pioneer species, colonizing patches of sea floor uninhabited by other seagrasses. We believe it is extremely unlikely that Johnson's seagrass would be found within the thick, established patches of seagrass where the project targets shrimp. For this reason, we believe any adverse effects from these projects are extremely unlikely to occur and are discountable.

3.1.6 Gulf Sturgeon

Gulf sturgeon move from the Gulf of Mexico into coastal rivers in early spring (i.e., March through May). Spawning occurs in the upper reaches of rivers in the spring when water temperature is around 15°C to 20°C. After hatching, young-of-year (YOY) generally disperse downstream of spawning sites, though some may travel upstream as well (Clugston et al. 1995; Sulak and Clugston 1999), and move into estuarine feeding areas for the winter months.

After spawning, Gulf sturgeon move downstream to areas referred to as "summer resting" or "holding" areas. Most subadult and adult Gulf sturgeon spend the cool winter months (October/November through March/April) in the bays, estuaries, and the nearshore Gulf of Mexico (Clugston et al. 1995; Fox et al. 2002; Odenkirk 1989). These shifting, predominantly sandy, areas support a variety of potential prey items including estuarine crustaceans, small bivalve mollusks, ghost shrimp, small crabs, various polychaete worms, and lancelets (Abele and Kim 1986; AFS 1989; Menzel 1971).

Gulf sturgeon are described as opportunistic and indiscriminate benthivores that change their diets and foraging areas during different life stages. Their guts generally contain benthic marine invertebrates including amphiopods, lancelets, polychaetes, gastropods, shrimp, isopods,

mollusks, and crustaceans (Carr et al. 1996; Fox et al. 2002; Huff 1975b; Mason and Clugston 1993). YOY sturgeon eat aquatic invertebrates and detritus (Mason and Clugston 1993; Sulak and Clugston 1999) and juveniles forage throughout the river on aquatic insects (e.g., mayflies and caddisflies), worms (oligochaete), and bivalves (Huff 1975b; Mason and Clugston 1993). Adults forage sparingly in freshwater and depend almost entirely on estuarine and marine prey for their growth (Gu et al. 2001).

Dip Nets, Electrofishing, Fyke Nets, Artificial Habitat Aggregation Structures, Visual Surveys, Fish Traps, Underwater Cameras, and Acoustic Equipment

Dip nets, electrofishing, fyke nets, and artificial habitat aggregation structures are used by projects that do not operate within the range of Gulf sturgeon and will not affect them. Visual surveys will not affect Gulf sturgeon. Only 1 visual survey occurs within the range of the species, but it takes place in August/September and May/June; a time of year when Gulf sturgeon are not likely to be in the Gulf of Mexico.

Fish traps and underwater cameras will not affect Gulf sturgeon. Seven FIM projects deploy fish traps and/or underwater cameras in the Gulf of Mexico. However, only 3 of them occur during times of year when we would anticipate that Gulf sturgeon would be in the Gulf of Mexico. The remaining 4 project occurs outside the range of the species.

Acoustic equipment used during FIM projects is described in Table 3.2; none of these pieces of equipment will effect Gulf sturgeon. The hearing range of sturgeon is reported to be 100-2,000 hertz (Hz) (Fay and Popper 2000, Lovell et al. 2005, Meyer and Popper 2002, Meyer et al. 2003). All the frequencies used are completely outside the hearing range of Gulf sturgeon; therefore, these projects will have no effect on these species.

Plankton Trawls, Seines, ROVs, Hook-and-Line, Bottom Trawl Gear, and Vessel Operations

FIM-based plankton trawls, seine ROVs, hook-and-line, and bottom trawl gears are not likely to adversely affect Gulf sturgeon. There has never been a documented interaction between these gears and Gulf sturgeon. FIM plankton trawl sampling may affect Gulf sturgeon via entanglement in nets or contact with other portions of the gear (e.g., trawl frames), but we believe these routes of effects are extremely unlikely to occur and are discountable. Plankton trawl sampling uses non-entangling fine-mesh (i.e., microns) bongo and neuston nets, measuring 5 ft or less, trawled at the surface for approximately 10 minutes to collect fish larvae samples. Gulf sturgeon spend the vast majority of their time near the bottom. For these reasons, and based on the past history of no captures of Gulf sturgeon by these projects, we believe any adverse effects to Gulf sturgeon are extremely unlikely to occur.

Two seine projects occur in the Gulf of Mexico, but 1 (IJA Shoreline Shellfish Bag Seine Survey - TPWD) is completely outside the range of Gulf sturgeon and will not affect them. The IJA Biloxi Bay Seine Survey - MDMR uses a small (i.e., 5-6 ft in width or height) seine, deployed in shallow water (less than 6 ft deep) and pulled by hand. The project is also not likely to affect Gulf sturgeon because it occurs shallower than most Gulf sturgeon are likely to be found. Fox et al. (2002b) indicate Gulf sturgeon are typically found in water 6.6-13.1 ft deep (2-4 m). For these reasons, and based on the past history of no captures of Gulf sturgeon by the project, we believe any adverse effects to Gulf sturgeon are extremely unlikely occur.

There has never been a documented interaction between ROVs and Gulf sturgeon. Gulf sturgeon may be affected by ROV deployments if they come into physical contact with the equipment or become entangled in the tether line. We believe this route of effects is extremely unlikely to occur and is discountable. ROVs are unbaited and are unlikely to attract Gulf sturgeon. The ROV tether is relatively short (i.e., no more than 100 ft), has no hooks, and is constantly monitored (i.e., someone is always monitoring it via a video feed). For these reasons, and based on the lack of any documented interactions with ROV gear, we believe any adverse effects to Gulf sturgeon are extremely unlikely occur.

There has never been a documented Gulf sturgeon capture on FIM-related hook-and-line gear. Hook-and-line gear could affect Gulf sturgeon via hooking and/or entanglement. We believe these routes of effects are extremely unlikely to occur and are discountable. Because of their diet and feeding mechanism, Gulf sturgeon are not likely to feed on baited hooks. Gulf sturgeon have been described as opportunistic bottom feeders that eat anything; their guts generally contain benthic marine invertebrates including amphipods, lancelets, polychaetes, gastropods, shrimp, isopods, mollusks, and crustaceans (Carr et al. 1996; Fox et al. 2000); Fox et al. (2002); (Huff 1975a; Mason and Clugston 1993; Scott and Crossman 1973a). These species are not used as bait during FIM sampling. The feeding habits of Gulf sturgeon, and the lack of any documented interactions, lead us to believe adverse effects from this gear are extremely unlikely to occur.

There has never been a documented Gulf sturgeon capture in FIM-related gillnet gear. Gillnet gear could affect Gulf sturgeon via entanglement, but this route of effect is extremely unlikely to occur and is discountable. Only 2 of 6 FIM gillnet projects (HMS - GULFSPAN Gillnet Survey -Florida State University and IJA - Coastal Finfish Gillnet Survey - MDMR) sample within the range of the species and during the periods of the year when Gulf sturgeon are most likely to be present. During the 7 month period when these projects and Gulf sturgeon might overlap relatively little fishing effort (70 total hours between the 2 projects) would occur. For these reasons, we believe any adverse effects from FIM gillnet sampling are extremely unlikely to occur and are discountable.

There has never been a documented Gulf sturgeon capture in FIM-related bottom trawl gear. Gulf sturgeon could be adversely affected by bottom trawl gear via abrasion, cuts, or blunt trauma caused by contacting the trawl frame. However, we believe those routes of effect are extremely unlikely to occur and are discountable. Commercial shrimp trawling is also known to take Gulf sturgeon; however, those events appear to be rare. Observers documented 2 Gulf sturgeon captures in the federal shrimp fisheries since 2009. During that same period, commercial shrimp fishing effort was: 2.6 million hours in 2009, 2 million hours in 2010, 2.3 million hours in 2011, and 2.3 million hours in 2012, (NMFS 2014h); approximately 2-3,000 times more effort than proposed under FIM sampling. The annual FIM bottom trawl sampling in both the South Atlantic and Gulf of Mexico combined is approximately 800 tow hours. The lack of any previous interactions, the relatively short tow times, and relatively low total tow hours leads us to believe FIM bottom trawl interactions with Gulf sturgeon are extremely unlikely to occur and are discountable.

Gulf sturgeon spend most of their time at or near the seafloor, where they are not subject to vessel interactions. Thus, we believe any adverse effects from the operation of FIM-related vessels are extremely unlikely to occur and are discountable.

3.2 Critical Habitat Not Likely to be Adversely Affected

FIM conducted using visual surveys, fish traps, underwater cameras, artificial habitat aggregation devices, dip nets, seining, gillnets, trawl gear (bottom and plankton), hook-and-line gear (bottom longline and vertical line), ROVs, acoustic equipment, and electrofishing, as described in Section 2.0 are not anticipated to adversely affect designated critical habitat for North Atlantic right whales, Gulf sturgeon, smalltooth sawfish, sea turtles (green, hawksbill, leatherbacks, and loggerheads), and *Acropora*. The following sections summarize our rationale for these determinations.

Table 3.10. Critical Habitat Not Likely to be Adversely Affected

	Gear Type					
Critical Habitat	**Bottom Longline**	**Vertical Line**	**Bottom Trawl**	**Plankton Trawl**	**Gillnets**	**Seines**
North Atlantic right whale	NE	NE	NE	NE	NE	NE
Elkhorn coral	NLAA	NLAA	NE	NE	NE	NE
Staghorn coral	NLAA	NLAA	NE	NE	NE	NE
Green sea turtle	NE	NE	NE	NE	NE	NE
Hawksbill sea turtle	NE	NE	NE	NE	NE	NE
Leatherback sea turtle	NE	NE	NE	NE	NE	NE
NWA DPS Loggerhead sea turtle	NLAA or NE	NLAA or NE	NLAA or NE	NLAA or NE	NLAA or NE	NLAA or NE
Gulf sturgeon	NLAA	NLAA	NLAA	NE	NLAA	NLAA
Smalltooth sawfish	NE	NE	NE	NE	NE	NE
Johnson's Seagrass	NE	NE	NE	NE	NE	NE

	Gear Types							
Critical Habitat	**Fish Traps**	**U/W Cameras**	**Visual Surveys**	**Artificial Habitat**	**Dip Net**	**ROVs**	**Acoustic Equip.**	**Electrofishing**
North Atlantic right whale	NE	NE	NE	NE	NE	NE	NE	NE
Elkhorn coral	NLAA	NLAA	NLAA	NE	NE	NE	NE	NE
Staghorn coral	NLAA	NLAA	NLAA	NE	NE	NE	NE	NE
Green sea turtle	NLAA	NLAA	NLAA	NE	NE	NE	NE	NE
Hawksbill sea turtle	NLAA	NLAA	NLAA	NE	NE	NE	NE	NE
Leatherback sea turtle	NLAA	NLAA	NLAA	NE	NE	NE	NE	NE
NWA DPS Loggerhead sea turtle	NLAA or NE	NLAA or NE	NLAA or NE	NLAA or NE	NLAA or NE	NLAA or NE	NLAA or NE	NE
Gulf sturgeon	NLAA	NLAA	NE	NLAA	NLAA	NE	NE	NE
Smalltooth sawfish	NE	NE	NE	NE	NE	NE	NE	NE
Johnson's seagrass	NE	NE	NE	NE	NE	NE	NE	NE

NLAA=Not Likely to Adversely Affect; NE = No Effect

3.2.1 North Atlantic Right Whale Critical Habitat

NMFS originally designated critical habitat for right whales in the North Atlantic Ocean when northern right whales were recognized as a single species (59 FR 28793, July 5, 1994). On January 27, 2016, NMFS published a final rule expanding the critical habitat designation for the North Atlantic right whale (81 FR 4838) (Figure 3.1). The new boundaries of the calving critical habitat that is within the action area include the marine waters from Cape Fear, North Carolina, southward to 28° N . latitude (approximately 31 miles south of Cape Canaveral, Florida) within the area bounded on the west by the shoreline and the 72 COLREGS lines, and on the east by rhumb lines connecting the following points in the order stated from north to south. The revision identifies the physical features of right whale calving habitat that are essential to the conservation of the North Atlantic right whale to be: (1) calm sea surface conditions of Force 4 or less on the Beaufort Wind Scale; (2) sea surface temperatures from a minimum of 7°C, and never more than 17°C; and (3) water depths of 6-28 meters, where these features simultaneously co-occur over contiguous areas of at least 231 km^2 of ocean waters during the months of November through April. None of the gear types/techniques or vessel activities associated with the proposed action will affect these essential features. FIM-related gear deployments and vessel operations will not affect sea state, sea surface temperature, or water depth individually or when they co-occur.

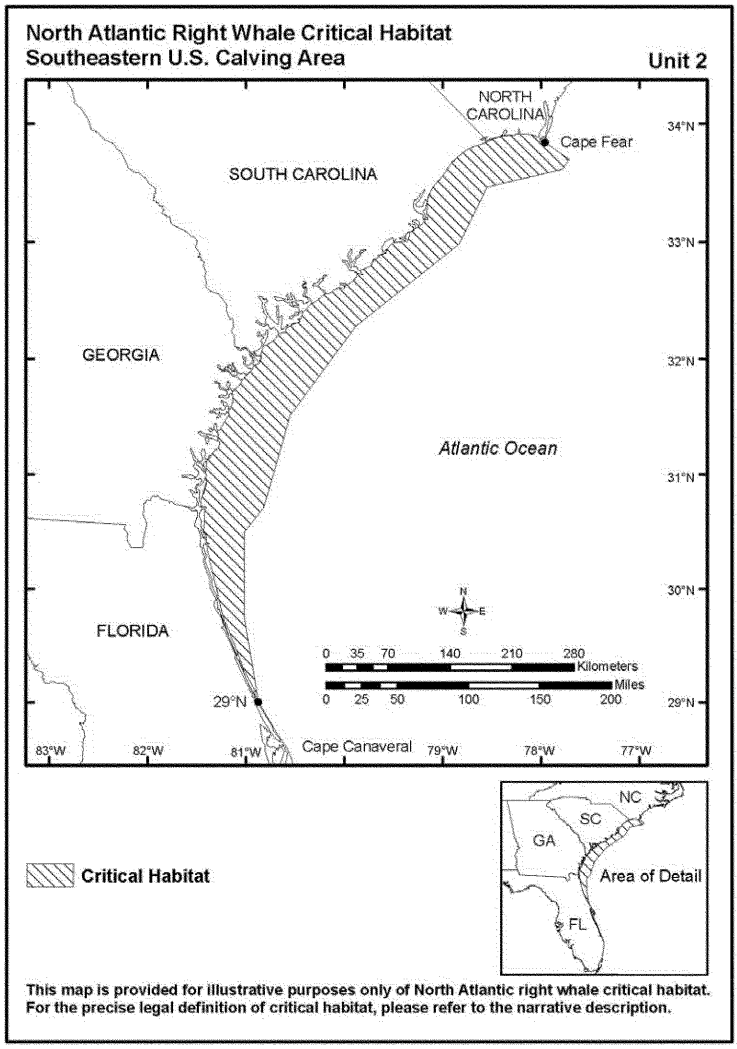

Figure 3.1. Proposed North Atlantic Right Whale Critical Habitat in the Action Area (Source: 80 FR 9313; February 20, 2015)

3.2.2 Gulf Sturgeon Critical Habitat

NMFS and USFWS jointly designated Gulf sturgeon critical habitat on April 18, 2003 (50 CFR 226.214). They designated 14 areas (Units) within rivers, tributaries, estuarine, and marine habitats in the Gulf of Mexico as critical habitat; Units 8-14 (see italics below) occur in the action area:

Unit 1	Pearl and Bogue Chitto Rivers in Louisiana and Mississippi
Unit 2	Pascagoula, Leaf, Bowie, Big Black Creek, and Chickasawhay Rivers in Mississippi
Unit 3	Escambia, Conecuh, and Sepulga Rivers in Alabama and Florida
Unit 4	Yellow, Blackwater, and Shoal Rivers in Alabama and Florida
Unit 5	Choctawhatchee and Pea Rivers in Florida and Alabama
Unit 6	Apalachicola and Brothers Rivers in Florida
Unit 7	Suwannee and Withlacoochee River in Florida
Unit 8	*Lake Pontchartrain (east of causeway), Lake Catherine, Little Lake, the Rigolets, Lake Borgne, Pascagoula Bay, and Mississippi Sound systems in Louisiana and Mississippi, and sections of the state waters within the Gulf of Mexico*
Unit 9	*Pensacola Bay system in Florida*
Unit 10	*Santa Rosa Sound in Florida*
Unit 11	*Nearshore Gulf of Mexico in Florida*
Unit 12	*Choctawhatchee Bay system in Florida*
Unit 13	*Apalachicola Bay system in Gulf and Franklin Counties, Florida*
Unit 14	*Suwannee Sound in Florida*

The physical and biological features identified as essential for the conservation of the Gulf sturgeon are abundant prey items; water quality (i.e., temperature, salinity, pH, hardness, turbidity, oxygen content, and other chemical characteristics) and sediment quality (i.e., texture and other chemical characteristics) necessary for normal behavior, growth, and viability of all life stages; and, safe unobstructed migratory pathways necessary for passage within and between riverine, estuarine, and marine habitats. Below are our determinations for how each gear type/technique may affect each essential feature. Artificial habitat aggregation devices are not used, and visual surveys, electrofishing, and dip net sampling are not conducted in any unit of Gulf Sturgeon critical habitat and will have no effect on any of the essential features.

Abundant Prey

Gulf sturgeon are described as opportunistic and indiscriminate benthivores. Their guts generally contain benthic marine invertebrates including amphiopods, lancelets, polychaetes, gastropods, shrimp, isopods, molluscs, and crustaceans (Carr et al. 1996; Fox et al. 2002; Huff 1975a; Mason Jr. and Clugston 1993). Generally, Gulf sturgeon prey are burrowing species that feed on detritus and/or suspended particles, and inhabit sandy substrate. The hook-and-line gears, fish traps, plankton trawl gear, and underwater cameras used during FIM activities do not catch Gulf sturgeon prey items and will have no effect on prey item abundance.

Acoustic equipment and ROV deployment will have no effect on Gulf sturgeon prey abundance. ROVs do not contact the bottom and will have no effect on prey abundance. Gulf sturgeon prey are benthic invertebrates they lay buried in the mud. There is no known impact to these species

from manmade sound. Thus, we believe the acoustic equipment used in FIM-related activity will not affect Gulf sturgeon prey.

Effects of bottom trawl, gillnet, and seine sampling on Gulf sturgeon prey items will be insignificant. The mesh sizes used during bottom trawl and gillnet sampling would allow the vast majority of Gulf sturgeon prey items to pass through the nets without retention. The mesh sizes used during seining could capture prey items, but the small size of the nets means the amount of prey items caught would likely be only a tiny fraction of the total amount of prey available. Bottom trawl gear could disturb benthic habitat in which Gulf sturgeon prey live. However, Gulf sturgeon prey communities are likely to recover quickly because the sediment composition pre- and post-trawling will be similar and prey species are known to recover relatively quickly from physical disturbance. While habitat known to support prey will be temporarily impacted, given that Gulf sturgeon forage opportunistically while benthic cruising, they can just as easily locate prey and fulfill nutritional requirements in areas adjacent to those impacted. Prey abundance elsewhere in the critical habitat units will not be affected by these localized sampling events (i.e., abundant alternative foraging resources will remain) and sampling locations will be available for foraging once sampling is completed. Additionally, because of the randomized sampling methodology of these projects, repetitive trawling over the same areas is very unlikely. Therefore, we believe any adverse effects on the prey abundance essential feature from the deployment of these gears will be insignificant.

Water and Sediment Quality

FIM-related gears or techniques are anticipated to have no effect on the water or sediment qualities (temperature, salinity, pH, hardness, turbidity, oxygen content, sediment texture, and other chemical characteristics) necessary for normal behavior, growth, and viability of all life stages.

Migratory Pathways

Effects of bottom trawl, gillnet, hook-and-line gear, fish trap, underwater camera, and seine sampling on migratory pathways will also be insignificant. During deployment of most of these gears a relatively small fraction of the total area of migratory pathways may be obstructed. Because of the relatively small size of all FIM projects compared to the overall area available for migration, we believe ample area will remain available for migration. Additionally, once those gears are removed the migratory pathway will immediately become unobstructed. Therefore, we believe any adverse effects on the migratory pathway essential feature from the deployment of these gears will be insignificant. Plankton trawl gear, acoustic equipment, and ROV deployments will have no effect on migratory pathways because these gear types do not contact the bottom; thus, they will not cause obstructions.

3.2.3 Smalltooth Sawfish Critical Habitat

Critical habitat for smalltooth sawfish was designated on September 2, 2009, and became effective on October 2, 2009. The critical habitat consists of 2 units that are nursery habitat: the Charlotte Harbor Estuary Unit and the Ten Thousand Islands/Everglades Unit (Figure 3.2). The essential features identified in these 2 units are: red mangroves and shallow euryhaline habitats

characterized by water depths between the mean high water line and 3 ft measured at mean lower low water (Figure 3.2).

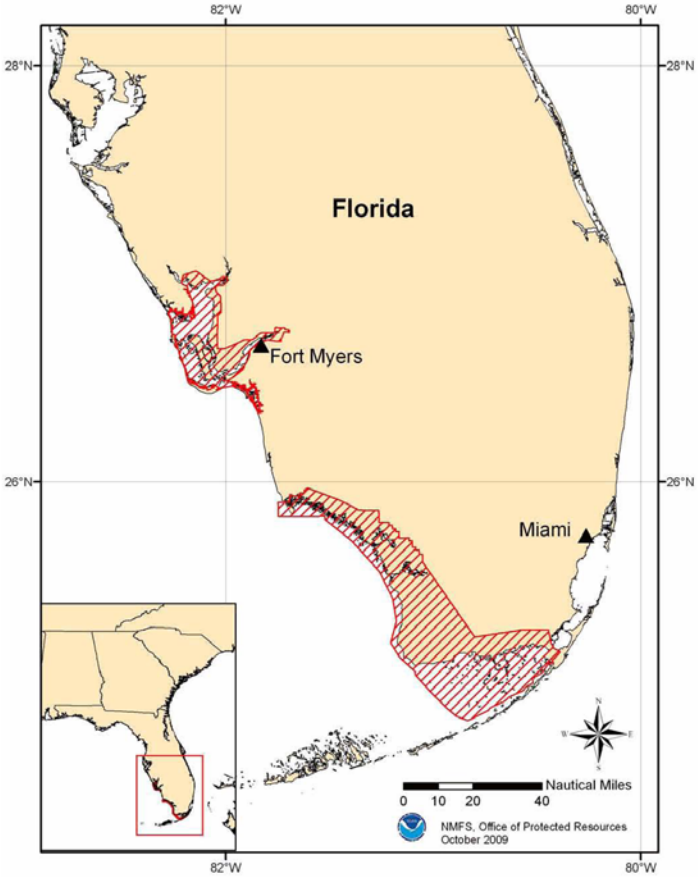

Figure 3.2. Designated critical habitat for smalltooth sawfish (Source: 74 FR 45353; September 2, 2009)

Only 1 bottom trawl [Juvenile Sport Fish Trawl Monitoring in Florida Bay (NMFS)] and 1 dip net project [Environmental Influences on Pink Shrimp (Dip Net) Survey (NMFS)] may occur in smalltooth sawfish critical habitat. These gears will have no effect on red mangroves or salinity, leaving both the euryhaline feature and red mangrove habitats intact. These projects may affect water quality by disturbing sediment, but no sediment will be removed and no changes to depth are anticipated. Thus, we believe dip net and bottom trawl sampling will have no effect on smalltooth sawfish critical habitat.

3.2.4 Sea Turtle Critical Habitat

Critical habitat for the green sea turtle has been designated in the waters surrounding the island of Culebra, Puerto Rico from the mean high water line seaward to 3 nmi. These waters include Culebra's outlying keys: Cayo Norte, Cayo Ballena, Cayos Geniquí, Isla Culebrita, Arrecife Culebrita, Cayo de Luis Peña, Las Hermanas, El Mono, Cayo Lobo, Cayo Lobito, Cayo Botijuela, Alcarraza, Los Gemelos, and Piedra Steven (63 FR 46693; September 2, 1998) (Figure 3.3).

Critical habitat for the hawksbill sea turtle has been designated in the waters surrounding the islands of Mona and Monito, Puerto Rico, from the mean high water line seaward to 3 nmi. (63 FR 46693; September 2, 1998) (Figure 3.4).

Critical habitat for the leatherback sea turtle has been designated in the waters adjacent to Sandy Point St. Croix, USVI, up to and inclusive of the waters from the 100-fathom curve shoreward to the level of mean high tide with boundaries at 17°42′12”N and 64°50′00″W (Figure 3.5).

Green and hawksbill sea turtles depend on the coral reefs and seagrass meadows for foraging; all 3 species depend on their respective beaches for nesting. Coral reef and seagrass habitats provide foraging and resting opportunities for these species. None of the gear types/techniques used during FIM are likely to adversely affect sea turtle critical habitat. Since all FIM occurs seaward of sea turtle nesting beaches, the proposed action will have no effect on them.

FIM-related gillnet, seine, dip net, electrofishing, and bottom trawl sampling, along with ROV deployment and acoustic equipment are not used in the Caribbean and will not affect green, hawksbill, or leatherback critical habitat. Plankton trawling will not affect sea turtle critical habitat because the gear does not interact with the benthos. Figure 2.11 depicts the locations of the artificial habitat aggregation devices; because they are not deployed inside sea turtle critical habitat, they will not affect any unit of sea turtle critical habitat. .

Nothing about the deployment of hook-and-line gear is expected to change the foraging resources available within critical habitat or alter the resting opportunities it provides. Only trained divers with scientific backgrounds conduct visual surveys, which makes it extremely unlikely they will affect the resting or foraging resources either. Therefore, we believe any effects from hook-and-line gear or visual surveys to sea turtle critical habitat are discountable.

Fish traps and underwater cameras could affect the seagrass essential feature of sea turtle critical habitat if those gears are deployed there but any affects will be temporary and insignificant. A trap or camera could temporarily cover a patch of seagrass. However, traps and cameras only soak for 1 hour and once those gears are retrieved, the area it covered immediately becomes available. Uhrin et al. (2005) report that seagrass shoot density only began to decline after being covered by traps for 6 weeks or longer. Therefore, we believe the adverse effects from covering areas of seagrass in sea turtle critical habitat will be temporary and of such limited scope that even during repeated deployment over the course of 5 years, any adverse effects from fish trap and underwater camera deployment will be insignificant.

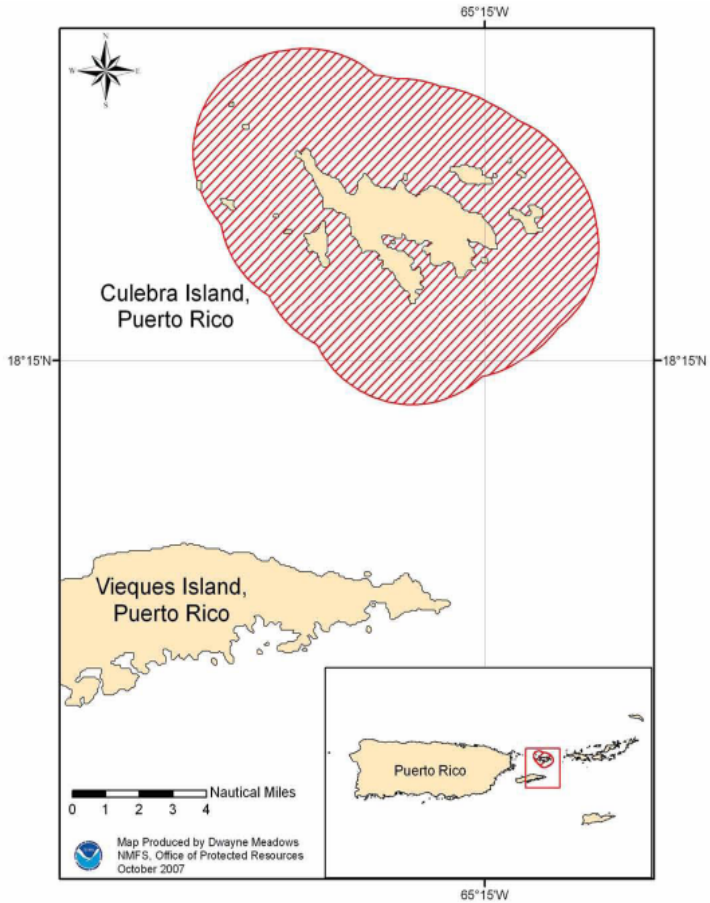

Figure 3.3. Green sea turtle critical habitat
(Source: 63 FR 46693; September 2, 1998)

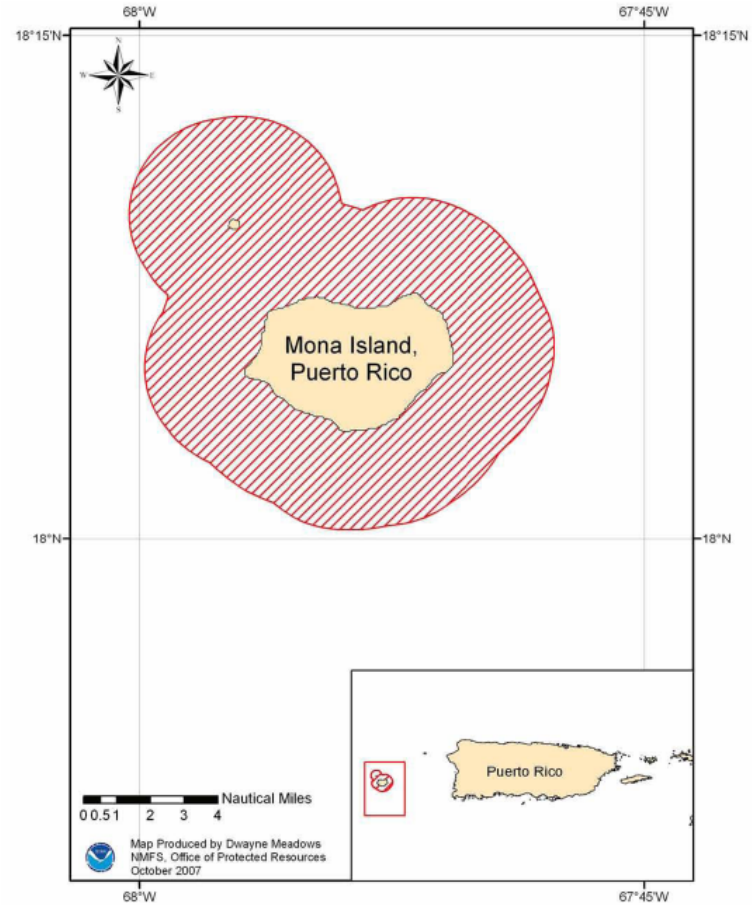

Figure 3.4. Hawksbill sea turtle critical habitat
(Source: 63 FR 46693; September 2, 1998)

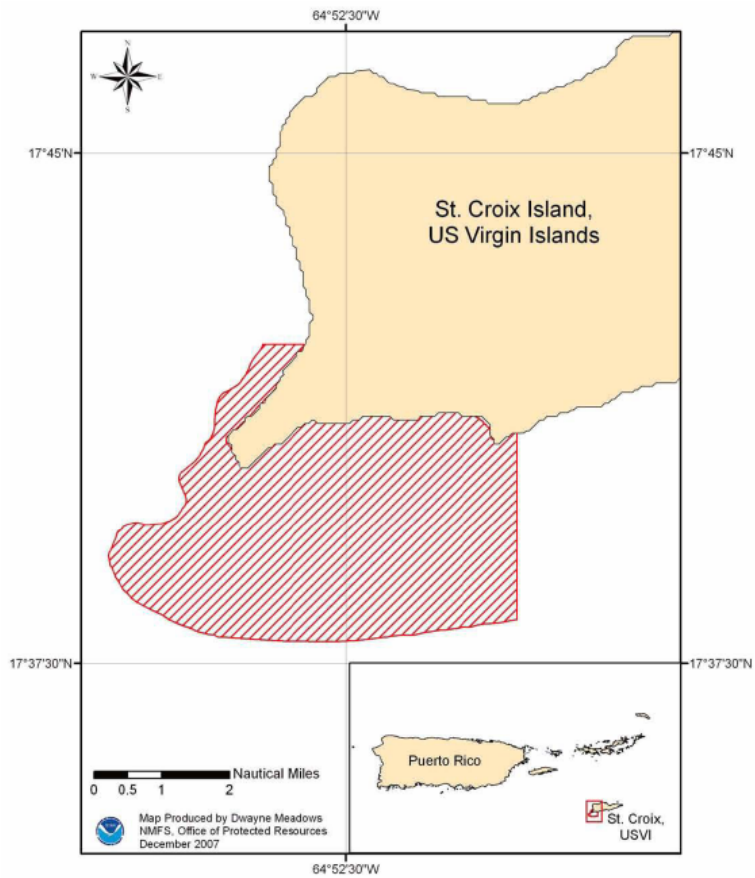

Figure 3.5. Designated leatherback sea turtle critical habitat (Source: 44 FR 17710; March 23, 1979)

3.2.5 NWA DPS of Loggerhead Sea Turtle Critical Habitat

NMFS designated critical habitat for the NWA DPS of loggerhead sea turtle on July 10, 2014 (effective August 11) (79 FR 39855). Specific areas for designation include 38 occupied marine areas within the range of the Northwest Atlantic Ocean DPS. These areas contain one or a combination of habitat types: nearshore reproductive habitat, wintering areas, breeding areas, constricted migratory corridors, and/or *Sargassum* habitat. Table 3.11 describes the Primary Constituent Elements (PCEs) of the habitat types identified in proposed designation of loggerhead critical habitat that occur in the action area. Figures 3.6-3.23 provide maps of each critical habitat unit.

Table 3.11 Primary Constituent Elements of Critical Habitat for NWA DPS of Loggerhead Sea Turtles (Source: 79 FR 39855)

Habitat Type	Units	State	Physical And Biological Features	Primary Constituent Elements
Nearshore Reproductive Habitat	LOGG-N-3, N-4, N-5, N-6	NC	Portion of nearshore waters adjacent to nesting beaches that are 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.	1) Nearshore waters with direct proximity to nesting beaches that support critical aggregations of nesting turtles (e.g., highest density nesting beaches) to 1.6 km (1 mile) offshore. 2) Waters sufficiently free of obstructions or artificial lighting to allow transit through the surf zone and outward toward open water. 3) Waters with minimal man-made structures that could promote predators (i.e., nearshore predator concentration caused by submerged and emergent offshore structures), disrupt wave patterns necessary for orientation, and/or create excessive longshore currents.
	LOGG-N-7, N-8, N-9, N-10, N-11	SC		
	LOGG-N-12, N-13	GA		
	LOGG-N-14, N-15, N-16, N-17, N-18, N-19, N-20, N-21, N-22, N-23, N-24, N-25, N-26, N-27, N-28, N-29, N-30, N-31, N-32	FL		
	LOGG-N-34, N-35, N-36	AL & MS		
Winter Concentration Habitat	LOGG-N-1, N-2	NC	Warm water habitat south of Cape Hatteras near the western edge of the Gulf Stream that supports meaningful aggregations of juveniles and adults during the winter months.	1) Water temperatures above 10°C during the colder months of November through April. 2) Continental shelf waters in proximity to the western boundary of the Gulf Stream. 3) Water depths between 20 and 100 meters.
Concentrated Breeding Habitat	LOGG-N-17, N-19	FL	Sites that support meaningful aggregations of both male and female adult individuals during the breeding season.	1) Meaningful concentrations of reproductive male and female loggerheads. 2) Proximity to primary Florida migratory corridor. 3) Proximity to Florida nesting grounds.
Constricted Migratory Corridor Habitat	LOGG-N-1	NC	High use migratory corridors that are constricted (limited in width) by land on one side and the edge of the continental shelf and Gulf Stream on the other side.	1) Constricted continental shelf area relative to nearby continental shelf waters that concentrate migratory pathways. 2) Passage conditions to allow for migration to and from nesting, breeding, and/or foraging areas.
	LOGG-N-17, N-18, N-19	FL		

Table 3.11 Primary Constituent Elements of Critical Habitat for NWA DPS of Loggerhead Sea Turtles, Cont'd (79 FR 39855)

Habitat Type	Units	State	Physical And Biological Features	Primary Constituent Elements
Sargassum Habitat	LOGG-S-1, S-2	Atlantic Ocean & Gulf of Mexico	Developmental and foraging habitat for young loggerheads where surface waters form accumulations of floating material, especially *Sargassum.*	1) Convergence zones, surface-water downwelling areas, and other locations where there are concentrated components of the *Sargassum* community in water temperatures suitable for optimal growth of *Sargassum* and inhabitance of loggerheads. 2) *Sargassum* in concentrations that support adequate prey abundance and cover. 3) Available prey and other material associated with *Sargassum* habitat such as, but not limited to, plants and cyanobacteria and animals endemic to the *Sargassum* community such as hydroids and copepods. 4) Sufficient water depth and proximity to available currents to ensure offshore transport, and foraging and cover requirements by Sargassum for post-hatchling loggerheads, i.e., > 10 m depth to ensure not in surf zone.

Nearshore Reproductive Habitat (Units LOGG-N-3 through N-36)

Any adverse effects from FIM-related projects to the Primary Constituent Elements (PCEs) of Nearshore Reproductive Habitat will be insignificant. No FIM-related project would affect these areas' proximity to the nesting beaches that support critical aggregations of nesting turtles. Nor will any FIM-related project introduce man-made structures that would measurably promote predators, disrupt wave patterns, or create excessive longshore currents. Some FIM-related projects may use artificial lighting during nighttime operations, but those projects take place at sea on moving vessels, away from nesting beaches, and are not permanent. Likewise, during the deployment of fishing gear a relatively small fraction of the total area of nearshore reproductive habitat may be obstructed. However, the gears are removed within a matter of hours. Because of the relatively small size of the FIM-related gear compared to the overall area of nearshore reproductive habitat, we believe ample area will remain unobstructed. Additionally, once those gears are removed the area will immediately become unobstructed. Therefore, any adverse effects from FIM-related projects to nearshore reproductive habitat will be insignificant.

Winter Concentration Habitat (Units LOGG-N-1, N-2)

The PCEs of the Winter Concentration Habitat will not be affected by any FIM-related projects. Only South Atlantic projects could occur in these habitats, but none of them occur during the winter months (November through April) in the area between Cape Hatteras, North Carolina, and Cape Lookout, North Carolina where the habitat has been identified.

Concentrated Breeding Habitat (Units LOGG-N-17 and N-19)

Only 5 FIM-related trawl and hook-and-line projects (All 3 MARMAP hook-and-line projects, the Shark and Red Snapper Bottom Longline Survey [NMFS] and the SEAMAP-SA Coastal Trawl Survey [SCDNR]) overlap spatially with Unit LOGG-N-17; no projects overlap Unit LOGG-N-19. Even the projects that do overlap Unit LOGG-N-17, do so very slightly. All the projects that do overlap sample the entire Southeast Coast from North Carolina to central Florida. Thus, the actual sampling effort is scattered across the entire coast, meaning the

sampling effort likely to occur within Unit LOGG-N-17 is just a subset of the total sampling effort of these projects. During a single trawl/set only a handful of animals, at most, are ever captured, they are released very close to the capture location, and have a very high survival rate. For these reasons, we do not believe that a possible capture of loggerhead sea turtle in these areas will meaningfully reduce the concentrations of male and female loggerheads occurring there and any adverse effects will be insignificant.

Constricted Migratory Corridor Habitat (Units LOGG-N-1 and LOGG-N-17 through N-19)
Any adverse effects from FIM-related projects to the PCEs of Constricted Migratory Corridor Habitat will be insignificant. No FIM project would change the width of these areas' or their relative position to the Gulf Stream or edge of the continental shelf. Any FIM-related fishing gear deployed in these areas are temporary and will not meaningfully alter the passage conditions that allow migration to and from nesting, breeding, or feeding habitats. Only 5 FIM-related trawl and hook-and-line projects (All 3 MARMAP hook-and-line projects, the Shark and Red Snapper Bottom Longline Survey [NMFS] and the SEAMAP-SA Coastal Trawl Survey [SCDNR]) overlap spatially with Unit LOGG-N-17 and LOGG-N-1; no projects overlap Unit LOGG-N-19. Even the projects that do overlap Units LOGG-N-17 and LOGG-N-1, do so very slightly. The projects that do overlap sample the entire Southeast Coast from North Carolina to central Florida. Gear that is deployed will cover a relatively small fraction of the total migratory corridor. Because of the relatively small size of the gear compared to the overall area available for migration, as well as the relatively few projects that may even be deploying gear in these areas, we believe ample area will remain available for migration. Additionally, once those gears are removed the migratory corridors will immediately become unobstructed. Therefore, we believe any adverse effects on the migratory corridor essential feature from the deployment of these gears will be insignificant.

***Sargassum* Habitat**
Any adverse effects from FIM-related projects to the PCEs of *Sargassum* habitat will be insignificant. No FIM project would affect the location of convergence zones, surface-water downwelling areas, or other locations where there are concentrated components of the *Sargassum* community in water temperatures suitable for optimal growth of *Sargassum* and inhabitance of loggerheads. No FIM project would affect the availability of prey for hatchling loggerhead sea turtles or other material associated with *Sargassum* habitat. Nor will any FIM project affect the water depth or proximity to currents necessary for offshore transport, foraging and cover. While some vessels associated with FIM-projects may transit through *Sargassum* habitats, those vessel tracks are not anticipated to scatter *Sargassum* occurring in concentrations that support adequate prey abundance and cover to such an extent that it adversely effects the functionality of the PCE. *Sargassum* contain numerous air-filled pockets that keep them a float (SAFMC 2002). The wakes and surface water disruption associated with these vessels may push or move *Sargassum* mats, but are unlikely to cause them to sink or otherwise disappear. Temporary and incidental removal of *Sargassum* via fishing gear (particularly trawl gear) could occur. However, any incidentally harvested S*argassum* is returned to the ocean so harvest is not anticipated to be at such a level that functionality of the PCE will be affected. For these reasons, we believe any adverse effects to the PCEs of *Sargassum* habitat will be insignificant.

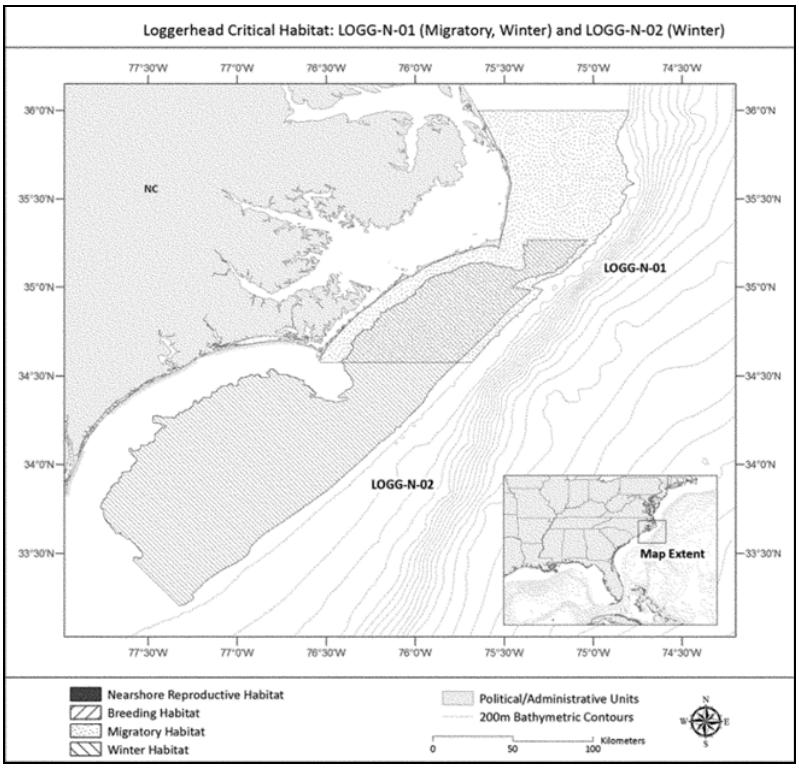

Figure 3.6. LOGG-N-1 – *North Carolina Constricted Migratory Corridor and Northern Portion of the North Carolina Winter Concentration Area* (Source: 79 FR 39856; July 10, 2014)

This unit contains constricted migratory and winter habitat. The unit includes the North Carolina constricted migratory corridor and the overlapping northern half of the North Carolina winter concentration area. We defined the constricted migratory corridor off North Carolina as the waters between 36°N latitude and Cape Lookout (approximately 34.58°N) from the edge of the Outer Banks, North Carolina barrier islands to the 200-m (656 ft) depth contour (continental shelf). The constricted migratory corridor overlaps with the northern portion of winter concentration area off North Carolina. The east and western boundaries of winter habitat are the 20-m and 100-m (65.6 and 328 ft) contours, respectively. The northern boundary of winter habitat starts at Cape Hatteras (35°16'N) in a straight latitudinal line between 20- and 100-m (65.6-328 ft) depth contours and ends at Cape Lookout (approximately 34.58°N).

LOGG-N-2 – *Southern Portion of the North Carolina Winter Concentration Area*

This unit contains winter habitat only. The boundaries include waters between the 20- and 100-m (65.6 and 328 ft) depth contours between Cape Lookout to Cape Fear. The eastern and western boundaries of winter habitat are the 20-m and 100-m (65.6 and 328 ft) contours, respectively. The northern boundary is Cape Lookout (approximately 34.58°N). The southern boundary is a 37.5-km (23.25-mile) line that extends from the 20-m (65.6 ft) depth contour at approximately 33.47°N, 77.58°W (off Cape Fear) to the 100-m (328 ft) depth contour at approximately 33.2°N, 77.32°W.

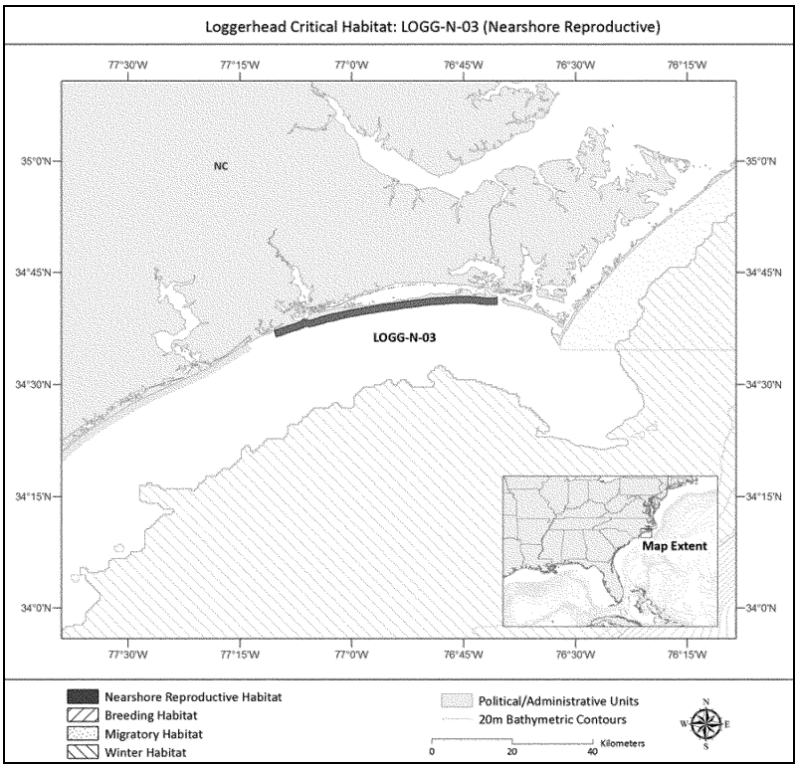

Figure 3.7. LOGG-N-3 – *Bogue Banks and Bear Island, Carteret and Onslow Counties, North Carolina* (Source: 79 FR 39856; July 10, 2014)

This unit contains nearshore reproductive habitat only. The unit consists of nearshore area from Beaufort Inlet to Bear Inlet (crossing Bogue Inlet) from the MHW line seaward 1.6 km.

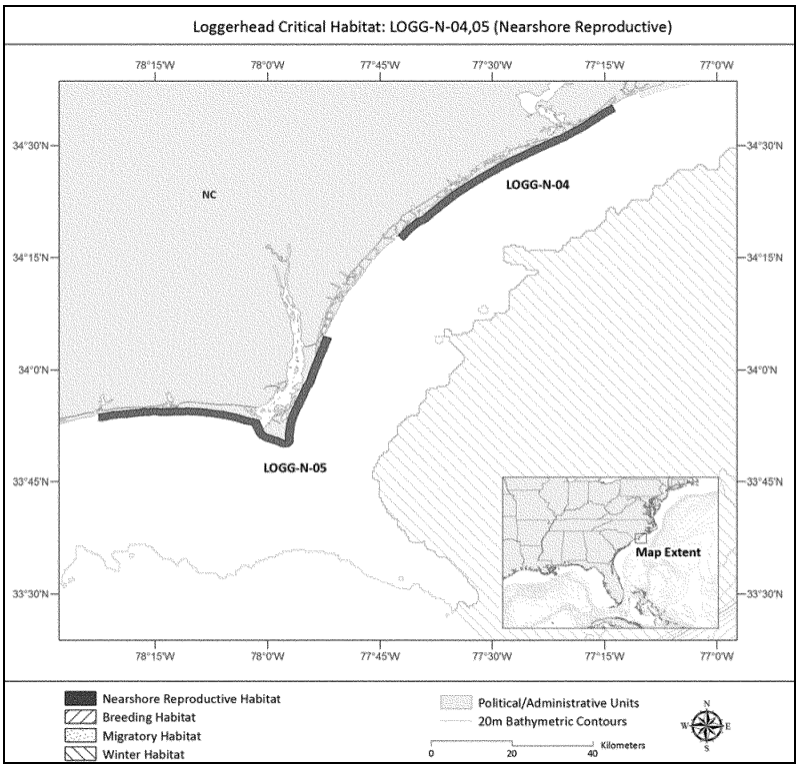

Figure 3.8. LOGG-N-4 – *Onslow Beach (Marine Corps Base Camp Lejeune), Topsail Island and Lea-Huttaf Island, Onslow and Pender Counties, North Carolina* (Source: 79 FR 39856; July 10, 2014)

This unit contains nearshore reproductive habitat only. The unit consists of nearshore area from Browns Inlet to Rich Inlet (crossing New River Inlet and New Topsail Inlet) from the MHW line seaward 1.6 km (1.0 mile).

LOGG-N-5 – *Pleasure Island, Bald Head Island, Oak Island, and Holden Beach, New Hanover and Brunswick Counties, North Carolina*

This unit contains nearshore reproductive habitat only. The unit consists of nearshore area from Carolina Beach Inlet around Cape Fear to Shallotte Inlet (crossing the mouths of the Cape Fear River and Lockwoods Folly Inlet), from the MHW line seaward 1.6 km.

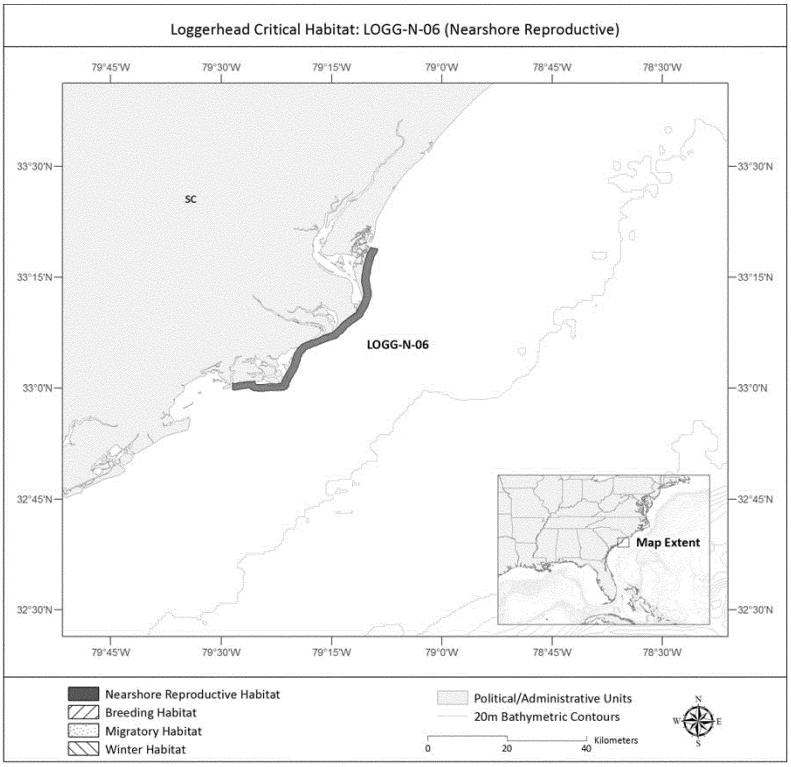

Figure 3.9. LOGG-N-6-- *North, Sand, South and Cedar Islands, Georgetown County, South Carolina; Murphy, Cape, Lighthouse Islands and Racoon Key, Charleston County, South Carolina* (Source: 79 FR 39856; July 10, 2014)

This unit contains nearshore reproductive habitat only. The unit consists of nearshore area from North Inlet to Five Fathom Creek Inlet (crossing Winyah Bay, North Santee Inlet, South Santee Inlet, Cape Romain Inlet, and Key Inlet) from the MHW line seaward 1.6 km.

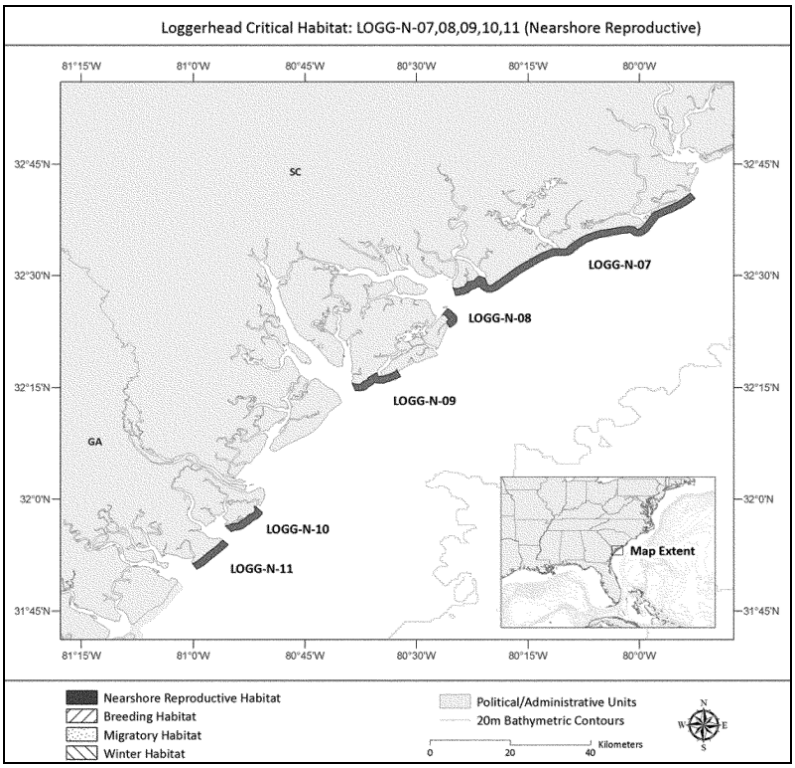

Figure 3.10. LOGG-N-7 – *Folly, Kiawah, Seabrook, Botany Bay Islands, Botany Bay Plantation, Interlude Beach, and Edingsville Beach, Charleston County, South Carolina; Edisto Beach State Park, Edisto Beach, and Pine and Otter Islands, Colleton County, South Carolina* (Source: 79 FR 39856; July 10, 2014)

This unit contains nearshore reproductive habitat only. The unit consists of nearshore area from Lighthouse Inlet to Saint Helena Sound (crossing Folly River, Stono, Captain Sam's, North Edisto, Frampton, Jeremy, South Edisto and Fish Creek Inlets) from the MHW line seaward 1.6 km.

LOGG-N-8 – *Harbor Island, Beaufort County, South Carolina*

This unit contains nearshore reproductive habitat only. The unit consists of nearshore area from Harbor Inlet to Johnson Inlet from the MHW line seaward 1.6 km.

LOGG-N-9 – *Little Capers, St. Phillips, and Bay Point Islands, Beaufort County, South Carolina*

This unit contains nearshore reproductive habitat only. The unit consists of nearshore area from Pritchards Inlet to Port Royal Sound (crossing Trenchards Inlet and Morse Island Creek Inlet East) from the MHW line seaward 1.6 km.

LOGG-N-10 – *Little Tybee Island, Chatham County, Georgia*

This unit contains nearshore reproductive habitat only. The boundaries of this unit are from Tybee Creek Inlet to Wassaw Sound from the MHW line seaward 1.6 km.

LOGG-N-11 – *Wassaw Island, Chatham County, Georgia*

This unit contains nearshore reproductive habitat only. The boundaries of the unit are from Wassaw Sound to Ossabaw Sound from the MHW line seaward 1.6 km.

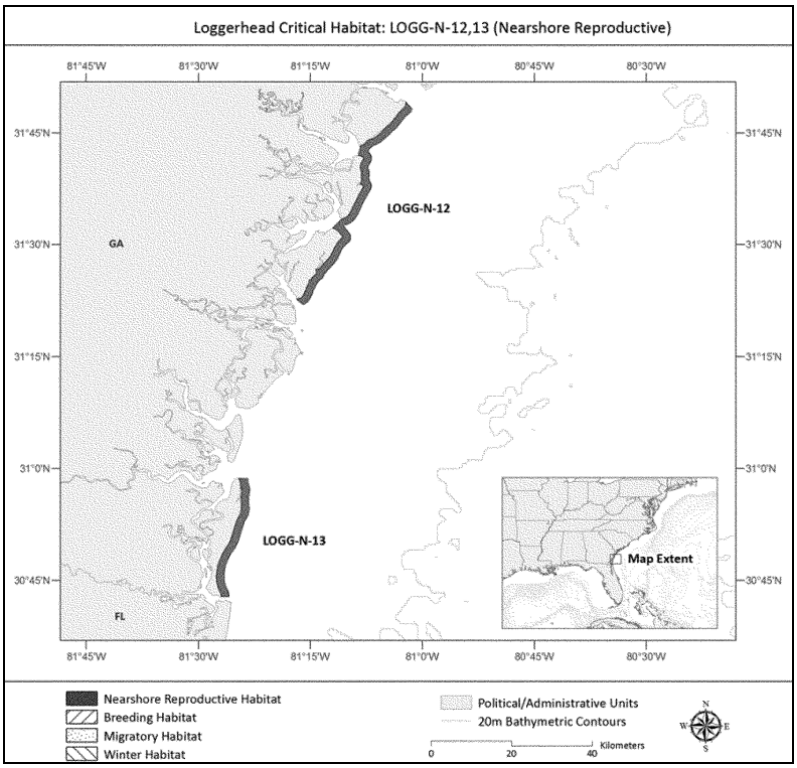

Figure 3.11. LOGG-N-12 – *Ossabaw Island, Chatham County, Georgia; St. Catherines Island, Liberty County, Georgia; Blackbeard and Sapelo Islands, McIntosh County, Georgia* (Source: 79 FR 39856; July 10, 2014)

This unit contains nearshore reproductive habitat only. The boundaries of this unit are nearshore areas from the Ogeechee River to Deboy Sound (crossing St. Catherines Sound, McQueen Inlet, Sapelo Sound, and Cabretta Inlet) extending from the MHW line and seaward 1.6 km.

LOGG-N-13 – *Little Cumberland Island and Cumberland Island, Camden County, Georgia*

This unit contains nearshore reproductive habitat only. The boundaries of this unit are nearshore areas from St. Andrew Sound to the St. Marys River (crossing Christmas Creek) from the MHW line seaward 1.6 km (1.0 mile).

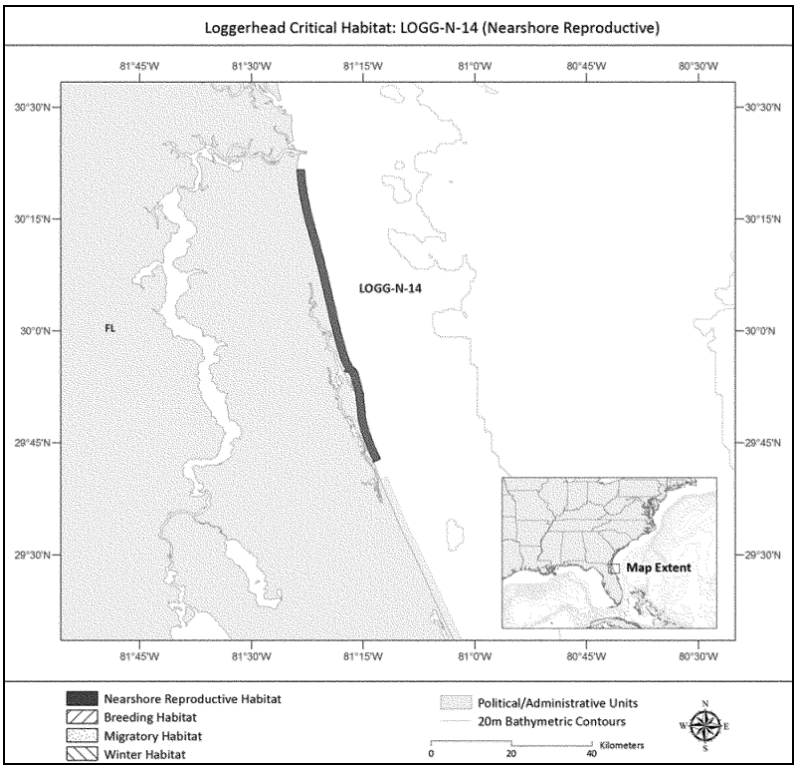

Figure 3.12. LOGG-N-14-- *Southern Boundary of Kathryn Abbey Hanna Park to Mantanzas Inlet, Duval and St. Johns Counties, Florida* (Source: 79 FR 39856; July 10, 2014)

This unit contains nearshore reproductive habitat only. The boundaries of the unit are nearshore areas from the south boundary of Kathryn Abbey Hanna Park to Matanzas Inlet (crossing St. Augustine Inlet) from the MHW line seaward 1.6 km.

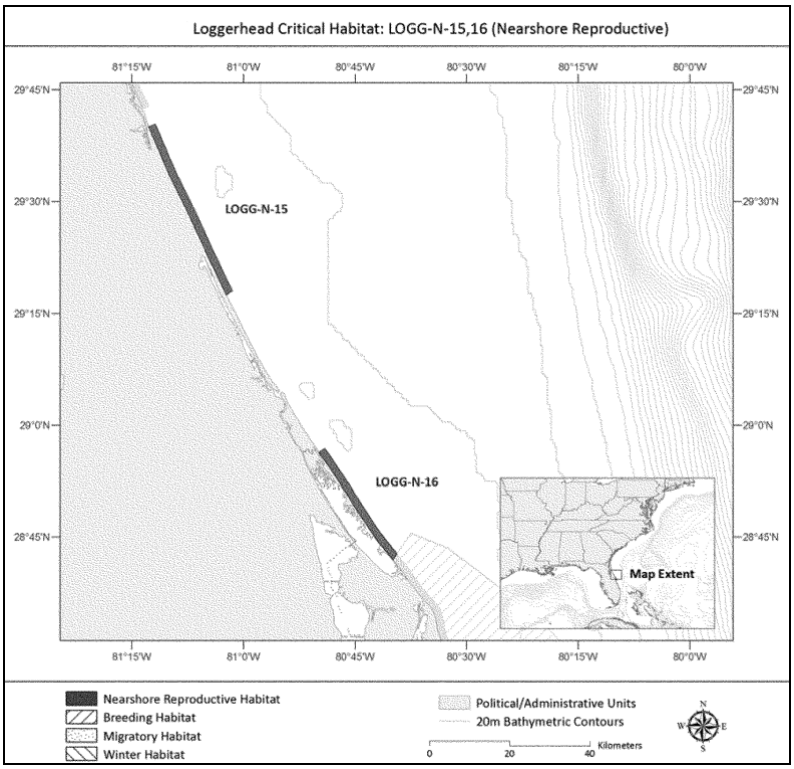

Figure 3.13. LOGG-N-15 – *Northern Boundary of River to Sea Preserve at Marineland to Granada Blvd., Flagler and Volusia Counties, Florida* (Source: 79 FR 39856; July 10, 2014)

This unit contains nearshore reproductive habitat only. The boundaries of the unit are nearshore areas from the north boundary of River to Sea Preserve at Marineland to Granada Boulevard in Ormond Beach from the MHW line seaward 1.6 km.

LOGG-N-16 – *Canaveral National Seashore to 28.70°N, 80.66 °W near Titusville, Volusia and Brevard Counties, Florida*

This unit contains nearshore reproductive habitat only. Boundaries of the unit are nearshore areas from the north boundary of Canaveral National Seashore to 28.70°N, 80.66°W near Titusville (at the start of the Titusville-Floridana Beach concentrated breeding area) from the MHW line seaward 1.6 km.

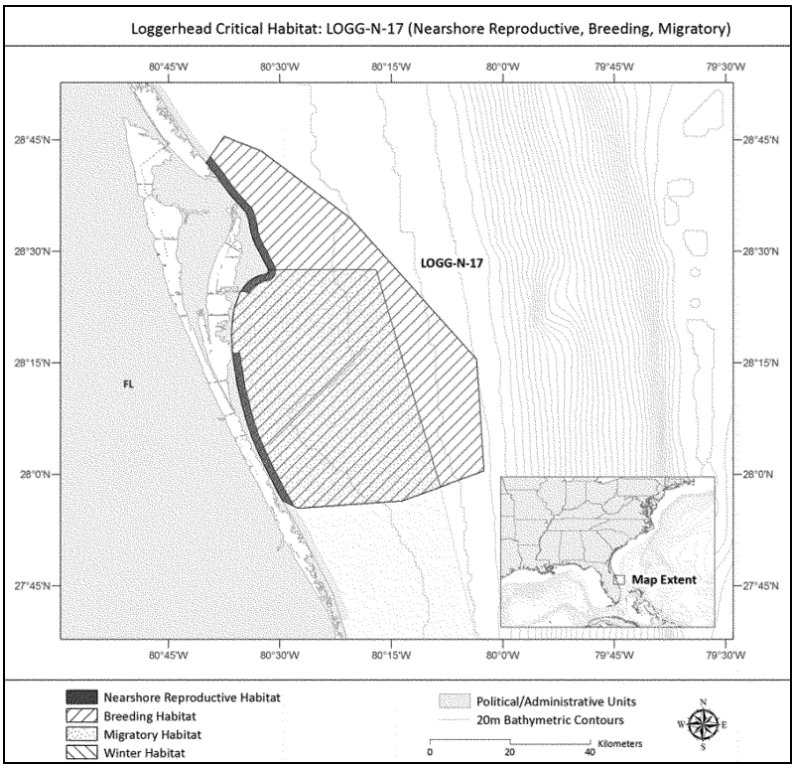

Figure 3.14. LOGG-N-17 – *Titusville to Floridana Beach Concentrated Breeding Area, Northern Portion of the Florida Constricted Migratory Corridor, Nearshore Reproductive Habitat from 28.70°N, 80.66°W near Titusville to Cape Canaveral Air Force Station; and Nearshore Reproductive Habitat from Patrick Air Force Base and Central Brevard Beaches, Brevard County, Florida* (Source: 79 FR 39856; July 10, 2014)

This unit includes overlapping areas of nearshore reproductive habitat, constricted migratory habitat, and breeding habitat. The concentrated breeding habitat area is from the MHW line on shore at 28.70°N, 80.66°W near Titusville to depths less than 60 m and extending south to Floridana Beach. This overlaps with waters in the northern portion of the Florida constricted migratory corridor, which begins at the tip of Cape Canaveral Air Force Station (28.46°N. lat.) and ends at Floridana beach, including waters from the MHW line on shore to the 30-m contour line. Additionally, the above 2 habitat areas overlap with 2 nearshore reproductive habitat areas. The first begins near Titusville at 28.70°N, 80.66°W to the south boundary of the Cape Canaveral Air Force Station/Canaveral Barge Canal Inlet from the MHW line seaward 1.6 km. The second begins at Patrick Air Force Base, Brevard County, through the central Brevard Beaches to Floridana Beach from the MHW line seaward 1.6 km.

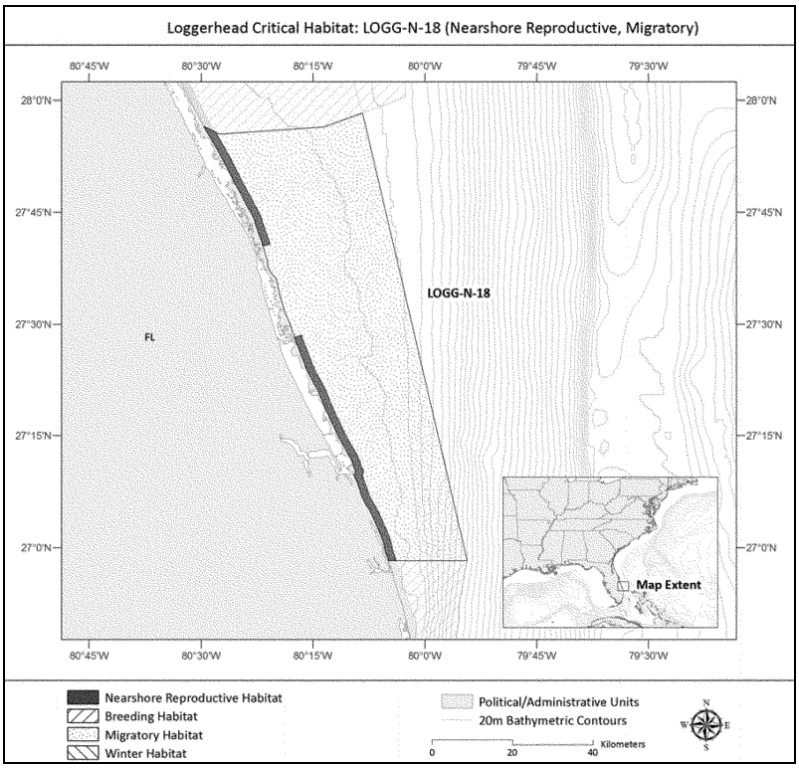

Figure 3.15. LOGG-N-18 – *Florida Constricted Migratory Corridor from Floridana Beach to Martin County/Palm Beach County Line; Nearshore Reproductive Habitat from Floridana Beach to the south end of Indian River Shores; Nearshore Reproductive Habitat from Fort Pierce inlet to Martin County/Palm Beach County Line, Brevard, Indian River and Martin Counties, Florida* (Source: 79 FR 39856; July 10, 2014)

This unit contains nearshore reproductive habitat and constricted migratory habitat. The unit contains a portion of the Florida constricted migratory corridor, which is located in the nearshore waters from the MHW line to the 30-m contour off Floridana Beach to the Martin County/Palm Beach County line. This overlaps with 2 nearshore reproductive habitat areas. The first nearshore reproductive area includes nearshore areas from Floridana Beach to the south end of Indian River Shores (crossing Sebastian Inlet) from the MHW line seaward 1.6 km. The second nearshore reproductive habitat area includes nearshore areas from Fort Pierce inlet to Martin County/Palm Beach County line (crossing St. Lucie Inlet) from the MHW line seaward 1.6 km.

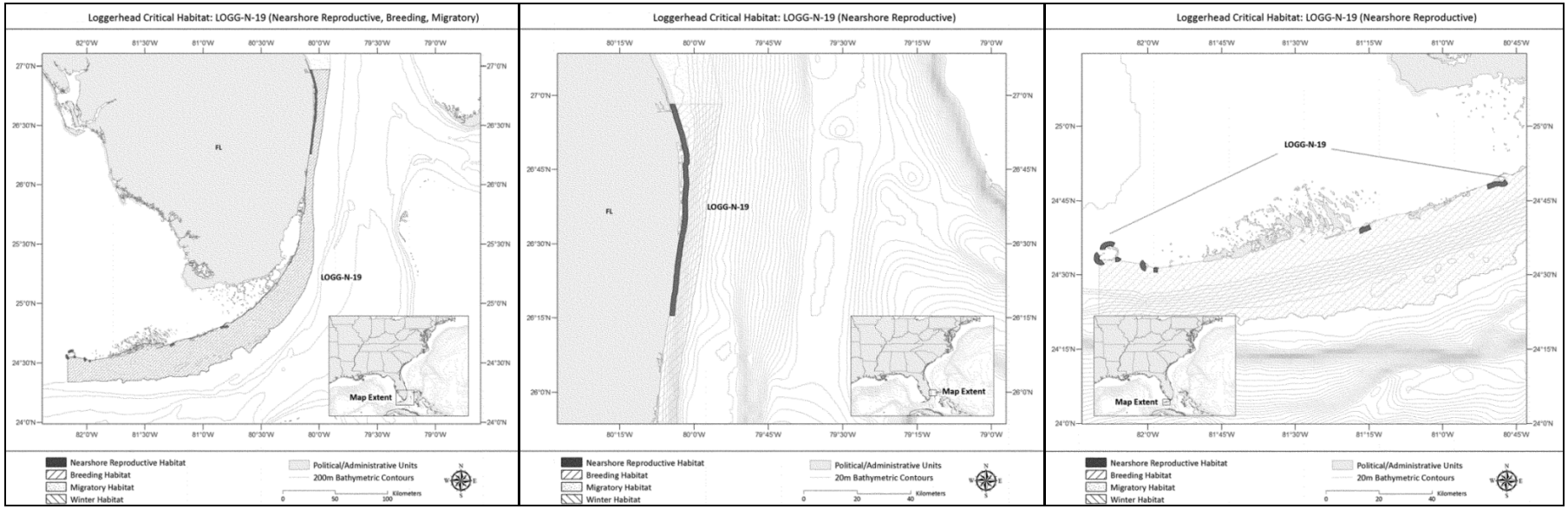

Figure 3.16. LOGG-N-19 – *Southern Florida Constricted Migratory Corridor; Southern Florida Concentrated Breeding Area; and Six Nearshore Reproductive Areas: Martin County/Palm Beach County line to Hillsboro Inlet, Palm Beach and Broward Counties, Florida; Long Key, Bahia Honda Key, Woman Key, Boca Grande Key, and Marquesas Keys, Monroe County, Florida* (Source: 79 FR 39856; July 10, 2014)

This unit contains nearshore reproductive habitat, constricted migratory habitat, and breeding habitat. The unit contains the southern Florida constricted migratory corridor habitat, overlapping southern Florida breeding habitat, and overlapping nearshore reproductive habitat. The southern portion of the Florida concentrated breeding area and the southern Florida constricted migratory corridor are both located in the nearshore waters starting at the Martin County/Palm Beach County line to the westernmost edge of the Marquesas Keys (82.17°W. long.), with the exception of the waters under the jurisdiction of Naval Air Station Key West. The seaward border then follows the 200-m contour line to the westernmost edge at the Marquesas Keys. The overlapping nearshore reproductive habitat includes nearshore waters starting at the Martin County/Palm Beach County line to Hillsboro Inlet (crossing Jupiter, Lake Worth, Boyton, and Boca Raton Inlets) from the MHW line seaward 1.6 km; Long Key, which is bordered on the east by the Atlantic Ocean, on the west by Florida Bay, and on the north and south by natural channels between Keys (Fiesta Key to the north and Conch Key to the south), and has boundaries following the borders of the island from the MHW line seaward to 1.6 km; Bahia Honda Key, from the MHW line seaward 1.6 km; 4) Woman Key, from the MHW line and seaward to 1.6 km; 5) Boca Grande Key, from the MHW line seaward to 1.6 km; 6) the Marquesas Keys unit boundary, including nearshore areas from the MHW line seaward to 1.6 km from four islands where loggerhead sea turtle nesting has been documented within the Marquesas Keys: Marquesas Key, Unnamed Key 1, Unnamed Key 2, and Unnamed Key 3.

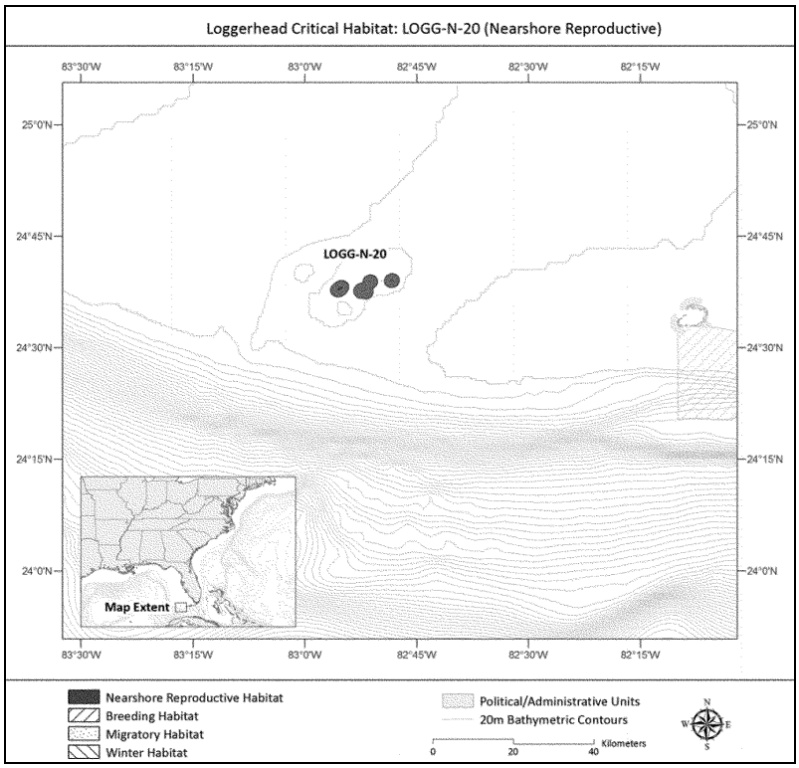

Figure 3.17. LOGG-N-20-- *Dry Tortugas, Monroe County, Florida* (Source: 79 FR 39856; July 10, 2014)

This unit contains nearshore reproductive habitat only. The unit boundary includes nearshore areas from the MHW line and seaward to 1.6 km (1.0 mile) from six islands where loggerhead sea turtle nesting has been documented within the Dry Tortugas. From west to east, these 6 islands are Loggerhead Key, Garden Key, Bush Key, Long Key, Hospital Key, and East Key.

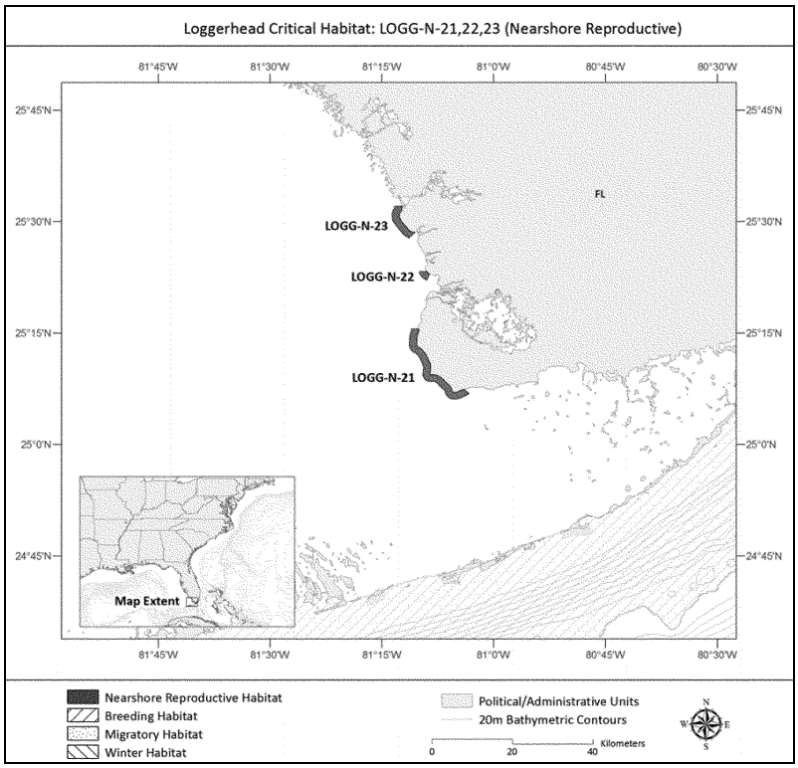

Figure 3.18. LOGG-N-21 – *Cape Sable, Monroe County, Florida* (Source: 79 FR 39856; July 10, 2014)

This unit contains nearshore reproductive habitat only. The boundaries of the unit are nearshore areas from the MHW line and seaward to 1.6 km from the north boundary of Cape Sable at 25.25°N, 81.17°W to the south boundary of Cape Sable at 25.12°N, 81.07°W.

LOGG-N-22 – *Graveyard Creek to Shark Point, Monroe County, Florida*

This unit contains nearshore reproductive habitat only. The boundaries of this unit are nearshore areas from Shark Point (25.39°N, 81.15°W) to Graveyard Creek Inlet from the MHW line seaward 1.6 km.

LOGG-N-23 – *Highland Beach, Monroe County, Florida*

This unit contains nearshore reproductive habitat only. The boundaries of this unit are from First Bay to Rogers River Inlet from the MHW line seaward 1.6 km.

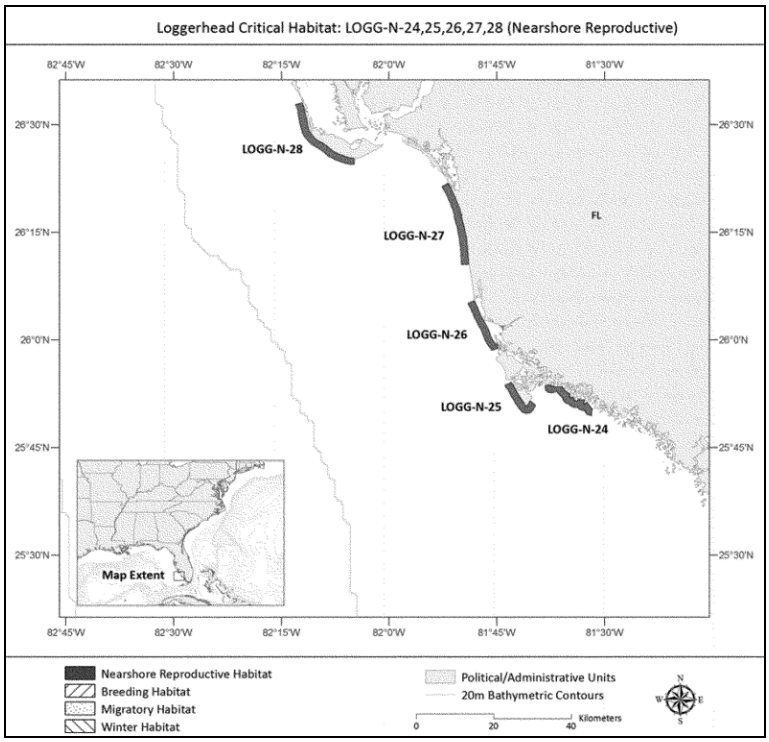

Figure 3.19. LOGG-N-24 – *Ten Thousand Islands North, Collier County, Florida* (Source: 79 FR 39856; July 10, 2014)

This unit contains nearshore reproductive habitat only. The unit boundary includes nearshore areas from the MHW line seaward 1.6 km (1.0 mile) of 9 keys where loggerhead sea turtle nesting has been documented within the northern part of the Ten Thousand Islands in Collier County in both the Ten Thousand Islands NWR and the Rookery Bay NERR.

LOGG-N-25 – *Cape Romano, Collier County, Florida*

This unit contains nearshore reproductive habitat only. The boundaries of the unit are nearshore areas from Caxambas Pass to Gullivan Bay from the MHW line seaward 1.6 km.

LOGG-N-26 – *Keewaydin Island and Sea Oat Island, Collier County, Florida*

This unit contains nearshore reproductive habitat only. The boundaries of the unit are nearshore areas from Gordon Pass to Big Marco Pass from the MHW line seaward 1.6 km.

LOGG-N-27 – *Little Hickory Island to Doctors Pass, Lee and Collier Counties, Florida*

This unit contains nearshore reproductive habitat only. The boundaries of the unit are nearshore areas from Little Hickory Island to Doctors Pass (crossing Wiggins Pass and Clam Pass) from the MHW line seaward 1.6 km.

LOGG-N-28 – *Captiva Island and Sanibel Island West, Lee County, Florida*

This unit contains nearshore reproductive habitat only. The boundaries of the unit are nearshore areas from the north end of Captiva/Captiva Island Golf Club (starting at Redfish Pass and crossing Blind Pass) and along Sanibel Island West to Tarpon Bay Road, from the MHW line seaward 1.6 km.

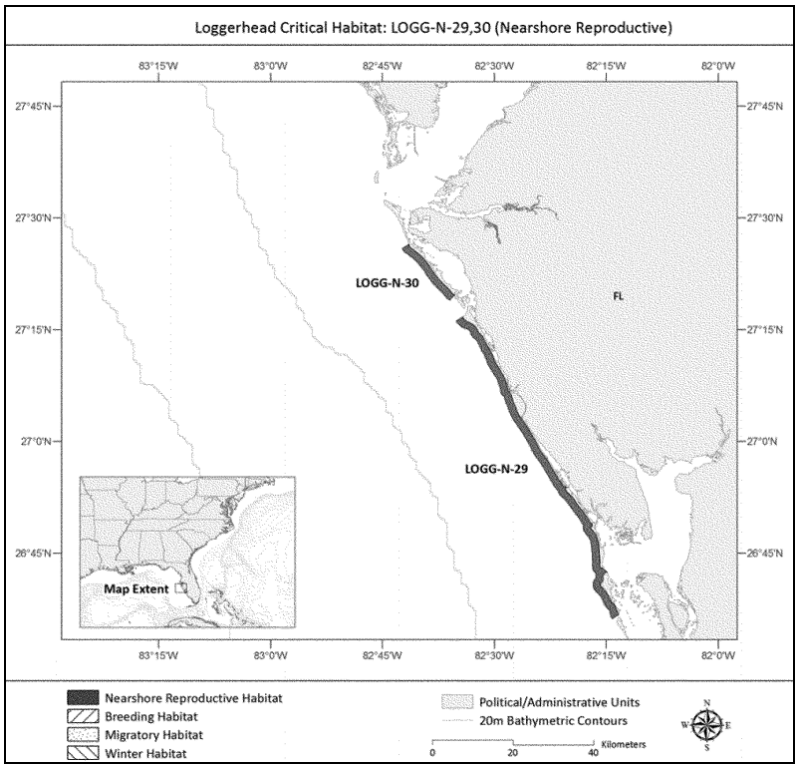

Figure 3.20. LOGG-N-29 – *Siesta and Casey Keys, Sarasota County; Venice Beaches and Manasota Key, Sarasota and Charlotte Counties; Knight, Don Pedro, and Little Gasparilla Islands, Charlotte County; Gasparilla Island, Charlotte and Lee Counties; Cayo Costa, Lee County, Florida* (Source: 79 FR 39856; July 10, 2014)

This unit contains nearshore reproductive habitat only. The boundaries of this unit are nearshore areas from Big Sarasota Pass to Captiva Pass (crossing Venice Inlet, Stump Pass, Gasparilla Pass, and Boca Grande Pass), from the MHW line seaward 1.6 km.

LOGG-N-30 – *Longboat Key, Manatee and Sarasota Counties, Florida*

This unit contains nearshore reproductive habitat only. The boundaries of this unit are the north point of Longboat Key at Longboat Pass to New Pass, from the MHW line seaward 1.6 km.

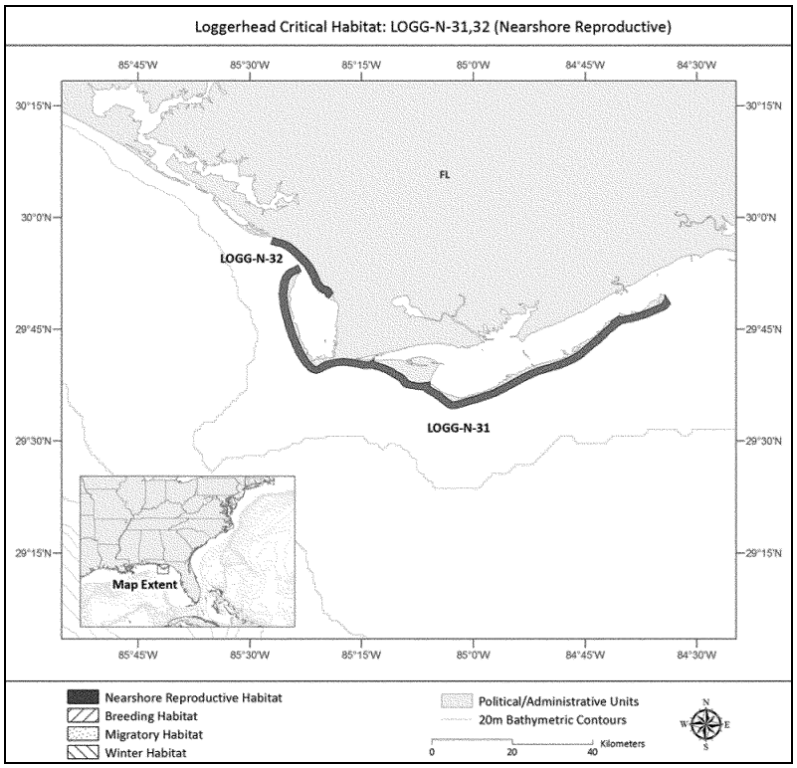

Figure 3.21. LOGG-N-31 – *St. Joseph Peninsula, Cape San Blas, St. Vincent, St. George and Dog Islands, Gulf and Franklin Counties, Florida* (Source: 79 FR 39856; July 10, 2014)

This unit contains nearshore reproductive habitat only. The boundaries of this unit are from St. Joseph Bay to St. George Sound (crossing Indian, West, and East Passes) from the MHW line seaward 1.6 km.

LOGG-N-32 – *Mexico Beach and St. Joe Beach, Bay and Gulf Counties, Florida*

This unit contains nearshore reproductive habitat only. The boundaries of the unit are from the eastern boundary of Tyndall Air Force Base to Gulf County Canal in St. Joseph Bay from the MHW line seaward 1.6 km.

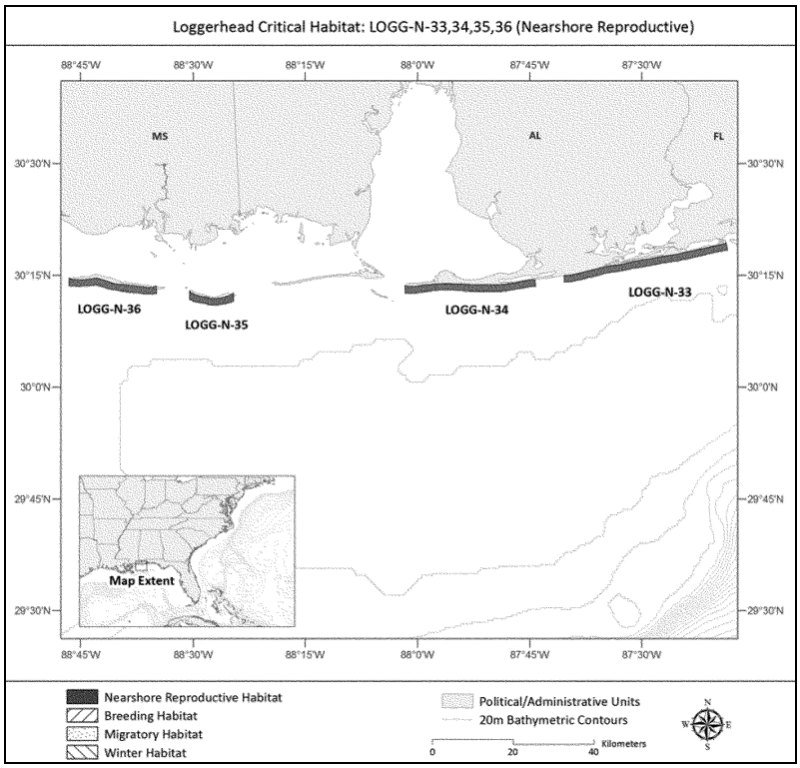

Figure 3.22. LOGG-N-33 – *Gulf State Park to FL/AL state line, Baldwin County, Alabama; FL/AL state line to Pensacola Pass, Escambia County, Florida* (Source: 79 FR 39856; July 10, 2014)

This unit contains nearshore reproductive habitat only. The boundaries of the unit are nearshore areas from the west boundary of Gulf State Park to the Pensacola Pass (crossing Perido Pass and the Alabama-Florida border) from the MHW line and seaward to 1.6 km.

LOGG-N-34 – *Mobile Bay--Little Lagoon Pass, Baldwin County, Alabama*

This unit contains nearshore reproductive habitat only. The boundaries of the unit are nearshore areas from Mobile Bay Inlet to Little Lagoon Pass from the MHW line and seaward to 1.6 km.

LOGG-N-35 – *Petit Bois Island, Jackson County, Mississippi*

This unit contains nearshore reproductive habitat only. The boundaries of the unit are nearshore areas from Horn Island Pass to Petit Bois Pass from the MHW line and seaward to 1.6 km.

LOGG-N-36 – *Horn Island, Jackson County, Mississippi*

This unit contains nearshore reproductive habitat only. The boundaries of the unit are nearshore areas from Dog Keys Pass to the eastern most point of the ocean-facing island shore from the MHW line and seaward to 1.6 km (1.0 mile).

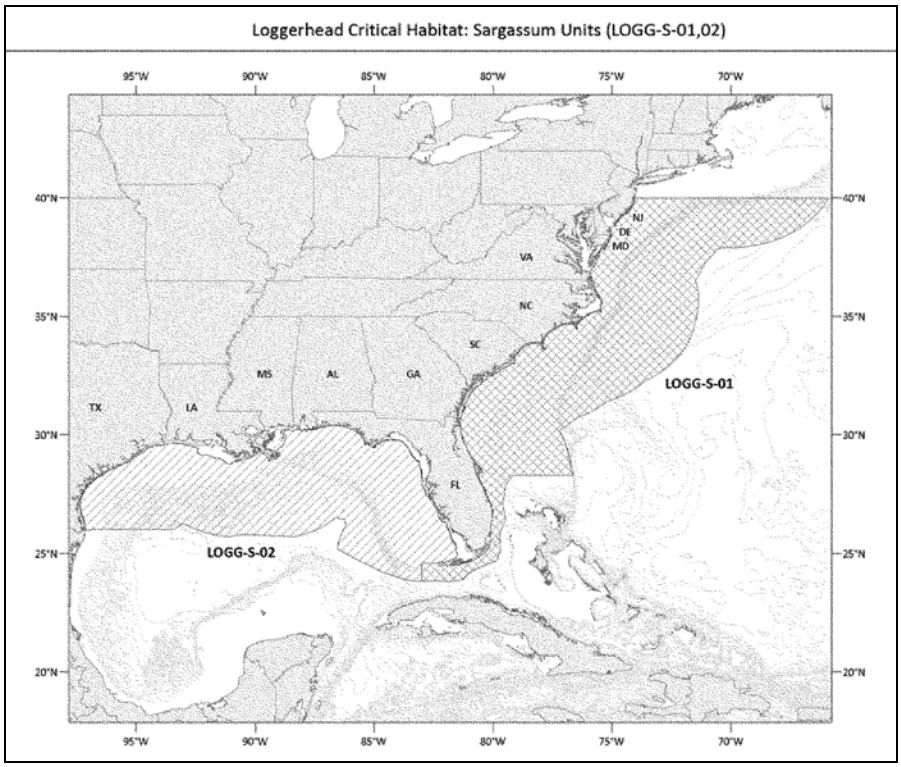

Figure 3.23 LOGG-S-01, 02 – *Atlantic Ocean and Gulf of Mexico Sargassum Habitat*
(Source: 79 FR 39856; July 10, 2014)

LOGG-S-1 – Atlantic Ocean *Sargassum*: U.S. waters south of 40°N lat. in the Atlantic Ocean to the beginning of the Gulf of Mexico (the Gulf of Mexico begins at the intersection of the outer boundary of the U.S. EEZ and 83°00'W long., and proceeds northward along that meridian to 24° 35'N lat. [near the Dry Tortugas Islands]) from the 10-m (32.8 ft) depth contour to the outer boundary of the EEZ, where there is *Sargassum* in concentrations that support adequate prey abundance and cover, and water temperatures warm enough to support *Sargassum* growth and loggerhead inhabitance.

LOGG-S-2 – Gulf of Mexico *Sargassum*:

U.S. waters in the Gulf of Mexico (the Gulf of Mexico/Atlantic Ocean division begins at 83° W. long., and proceeds northward along that meridian to 24° 35' N lat. near the Dry Tortugas Islands) from the 10 m (32.8 ft) depth contour to the outer boundary of the EEZ, where there is *Sargassum* in concentrations that support adequate prey abundance and cover, and water temperatures warm enough to support *Sargassum* growth and loggerhead inhabitance.

Acropora Critical Habitat

The physical or biological feature of *Acropora* critical habitat essential to their conservation is substrate of suitable quality and availability to support larval settlement and recruitment, and reattachment and recruitment of asexual fragments. Substrate of suitable quality and availability is defined as consolidated hardbottom or dead coral skeleton that is free from fleshy macroalgae cover and sediment cover, occurring in water depths from the MLW line to 30 m (98 ft). Four areas of critical habitat were designated in Florida, Puerto Rico, St. Thomas/St. John, USVI, and St. Croix, USVI (Figure 3.24-3.27). The Florida area contains 3 sub-areas. Table 3.12 provides the boundaries of those sub-areas.

Table 3.12 Boundaries of the Florida Sub-Areas of *Acropora* Critical Habitat

Florida Sub-Area	Boundary
A (Boynton Inlet, Palm Beach County)	• Shoreward boundary begins at the 6-ft (1.8 m) contour at the south side of Boynton Inlet, Palm Beach County (26°32'42.5"N); • then runs due east to the point of intersection with the 98-ft (30 m) contour; • then follows the 98-ft (30 m) contour to the point of intersection with latitude 25°45'55"N, Government Cut, Miami-Dade County; • then runs due west to the point of intersection with the 6-ft (1.8 m) contour, • then follows the 6-ft (1.8 m) contour to the beginning point;
B (Government Cut, Miami-Dade County)	• Shoreward boundary begins at the MLW line at 25°45'55"N, Government Cut, Miami-Dade County; • then runs due east to the point of intersection with the 98-ft (30 m) contour; • then follows the 98-ft (30 m) contour to the point of intersection with longitude 82°W; • then runs due north to the point of intersection with the South Atlantic Fishery Management Council (SAFMC) boundary at 24°31’35.75”N; • then follows the SAFMC boundary to a point of intersection with the MLW line at Key West, Monroe County; • then follows the MLW line, the SAFMC boundary (see 50 CFR 600.105(c)), and the COLREGS line (see 33 CFR 80.727. 730, 735, and 740) to the beginning point; and
C (Dry Tortugas)	• The seaward boundary begins at the northern intersection of the 98-ft (30 m) contour and longitude 82°45’W; • then follows the 98-ft (30 m) contour west around the Dry Tortugas, to the southern point of intersection with longitude 82°45’W; • then runs due north to the beginning point

The gear types or techniques used during FIM research (i.e., hook-and-line or trawl sampling, fish traps, underwater cameras, visual surveys, dip net, seines/gillnets or artificial habitat aggregation devices) will not cause adverse effects to *Acropora* critical habitat. Visual surveys will have no effect on substrate of suitable quality, nor will they affect its availability. Only trained divers with scientific backgrounds conduct visual surveys, which makes any interaction between them and dead coral skeleton that is free

from fleshy macroalgae cover and sediment cover extremely unlikely to occur and discountable.

Dip net sampling and artificial habitat aggregation structures are used in seagrass habitats and that are not *Acropora* critical habitat, therefore, this gear type will not affect it. Similarly, trawling (bottom and plankton) will not affect *Acropora* critical habitat. *Acropora* critical habitat does not occur in the Gulf of Mexico; therefore, trawl projects in this region will not affect them. The South Atlantic trawling projects occur in areas not designated as *Acropora* critical habitat and will not affect it. The only trawling surveys that occur in the Caribbean region are plankton trawls and they will not affect *Acropora* critical habitat because the gear does not interact with the benthos.

Seine and gillnet projects occurring the Gulf of Mexico will not affect *Acropora* critical habitat because it is not designated in this region. Likewise, the seine and gillnet projects in the South Atlantic are conducted in rivers and estuaries of South Carolina and Georgia, which are also not designated as *Acropora* critical habitat. No seine or gillnet projects are conducted in the Caribbean region.

Fish traps and underwater cameras are not likely to adversely affect the essential features of *Acropora* critical habitat. Traps and underwater cameras do not cause consolidated hardbottom to become unconsolidated, nor do they cause growth of macroalgae or cause sedimentation. A trap could temporarily cover an area of consolidated hardbottom or dead coral skeleton that is free from fleshy macroalgae cover and sediment cover. But fish traps and underwater cameras only soak for 1 hour, and once the gear is retrieved, the area it covered immediately becomes available. Therefore, we believe the covering of consolidated hardbottom or dead coral skeletons that are free from fleshy macroalgae cover and sediment cover will be temporary and of such limited scope, that even during repeated deployment over the course of 5 years, any adverse effects from fish trap and underwater camera deployment will be insignificant.

Hook-and-line sampling (i.e., bottom longline, pelagic longline, and rod-and-reel) is not likely to adversely affect *Acropora* critical habitat. *Acropora* critical habitat is not designated in the Gulf of Mexico so the hook-and-line sampling conducted there will have no effect on it. Several bottom longline and rod-and-reel projects are conducted in the South Atlantic but none occur within *Acropora* critical habitat; therefore, these projects will not affect it. The pelagic longline sampling that occurs in the South Atlantic will not affect *Acropora* critical habitat because the gear does not contact the benthos.

Hook-and line sampling (i.e., rod-and-reel, bandit gear, and bottom longline) projects do overlap with designated critical habitat in the Caribbean. However, we believe those activities are not likely to adversely affect the essential feature of *Acropora* critical habitat. These gear types would not affect consolidated hard substrate or dead coral skeletons in any manner that would appreciably alter the biological or physical characteristics that make them suitable for larval settlement or coral regeneration. In the rare event these gears do interact with consolidated hard substrate or dead coral skeletons (e.g., entanglement of line), the interaction will not have a measurable adverse effect on the quality or availability

of substrate for larval settlement or coral regeneration. Such events will not lead to any increases in fleshy or turf macroalgae cover and sediment cover. Therefore, we believe any adverse effects from FIM-related hook-and-line sampling in the Caribbean will be insignificant.

Acoustic equipment and ROV deployment will have no effect on the essential features of *Acropora* critical habitat because the gear does not interact with the benthos.

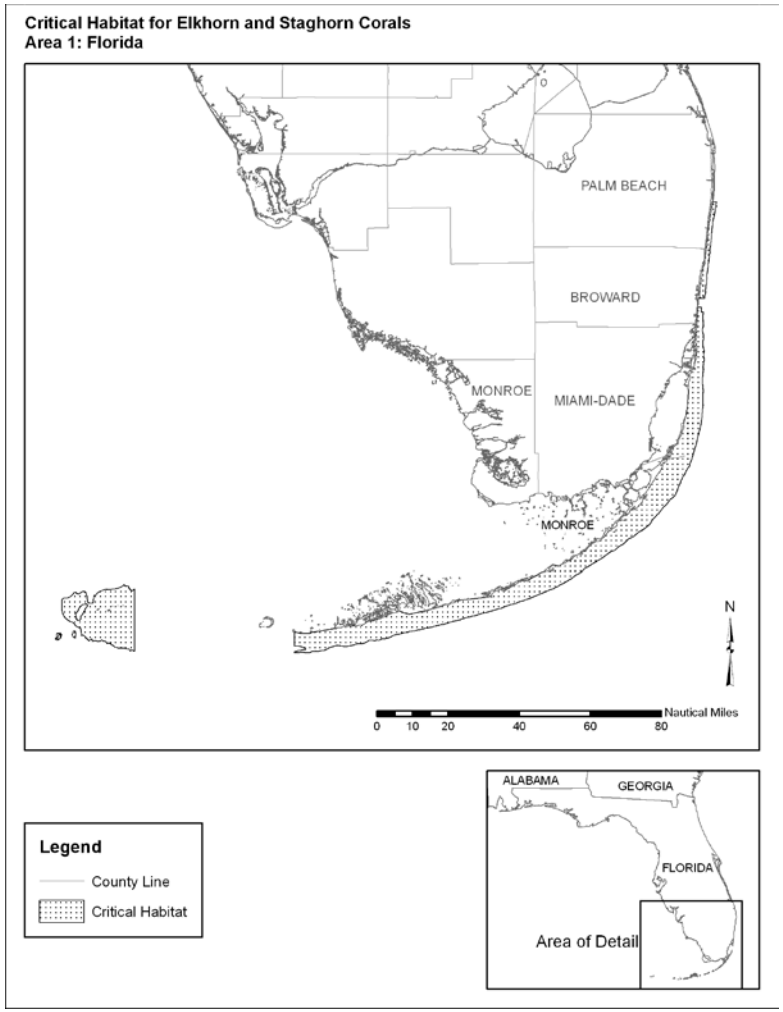

Figure 3.24. Florida Unit (Source: 73 FR 72210; November 26, 2008)

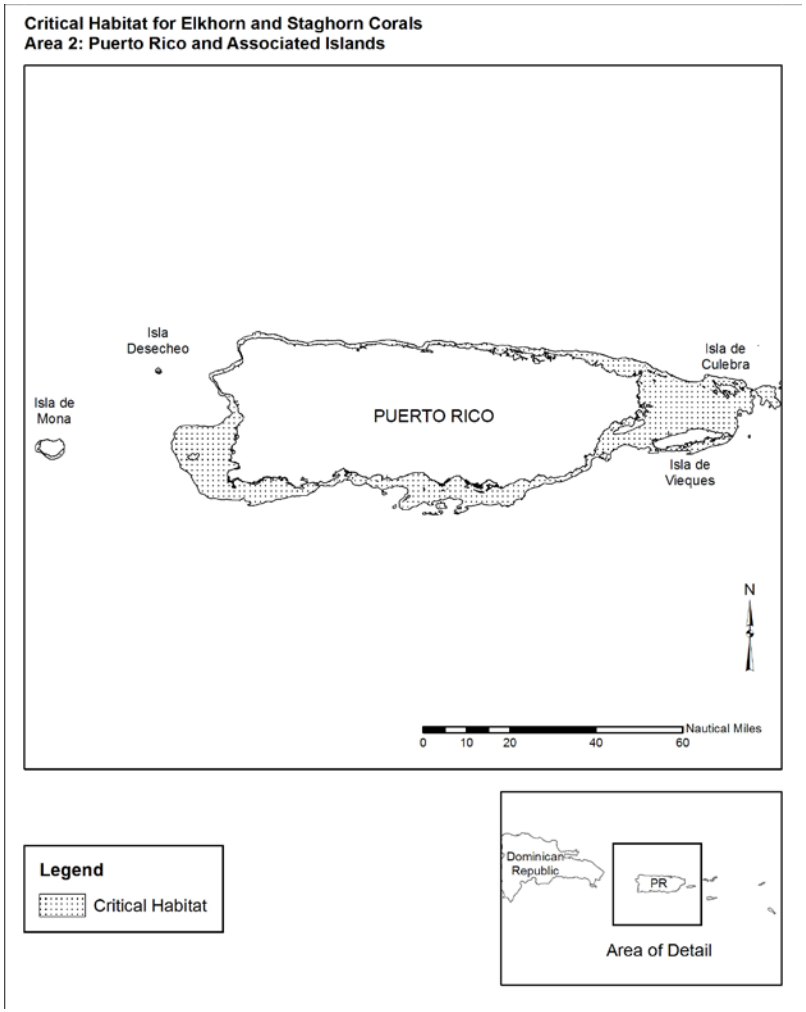

Figure 3.25. Puerto Rico Unit (Source: 73 FR 72210; November 26, 2008)

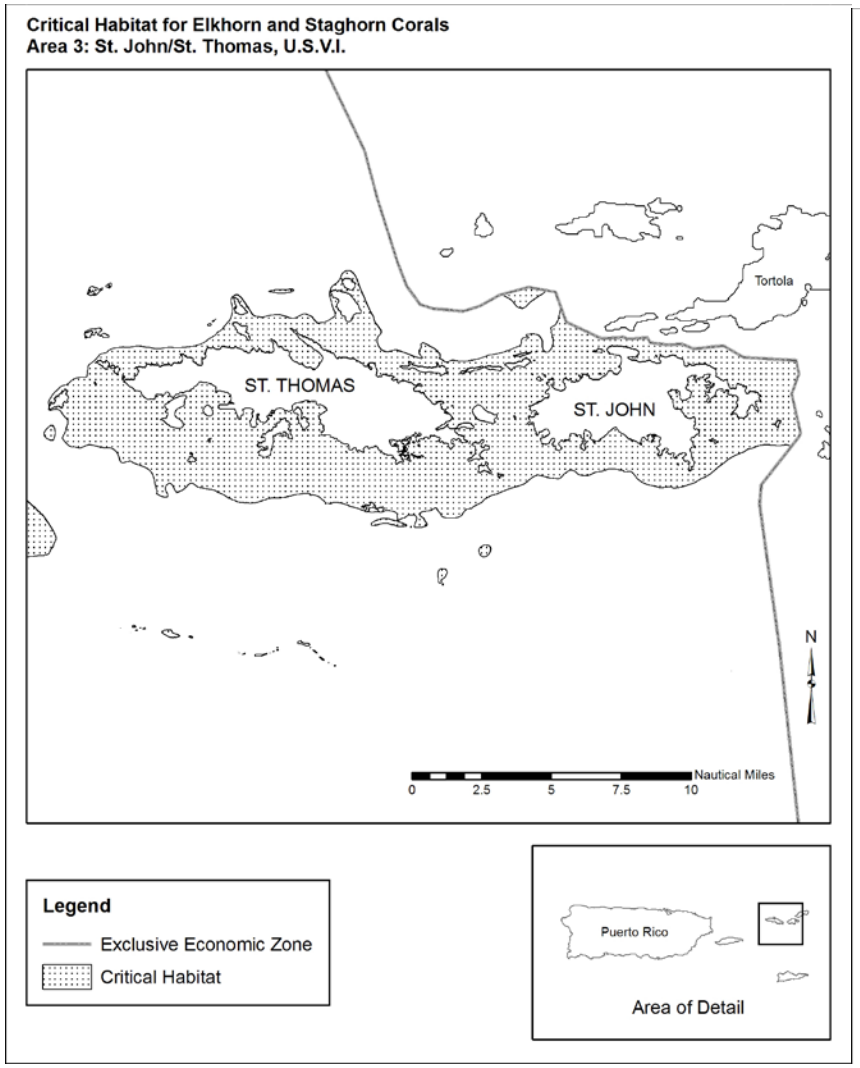

Figure 3.26. St. John/St. Thomas Unit
(Source: 73 FR 72210; November 26, 2008)

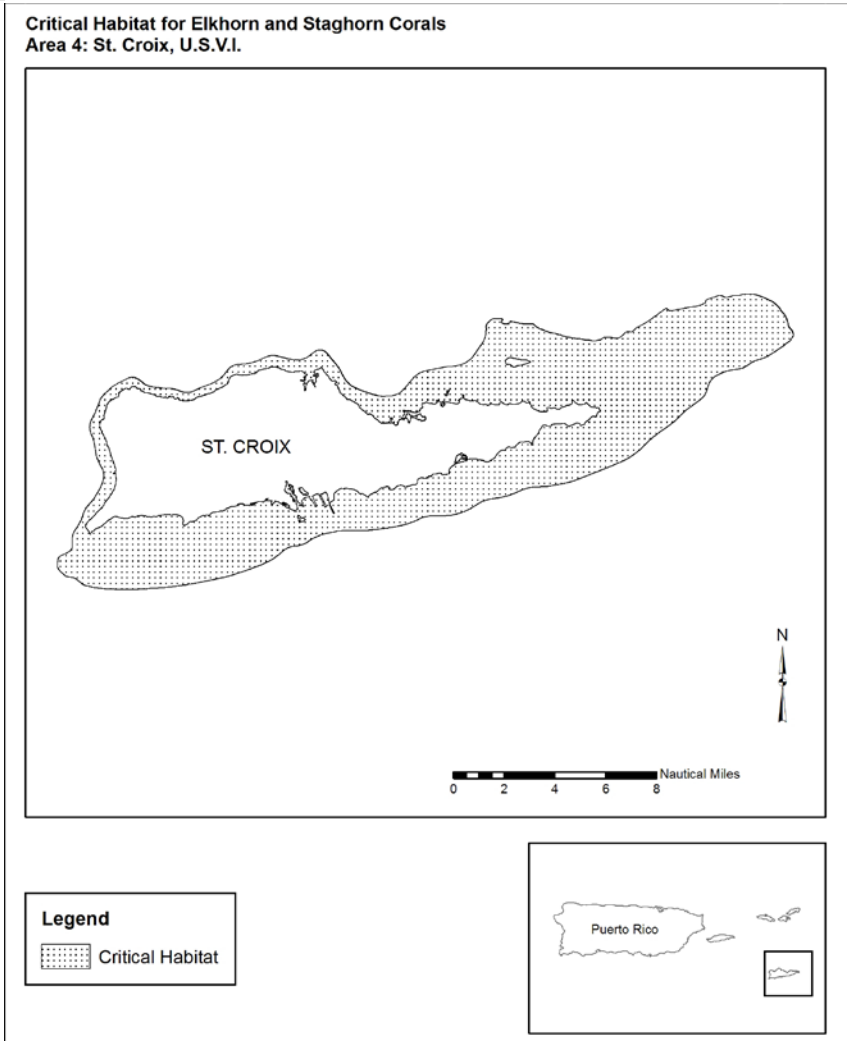

Figure 3.27. St. Croix Unit
(Source: 73 FR 72210; November 26, 2008)

3.3 Status of the Species Likely to be Adversely Affected

Green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles; smalltooth sawfish; shortnose sturgeon, and Atlantic sturgeon; and the Central and Southwest Atlantic DPS of scalloped hammerhead sharks are all likely to be adversely affected by the proposed action. The sea turtle species likely to be affected are all highly migratory and travel widely throughout the Gulf of Mexico, South Atlantic, and Caribbean regions, and the species discussions in this section will focus primarily on the Atlantic Ocean populations of these species. Smalltooth sawfish are also known to occur in the Gulf of Mexico and South Atlantic where FIM activities occur, but they are mainly found only off peninsular Florida. Shortnose and Atlantic sturgeon occur only in the South Atlantic but may occur in areas where FIM activities occur. The Central and Southwest Atlantic DPS of scalloped hammerhead sharks occurs in the Caribbean and may be effected by FIM-related projects in the region. All of these species have either been documented as taken incidentally during FIM activities or by gears analogous to those used during FIM activities.

The following subsections are synopses of the best available information on the life history, distribution, population trends, and current status of the Central and Southwest Atlantic DPS scalloped hammerhead, smalltooth sawfish, shortnose sturgeon, Atlantic sturgeon, and the 5 species of sea turtles that are likely to be adversely affected by 1 or more components of the proposed action. Additional background information on the status of sea turtle species can be found in a number of published documents, including: recovery plans and 5-year status reviews for the loggerhead sea turtle (Conant et al. 2009; NMFS and USFWS 1991c; NMFS and USFWS 2007h), Atlantic green sea turtle (NMFS and USFWS 1991a; NMFS and USFWS 2007a; Seminoff et al. 2015), leatherback sea turtle (NMFS and USFWS 1992b; NMFS and USFWS 2007g), hawksbill sea turtles (NMFS and USFWS 2007c) Kemp's ridley sea turtle (NMFS and USFWS 1992d; NMFS and USFWS 2007d); Pacific sea turtle recovery plans (NMFS and USFWS 1998a; NMFS and USFWS 1998b; NMFS and USFWS 1998c; NMFS and USFWS 1998d); sea turtle stock assessments, and biological reports (NMFS and USFWS 1995), Marine Turtle Expert Working Group (TEWG) Conant et al. (2009); NMFS (2001c); (TEWG 1998a; TEWG 2000a; TEWG 2007; TEWG 2009b).

Information on the smalltooth sawfish include the smalltooth sawfish status review (NMFS 2000c), 5-year review (NMFS 2010f), recovery plan (NMFS 2009i) the proposed and final listing rules, and several publications (Poulakis and Seitz 2004b; Seitz and Poulakis 2002b; Simpfendorfer 2001a; Simpfendorfer and Wiley 2004a).

Information on the shortnose sturgeon comes from its respective recovery plan (NMFS 1998c), discussions with species experts, the shortnose sturgeon biological assessment (NMFS 2010a) and other pertinent publications. Information on Atlantic sturgeon comes from tagging and genetic studies (ASSRT 2007; Grunwald et al. 2008; King et al. 2001; Waldman et al. 2002c; Wirgin et al. 2000), fisheries bycatch studies (Stein et al. 2004a), the status review (ASSRT 2007), listing rules (77 FR 5880 and 5914; February 6, 2012), and peer-reviewed articles on Atlantic sturgeon life history (ASSRT 2007; Bigelow and

Schroeder 1953a; Dadswell 2006; Mangin 1964; Pikitch et al. 2005; Vladykov and Greely 1963).

The best available information on the Central and Southwest Atlantic DPS of the scalloped hammerhead shark is pulled from the species status review report (Miller et al. 2014).

3.3.1 General Threats Faced by All Sea Turtle Species

There are 5 species of sea turtles (green, hawksbill, Kemp's ridley, leatherback, and loggerhead) that travel widely throughout the South Atlantic, Gulf of Mexico and the Caribbean. These species are highly migratory and therefore could occur within the action area. This section will address the general threats that confront all sea turtle species. Sections 3.3.2 – 3.3.7 will address information on the distribution, life history, population structure, abundance, population trends, and unique threats to each species of sea turtle.

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

Fisheries

Incidental bycatch in commercial fisheries is identified as a major contributor to past declines, and threat to future recovery, for all of the sea turtle species (NMFS and USFWS 1991b; NMFS and USFWS 1992c; NMFS and USFWS 1993a; NMFS and USFWS 2008a; NMFS et al. 2011b). Domestic fisheries often capture, injure, and kill sea turtles at various life stages. Sea turtles in the pelagic environment are exposed to U.S. Atlantic pelagic longline fisheries. Sea turtles in the benthic environment in waters off the coastal United States are exposed to a suite of other fisheries in federal and state waters. These fishing methods include trawls, gillnets, purse seines, hook-and-line gear (including bottom longlines and vertical lines [e.g., bandit gear, handlines, and rod-reel]), pound nets, and trap fisheries. 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. 1995; Bolten et al. 1994; Crouse 1999). 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. 1997b). These factors may decrease the amount of nesting area available to females and change the natural behaviors of both adults and hatchlings, directly or indirectly, through loss of beach habitat or changing thermal profiles and increasing erosion, respectively. (Ackerman 1997; Witherington et al. 2003; Witherington et al. 2007). In addition, coastal development is usually accompanied by artificial lighting which can alter the behavior of nesting adults (Witherington 1992) and is often fatal to emerging hatchlings that are drawn away from the water (Witherington and Bjorndal 1991). In-water erosion control structures such as breakwaters, groins, and jetties can impact nesting females and hatchling as they approach and leave the surf zone or head out to sea by creating physical blockage, concentrating predators, creating longshore currents, and disrupting of wave patterns.

Environmental Contamination

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

populations, and therefore may affect listed species indirectly by reducing food availability in the action area.

The April 20, 2010 explosion of the *Deepwater Horizon* oil rig affected sea turtles in the Gulf of Mexico. An assessment has been completed on the injury to Gulf of Mexico marine life, including sea turtles, resulting from the spill (DWH Trustees 2015). Following the spill, juvenile Kemp's ridley, green, and loggerhead sea turtles were found in *Sargassum* algae mats in the convergence zones, where currents meet and oil collected. Sea turtles found in these areas were often coated in oil and/or had ingested oil. The spill resulted in the direct mortality of many sea turtles, and it 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 below.

Marine Debris

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 2007e). 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 2007e).

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 2007e). 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.

3.3.2 Loggerhead Sea Turtle – Northwest Atlantic (NWA) DPS

The loggerhead sea turtle was listed as a threatened species throughout its global range on July 28, 1978. NMFS and USFWS published a final rule designating 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 is the only one considered in this Opinion.

Species Description and Distribution

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

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

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

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

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

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 2008c). 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[16]), (4) juvenile stage (oceanic zone), (5) juvenile stage (neritic zone), (6) adult stage (oceanic zone), (7) adult stage (neritic zone), and (8) nesting female (terrestrial zone) (NMFS and USFWS 2008c). 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 1985a; NMFS 2001c). 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 2008c). Loggerhead hatchlings are 1.5-2 inches long and weigh about 0.7 ounces (20 grams).

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. 2009; Witherington 2002). Oceanic juveniles grow at rates of 1-2 inches (2.9-5.4 cm) per year (Bjorndal et al. 2003b; 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 inches (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

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

Sounds, Mosquito and Indian River Lagoons, Biscayne Bay, Florida Bay, and 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. 2009).

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. 2009).

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 in Cuban waters of 5 adult female loggerheads originally flipper-tagged in Quintana Roo, Mexico, indicating 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. 2009; Heppell et al. 2003a; NMFS-SEFSC 2009a; NMFS 2001c; NMFS and USFWS 2008c; TEWG 1998a; TEWG 2000a; TEWG 2009b) have examined the stock status of loggerheads in the Atlantic Ocean, but none have been able to develop a reliable estimate of absolute population size.

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

clutch frequency, indicate that time series on numbers of nests can provide reliable information on trends in the female population.

Peninsular Florida Recovery Unit

The Peninsular Florida Recovery Unit (PFRU) is the largest loggerhead nesting assemblage in the Northwest Atlantic. A near-complete nest census (all beaches including index nesting beaches) undertaken from 1989-2007 showed an average of 64,513 loggerhead nests per year, representing approximately 15,735 nesting females per year (NMFS and USFWS 2008c). The statewide estimated total for 2013 was 77,975 nests (FWRI nesting database).

In addition to the total nest count estimates, the Florida Fish and Wildlife Research Institute (FWRI) uses an index nesting beach survey method. The index survey uses standardized data-collection criteria to measure seasonal nesting and allow accurate comparisons between beaches and between years. This provides a better tool for understanding the nesting trends (Figure 3.28). FWRI performed a detailed analysis of the long-term loggerhead index nesting data (1989-2015) (http://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead-trends/). Over that time period, 3 distinct trends were identified. From 1989-1998 there was a 24% increase that was then followed by a sharp decline over the subsequent 9 years. A large increase in loggerhead nesting has occurred since, as indicated by the 74% increase in nesting between 2008 and 2015. FWRI examined the trend from the 1998 nesting high through 2015 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 2015 (an increase of over 38%), FWRI concluded that there was an overall positive change in the nest counts (http://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead-trends/).

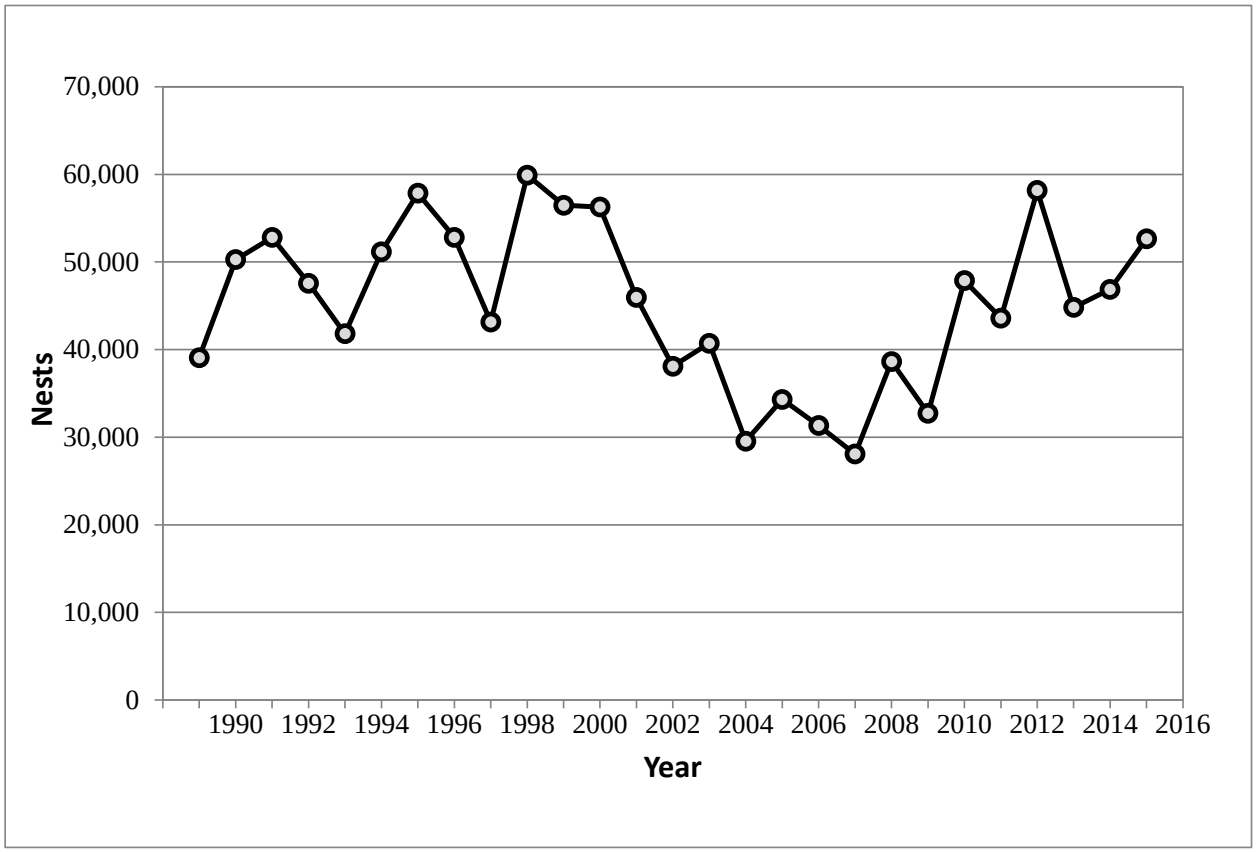

Figure 3.28. Loggerhead sea turtle nesting at Florida index beaches since 1989

Northern Recovery Unit

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

Data since that analysis (Table 3.13) 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 (M. Dodd, GADNR press release, http://www.georgiawildlife.com/node/3139). South Carolina and North Carolina nesting have also begun to show a shift away from the declining trend of the past.

Table 3.13 Total Number of NRU Loggerhead Nests (GADNR, SCDNR, and NCWRC nesting datasets)

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

South Carolina also conducts an index beach nesting survey similar to the one described for Florida. Although the survey only includes a subset of nesting, the standardized effort and locations allow for a better representation of the nesting trend over time. Increases in nesting were seen for the period from 2009-2012, with 2012 showing the highest index nesting total since the start of the program (Figure 3.29).

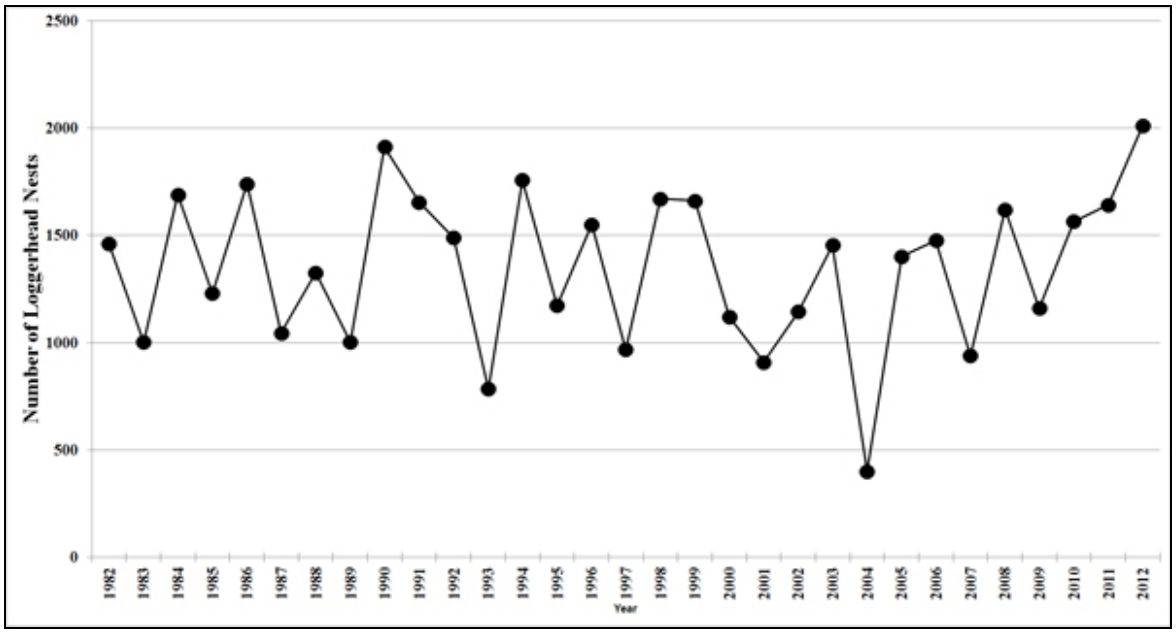

Figure 3.29. South Carolina index nesting beach counts for loggerhead sea turtles (from the SCDNR website, http://www.dnr.sc.gov/seaturtle/nest.htm)

Other Northwest Atlantic DPS Recovery Units

The remaining 3 recovery units—Dry Tortugas (DTRU), Northern Gulf of Mexico (NGMRU), and Greater Caribbean (GCRU)—are much smaller nesting assemblages, but they are still considered essential to the continued existence of the species. Nesting surveys for the DTRU are conducted as part of Florida's statewide survey program. Survey effort was relatively stable during the 9-year period from 1995-2004, although the 2002 year was missed. Nest counts ranged from 168-270, with a mean of 246, but there was no detectable trend during this period (NMFS and USFWS 2008c). 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 2008c). 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 2008c).

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 (2008c), caution about extrapolating localized in-water trends to the broader population and relating localized trends in neritic sites to population trends at nesting beaches. The apparent overall increase in the abundance of neritic loggerheads in the southeastern United States may be due to increased abundance of the largest oceanic/neritic juveniles (historically referred to as small benthic juveniles), which could indicate a relatively large number of individuals around the same age may mature in the near future (TEWG 2009b). 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 2009b).

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 to 40,000 individuals, with a low likelihood of being up to 70,000 (NMFS-SEFSC 2009a). A less robust estimate for total benthic females in the western North Atlantic was also obtained, yielding approximately 30,000-300,000 individuals, up to less than 1 million (NMFS-SEFSC 2009a). A preliminary regional abundance survey of loggerheads within the northwestern Atlantic continental shelf for positively identified loggerhead in all strata estimated about 588,000 loggerheads (interquartile range of 382,000-817,000). When correcting for unidentified turtles in proportion to the ratio of

identified turtles, the estimate increased to about 801,000 loggerheads (interquartile range of 521,000-1,111,000) (NMFS-NEFSC 2011).

Threats (Specific to Loggerhead Sea Turtles)

The threats faced by loggerhead sea turtles are well summarized in the general discussion of threats in Section 3.3.1. Yet the impact of fishery interactions is a point of further emphasis for this species. The joint NMFS and USFWS Loggerhead Biological Review Team determined that the greatest threats to the NWA DPS of loggerheads result from cumulative fishery bycatch in neritic and oceanic habitats (Conant et al. 2009).

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

While oil spill impacts are discussed generally for all species in Section 3.3.1, specific impacts of the DWH spill 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, with 30,000 exposures (almost 52% of all exposures for those age/size classes) and 3,600 estimated mortalities. A total of 265 nests (27,618 eggs) were also translocated during response efforts, with 14,216 hatchlings released (the fate of which is unknown) (DWH Trustees 2015). Additional unquantified effects may have included inhalation of volatile compounds, disruption of foraging or migratory movements due to surface or subsurface oil, ingestion of prey species contaminated with oil and/or dispersants, and loss of foraging resources which could lead to compromised growth and/or reproductive potential. There is no information currently available to determine the extent of those impacts, if they occurred. Unlike Kemp's ridleys, the majority of nesting for the Northwest Atlantic Ocean loggerhead DPS occurs on the Atlantic coast, and thus loggerheads were impacted to a relatively lesser degree. However, it is likely that impacts to the NGMRU of the NWA loggerhead DPS would be proportionally much greater than the impacts occurring to other recovery units. Impacts to nesting and oiling effects on a large proportion of the NGMRU recovery unit, especially mating and nesting adults likely had an impact on the NGMRU. Based on the response injury evaluations for Florida Panhandle and Alabama nesting beaches (which fall under the NFMRU), the Trustees estimated that approximately 20,000 loggerhead hatchlings were lost due to DWH response activities on nesting beaches. Although the long-term effects remain unknown, the DWH impacts to the Northern Gulf of Mexico Recovery Unit may result in some nesting declines for that

recovery unit in the future due to a large reduction of oceanic age classes during DWH. 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 event is relatively small, and thus a population-level impact is not believed to have 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 above preindustrial levels would result in a sex ratio of over 80% female offspring for loggerheads nesting near Southport, North Carolina. The same increase in air temperatures at nesting beaches in Cape Canaveral, Florida, would result in close to 100% female offspring. Such highly skewed sex ratios could undermine the reproductive capacity of the species. More ominously, an air temperature increase of 3°C is likely to exceed the thermal threshold of most nests, leading to egg mortality (Hawkes et al. 2007). Warmer sea surface temperatures have also been correlated with an earlier onset of loggerhead nesting in the spring (Hawkes et al. 2007; Weishampel et al. 2004), short inter-nesting intervals (Hays et al. 2002), and shorter nesting seasons (Pike et al. 2006).

3.3.3 Green Sea Turtle – North Atlantic (NA) DPS

The green sea turtle was 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 4, 2016, NMFS published a final rule (81 FR 20057), effective May 4, 2016, listing 11 DPSs of green sea turtle. The North Atlantic DPS (NA DPS) is listed as threatened. Its distribution includes the area from the boundary of South and Central America north along the coast to the northern extent of the green turtle's range to include Panama, Costa Rica, Nicaragua, Honduras, Belize, Mexico, and the United States. It then extends due east across the Atlantic Ocean at 48° N.; follows the coast south to include the northern portion of the Islamic Republic of Mauritania (Mauritania; to 19° N.) on the African continent; and west along the 19° N. latitude to the Caribbean basin to 65.1° W., then due south to 14° N., 65.1° W., then due west to 14° N., 77° W., and due south to 7.5° N., 77° W., the boundary of South and Central America. It includes Puerto Rico, the Bahamas, Cuba, Turks and Caicos Islands, Republic of Haiti, Dominican Republic, Cayman Islands, and Jamaica.

Species Description and Distribution

The green sea turtle is the largest of the hardshell sea 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 and USFWS 1997). The 3 largest nesting populations in the NA DPS are found at Tortuguero, Costa Rica, Quintana Roo, Mexico, and Florida, USA.

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). Mixed-stock analyses of foraging grounds show that green sea turtles from multiple nesting beaches commonly mix at feeding areas across the Caribbean and Gulf of Mexico, with higher contributions from nearby large nesting sites and some contribution estimated from nesting populations from the SA DPS (Bass et al. 1998; Bass and Witzell 2000; Bjorndal and Bolten 2008; Bolker et al. 2007). In other words, animals originating from various beaches throughout the NA DPS, as well as some from the SA DPS, co-mingle in these foraging habitats. As might be expected, the larger and more important nesting beaches produce more individuals and the proportion of individuals from these areas occurring on foraging grounds tends to be higher than the proportion of individuals from smaller nesting beaches. For example, Tortuguero, Costa Rica, is the largest nesting beach in the NA DPS. As a result, the number of animals from that nesting beach on any given foraging ground is higher than from any other nesting beach. More specifically, Lahanas et al. (1998) showed that juvenile green sea turtles in the Bahamas originate mainly from western Caribbean (Tortuguero, Costa Rica) (79.5%) (NA DPS) but that a significant proportion may be coming from the eastern Caribbean (Aves Island/Suriname; 12.9%) (SA DPS).

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; Carr 1984), 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 1997a). 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.

The complete nesting range of green sea turtles within the southeastern United States includes sandy beaches between Texas and North Carolina, as well as the U.S. Virgin Islands and Puerto Rico (Dow et al. 2007; NMFS and USFWS 1991b). Still, 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. For more information on NA DPS green sea turtle nesting in other countries refer to the 2015 *Green Sea Turtle Status Review* (Seminoff et al. 2015).

***Life History Informati*on**

Green sea turtles reproduce sexually, and mating occurs in the waters off nesting beaches. Mature females return to their natal beaches (i.e., the same beaches where they were born) to lay eggs (Balazs 1982; Frazer and Ehrhart 1985b) every 2-3 years (Troëng and Chaloupka 2007; Witherington and Ehrhart 1989; Zurita et al. 1994) 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 1989). During the nesting season, females nest at approximately 2-week intervals, laying an average of 3-4 clutches (Johnson and Ehrhart 1996b). Clutch size varies among subpopulations, but mean clutch size in the NA DPS ranges from 110-140 eggs (Seminoff et al. 2015). In Florida, green sea turtle nests contain between 128 and 136 eggs (Seminoff et al. 2015; Witherington and Ehrhart 1989). 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 anthropogenic stressors. At a Bahamas foraging habitat, juvenile green sea turtle survivorship was relatively high at 0.89, although this value dropped to 0.76 once turtles emigrated from this protected site (Bjorndal et al. 2003a). Campbell and Lagueux (2005) report low survivorship (0.55) among large juveniles and adults as a result of human impacts at a Caribbean Nicaraguan foraging area. Campbell and Lagueux (2005) also report annual survival of adults nesting at Tortuguero of 0.82, which is close to the value of 0.85 reported by Troëng and Chaloupka (2007) for the same nesting site.

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 2007b). Green sea turtles exhibit particularly slow growth rates of about 0.4-2 inches (1-5 cm) per year (Green 1993; McDonald-Dutton and Dutton 1998), 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 1997b; Hirth and USFWS 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, with some post-nesting turtles also residing in Bahamian waters as well (NMFS and USFWS 2007b).

Status and Population Dynamics

Population estimates for sea 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 is provided in the most recent status review for the species (Seminoff et al. 2015) organized by DPS.

For the NA DPS, Seminoff et al. (2015) indicate there were 7 green sea turtle nesting sites for which 10 years or more of recent data are available for annual number of nesting females. Of those 7 sites, 4 met the criteria for conducting a Population Viability Analysis (PVA), discussed below (Seminoff et al. 2015). Of the remaining 3 sites, 2 sites (El Cuyo, Mexico, and Guanal, Cuba) showed alternating patterns of high seasonal nesting, followed by low seasonal nesting; no trend was detected for these sites (Seminoff et al. 2015). In San Felipe, Cuba, the last 2 years of nesting (2010 and 2011) were higher than previous years (2001-2009) (Seminoff et al. 2015).

PVAs were conducted for 4 nesting sites (Tortuguero, Costa Rica; Isla Aguada, Mexico; Guanahacabibes, Cuba; and Florida, USA) that had a minimum of 15 years of recent data on the annual number of nesting females (sites had to have at least 10 females annually). The PVAs evaluated the probabilities of nesting populations declining to 2 separate biological thresholds after 100 years: (1) a trend-based reference point where nesting populations decline by 50% and (2) the number of total adult females falls to 300 or fewer at a these sites (Seminoff et al. 2015).[17] Seminoff et al. (2015) also point out that PVAs do not fully incorporate spatial structure or threats. They also assume all environmental and man-made pressures will remain constant in the forecast period, while also relying solely on nesting data.

At Tortuguero, Costa Rica, the number of nests laid per year from 1999 to 2003, was approximately 104,411 nests/year (which corresponds to approximately 17,402-37,290

[17] Since green sea turtles are believed to nest every 3 years, the analysis evaluated the likelihood that population would fall to 100 or fewer nesters annually (300 adult females/nesting every 3 years = 100 adult female nesters annually).

nesting females each year) (Troëng and Rankin 2005). That number increased to an estimated 180,310 during 2010; corresponding to 30,052-64,396 nesters. This increase has occurred despite substantial human impacts to the population at the nesting beaches and foraging areas (Campell and Lagueux 2005; Troëng 1998; Troëng and Rankin 2005). Modeling by Chaloupka et al. (2008b) using data sets of 25 years or more resulted in an estimate of the Tortuguero, Costa Rica, population growing at 4.9% annually.

The Tortuguero, Costa Rica, PVA indicated there is a 0.7% probability that this population will fall below the 50% decline threshold at the end of 100 years, and a 0% probability that this population will fall below the absolute abundance reference point of 100 females per year at the end of 100 years (Seminoff et al. 2015).

The Isla Aguada, Mexico, PVA indicated there is a 3.7% probability that this population will fall below the 50% decline threshold at the end of 100 years, and a 2.2% probability that this population falls below the absolute abundance threshold of 100 nesting females per year at the end of 100 years (Seminoff et al. 2015). Seminoff et al. (2015) report an estimated nester abundance of 2,207 females in Campeche, which includes Isla Aguada.

The PVA for Guanahacabibes, Cuba, indicated there is a 27.8% probability that this population will fall below the 50% decline threshold at the end of 100 years, and the model estimates a 37.3% probability that this population falls below the absolute abundance threshold of 100 nesting females per year at the end of 100 years (Seminoff et al. 2015). Seminoff et al. (2015) report an estimated nester abundance of 201 females on the beaches of the Guahanacabibes Peninsula.

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 with a positive trend during the 10 years of regular monitoring (Figure 3.30). According to data collected from Florida's index nesting beach survey from 1989-2015, green sea turtle nest counts across Florida have increased approximately 100-fold from a low of 267 in the early 1990s to a high of 27,975 in 2015. Two consecutive years of nesting declines in 2008 and 2009 caused some concern, but this was followed by increases in 2010 and 2011, and a return to the trend of biennial peaks in abundance thereafter (Figure 3.30). Modeling by Chaloupka et al. (2008a) using data sets of 25 years or more has resulted in an estimate of the Florida nesting stock at the Archie Carr National Wildlife Refuge growing at an annual rate of 13.9%.

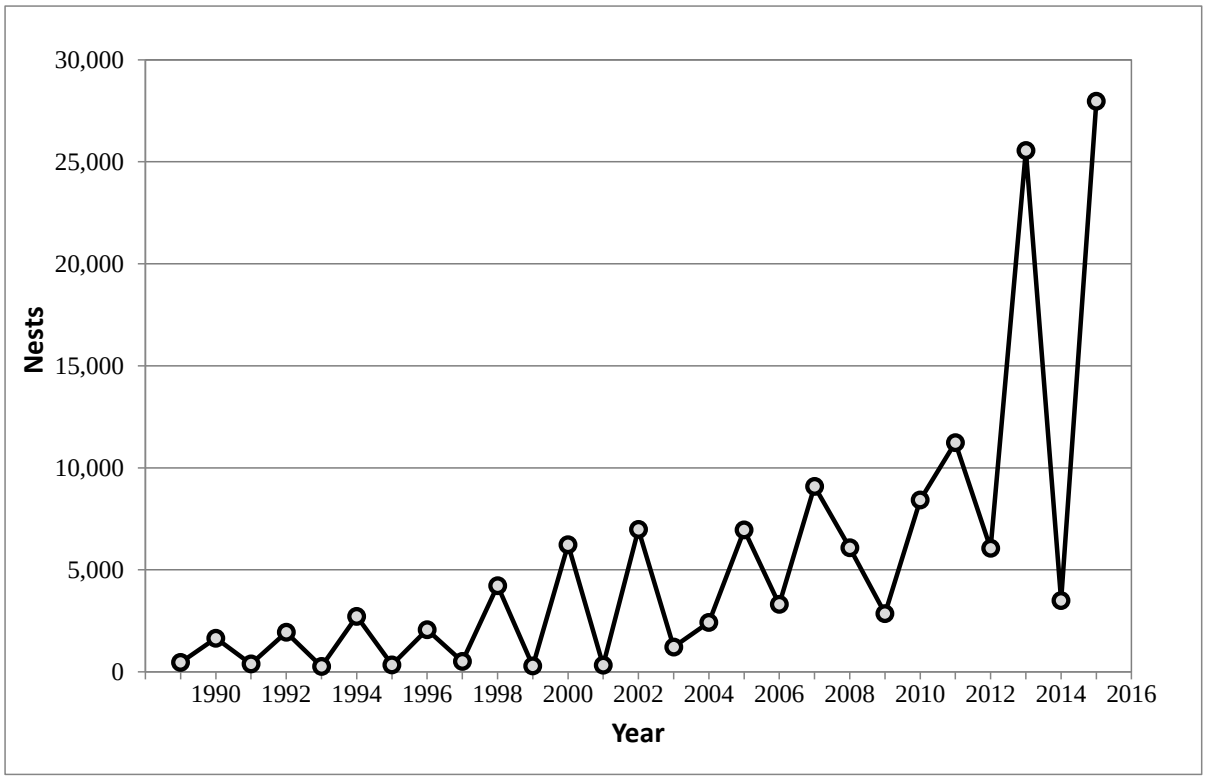

Figure 3.30. Green sea turtle nesting at Florida index beaches since 1989

For the Florida, USA, population, based on nesting data through 2012, the PVA indicated there is a 0.3% probability that this population will fall below the 50% decline threshold at the end of 100 years, and a 0% probability this population falls below the absolute abundance threshold of 100 nesting females per year at the end of 100 years (Seminoff et al. 2015).

Threats

The principal cause of past declines and extirpations of green sea turtle assemblages has been the overexploitation of the species for food and other products. Although intentional take of green sea turtles and their eggs is not extensive within the southeastern United States, green sea turtles that nest and forage in the region may spend large portions of their life history outside the region and outside U.S. jurisdiction, where exploitation is still a threat. Green sea turtles also face many of the same threats as other sea turtle species, including destruction of nesting habitat from storm events, oceanic events such as cold-stunning, pollution (e.g., plastics, petroleum products, petrochemicals), ecosystem alterations (e.g., nesting beach development, beach nourishment and shoreline stabilization, vegetation changes), poaching, global climate change, fisheries interactions, natural predation, and disease. A discussion on general sea turtle threats can be found in Section 3.3.1.

In addition to general threats, green sea turtles are susceptible to natural mortality from Fibropapillomatosis (FP) disease. FP results in the growth of tumors on soft external tissues (flippers, neck, tail, etc.), the carapace, the eyes, the mouth, and internal organs (gastrointestinal tract, heart, lungs, etc.) of turtles (Aguirre et al. 2002; Herbst 1994;

Jacobson et al. 1989). These tumors range in size from 0.04 inches (0.1 cm) to greater than 11.81 inches (30 cm) in diameter and may affect swimming, vision, feeding, and organ function (Aguirre et al. 2002; Herbst 1994; Jacobson et al. 1989). Presently, scientists are unsure of the exact mechanism causing this disease, though it is believed to be related to both an infectious agent, such as a virus (Herbst et al. 1995), and environmental conditions (e.g., habitat degradation, pollution, low wave energy, and shallow water (Foley et al. 2005). FP is cosmopolitan, but it has been found to affect large numbers of animals in specific areas, including Hawaii and Florida (Herbst 1994; Jacobson 1990; Jacobson et al. 1991).

Cold-stunning is another natural threat to green sea turtles. Although it is not considered a major source of mortality in most cases, as temperatures fall below 46.4°F-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 1989). 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, with 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. Additionally, 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.

Oil spill impacts are discussed generally for all sea turtle species in Section 3.3.1. Information regarding the DWH spill impacts specifically on either the NA or SA DPS green sea turtles is not available. However, given the location of the spill, we believe the majority of the impacts likely affected the NA DPS. 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 juvenile greens are estimated to have died as a result of the exposure. A total of 4 nests (580 eggs) were also translocated during response efforts, with 455 hatchlings released (the fate of which is unknown) (DWH Trustees 2015). Additional unquantified effects may have included inhalation of volatile compounds, disruption of foraging or migratory movements due to surface or subsurface oil, ingestion of prey species contaminated with oil and/or dispersants, and loss of foraging resources which could lead to compromised growth and/or reproductive potential. There is no information currently available to determine the extent of those impacts, if they occurred. While green turtles regularly use the northern Gulf of Mexico, they have a widespread distribution throughout the entire Gulf of Mexico, Caribbean, and Atlantic, and the proportion of the population using the northern Gulf of Mexico at any given time is relatively low. Although it is known that adverse impacts occurred and numbers of animals in the Gulf of Mexico were reduced as a result of DWH, the relative proportion

of the population that is expected to have been exposed to and directly impacted by the DWH event, as well as the impacts being primarily to smaller juveniles (lower reproductive value than adults and large juveniles), reduces the impact to the overall population. It is unclear what impact these losses may have caused on a population level, but it is not expected to have had a large impact on the population trajectory moving forward. However, recovery of green turtle numbers equivalent to what was lost in the northern Gulf of Mexico as a result of the spill will likely take decades of sustained efforts to reduce the existing threats and enhance survivorship of multiple life stages (DWH Trustees 2015).

3.3.4 Green Sea Turtle – South Atlantic (SA) DPS

The green sea turtle was 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 4, 2016, NMFS published a final rule (81 FR 20057), effective May 4, 2016, listing 11 DPSs of green sea turtle. The South Atlantic DPS (SA DPS) is listed as threatened. Its distribution includes the area from the border of Panama and Colombia at 7.5° N., 77° W., heads due north to 14° N., 77° W., then east to 14° N., 65.1° W., then north to 19° N., 65.1° W., and along 19° N. latitude to Mauritania in Africa, to include the U.S. Virgin Islands in the Caribbean. It extends along the coast of Africa to South Africa, with the southern border being 40° S. latitude.

Species Description and Distribution

The appearance of animals in the SA DPS does not vary significantly from those in the NA DPS. For information on the general appearance of green sea turtles in the SA DPS, refer to discussion above in Section 3.3.3.

The in-water range of the SA DPS is widespread. Foraging grounds for both juveniles and adults occur in the eastern South Atlantic along the West African coast, throughout the Caribbean areas of the South Atlantic, and off South America, all the way down to Uruguay and Argentina (Seminoff et al. 2015). As noted in the discussion about the NA DPS, animals from the NA and SA DPSs appear to co-mingle to some degree on the foraging grounds of the Gulf of Mexico and Bahamas. Lahanas et al. (1998) showed that juvenile green sea turtles in the Bahamas originate mainly from western Caribbean (Tortuguero, Costa Rica) (79.5%) (NA DPS) but that a significant proportion may be coming from the eastern Caribbean (Aves Island/Suriname; 12.9%) (SA DPS). Likewise, tag returns have found green turtles with origins from NA DPS nesting beaches (Tortuguero, Costa Rica) foraging in the SA (Brazil) (Troeng et al. 2005), Venezuela, Guyana, and Colombia (Sea Turtle Conservancy online data-http://www.conserveturtles.org/costarica.php?page=tort-tag-returns).

Nesting sites for the SA DPS occur in roughly 4 regions: 1) western Africa, 2) Ascension Island, 3) Brazil, and 4) the South Atlantic Caribbean (including Colombia, the Guianas, and Aves Island in addition to the numerous small, insular nesting sites).

***Life History Informati*on**

Green sea turtles reproduce sexually, and mating occurs in the waters off nesting beaches. Mature females return to their natal beaches (i.e., the same beaches where they were born) to lay eggs (Balazs 1982; Frazer and Ehrhart 1985b) every 2-4 years (Mortimer and Carr 1987; Prieto et al. 2012; Sole and Medina 1989) while males are known to reproduce every year (Balazs 1983). During the nesting season, females nest at approximately 2-week intervals, laying between 2-6 clutches (Seminoff et al. 2015). Clutch size varies among subpopulations, but clutch sizes in the SA DPS range from approximately 100-140 eggs (Seminoff et al. 2015). 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 anthropogenic stressors. Unlike the NA DPS, information on the survivorship of animals in the SA DPS is not available. However, survivorship at any particular nesting site regardless of DPS is greatly influenced by the level of anthropogenic stressors, with the more pristine and less disturbed nesting sites (e.g., along the Great Barrier Reef in Australia (Southwest Pacific DPS) showing higher survivorship values than nesting sites known to be highly disturbed (e.g., Nicaragua (NA DPS); (Campbell and Lagueux 2005; Chaloupka and Limpus 2005)).

Other than the SA DPS specific information provided in the previous paragraph, there is no difference in the life history information between animals from the SA and NA DPS. For additional life history information, refer to relevant discussion provided for the NA DPS.

Status and Population Dynamics

Population estimates for sea 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 is provided in the most recent status review for the species (Seminoff et al. 2015) organized by DPS.

Seminoff et al. (2015) estimate there are greater than 63,000 nesting females in the SA DPS, though they note the adult female nesting abundance from 37 of 51 beaches could not be quantified. The nesting at Poilão, Guinea-Bissau, account 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).

Unlike the NA DPS, the data available for nesting beaches in the SA DPS are not sufficient to conduct PVAs. Seminoff et al. (2015) report 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) indicate the nesting concentration at Ascension Island (United Kingdom) is 1 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) report 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).

Threats

Green sea turtles are generally vulnerable to same threats described for all sea turtles in Section 3.3.1. Threats specific to green sea turtles in the SA DPS are essentially the same as those described in the Section 3.3.3 for animals from the NA DPS. Specific information regarding the DWH spill impacts on either the NA or SA DPS of green sea turtles is not available. Given the location of the spill, we believe the majority of the impacts likely affected the NA DPS. Thus, the effect of the spill to the SA DPS was likely limited to a relatively small number of individuals that may have been foraging in the Gulf of Mexico when oil was in the region.

3.3.5 Leatherback Sea Turtle

The leatherback sea turtle was listed as endangered throughout its entire range on June 2, 1970, (35 FR 8491) under the Endangered Species Conservation Act of 1969.

Species Description and Distribution

The leatherback is the largest sea turtle in the world, with a curved carapace length (CCL) often exceeding 5 ft (150 cm) and front flippers that can span almost 9 ft (270 cm)

(NMFS and USFWS 1998c). Mature males and females can reach lengths of over 6 ft (2 m) and weigh close to 2,000 lb (900 kg). The leatherback does not have a bony shell. Instead, its shell is approximately 1.5 inches (4 cm) thick and consists of a leathery, oil-saturated connective tissue overlaying loosely interlocking dermal bones. The ridged shell and large flippers help the leatherback during its long-distance trips in search of food.

Unlike other sea turtles, leatherbacks have several unique traits that enable them to live in cold water. For example, leatherbacks have a countercurrent circulatory system (Greer et al. 1973),[18] a thick layer of insulating fat (Davenport et al. 1990; Goff and Lien 1988), gigantothermy (Paladino et al. 1990),[19] and they can increase their body temperature through increased metabolic activity (Bostrom and Jones 2007; Southwood et al. 2005). These adaptations allow leatherbacks to be comfortable in a wide range of temperatures, which helps them to travel further than any other sea turtle species (NMFS and USFWS 1995). For example, a leatherback may swim more than 6,000 miles (10,000 km) in a single year (Benson et al. 2007a; Benson et al. 2011; Eckert 2006; Eckert et al. 2006). They search for food between latitudes 71°N and 47°S, in all oceans, and travel extensively to and from their tropical nesting beaches. In the Atlantic Ocean, leatherbacks have been recorded as far north as Newfoundland, Canada, and Norway, and as far south as Uruguay, Argentina, and South Africa (NMFS 2001c).

While leatherbacks will look for food in coastal waters, they appear to prefer the open ocean at all life stages (Heppell et al. 2003b). Leatherbacks have pointed tooth-like cusps and sharp-edged jaws that are adapted for a diet of soft-bodied prey such as jellyfish and salps. A leatherback's mouth and throat also have backward-pointing spines that help retain jelly-like prey. Leatherbacks' favorite prey (e.g., medusae, siphonophores, and salps) occur commonly in temperate and northern or sub-arctic latitudes and likely has a strong influence on leatherback distribution in these areas (Plotkin 2003). Leatherbacks are known to be deep divers, with recorded depths in excess of a half-mile (Eckert et al. 1989), but they may also come into shallow waters to locate prey items.

Genetic analyses using microsatellite markers along with mitochondrial DNA and tagging data indicate there are 7 groups or breeding populations in the Atlantic Ocean: Florida, Northern Caribbean, Western Caribbean, Southern Caribbean/Guianas, West Africa, South Africa, and Brazil (TEWG 2007). General differences in migration patterns and foraging grounds may occur between the seven nesting assemblages, although data to support this is limited in most cases.

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[18] Countercurrent circulation is a highly efficient means of minimizing heat loss through the skin's surface because heat is recycled. For example, a countercurrent circulation system often has an artery containing warm blood from the heart surrounded by a bundle of veins containing cool blood from the body's surface. As the warm blood flows away from the heart, it passes much of its heat to the colder blood returning to the heart via the veins. This conserves heat by recirculating it back to the body's core.

[19] "Gigantothermy" refers to a condition when an animal has relatively high volume compared to its surface area, and as a result, it loses less heat.

Life History Information

The leatherback life cycle is broken into several stages: (1) egg/hatchling, (2) post-hatchling, (3) juvenile, (4) subadult, and (5) adult. Leatherbacks are a long-lived species that delay age of maturity, have low and variable survival in the egg and juvenile stages, and have relatively high and constant annual survival in the subadult and adult life stages (Chaloupka 2002; Crouse 1999; Heppell et al. 1999; Heppell et al. 2003b; Spotila et al. 1996; Spotila et al. 2000). While a robust estimate of the leatherback sea turtle's life span does not exist, the current best estimate for the maximum age is 43 (Avens et al. 2009). It is still unclear when leatherbacks first become sexually mature. Using skeletochronological data, Avens et al. (2009) estimated that leatherbacks in the western North Atlantic may not reach maturity until 29 years of age, which is longer than earlier estimates of 2-3 years by Pritchard and Trebbau (1984), of 3-6 years by Rhodin (1985), of 13-14 years for females by Zug and Parham (1996), and 12-14 years for leatherbacks nesting in the U.S. Virgin Islands by Dutton et al. (2005). A more recent study that examined leatherback growth rates estimated an age at maturity of 16.1 years (Jones et al. 2011).

The average size of reproductively active females in the Atlantic is generally 5-5.5 ft (150-162 cm) CCL (Benson et al. 2007a; Hirth et al. 1993; Starbird and Suarez 1994). Still, females as small as 3.5-4 ft (105-125 cm) CCL have been observed nesting at various sites (Stewart et al. 2007).

Female leatherbacks typically nest on sandy, tropical beaches at intervals of 2-4 years (Garcia M. and Sarti 2000; McDonald and Dutton 1996; Spotila et al. 2000). Unlike other sea turtle species, female leatherbacks do not always nest at the same beach year after year; some females may even nest at different beaches during the same year (Dutton et al. 2005; Eckert 1989; Keinath and Musick 1993; Steyermark et al. 1996). Individual female leatherbacks have been observed with fertility spans as long as 25 years (Hughes 1996). Females usually lay up to 10 nests during the 3-6 month nesting season (March through July in the United States), typically 8-12 days apart, with 100 eggs or more per nest (Eckert et al. 2012; Eckert 1989; Maharaj 2004; Matos 1986; Stewart and Johnson 2006; Tucker 1988). Yet, up to approximately 30% of the eggs may be infertile (Eckert 1989; Eckert et al. 1984; Maharaj 2004; Matos 1986; Stewart and Johnson 2006; Tucker 1988). The number of leatherback hatchlings that make it out of the nest on to the beach (i.e., emergent success) is approximately 50% worldwide (Eckert et al. 2012), which is lower than the greater than 80% reported for other sea turtle species (Miller 1997). In the United States, the emergent success is higher at 54%-72% (Eckert and Eckert 1990; Stewart and Johnson 2006; Tucker 1988). Thus the number of hatchlings in a given year may be less than the total number of eggs produced in a season. Eggs hatch after 60-65 days, and the hatchlings have white striping along the ridges of their backs and on the edges of the flippers. Leatherback hatchlings weigh approximately 1.5-2 ounces (40-50 g), and are approximately 2-3 inches (51-76 mm) in length, with fore flippers as long as their bodies. Hatchlings grow rapidly with reported growth rates for leatherbacks from 2.5-27.6 inches (6-70 cm) in length, estimated at 12.6 inches (32 cm) per year (Jones et al. 2011).

In the Atlantic, the sex ratio appears to be skewed toward females. The Turtle Expert Working Group (TEWG) reports that nearshore and onshore strandings data from the U.S. Atlantic and Gulf of Mexico coasts indicate that 60% of strandings were females (TEWG 2007). Those data also show that the proportion of females among adults (57%) and juveniles (61%) was also skewed toward females in these areas (TEWG 2007). James et al. (2007) collected size and sex data from large subadult and adult leatherbacks off Nova Scotia and also concluded a bias toward females at a rate of 1.86:1.

The survival and mortality rates for leatherbacks are difficult to estimate and vary by location. For example, the annual mortality rate for leatherbacks that nested at Playa Grande, Costa Rica, was estimated to be 34.6% in 1993-1994 and 34.0% in 1994-1995 (Spotila et al. 2000). In contrast, leatherbacks nesting in French Guiana and St. Croix had estimated annual survival rates of 91% (Rivalan et al. 2005) and 89% (Dutton et al. 2005), respectively. For the St. Croix population, the average annual juvenile survival rate was estimated to be approximately 63% and the total survival rate from hatchling to first year of reproduction for a female was estimated to be between 0.4% and 2% (assuming age at first reproduction is between 9-13 years (Eguchi et al. 2006). Spotila et al. (1996) estimated first-year survival rates for leatherbacks at 6.25%.

Migratory routes of leatherbacks are not entirely known; however, recent information from satellite tags have documented long travels between nesting beaches and foraging areas in the Atlantic and Pacific Ocean basins (Benson et al. 2007a; Benson et al. 2011; Eckert 2006; Eckert et al. 2006; Ferraroli et al. 2004; Hays et al. 2004; James et al. 2005). Leatherbacks nesting in Central America and Mexico travel thousands of miles through tropical and temperate waters of the South Pacific (Eckert and Sarti 1997; Shillinger et al. 2008). Data from satellite tagged leatherbacks suggest that they may be traveling in search of seasonal aggregations of jellyfish (Benson et al. 2007b; Bowlby et al. 1994; Graham 2009; Shenker 1984; Starbird et al. 1993; Suchman and Brodeur 2005).

Status and Population Dynamics

The status of the Atlantic leatherback population has been less clear than the Pacific population, which has shown dramatic declines at many nesting sites (Santidrián Tomillo et al. 2007; Sarti Martínez et al. 2007; Spotila et al. 2000). This uncertainty has been a result of inconsistent beach and aerial surveys, cycles of erosion, and reformation of nesting beaches in the Guianas (representing the largest nesting area). Leatherbacks also show a lesser degree of nest-site fidelity than occurs with the hardshell sea turtle species. Coordinated efforts of data collection and analyses by the leatherback Turtle Expert Working Group have helped to clarify the understanding of the Atlantic population status (TEWG 2007).

The Southern Caribbean/Guianas stock is the largest known Atlantic leatherback nesting aggregation (TEWG 2007). This area includes the Guianas (Guyana, Suriname, and French Guiana), Trinidad, Dominica, and Venezuela, with most of the nesting occurring in the Guianas and Trinidad. The Southern Caribbean/Guianas stock of leatherbacks was designated after genetics studies indicated that animals from the Guianas (and possibly

Trinidad) should be viewed as a single population. Using nesting females as a proxy for population, the TEWG (2007) determined that the Southern Caribbean/Guianas stock had demonstrated a long-term, positive population growth rate. TEWG observed positive growth within major nesting areas for the stock, including Trinidad, Guyana, and the combined beaches of Suriname and French Guiana (TEWG 2007). More specifically, Wallace et al. (2014) report an estimated three-generation abundance change of +3%, +20,800%, +1,778%, and +6% in Trinidad, Guyana, Suriname, and French Guiana, respectively.

Researchers believe the cyclical pattern of beach erosion and then reformation has affected leatherback nesting patterns in the Guianas. For example, between 1979 and 1986, the number of leatherback nests in French Guiana had increased by about 15% annually (NMFS 2001c). This increase was then followed by a nesting decline of about 15% annually. This decline corresponded with the erosion of beaches in French Guiana and increased nesting in Suriname. This pattern suggests that the declines observed since 1987 might actually be a part of a nesting cycle that coincides with cyclic beach erosion in Guiana (Schulz 1975). Researchers think that the cycle of erosion and reformation of beaches may have changed where leatherbacks nest throughout this region. The idea of shifting nesting beach locations was supported by increased nesting in Suriname,[20] while the number of nests was declining at beaches in Guiana (Hilterman et al. 2003). Though this information suggested the long-term trend for the overall Suriname and French Guiana population was increasing.

The Western Caribbean stock includes nesting beaches from Honduras to Colombia. Across the Western Caribbean, nesting is most prevalent in Costa Rica, Panama, and the Gulf of Uraba in Colombia (Duque et al. 2000). The Caribbean coastline of Costa Rica and extending through Chiriquí Beach, Panama, represents the fourth largest known leatherback rookery in the world (Troëng et al. 2004). Examination of data from index nesting beaches in Tortuguero, Gandoca, and Pacuaré in Costa Rica indicate that the nesting population likely was not growing over the 1995-2005 time series (TEWG 2007). Other modeling of the nesting data for Tortuguero indicates a possible 67.8% decline between 1995 and 2006 (Troëng et al. 2007). Wallace et al. (2014) report an estimated three-generation abundance change of -72%, -24%, and +6% for Tortuguero, Gandoca, and Pacuare, respectively.

Nesting data for the Northern Caribbean stock is available from Puerto Rico, St. Croix (U.S. Virgin Islands), and the British Virgin Islands (Tortola). In Puerto Rico, the primary nesting beaches are at Fajardo and on the island of Culebra. Nesting between 1978 and 2005 has ranged between 469-882 nests, and the population has been growing since 1978, with an overall annual growth rate of 1.1% (TEWG 2007). Wallace et al. (2014) report an estimated three-generation abundance change of -4% and +5,583% at Culebra and Fajardo, respectively. At the primary nesting beach on St. Croix, the Sandy

[20] Leatherback nesting in Suriname increased by more than 10,000 nests per year since 1999 with a peak of 30,000 nests in 2001.

Point National Wildlife Refuge, nesting has varied from a few hundred nests to a high of 1,008 in 2001, and the average annual growth rate has been approximately 1.1% from 1986-2004 (TEWG 2007). From 2006-2010, Wallace et al. (2014) report an annual growth rate of +7.5% in St. Croix and a three-generation abundance change of +1,058%. Nesting in Tortola is limited, but has been increasing from 0-6 nests per year in the late 1980s to 35-65 per year in the 2000s, with an annual growth rate of approximately 1.2% between 1994 and 2004 (TEWG 2007).

The Florida nesting stock nests primarily along the east coast of Florida. This stock is of growing importance, with total nests between 800-900 per year in the 2000s following nesting totals fewer than 100 nests per year in the 1980s (Florida Fish and Wildlife Conservation Commission, unpublished data). Using data from the index nesting beach surveys, the TEWG (TEWG 2007) estimated a significant annual nesting growth rate of 1.17% between 1989 and 2005. FWC Index Nesting Beach Survey Data generally indicates biennial peaks in nesting abundance beginning in 2007 (Figure 3.31 and Table 3.10). A similar pattern was also observed statewide (Table 3.14). This up-and-down pattern is thought to be a result of the cyclical nature of leatherback nesting, similar to the biennial cycle of green turtle nesting. Overall, the trend shows growth on Florida's east coast beaches. Wallace et al. (2014) report an annual growth rate of 9.7% and a three-generation abundance change of +1,863%.

Table 3.14 Number of Leatherback Sea Turtle Nests in Florida

Nests Recorded	2011	2012	2013	2014	2015
Index Nesting Beaches	625	515	322	641	489
Statewide	1,653	1,712	896	1,604	NA

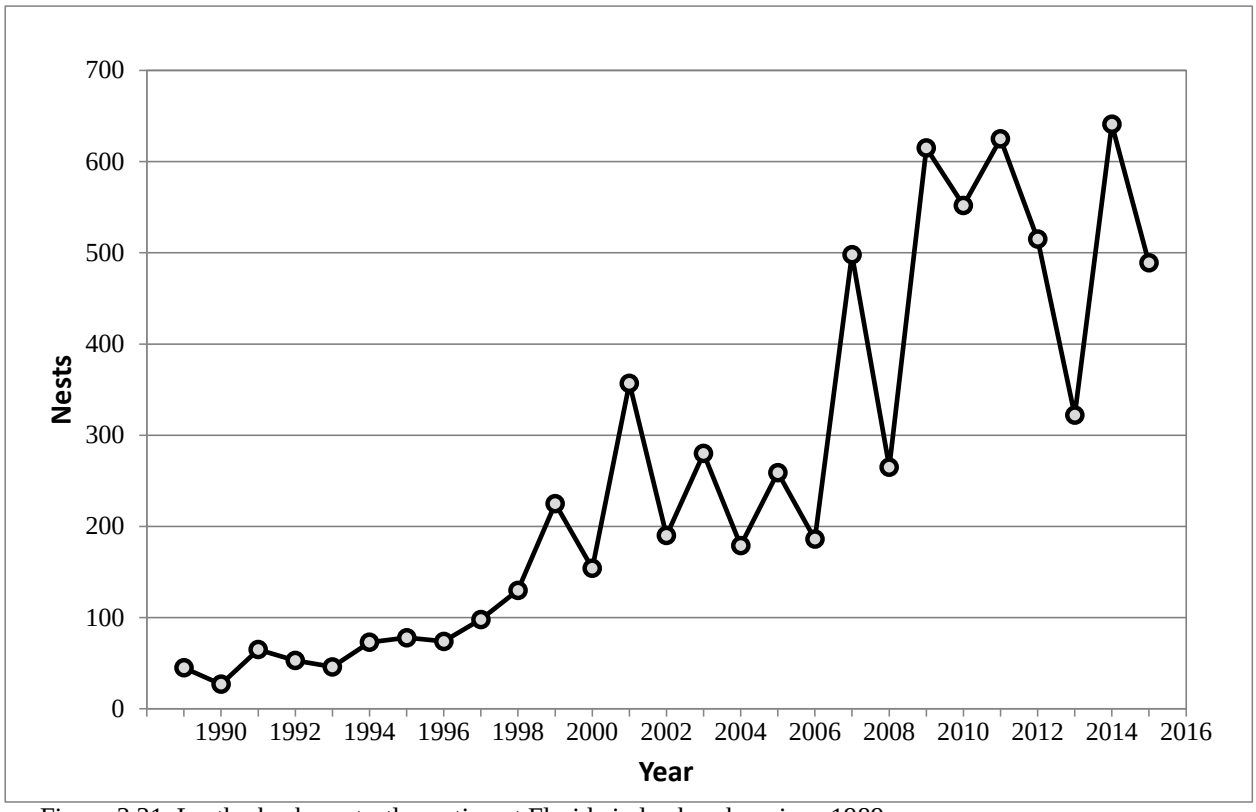

Figure 3.31 Leatherback sea turtle nesting at Florida index beaches since 1989

The West African nesting stock of leatherbacks is large and important, but it is a mostly unstudied aggregation. Nesting occurs in various countries along Africa's Atlantic coast, but much of the nesting is undocumented and the data are inconsistent. Gabon has a very large amount of leatherback nesting, with at least 30,000 nests laid along its coast in a single season (Fretey et al. 2007). Fretey et al. (2007) provide detailed information about other known nesting beaches and survey efforts along the Atlantic African coast. Because of the lack of consistent effort and minimal available data, trend analyses were not possible for this stock (TEWG 2007).

Two other small but growing stocks nest on the beaches of Brazil and South Africa. Based on the data available, TEWG (2007) determined that between 1988 and 2003, there was a positive annual average growth rate between 1.07 and 1.08% for the Brazilian stock. TEWG (2007) estimated an annual average growth rate between 1.04 and 1.06% for the South African stock.

Because the available nesting information is inconsistent, it is difficult to estimate the total population size for Atlantic leatherbacks. Spotila et al. (1996) characterized the entire Western Atlantic population as stable at best and estimated a population of 18,800 nesting females. Spotila et al. (1996) further estimated that the adult female leatherback population for the entire Atlantic basin, including all nesting beaches in the Americas, the Caribbean, and West Africa, was about 27,600 (considering both nesting and interesting females), with an estimated range of 20,082-35,133. This is consistent with the estimate of 34,000-95,000 total adults (20,000-56,000 adult females; 10,000-21,000 nesting

females) determined by the TEWG (2007). The TEWG (2007) also determined that at of the time of their publication, leatherback sea turtle populations in the Atlantic were all stable or increasing with the exception of the Western Caribbean and West Africa populations. The latest review by NMFS USFWS (2013) suggests the leatherback nesting population is stable in most nesting regions of the Atlantic Ocean.

Threats

Leatherbacks face many of the same threats as other sea turtle species, including destruction of nesting habitat from storm events, oceanic events such as cold-stunning, pollution (plastics, petroleum products, petrochemicals, etc.), ecosystem alterations (nesting beach development, beach nourishment and shoreline stabilization, vegetation changes, etc.), poaching, global climate change, fisheries interactions, natural predation, and disease. A discussion on general sea turtle threats can be found in Section 3.3.1; the remainder of this section will expand on a few of the aforementioned threats and how they may specifically impact leatherback sea turtles.

Of all sea turtle species, leatherbacks seem to be the most vulnerable to entanglement in fishing gear, especially gillnet and pot/trap lines. This may be because of their body type (large size, long pectoral flippers, and lack of a hard shell), their attraction to gelatinous organisms and algae that collect on buoys and buoy lines at or near the surface, their method of locomotion, and/or perhaps their attraction to the lightsticks used to attract target species in longline fisheries. From 1990-2000, 92 entangled leatherbacks were reported from New York through Maine and many other stranded individuals exhibited evidence of prior entanglement (Dwyer et al. 2003). Zug and Parham (1996) point out that a combination of the loss of long-lived adults in fishery-related mortalities and a lack of recruitment from intense egg harvesting in some areas has caused a sharp decline in leatherback sea turtle populations and represents a significant threat to survival and recovery of the species worldwide.

Leatherback sea turtles may also be more susceptible to marine debris ingestion than other sea turtle species due to their predominantly pelagic existence and the tendency of floating debris to concentrate in convergence zones that adults and juveniles use for feeding and migratory purposes (Lutcavage et al. 1997a; Shoop and Kenney 1992). The stomach contents of leatherback sea turtles revealed that a substantial percentage (33.8% or 138 of 408 cases examined) contained some form of plastic debris (Mrosovsky et al. 2009). Blocking of the gut by plastic to an extent that could have caused death was evident in 8.7% of all leatherbacks that ingested plastic (Mrosovsky et al. 2009). Mrosovsky et al. (2009) also note that in a number of cases, the ingestion of plastic may not cause death outright, but could cause the animal to absorb fewer nutrients from food, eat less in general, etc.– factors which could cause other adverse effects. The presence of plastic in the digestive tract suggests that leatherbacks might not be able to distinguish between prey items and forms of debris such a plastic bags (Mrosovsky et al. 2009). Balazs (1985) speculated that the plastic object might resemble a food item by its shape, color, size, or even movement as it drifts about, and therefore induce a feeding response in leatherbacks.

As discussed in Section 3.3.1, global climate change can be expected to have various impacts on all sea turtles, including leatherbacks. Global climate change is likely to also influence the distribution and abundance of jellyfish, the primary prey item of leatherbacks (NMFS and USFWS 2007g). Several studies have shown leatherback distribution is influenced by jellyfish abundance (e.g., (Houghton et al. 2006; Witt et al. 2007; Witt et al. 2006)); however, more studies need to be done to monitor how changes to prey items affect distribution and foraging success of leatherbacks so population-level effects can be determined.

While oil spill impacts are discussed generally for all species in Section 3.3.1, specific impacts of the DWH spill on leatherback sea turtles are considered here. Available information indicates leatherback sea turtles (along with hawksbill turtles) were likely least affected by the oil spill, at least directly. Leatherbacks were documented in the spill area, but the number of affected leatherbacks was not estimated due to a lack of information compared to other species. However, given that the northern Gulf of Mexico is important habitat for leatherback migration and foraging (Turtle Expert Working Group 2007), and documentation of leatherbacks in the DWH oil spill zone during the spill period, the Trustees conclude that leatherbacks were exposed to DWH oil, and some portion of those exposed leatherbacks likely died. Potential DWH-related impacts to leatherback sea turtles include direct oiling or contact with dispersants from surface and subsurface oil and dispersants, 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. Although adverse impacts likely occurred to leatherbacks, the relative proportion of the population that is expected to have been exposed to and directly impacted by the DWH event may be relatively low. Thus, a population-level impact may not have occurred due to the widespread distribution and nesting location outside of the Gulf of Mexico for this species.

3.3.6 Hawksbill Sea Turtle

The hawksbill sea turtle was listed as endangered throughout its entire range on June 2, 1970 (35 FR 8491) under the Endangered Species Conservation Act of 1969, a precursor to the ESA. Critical habitat was designated on June 2, 1998, in coastal waters surrounding Mona and Monito Islands in Puerto Rico (63 FR 46693).

Species Description and Distribution

Hawksbill sea turtles are small- to medium-sized (99 to 150 lb on average [45 to 68 kg]) although females nesting in the Caribbean are known to weigh up to 176 lb (80 kg) (Pritchard et al. 1983). The carapace is usually serrated and has a "tortoise-shell" coloring, ranging from dark to golden brown, with streaks of orange, red, and/or black. The plastron of a hawksbill turtle is typically yellow. The head is elongated and tapers to a point, with a beak-like mouth that gives the species its name. The shape of the mouth allows the hawksbill turtle to reach into holes and crevices of coral reefs to find sponges,

their primary adult food source, and other invertebrates. The shells of hatchlings are 1.7 in (42 mm) long, are mostly brown, and somewhat heart-shaped (Eckert 1995; Hillis and Mackay 1989; van Dam and Sarti 1989).

Hawksbill sea turtles have a circumtropical distribution and usually occur between latitudes 30°N and 30°S in the Atlantic, Pacific, and Indian Oceans. In the western Atlantic, hawksbills are widely distributed throughout the Caribbean Sea, off the coasts of Florida and Texas in the continental United States, in the Greater and Lesser Antilles, and along the mainland of Central America south to Brazil (Amos 1989; Groombridge and Luxmoore 1989; Lund 1985; Meylan and Donnelly 1999; NMFS and USFWS 1998a; Plotkin and Amos 1990; Plotkin and Amos 1988). They are highly migratory and use a wide range of habitats during their lifetimes (Musick and Limpus 1997b; Plotkin 2003). Adult hawksbill sea turtles are capable of migrating long distances between nesting beaches and foraging areas. For instance, a female hawksbill sea turtle tagged at Buck Island Reef National Monument (BIRNM) was later identified 1,160 miles (1,866 km) away in the Miskito Cays in Nicaragua (Spotila 2004).

Hawksbill sea turtles nest on sandy beaches throughout the tropics and subtropics. Nesting occurs in at least 70 countries, although much of it now only occurs at low densities compared to that of other sea turtle species (NMFS and USFWS 2007b). Meylan and Donnelly (1999) believe that the widely dispersed nesting areas and low nest densities is likely a result of overexploitation of previously large colonies that have since been depleted over time. The most significant nesting within the United States occurs in Puerto Rico and the U.S. Virgin Islands, specifically on Mona Island and BIRNM, respectively. Although nesting within the continental United States is typically rare, it can occur along the southeast coast of Florida and the Florida Keys. The largest hawksbill nesting population in the western Atlantic occurs in the Yucatán Peninsula of Mexico, where several thousand nests are recorded annually in the states of Campeche, Yucatán, and Quintana Roo (Garduño-Andrade et al. 1999; Spotila 2004). In the U.S. Pacific, hawksbills nest on main island beaches in Hawaii, primarily along the east coast of the island. Hawksbill nesting has also been documented in American Samoa and Guam. More information on nesting in other ocean basins may be found in the 5-year status review for the species (NMFS and USFWS 2007c).

Mitochondrial DNA studies show that reproductive populations are effectively isolated over ecological time scales (Bass et al. 1996). Substantial efforts have been made to determine the nesting population origins of hawksbill sea turtles assembled in foraging grounds, and genetic research has shown that hawksbills of multiple nesting origins commonly mix in foraging areas (Bowen and Witzell 1996). Since hawksbill sea turtles nest primarily on the beaches where they were born, if a nesting population is decimated, it might not be replenished by sea turtles from other nesting rookeries (Bass et al. 1996).

Life History Information

Hawksbill sea turtles exhibit slow growth rates although they are known to vary within and among populations from a low of 0.4-1.2 in (1-3 cm) per year, measured in the Indo-Pacific (Chaloupka and Limpus 1997; Mortimer et al. 2003; Mortimer et al. 2002;

Whiting 2000), to a high of 2 in (5 cm) or more per year, measured at some sites in the Caribbean (Diez and Van Dam 2002; León and Diez 1999). Differences in growth rates are likely due to differences in diet and/or density of sea turtles at foraging sites and overall time spent foraging (Bjorndal and Bolten 2002; Chaloupka et al. 2004). Consistent with slow growth, age to maturity for the species is also long, taking between 20 and 40 years, depending on the region (Chaloupka and Musick 1997a; Limpus and Miller 2000). Hawksbills in the western Atlantic are known to mature faster (i.e., 20 or more years) than sea turtles found in the Indo-Pacific (i.e., 30-40 years) (Boulan 1983; Boulon Jr. 1994; Diez and Van Dam 2002; Limpus and Miller 2000). Males are typically mature when their length reaches 27 in (69 cm), while females are typically mature at 30 in (75 cm) (Eckert et al. 1992; Limpus 1992).

Female hawksbills return to the beaches where they were born (natal beaches) every 2-3 years to nest (Van Dam et al. 1991; Witzell 1983) and generally lay 3-5 nests per season (Richardson et al. 1999). Compared with other sea turtles, the number of eggs per nest (clutch) for hawksbills can be quite high. The largest clutches recorded for any sea turtle belong to hawksbills (approximately 250 eggs per nest) ((Hirth and Latif 1980), though nests in the U.S. Caribbean and Florida more typically contain approximately 140 eggs (USFWS hawksbill fact sheet, http://www.fws.gov/northflorida/SeaTurtles/Turtle%20Factsheets/hawksbill-sea-turtle.htm). Eggs incubate for approximately 60 days before hatching (USFWS hawksbill fact sheet). Hatchling hawksbill sea turtles typically measure 1-2 in (2.5-5 cm) in length and weigh approximately 0.5 oz (15 g).

Hawksbills may undertake developmental migrations (migrations as immatures) and reproductive migrations that involve travel over many tens to thousands of miles (Meylan 1999a). Post-hatchlings (oceanic stage juveniles) are believed to live in the open ocean, taking shelter in floating algal mats and drift lines of flotsam and jetsam in the Atlantic and Pacific oceans (Musick and Limpus 1997b) before returning to more coastal foraging grounds. In the Caribbean, hawksbills are known to almost exclusively feed on sponges (Meylan 1988b; Van Dam and Diez 1997), although at times they have been seen foraging on other food items, notably corallimorphs and zooanthids (León and Diez 2000; Mayor et al. 1998b; Van Dam and Diez 1997).

Reproductive females undertake periodic (usually non-annual) migrations to their natal beaches to nest and exhibit a high degree of fidelity to their nest sites. Movements of reproductive males are less certain, but are presumed to involve migrations to nesting beaches or to courtship stations along the migratory corridor. Hawksbills show a high fidelity to their foraging areas as well (Van Dam and Diez 1998). Foraging sites are typically areas associated with coral reefs, although hawksbills are also found around rocky outcrops and high energy shoals which are optimum sites for sponge growth. They can also inhabit seagrass pastures in mangrove-fringed bays and estuaries, particularly along the eastern shore of continents where coral reefs are absent (Bjorndal 1997; Van Dam and Diez 1998).

Status and Population Dynamics

There are currently no reliable estimates of population abundance and trends for non-nesting hawksbills at the time of this consultation; therefore, nesting beach data is currently the primary information source for evaluating trends in global abundance. Most hawksbill populations around the globe are either declining, depleted, and/or remnants of larger aggregations (NMFS and USFWS 2007c). The largest nesting population of hawksbills occurs in Australia where approximately 2,000 hawksbills nest off the northwest coast and about 6,000-8,000 nest off the Great Barrier Reef each year (Spotila 2004). Additionally, about 2,000 hawksbills nest each year in Indonesia and 1,000 nest in the Republic of Seychelles (Spotila 2004). In the United States, hawksbills typically laid about 500-1,000 nests on Mona Island, Puerto Rico in the past (Diez and Van Dam 2007), but the numbers appear to be increasing, as the Puerto Rico Department of Natural and Environmental Resources counted nearly 1,600 nests in 2010 (PRDNER nesting data). Another 56-150 nests are typically laid on Buck Island off St. Croix (Meylan 1999b; Mortimer and Donnelly 2008). Nesting also occurs to a lesser extent on beaches on Culebra Island and Vieques Island in Puerto Rico, the mainland of Puerto Rico, and additional beaches on St. Croix, St. John, and St. Thomas, U.S. Virgin Islands.

Mortimer and Donnelly (2008) reviewed nesting data for 83 nesting concentrations organized among 10 different ocean regions (i.e., Insular Caribbean, Western Caribbean Mainland, Southwestern Atlantic Ocean, Eastern Atlantic Ocean, Southwestern Indian Ocean, Northwestern Indian Ocean, Central Indian Ocean, Eastern Indian Ocean, Western Pacific Ocean, Central Pacific Ocean, and Eastern Pacific Ocean). They determined historic trends (i.e., 20-100 years ago) for 58 of the 83 sites, and also determined recent abundance trends (i.e., within the past 20 years) for 42 of the 83 sites. Among the 58 sites where historic trends could be determined, all showed a declining trend during the long-term period. Among the 42 sites where recent (past 20 years) trend data were available, 10 appeared to be increasing, 3 appeared to be stable, and 29 appeared to be decreasing. With respect to regional trends, nesting populations in the Atlantic (especially in the Insular Caribbean and Western Caribbean Mainland) are generally doing better than those in the Indo-Pacific regions. For instance, 9 of the 10 sites that showed recent increases are located in the Caribbean. Buck Island and St. Croix's East End beaches support 2 remnant populations of between 17-30 nesting females per season (Hillis and Mackay 1989; Mackay 2006). While the proportion of hawksbills nesting on Buck Island represents a small proportion of the total hawksbill nesting occurring in the greater Caribbean region, Mortimer and Donnelly (2008) report an increasing trend in nesting at that site based on data collected from 2001-2006. The conservation measures implemented when BIRNM was expanded in 2001 most likely explains this increase.

Nesting concentrations in the Pacific Ocean appear to be performing the worst of all regions despite the fact that the region currently supports more nesting hawksbills than either the Atlantic or Indian Oceans (Mortimer and Donnelly 2008). Even so, while still critically low in numbers, sightings of hawksbills in the eastern Pacific appear to have been increasing since 2007, though some of that increase may be attributable to better

observations (Gaos et al. 2010). More information about site-specific trends can be found in the most recent 5-year status review for the species (NMFS and USFWS 2007c).

Threats

Hawksbills are currently subjected to the same suite of threats on both nesting beaches and in the marine environment that affect other sea turtles (e.g., interaction with federal and state fisheries, coastal construction, oil spills, climate change affecting sex ratios) as discussed in Section 3.3.1. There are also specific threats that are of special emphasis, or are unique, for hawksbill sea turtles discussed in further detail below.

While oil spill impacts are discussed generally for all species in Section 3.3.1, specific impacts of the DWH spill on hawksbill turtles have been estimated. Hawksbills made up 2.2% (8,850) of small juvenile sea turtle (of those that could be identified to species) exposures to oil in offshore areas, with an estimate of 615 to 3,090 individuals dying as a result of the direct exposure (DWH Trustees 2015). No quantification of large benthic juveniles or adults was made. 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. Although adverse impacts occurred to hawksbills, the relative proportion of the population that is expected to have been exposed to and directly impacted by the DWH event is relatively small, and thus a population-level impact is not believed to have occurred due to the widespread distribution and nesting location outside of the Gulf of Mexico for this species.

The historical decline of the species is primarily attributed to centuries of exploitation for the beautifully patterned shell, which made it a highly attractive species to target (Parsons 1972). The fact that reproductive females exhibit a high fidelity for nest sites and the tendency of hawksbills to nest at regular intervals within a season made them an easy target for capture on nesting beaches. The shells from hundreds of thousands of sea turtles in the western Caribbean region were imported into the United Kingdom and France during the nineteenth and early twentieth centuries (Parsons 1972). Additionally, hundreds of thousands of sea turtles contributed to the region's trade with Japan prior to 1993 when a zero quota was imposed (Milliken and Tokunaga 1987), as cited in (Brautigam and Eckert 2006).

The continuing demand for the hawksbills' shells as well as other products derived from the species (e.g., leather, oil, perfume, and cosmetics) represents an ongoing threat to its recovery. The British Virgin Islands, Cayman Islands, Cuba, Haiti, and the Turks and Caicos Islands (United Kingdom) all permit some form of legal take of hawksbill sea turtles. In the northern Caribbean, hawksbills continue to be harvested for their shells, which are often carved into hair clips, combs, jewelry, and other trinkets (Márquez M. 1990; Stapleton and Stapleton 2006). Additionally, hawksbills are harvested for their eggs and meat, while whole, stuffed sea turtles are sold as curios in the tourist trade. Hawksbill sea turtle products are openly available in the Dominican Republic and

Jamaica, despite a prohibition on harvesting hawksbills and their eggs (Fleming 2001). Up to 500 hawksbills per year from 2 harvest sites within Cuba were legally captured each year until 2008 when the Cuban government placed a voluntary moratorium on the sea-turtle fishery (Carillo et al. 1999; Mortimer and Donnelly 2008). While current nesting trends are unknown, the number of nesting females is suspected to be declining in some areas (Carillo et al. 1999; Moncada et al. 1999). International trade in the shell of this species is prohibited between countries that have signed the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES), but illegal trade still occurs and remains an ongoing threat to hawksbill survival and recovery throughout its range.

Due to their preference to feed on sponges associated with coral reefs, hawksbill sea turtles are particularly sensitive to losses of coral reef communities. Coral reefs are vulnerable to destruction and degradation caused by human activities (e.g., nutrient pollution, sedimentation, contaminant spills, vessel groundings and anchoring, recreational uses) and are also highly sensitive to the effects of climate change (e.g., higher incidences of disease and coral bleaching) (Crabbe 2008; Wilkinson 2004). Because continued loss of coral reef communities (especially in the greater Caribbean region) is expected to impact hawksbill foraging, it represents a major threat to the recovery of the species.

3.3.7 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 2000c; 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 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 and females lay approximately 2.5 nests per season with each nest containing approximately 100 eggs (Márquez M. 1994).

Population Dynamics

Of the 7 species of sea turtles in the world, the Kemp's ridley has declined to the lowest population level. Most of the population of adult females nest on the beaches of Rancho Nuevo, Mexico (Pritchard 1969). When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand 1963). By the mid-1980s, however, nesting numbers from Rancho Nuevo and adjacent Mexican beaches were below 1,000, with a low of 702 nests in 1985. Yet, nesting steadily increased through the 1990s, and then accelerated during the first decade of the twenty-first century (Figure 3.32), which indicates the species is recovering. It is worth noting that when the Bi-National Kemp's Ridley Sea Turtle

Population Restoration Project was initiated in 1978, only Rancho Nuevo nests were recorded. In 1988, nesting data from southern beaches at Playa Dos and Barra del Tordo were added. In 1989, data from the northern beaches of Barra Ostionales and Tepehuajes were added, and most recently in 1996, data from La Pesca and Altamira beaches were recorded. Currently, nesting at Rancho Nuevo accounts for just over 81% of all recorded Kemp's ridley nests in Mexico.

Following a significant, unexplained 1-year decline in 2010, Kemp's ridley nests in Mexico reached a record high of 21,797 in 2012 (Gladys Porter Zoo 2013). In 2013 through 2014, there was a second significant decline, with only 16,385 and 11,279 nests recorded, respectively. In 2015, nesting in Mexico improved to 14,006 recorded nests (J. Pena, Gladys Porter Zoo, pers. comm. to M. Barnette, NMFS, October 19, 2015). At this time, it is unclear if nesting will now steadily increase uninterrupted, similar to what occurred from 1990-2009, or if nesting will continue to exhibit sporadic declines and increases as recorded in the past 5 years. A small nesting population is also emerging in the United States, primarily in Texas, rising from 6 nests in 1996 to 42 in 2004, to a record high of 209 nests in 2012 (National Park Service data, http://www.nps.gov/pais/naturescience/strp.htm, http://www.nps.gov/pais/naturescience/current-season.htm). It is worth noting that nesting in Texas has paralleled the trends observed in Mexico, with a significant decline in 2010 followed by a second decline in 2013-2014. Nesting rebounded in 2015, with 159 nests documented along the Texas coast (D. Shaver, National Park Service, pers. comm. to M. Barnette, NMFS, October 28, 2015).

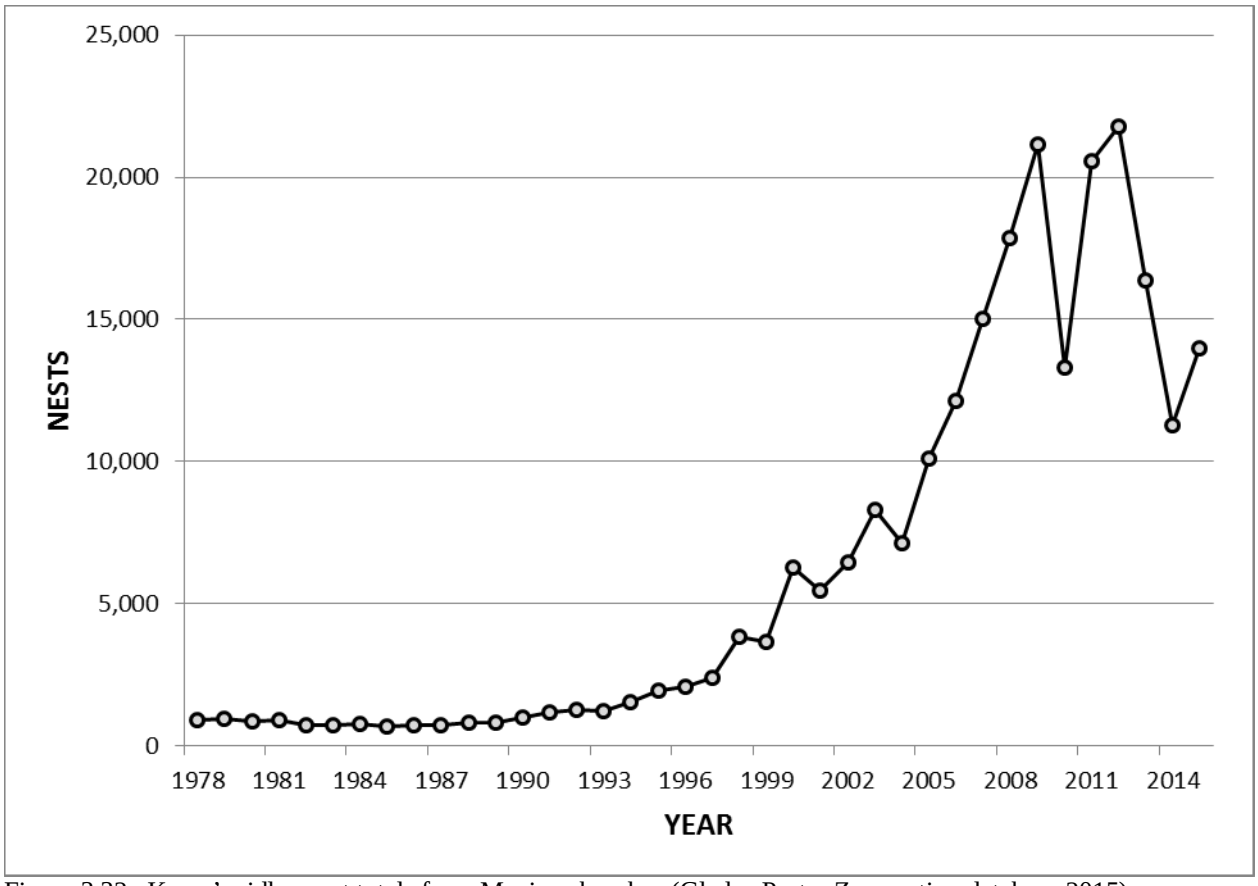

Figure 3.32. Kemp's ridley nest totals from Mexican beaches (Gladys Porter Zoo nesting database 2015)

Heppell et al. (2005) predicted in a population model that the population is expected to increase at least 12-16% per year and that the population could attain 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 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 2000a). While these results are encouraging, the species limited range as well as low global abundance makes it particularly vulnerable to new sources of mortality as well as demographic and environmental randomness, all of which are often difficult to predict with any certainty. Additionally, the significant nesting declines observed in 2010 and 2013-2014 potentially indicate a serious population-level impact, and there is cause for concern regarding the ongoing recovery trajectory.

Threats

Kemp's ridley sea turtles face many of the same threats as other sea turtle species, including destruction of nesting habitat from storm events, oceanic events such as cold-stunning, pollution (plastics, petroleum products, petrochemicals, etc.), ecosystem alterations (nesting beach development, beach nourishment and shoreline stabilization, vegetation changes, etc.), poaching, global climate change, fisheries interactions, natural predation, and disease. A discussion on general sea turtle threats can be found in Section 3.3.1; the remainder of this section will expand on a few of the aforementioned threats and how they may specifically impact Kemp's ridley sea turtles.

As Kemp's ridley sea turtles continue to recover and nesting arribadas[21] 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) occurring 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

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

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, March 2012). Yet, available information indicates fishery effort was extremely limited during the stranding events. The fact that 80% or more of all Louisiana, Mississippi, and Alabama stranded sea turtles in the past 5 years were Kemp's ridleys is notable; however, this could simply be a function of the species' preference for shallow, inshore waters coupled with increased population abundance as reflected in recent Kemp's ridley nesting increases.

In response to these strandings, and due to speculation that fishery interactions may be the cause, fishery observer effort was shifted to evaluate the inshore skimmer trawl fishery during the summer of 2012. During May-July of that year, observers reported 24 sea turtle interactions in the skimmer trawl fishery, all but one of which 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), and 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-inch 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.

Following the withdrawal of the final rule, we initiated additional TED testing, evaluating both small sea turtle exclusion and shrimp retention within the skimmer trawl fishery. This testing has produced a TED grid with narrow bar spacing (i.e., less than the current 4-inch bar spacing maximum) and escape-opening flap specifications that would allow small turtles to effectively escape the trawl net. This new design could be used by skimmer and otter trawlers in areas where these small turtles occur. Based on this and information indicating sea turtles are vulnerable to capture by skimmer trawls and tow times may not be as effective in reducing bycatch-related mortality as TEDs, we are re-evaluating the efficacy of turtle conservation requirements associated with the skimmer trawl fishery.

On February 15, 2016, we published notice of intent to prepare an environmental impact statement for sea turtle conservation and recovery actions in relation to Southeastern shrimp fisheries and to conduct public scoping meetings. NMFS is considering several alternatives, including withdrawing alternative tow time restrictions, which would require all skimmer trawls, pusher-head trawls, and wing nets (butterfly trawls) rigged for fishing to use a currently-approved TED or a modified TED with narrow bar and lighter webbing in the escape opening flap; time and area closures; or other measures to reduce sea turtle bycatch and mortality in the southeastern shrimp fisheries. Depending on the alternative

selected, new requirements may apply to all vessels from Texas through North Carolina fishing in both state and federal waters. We anticipate publishing a proposed rule with information on any specific new management measures for the southeastern shrimp fisheries by August 2016.

While oil spill impacts are discussed generally for all species in Section 4.2.1, specific impacts of the DWH spill on Kemp's ridley sea turtles are considered here. Kemp's ridleys experienced the greatest negative impact from the DWH spill 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 able to be 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. However, 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 2015).

A total of 217,000 small juvenile Kemp's ridleys (51.5 percent 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 percent 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 percent of the total estimated population for those age classes), with an estimated 3,110 mortalities (or 3 percent 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 approximately 65,000 and 95,000 unrealized hatchlings (DWH Trustees 2015). However, this is a minimum estimate of the overall potential DWH effect because the sub-lethal effects of DWH oil on turtles, their prey, and their habitats might have delayed or reduced reproduction in subsequent years and contributed substantially to additional nesting deficits observed following DWH. These sub-lethal 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 effects on reduced Kemp's ridley nesting abundance and associated hatchling production after 2010 requires further evaluation. Additionally, 483 eggs from 5 nests were translocated, with 125 ultimately released as hatchlings (the fate of which is unknown) (DWH Trustees 2015).

Additional unquantified effects may have included inhalation of volatile compounds, disruption of foraging or migratory movements due to surface or subsurface oil, ingestion of prey species contaminated with oil and/or dispersants, and loss of foraging resources which could lead to compromised growth and/or reproductive potential. There is no information currently available to determine the extent of those impacts, if they occurred. It is clear that the DWH 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. However, we do not have a clear understanding of those impacts on the population trajectory for the species into the future.

3.3.8 Smalltooth Sawfish – U.S. DPS

The U.S. DPS of smalltooth sawfish was listed as endangered under the ESA effective May 1, 2003 (68 FR 15674; April 1, 2003).

Species Description and Distribution

The smalltooth sawfish is a tropical marine and estuarine elasmobranch. It has an extended snout with a long, narrow, flattened, rostral blade (rostrum) with a series of transverse teeth along either edge. In general, smalltooth sawfish inhabit shallow coastal waters of warm seas throughout the world and feed on a variety of small fish (e.g., mullet, jacks, and ladyfish) (Simpfendorfer 2001b), and crustaceans (e.g., shrimp and crabs) (Bigelow and Schroeder 1953b; Norman and Fraser 1937).

Although this species is reported to have a circumtropical distribution, NMFS identified smalltooth sawfish from the Southeast United States as a distinct population segment (DPS), due to the physical isolation of this population from others, the differences in international management of the species, and the significance of the U.S. population in relation to the global range of the species (see 68 FR15674). Within the United States, smalltooth sawfish have been captured in estuarine and coastal waters from New York southward through Texas, although peninsular Florida has historically been the region of the United States with the largest number of recorded captures (NMFS 2000b). Recent records indicate there is a resident reproducing population of smalltooth sawfish in south and southwest Florida from Charlotte Harbor through the Dry Tortugas, which is also the last U.S. stronghold for the species (Poulakis and Seitz 2004a; Seitz and Poulakis 2002a; Simpfendorfer and Wiley 2005). Water temperatures (no lower than 16-18°C) and the availability of appropriate coastal habitat (shallow, euryhaline waters and red mangroves) are the major environmental constraints limiting the northern movements of smalltooth sawfish in the western North Atlantic. Most specimens captured along the Atlantic coast north of Florida are large adults (over 10 ft) that likely represent seasonal migrants, wanderers, or colonizers from a historic Florida core population(s) to the south, rather than being members of a continuous, even-density population (Bigelow and Schroeder 1953b).

Life History Information

Smalltooth sawfish fertilization is internal and females give birth to live young. The brood size, gestation period, and frequency of reproduction are unknown for smalltooth sawfish. Therefore, data from the closely related (in terms of size and body morphology) largetooth sawfish represent our best estimates of these parameters. The largetooth sawfish likely reproduces every other year, has a gestation period of approximately 5 months, and produces a mean of 7.3 offspring per brood, with a range of 1-13 offspring (Thorson 1976). Smalltooth sawfish are approximately 31 in (80 cm) at birth and may grow to a length of 18 ft (548 cm) or greater during their lifetime (Bigelow and Schroeder 1953b; Simpfendorfer 2002). Simpfendorfer et al. (2008) report rapid juvenile growth for smalltooth sawfish for the first 2 years after birth, with stretched total length increasing by an average of 25-33 in (65-85 cm) in the first year and an average of 19-27 in (48-68 cm) in the second year. By contrast, very little information exists on size classes other than juveniles, which make up the majority of sawfish encounters; therefore, much uncertainty remains in estimating life history parameters for smalltooth sawfish, especially as it relates to age at maturity and post-juvenile growth rates. Based on age and growth studies of the largetooth sawfish (Thorson 1982) and research by Simpfendorfer (2000), the smalltooth sawfish is likely a slow-growing (with the exception of early juveniles), late-maturing (10-20 years) species with a long lifespan (30-60 years). Juvenile growth rates presented by Simpfendorfer et al. (2008) suggest smalltooth sawfish are growing faster than previously thought and therefore may reach sexual maturity at an earlier age.

There are distinct differences in habitat use based on life history stage. Juvenile smalltooth sawfish, those up to 3 years of age or approximately 8 ft in length (Simpfendorfer et al. 2008), inhabit the shallow waters of estuaries and can be found in sheltered bays, dredged canals, along banks and sandbars, and in rivers (NMFS 2000b). Juvenile smalltooth sawfish occur in euryhaline waters (i.e., waters with a wide range of salinities) and are often closely associated with muddy or sandy substrates, and shorelines containing red mangroves, *Rhizophora mangle* (Simpfendorfer 2001b; Simpfendorfer 2003). Tracking data from the Caloosahatchee River in Florida indicate very shallow depths and salinity are important abiotic factors influencing juvenile smalltooth sawfish movement patterns, habitat use, and distribution (Simpfendorfer et al. 2011). Another recent acoustic tagging study in a developed region of Charlotte Harbor, Florida, identified the importance of mangroves in close proximity to shallow water habitat for juvenile smalltooth sawfish, stating that juveniles generally occur in shallow water within 328 ft (100 m) of mangrove shorelines, generally red mangroves (Simpfendorfer et al. 2010a). Juvenile smalltooth sawfish spend the majority of their time in waters less than 13 ft (4 m) in depth (Simpfendorfer et al. 2010a) and are seldom found in depths greater than 32 ft (10 m) (Poulakis and Seitz 2004a). Simpfendorfer et al. (2010a) also indicated developmental differences in habitat use: the smallest juveniles (young-of-the-year juveniles measuring < 100 cm in length) generally used water depths less than 0.5 m (1.64 ft), had small home ranges (4,264-4,557 m^2), and exhibited high levels of site fidelity. Although small juveniles exhibit high levels of site fidelity for specific nursery habitats for periods of time lasting up to 3 months (Wiley and Simpfendorfer 2007), they do undergo small movements coinciding with changing tidal stages. These movements

often involve moving from shallow sandbars at low tide to within red mangrove prop roots at higher tides (Simpfendorfer et al. 2010a), behavior likely to reduce the risk of predation (Simpfendorfer 2006). As juveniles increase in size, they begin to expand their home ranges (Simpfendorfer et al. 2010a; Simpfendorfer et al. 2011), eventually moving to more offshore habitats where they likely feed on larger prey and eventually reach sexual maturity.

Researchers have identified several areas within the Charlotte Harbor Estuary that are disproportionately more important to juvenile smalltooth sawfish, based on intra- or inter-annual (within or between year) capture rates during random sampling events within the estuary (Poulakis 2012; Poulakis et al. 2011). These areas were termed "hotspots" and also correspond with areas where public encounters are most frequently reported. Use of these "hotspots" can vary within and among years based on the amount and timing of freshwater inflow. Smalltooth sawfish use hotspots further upriver during high salinity conditions (drought) and areas closer to the mouth of the Caloosahatchee River during times of high freshwater inflow (Poulakis et al. 2011). At this time, researchers are unsure what specific biotic or abiotic factors influence this habitat use, but they believe a variety of conditions in addition to salinity, such as temperature, dissolved oxygen, water depth, shoreline vegetation, and food availability, may influence habitat selection (Poulakis et al. 2011).

While adult smalltooth sawfish may also use the estuarine habitats used by juveniles, they are commonly observed in deeper waters along the coasts. Poulakis and Seitz (2004a) noted that nearly half of the encounters with adult-sized smalltooth sawfish in Florida Bay and the Florida Keys occurred in depths from 200-400 ft (70-122 m) of water. Similarly, Simpfendorfer and Wiley (2005) reported encounters in deeper waters off the Florida Keys, and observations from both commercial longline fishing vessels and fishery-independent sampling in the Florida Straits report large smalltooth sawfish in depths up to 130 ft (~40 m)(ISED 2014). Even so, NMFS believes adult smalltooth sawfish use shallow estuarine habitats during parturition (when adult females return to shallow estuaries to pup) because very young juveniles still containing rostral sheaths are captured in these areas. Since very young juveniles have high site fidelities, we hypothesize that they are birthed nearby or in their nursery habitats.

Status and Population Dynamics

Few long-term abundance data exist for the smalltooth sawfish, making it very difficult to estimate the current population size. Simpfendorfer (2001b) estimated that the U.S. population may number less than 5% of historic levels, based on anecdotal data and the fact that the species' range has contracted by nearly 90%, with south and southwest Florida the only areas known to support a reproducing population. Since actual abundance data are limited, researchers have begun to compile capture and sightings data (collectively referred to as encounter data) in the International Sawfish Encounter Database (ISED) that was developed in 2000. Although this data cannot be used to assess the population because of the opportunistic nature in which they are collected (i.e., encounter data are a series of random occurrences rather than an evenly distributed search over a defined period of time), researchers can use this database to assess the spatial and

temporal distribution of smalltooth sawfish. We expect that as the population grows, the geographic range of encounters will also increase. Since the conception of the ISED, over 3,000 smalltooth sawfish encounters have been reported and compiled in the encounter database (ISED 2014).

Despite the lack of scientific data on abundance, recent encounters with young-of-the-year, older juveniles, and sexually mature smalltooth sawfish indicate that the U.S. population is currently reproducing (Seitz and Poulakis 2002a; Simpfendorfer 2003). The abundance of juveniles encountered, including very small individuals, suggests that the population remains viable (Simpfendorfer and Wiley 2004b), and data analyzed from Everglades National Park as part of an established fisheries-dependent monitoring program (angler interviews) indicate a slightly increasing trend in abundance within the park over the past decade (Carlson and Osborne 2012; Carlson et al. 2007). Using a demographic approach and life history data for smalltooth sawfish and similar species from the literature, Simpfendorfer (2000) estimated intrinsic rates of natural population increase for the species at 0.08-0.13 per year and population doubling times from 5.4-8.5 years. These low intrinsic rates[22] of population increase, suggest that the species is particularly vulnerable to excessive mortality and rapid population declines, after which recovery may take decades.

Threats

Past literature indicates smalltooth sawfish were once abundant along both coasts of Florida and quite common along the shores of Texas and the northern Gulf Coast (NMFS 2010f) and citations therein). Based on recent comparisons with these historical reports, the U.S. DPS of smalltooth sawfish has declined over the past century (Simpfendorfer 2001b; Simpfendorfer 2002). The decline in smalltooth sawfish abundance has been attributed to several factors including bycatch mortality in fisheries, habitat loss, and life history limitations of the species (NMFS 2010f).

<u>Bycatch Mortality</u>

Bycatch mortality is cited as the primary cause for the decline in smalltooth sawfish in the United States (NMFS 2010f). While there has never been a large-scale directed fishery, smalltooth sawfish easily become entangled in fishing gears (gill nets, otter trawls, trammel nets, and seines) directed at other commercial species, often resulting in serious injury or death (NMFS 2009h). This has historically been reported in Florida (Snelson and Williams 1981), Louisiana (Simpfendorfer 2002), and Texas (Baughman 1943). For instance, one fisherman interviewed by Evermann and Bean (1897) reported taking an estimated 300 smalltooth sawfish in just one netting season in the Indian River Lagoon, Florida. In another example, smalltooth sawfish landings data gathered by Louisiana shrimp trawlers from 1945-1978, which contained both landings data and crude information on effort (number of vessels, vessel tonnage, number of gear units), indicated declines in smalltooth sawfish landings from a high of 34,900 lbs in 1949 to

[22] The rate at which a population increases in size if there are no density-dependent forces regulating the population

less than 1,500 lbs in most years after 1967. The Florida net ban passed in 1995 has led to a reduction in the number of smalltooth sawfish incidentally captured, "…by prohibiting the use of gill and other entangling nets in all Florida waters, and prohibiting the use of other nets larger than 500 square feet in mesh area in nearshore and inshore Florida waters"[23] (FLA. CONST. art. X, § 16). However, the threat of bycatch currently remains in commercial fisheries (e.g., South Atlantic shrimp fishery, Gulf of Mexico shrimp fishery, federal shark fisheries of the South Atlantic, and the Gulf of Mexico reef fish fishery), though anecdotal information collected by NMFS port agents suggest smalltooth sawfish captures are now rare.

In addition to incidental bycatch in commercial fisheries, smalltooth sawfish have historically been and continue to be captured by recreational fishers. Encounter data (ISED 2014) and past research (Caldwell 1990) document that rostrums are sometimes removed from smalltooth sawfish caught by recreational fishers, thereby reducing their chances of survival. While the current threat of mortality associated with recreational fisheries is expected to be low given that possession of the species in Florida has been prohibited since 1992, bycatch in recreational fisheries remains a potential threat to the species.

Habitat Loss

Modification and loss of smalltooth sawfish habitat, especially nursery habitat, is another contributing factor in the decline of the species. Activities such as agricultural and urban development, commercial activities, dredge-and-fill operations, boating, erosion, and diversions of freshwater runoff contribute to these losses (SAFMC 1998). Large areas of coastal habitat were modified or lost between the mid-1970s and mid-1980s within the United States (Dahl and Johnson 1991). Since then, rates of loss have decreased, but habitat loss continues. From 1998-2004, approximately 64,560 acres (ac) of coastal wetlands were lost along the Atlantic and Gulf Coasts of the United States, of which approximately 2,450 ac were intertidal wetlands consisting of mangroves or other estuarine shrubs (Stedman and Dahl 2008). Further, Orlando et al. (1994) analyzed 18 major southeastern estuaries and recorded over 703 mi of navigation channels and 9,844 mi of shoreline with modifications. In Florida, coastal development often involves the removal of mangroves and the armoring of shorelines through seawall construction. Changes to the natural freshwater flows into estuarine and marine waters through construction of canals and other water control devices have had other impacts: altered the temperature, salinity, and nutrient regimes; reduced both wetlands and submerged aquatic vegetation; and degraded vast areas of coastal habitat utilized by smalltooth sawfish (Gilmore 1995; Reddering 1988; Whitfield and Bruton 1989). While these modifications of habitat are not the primary reason for the decline of smalltooth sawfish abundance, it is likely a contributing factor and almost certainly hampers the recovery of the species. Juvenile sawfish and their nursery habitats are particularly likely to be affected by these

[23] "nearshore and inshore Florida waters" means all Florida waters inside a line 3 mi seaward of the coastline along the Gulf of Mexico and inside a line 1 mi seaward of the coastline along the Atlantic Ocean.

kinds of habitat losses or alternations, due to their affinity for shallow, estuarine systems. Although many forms of habitat modification are currently regulated, some permitted direct and/or indirect damage to habitat from increased urbanization still occurs and is expected to continue to threaten survival and recovery of the species in the future.

Life History Limitations

The smalltooth sawfish is also limited by its life history characteristics as a slow-growing, relatively late-maturing, and long-lived species. Animals using this life history strategy are usually successful in maintaining small, persistent population sizes in constant environments, but are particularly vulnerable to increases in mortality or rapid environmental change (NMFS 2000b). The combined characteristics of this life history strategy result in a very low intrinsic rate of population increase (Musick 1999) that make it slow to recover from any significant population decline (Simpfendorfer 2000). More recent data suggest smalltooth sawfish may mature earlier than previously thought, meaning rates of population increase could be higher and recovery times shorter than those currently reported (Simpfendorfer et al. 2008).

Current Threats

The 3 major factors that led to the current status of the U.S. DPS of smalltooth sawfish – bycatch mortality, habitat loss, and life history limitations – continue to be the greatest threats today. All the same, other threats such as the illegal commercial trade of smalltooth sawfish or their body parts, predation, and marine pollution and debris may also affect the population and recovery of smalltooth sawfish on smaller scales (NMFS 2010f). We anticipate that all of these threats will continue to affect the rate of recovery for the U.S. DPS of smalltooth sawfish.

In addition to the anthropogenic effects mentioned previously, changes to the global climate are likely to be a threat to smalltooth sawfish and the habitats they use. The Intergovernmental Panel on Climate Change has stated that global climate change is unequivocal (IPCC and its impacts to coastal resources may be significant. Some of the likely effects commonly mentioned are sea level rise, increased frequency of severe weather events, changes in the amount and timing of precipitation, and changes in air and water temperatures (EPA 2012; NOAA 2012). The impacts to smalltooth sawfish cannot, for the most part, currently be predicted with any degree of certainty, but we can project some effects to the coastal habitats where they reside. We know that the coastal habitats that contain red mangroves and shallow, euryhaline waters will be directly impacted by climate change through sea level rise, which is expected to exceed 1 meter globally by 2100 according to Meehl et al. (2007), Pfeffer et al. (2008), and Vermeer and Rahmstorf (2009). Sea level rise will impact mangrove resources, as sediment surface elevations for mangroves will not keep pace with conservative projected rates of elevation in sea level (Gilman et al. 2008). Sea level increases will also affect the amount of shallow water available for juvenile smalltooth sawfish nursery habitat, especially in areas where there is shoreline armoring (e.g., seawalls). Further, the changes in precipitation coupled with sea level rise may also alter salinities of coastal habitats, reducing the amount of available smalltooth sawfish nursery habitat.

3.3.9 Shortnose Sturgeon

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

Species Description and Distribution

The shortnose sturgeon (*Acipenser brevirostrum)* is the smallest of the 3 sturgeon species that occur in eastern North America. They attain a maximum length of about 6 feet, and a weight of about 55 lbs. Shortnose sturgeon inhabit large coastal rivers of eastern North America. Although considered an anadromous species,[24] shortnose sturgeon are more properly characterized as "freshwater amphidromous," meaning that they move between fresh and salt water during some part of their life cycle, but not necessarily for spawning. Shortnose sturgeon rarely leave the rivers where they were born ("natal rivers"). Shortnose sturgeon feed opportunistically on benthic insects, crustaceans, mollusks, and polychaetes (Dadswell et al. 1984).

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

Life History Information

Shortnose sturgeon populations show clinal variation, [25] with a general trend of faster growth and earlier age at maturity in more southern systems. Fish in the southern portion of the range grow the fastest, but do not reach the larger size of fish in the northern part

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

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

of the range that continue to grow throughout life. Male shortnose sturgeon mature at 2-3 years of age in Georgia, 3-5 years of age in South Carolina, and 10-11 years of age in the Saint John River, Canada. Females mature at 4-5 years of age in Georgia, 7-10 years of age in the Hudson River, and 12-18 years of age in the Saint John River, Canada. Males begin to spawn 1-2 years after reaching sexual maturity and spawn every 1-2 years (Dadswell 1979a; Kieffer and Kynard 1996; NMFS 1998d). Age at first spawning for females is about 5 years post-maturation with spawning occurring every 3-5 years (Dadswell 1979a). Fecundity of shortnose sturgeon ranges between approximately 30,000-200,000 eggs per female (Gilbert 1989).

Adult shortnose sturgeon spawn in the rivers where they were born. Initiation of the upstream movement of shortnose sturgeon to spawn is likely triggered partially by water temperatures above 46°F [8°C (Dadswell 1979a; Kynard 1997)]. This typically occurs during the late winter to early spring (December-March) in southern rivers (North Carolina and south) and the mid- to late spring in northern rivers. Southern populations of shortnose sturgeon usually spawn at least 125 miles (200 km) upriver (Kynard 1997) or throughout the fall line[26] zone if they are able to reach it. Substrate in spawning areas is usually composed of gravel, rubble, cobble, or large rocks (Buckley and Kynard 1985; Dadswell 1979a; Kynard 1997; Taubert and Dadswell 1980), or timber, scoured clay, and gravel (Hall et al. 1991). Water depth and flow are also important parameters for spawning sites (Kieffer and Kynard 1996). Spawning sites are characterized by moderate river flows with average bottom velocities between 1-2.5 ft (0.4-0.8 m) per second (Hall et al. 1991; Kieffer and Kynard 1996; NMFS 1998d). Spawning in the southern rivers has been reported at water temperatures of 51°F (10.5°C) in the Altamaha River (Heidt and Gilbert 1978) and 48°-54°F (9°-12°C) in the Savannah River (Hall et al. 1991). In the southern portion of the range, adults typically spawn well upriver in the late winter to early spring and spend the rest of the year in the vicinity of the saltwater/freshwater interface (Collins and Smith 1993).

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

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

and mud substrate for foraging and resting (Dovel et al. 1992b; Hall et al. 1991; Pottle and Dadswell 1979).

Status and Population Dynamics

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

Significant levels of genetic diversity are present in the shortnose sturgeon genome. Characterization of genetic differentiation (haplotype frequency) and estimates of gene flow (genetic distance) provide a quantitative measure to investigate population structure across the range of the shortnose sturgeon and determine their reproductive isolation or connection. Researchers have identified levels of genetic differentiation that indicate high degrees of reproductive isolation in at least 3 groupings (i.e., metapopulations) of shortnose sturgeon (Figure 3.33). Genetic analyses grouped shortnose sturgeon populations in the Southeast into 1 metapopulation (shown within the “Carolinian Province” in Figure 3.33). Wirgin et al. (2009) note that genetic differentiation among populations within the Carolinian Province was considerably less pronounced than among those in the other 2 provinces and contemporary genetic data suggest that reproductive isolation among these populations is less than elsewhere.

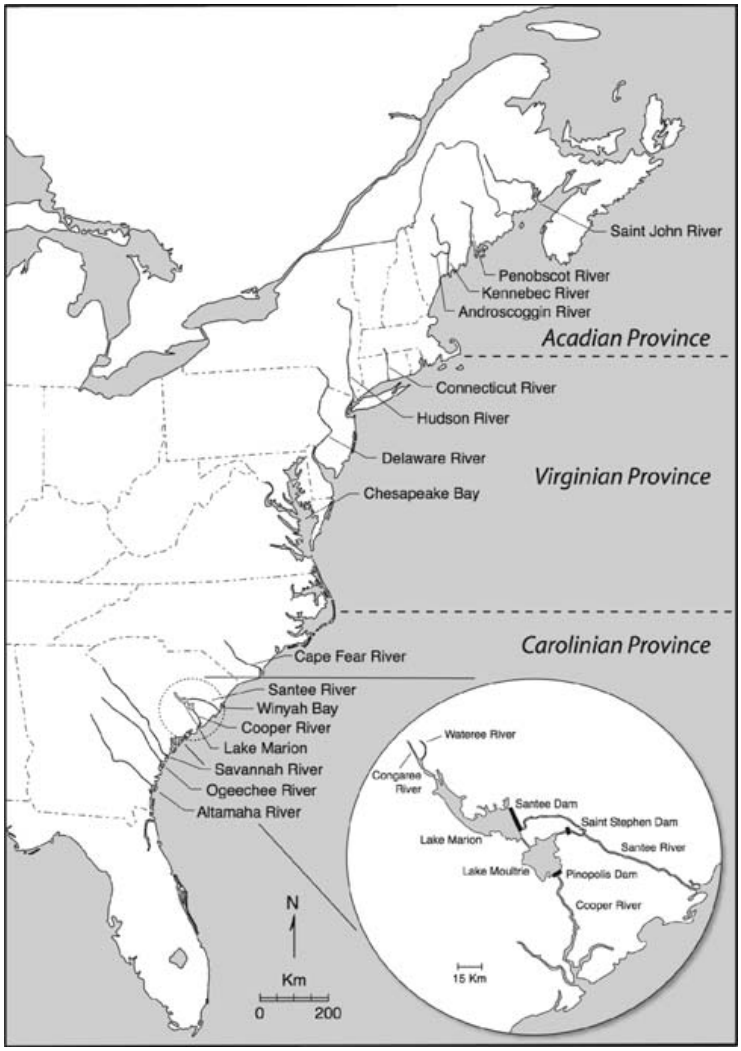

Figure 3.33. The North American Atlantic coast depicting 3 shortnose sturgeon metapopulations based on mitochondrial DNA control region sequence analysis (Wirgin et al. 2009).

The current status of the shortnose sturgeon in the Southeast is variable. Populations within the southern metapopulation are relatively small compared to their northern counterparts. Table 3.15 shows available abundance estimates for rivers in the Southeast. The Altamaha River supports the largest known shortnose sturgeon population in the Southeast with successful self-sustaining recruitment. Population estimates for shortnose sturgeon in the Altamaha have been calculated several times since 1993. Total population estimates in the Altamaha show large interannual variation is occurring; estimates have ranged from as low as 468 fish in 1993 to over 6,300 fish in 2006 (DeVries 2006b; NMFS 1998b). The Ogeechee River is the next most-studied river south of Chesapeake Bay, and abundance estimates indicate that the shortnose sturgeon population in this river is considerably smaller than that in the Altamaha River. The highest point estimate in 1993 using a modified Schnabel technique resulted in a total Ogeechee River population estimate of 361 shortnose sturgeon (95% confidence interval [CI]: 326-400). In contrast, the most recent survey resulted in an estimate of 147 shortnose sturgeon (95% CI: 104-249), suggesting that the population may be declining.

Spawning is also occurring in the Savannah River, the Cooper River, the Congaree River, and the Yadkin-Pee Dee River. The Savannah River shortnose sturgeon population, possibly the second largest in the Southeast with an estimated 1,000-3,000 adults, is facing many environmental stressors and spawning is likely occurring in only a very small area. While active spawning is occurring in South Carolina's Winyah Bay complex (Black, Sampit, Yadkin-Pee Dee, and Waccamaw Rivers) the population status there is unknown. Status of the other riverine populations supporting the southern metapopulation is unknown due to limited survey effort, with capture in some rivers limited to less than 5 specimens.

Table 3.15 Shortnose Sturgeon Populations and Their Estimated Abundances

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

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

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

estimates across the species range, and could provide the opportunity to more closely link strong-year classes to habitat conditions.

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

Threats

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

<u>Dams</u>

Dams for hydropower generation, flood control, and navigation adversely affect shortnose sturgeon habitat by impeding access to spawning, developmental, and foraging habitat, modifying free-flowing rivers to reservoirs, physically damaging fish on upstream and downstream migrations, and altering water quality in the remaining downstream portions of spawning and nursery habitat. Fish passage has not proven very successful in minimizing the impacts of dams on shortnose sturgeon, as they do not regularly use existing fish passage devices, which are generally designed to pass pelagic fish (i.e., those living in the water column) rather than bottom-dwelling species like sturgeon. Dams have separated the shortnose sturgeon population in the Cooper River, trapping some above the structure while blocking access upstream to sturgeon below the dam. Telemetry studies indicate that shortnose sturgeon do not pass upriver through the vessel lock in the Pinopolis Dam on the Cooper River. Shortnose sturgeon have been documented entering the lock, but they have never passed into the reservoir, probably

because there is a 40 ft (12 m) vertical wall at the upstream end. Shortnose sturgeon inhabit only Lake Marion, the upper of the 2 reservoirs. There is currently no estimate for the portion of the population that inhabits the reservoirs and rivers above the dam.

Dredging

Riverine, nearshore, and offshore areas are often dredged to support commercial shipping and recreational boating, construction of infrastructure, and marine mining. Environmental impacts of dredging include the direct removal/burial of prey species; turbidity/siltation effects; contaminant resuspension; noise/disturbance; alterations to hydrodynamic regime and physical habitat; and actual loss of riparian habitat (Chytalo 1996; Winger et al. 2000). Dredging in spawning and nursery grounds modifies the quality of the habitat and further restricts the extent of available habitat in the Cooper and Savannah Rivers, where shortnose sturgeon habitat has already been modified and restricted by the presence of dams.

Water Quality

Shortnose sturgeon rely on a variety of water quality parameters to successfully carry out their life functions. Low dissolved oxygen (DO) and the presence of contaminants modify the quality of sturgeon habitat and, in some cases, restrict the extent of suitable habitat for life functions. Secor (1995) noted a correlation between low abundances of sturgeon during this century and decreasing water quality caused by increased nutrient loading and increased spatial and temporal frequency of hypoxic (low oxygen) conditions. Of particular concern is the high occurrence of low DO coupled with high temperatures in the river systems throughout the range of the shortnose sturgeon in the Southeast. Sturgeon are more sensitive to low DO than other fish species (Niklitschek and Secor 2009a; Niklitschek and Secor 2009b), and low DO in combination with high temperature is particularly problematic. Dredging activities in the Savannah River are modifying sturgeon habitat by lowering DO, and nonpoint source inputs are causing low DO in the Ogeechee River.

Water Quantity

Water allocation issues are a growing threat in the Southeast and exacerbate existing water quality problems. Taking water from one basin and transferring it to another fundamentally and irreversibly alters natural water flows in both the originating and receiving basins. This transfer can affect DO levels, temperature, and the ability of the basin of origin to assimilate pollutants (GWC 2006). Water quality within the river systems in the range of the shortnose sturgeon is negatively affected by large water withdrawals. Known water withdrawals of over 240 million gallons per day are permitted from the Savannah River for power generation and municipal uses. However, permits for users withdrawing less than 100,000 gallons per day are not required, so actual water withdrawals from the Savannah River and other rivers within the range of the shortnose sturgeon are likely much higher. The removal of large amounts of water from the system alters flows, temperature, and DO. Water shortages and “water wars” are already occurring in the rivers occupied by the shortnose sturgeon and will likely be compounded in the future by human population growth and potentially by climate change.

Climate Change

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

Shortnose sturgeon are already susceptible to reduced water quality resulting from dams, inputs of nutrients, contaminants from industrial activities and nonpoint sources, and interbasin transfers of water. The IPCC report projects with high confidence that higher water temperatures and changes in extremes in this region, including floods and droughts, will affect water quality and exacerbate many forms of water pollution from sediments, nutrients, dissolved organic carbon, pathogens, pesticides, and salt, as well as thermal pollution, with possible negative impacts on ecosystems (IPCC 2007b). In addition, sea level rise is projected to extend areas of salinization of groundwater and estuaries, resulting in a decrease of freshwater availability for humans and ecosystems in coastal areas. Some of the most populated areas of this region are low-lying; the threat of saltwater entering into this region's aquifers with projected sea level rise is a concern (USGRG 2004). Existing water allocation issues would be exacerbated, leading to an increase in reliance on interbasin water transfers to meet municipal water needs, further stressing water quality. Dams, dredging, and poor water quality have already modified and restricted the extent of suitable habitat for shortnose sturgeon spawning and nursery habitat. Changes in water availability (depth and velocities) and water quality (temperature, salinity, DO, contaminants, etc.) in rivers and coastal waters inhabited by shortnose sturgeon resulting from climate change will further modify and restrict the extent of suitable habitat for shortnose sturgeon. Effects could be especially harmful since these populations have already been reduced to low numbers, potentially limiting their capacity for adaptation to changing environmental conditions (Belovsky 1987; Salwasser et al. 1984; Soulé 1987; Thomas 1990).

Bycatch

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

because they are a long-lived species, have an older age at maturity, have lower maximum reproductive rates, and a large percentage of egg production occurs later in life. In addition, stress or injury to shortnose sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins and low DO). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality.

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

3.3.10 Atlantic Sturgeon

Five separate DPSs of Atlantic sturgeon were listed under the ESA by NMFS effective April 6, 2012 (77 FR 5880 and 5914, February 6, 2012). The New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs were listed as endangered. The Gulf of Maine DPS was listed as threatened. Since adults mix extensively in the marine environment, we believe individuals from all 5 DPSs could be found in the action area.

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 fish. Juvenile sturgeon feed on aquatic insects and other invertebrates (Smith 1985b).

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 1973b). Most Atlantic sturgeon adults likely do not spawn every year. Multiple studies have shown that spawning intervals range from 1-5 years for males (Caron et al. 2002; Collins et al. 2000c; Smith 1985a) 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 1985a; Smith and Clugston 1997). In some southern rivers, a fall spawning migration may also occur (Moser et al. 1998; Rogers and Weber 1995b; Weber and Jennings 1996). 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 1973b) over hard substrate, such as cobble, gravel, or boulders, which the highly adhesive sturgeon eggs adhere to (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 refuge (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 1985a), after which Atlantic sturgeon start outmigration 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 1985a). 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 1985a; 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 1985a). In some rivers, predominantly in the south, a fall spawning migration may also occur (Moser et al. 1998; Rogers and Weber 1995b), with running ripe males found August through October and post-spawning females captured in late September and October (Collins et al. 2000c).

Status and Population Dynamics

At the time Atlantic sturgeon were listed, the best available abundance information for each of the 5 DPSs was the estimated number of adult Atlantic sturgeon spawning in each of the rivers on an annual basis. The estimated number of annually spawning adults in each of the river populations is insufficient to quantify the total population numbers for each DPS of Atlantic sturgeon due to the lack of other necessary accompanying life history data. An Atlantic sturgeon population estimate was derived from the Northeast Area Monitoring and Assessment Program (NEAMAP). NEAMAP trawl surveys were conducted from Cape Cod, Massachusetts, to Cape Hatteras, North Carolina, in nearshore waters to depths of 60 ft from fall 2007 through spring 2012. The results of these surveys, assuming 50% gear efficiency (i.e., assumption that the gear will capture some, but not all, of the sturgeon in the water column along the tow path, and the survey area is only a portion of Atlantic sturgeon habitat), are presented in Table 3.16. It is important to note that the NEAMAP surveys were conducted primarily in the Northeast and may underestimate the actual population abundances of the Carolina and South Atlantic DPSs, which are likely more concentrated in the Southeast since they originated from and spawn there. However, the total ocean population abundance estimates listed in Table 3.16 currently represent the best available population abundance estimates for the 5 U.S. Atlantic sturgeon DPSs.

Table 3.16 Summary of Calculated Population Estimates Based upon the NEAMAP Survey Swept Area (NMFS 2013b)

DPS	Estimated Ocean Population Abundance	Estimated Ocean Population of Adults	Estimated Ocean Population of Subadults (of size vulnerable to capture in fisheries)
South Atlantic	14,911	3,728	11,183
Carolina	1,356	339	1,017
Chesapeake Bay	8,811	2,203	6,608
New York Bight	34,566	8,642	25,925
Gulf of Maine	7,455	1,864	5,591
Canada	678	170	509

South Atlantic DPS

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

Historically, both the Broad-Coosawatchie and St. Marys Rivers were documented to have spawning populations; there is also evidence that spawning may have occurred in the St. Johns River or one of its tributaries. However, the spawning population in the St. Marys River, as well as any historical spawning population in the St. Johns, is 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 River. 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 3.12) indicate the current number of spawning adults is likely an order of magnitude lower than historical levels (ASSRT 2007; Kahnle et al. 2007). The NEAMAP model estimates a minimum ocean population of 8,811 Chesapeake Bay DPS Atlantic sturgeon, of which 2,319 are adults.

New York Bight DPS

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

Prior to the onset of expanded fisheries exploitation of sturgeon in the 1800s, a conservative historical estimate for the Hudson River Atlantic sturgeon population was 10,000 adult females (Secor 2002). Current population abundance is likely at least one order of magnitude smaller than historical levels (ASSRT 2007; Kahnle et al. 2007; Secor 2002). Based on data collected from 1985-1995, there are 870 spawning adults per year in the Hudson River (Kahnle et al. 2007). Kahnle (2007; 1998b) also showed that the level of fishing mortality from the Hudson River Atlantic sturgeon fishery during the period of 1985-1995 exceeded the estimated sustainable level of fishing mortality for the riverine population, and may have led to reduced recruitment. All available data on abundance of juvenile Atlantic sturgeon in the Hudson River Estuary indicate a substantial drop in production of young since the mid-1970s (Kahnle et al. 1998b). A decline appeared to occur in the mid- to late 1970s followed by a secondary drop in the late 1980s (ASMFC 2010; Kahnle et al. 1998b; Sweka et al. 2007). Catch-per-unit-effort (CPUE) data suggest that recruitment has remained depressed relative to catches of juvenile Atlantic sturgeon in the estuary during the mid- to late 1980s (ASMFC 2010; Sweka et al. 2007). From 1985-2007, there were significant fluctuations in CPUE. The number of juveniles appears to have declined between the late 1980s and early 1990s. While the CPUE is generally higher in the 2000s as compared to the 1990s, significant

annual fluctuations make it difficult to discern any trend. The CPUEs from 2000-2007 are generally higher than those from 1990-1999; however, they remain lower than the CPUEs observed in the late 1980s. There is currently not enough information regarding any life stage to establish a trend for the Hudson River population (ASMFC 2010; Sweka et al. 2007).

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

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.

However, there is not enough information to establish a trend for this DPS. The NEAMAP model estimates a minimum ocean population of 7,455 Atlantic sturgeon, of which 1,864 are adults.

Viability of Atlantic Sturgeon DPSs

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

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

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

Threats

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

Dams

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

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

Dredging

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

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

Water Quality

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

Reductions in water quality from terrestrial activities have modified habitat utilized by the South Atlantic DPS. Low DO is modifying sturgeon habitat in the Savannah due to dredging, and non-point source inputs are causing low DO in the Ogeechee River and in

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

Water Quantity

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

Climate Change

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

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

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

Vessel Strikes

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

know the percent of total vessel strikes that these observed mortalities represent, we are not able to quantify the number of individuals likely killed as a result of vessel strikes in the Chesapeake and New York Bight DPSs.

Bycatch Mortality

Overutilization of Atlantic sturgeon from directed fishing caused initial severe declines in Atlantic sturgeon populations, from which they have never rebounded. Further, continued overutilization of Atlantic sturgeon as bycatch in commercial fisheries is an ongoing impact to Atlantic sturgeon in all 5 DPSs. Atlantic sturgeon are more sensitive to bycatch mortality because they are a long-lived species, have an older age at maturity, have lower maximum reproductive rates, and a large percentage of egg production occurs later in life. Based on these life history traits, Boreman (1997) calculated that Atlantic sturgeon can only withstand the annual loss of up to 5% of their population to bycatch mortality without suffering population declines. Mortality rates of Atlantic sturgeon taken as bycatch in various types of fishing gear range between 0-51%, 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 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 (Shepherd et al. 2007; Stein et al. 2004a). Little data exists on bycatch in the Southeast and high levels of bycatch underreporting are suspected. However, fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may access multiple river systems, they are subject to being caught in multiple fisheries throughout their range. In addition, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins and low DO). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality.

3.3.11 Scalloped Hammerhead Shark – Central and Southwest Atlantic DPS

Four of 6 identified DPSs of scalloped hammerhead shark (*Sphyrna lewini*) were listed under the ESA by NMFS effective September 2, 2014 (79 FR 38213, July 3, 2014) (Figure 3.34). The Central and Southwest Atlantic and the Indo-West Pacific DPSs were listed as threatened, while the Eastern Atlantic and Eastern Pacific DPSs were listed as endangered. The Central and Southwest Atlantic DPS is bounded to the north by 28°N latitude, to the east by 30°W longitude, and to the south by 36°S latitude. All waters of the Caribbean Sea are within this DPS boundary, including The Bahamas' EEZ off the

coast of Florida, the U.S. EEZ off Puerto Rico and the U.S. Virgin Islands, and Cuba's EEZ.

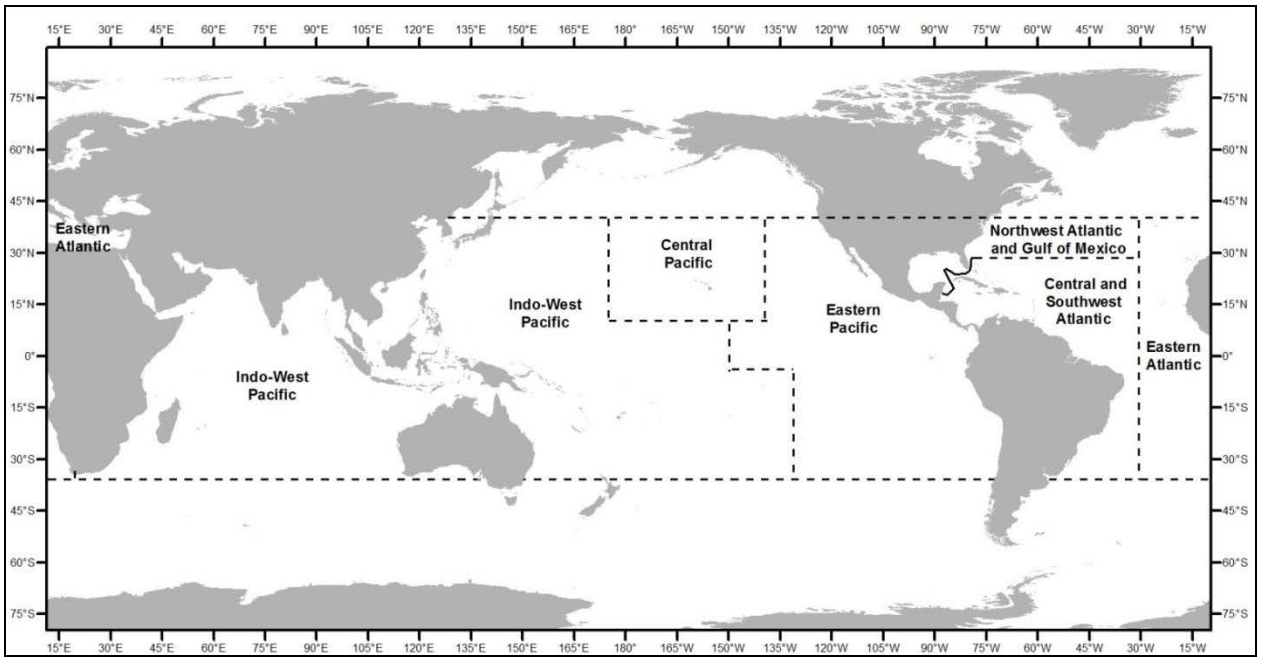

Figure 3.34. Scalloped hammerhead shark DPS boundaries (Source: 78 FR 20717; April 5, 2013). The Northwest Atlantic/Gulf of Mexico and Central Pacific DPSs are not listed under the ESA.

Species Description and Distribution

All hammerhead sharks belong to the family *Sphyrnidae* and are classified as ground sharks (order Carcharhiniformes). The hammerhead sharks are recognized by their laterally expanded head that resembles a hammer, hence the common name "hammerhead." The scalloped hammerhead shark is distinguished from other hammerheads by a noticeable indentation on the center and front portion of the head, along with 2 more indentations on each side of this central indentation, giving the head a "scalloped" appearance. It has a broadly arched mouth, and the back of the head is slightly swept backward.

The scalloped hammerhead shark is found throughout the world and lives in coastal warm temperate and tropical seas. It occurs over continental shelves and the shelves surrounding islands, as well as adjacent deep waters, but it is seldom found in waters cooler than 22°C (Compagno 1984; Schulze-Haugen et al. 2003). It ranges from the intertidal and surface waters to depths of up to approximately 1,475-1,675 ft (450-512 m) (Klimley 1993; Sanches 1991), with occasional dives even deeper (Jorgensen et al. 2009). It has also been documented entering enclosed bays and estuaries (Compagno 1984). In the western Atlantic Ocean, the scalloped hammerhead's range extends from the northeast coast of the United States (New Jersey) to Florida and on to Brazil, including the Gulf of Mexico and Caribbean Sea.

Scalloped hammerhead sharks are highly mobile and partly migratory, and are likely the most abundant of the hammerhead species (Maguire et al. 2006). These sharks have been

observed making migrations along the edges of continents as well as between oceanic islands in tropical waters (Bessudo et al. 2011; Diemer et al. 2011; Duncan and Holland 2006; Kohler and Turner 2001). Although scalloped hammerhead sharks are highly mobile, this species rarely crosses entire oceans (Diemer et al. 2011; Duncan and Holland 2006; Kohler and Turner 2001). The median distance between mark and recapture of 3,278 tagged adult sharks along the eastern United States was less than 65 miles (100 km) (Kohler and Turner 2001). Tagging studies reveal the tendency for scalloped hammerhead sharks to aggregate around and travel to and from core areas or "hot spots" within locations (Duncan and Holland 2006; Hearn et al. 2010; Holland et al. 1993) (Bessudo et al. 2011). However, other studies indicate they are also capable of traveling long distances (e.g., 1,206 miles [1,941 km] (Bessudo et al. 2011); 1,038 mi [1,671 km] (Kohler and Turner 2001); 390 miles [629 km] (Diemer et al. 2011).).

Both juveniles and adult scalloped hammerhead sharks occur as solitary individuals, pairs, or in schools (Compagno 1984). Adult aggregations are most common offshore over seamounts and near islands, especially near the Galapagos, Malpelo, Cocos and Revillagigedo Islands, and within the Gulf of California (Bessudo et al. 2011; CITES 2010; Compagno 1984; Hearn et al. 2010). Neonate and juvenile aggregations are more common in nearshore nursery habitats (Bejarano-Álvarez et al. 2011; Diemer et al. 2011; Duncan and Holland 2006). It has been suggested that juveniles inhabit these nursery areas for up to or more than 1 year as they provide valuable refuges from predation (Duncan and Holland 2006).

The scalloped hammerhead shark is a high trophic level predator (Cortés 1999) and an opportunistic feeder with a diet that includes a wide variety of bony fish, octopi/cuttlefish/squid, crabs/lobsters, and rays (Bush 2003; Compagno 1984) (Júnior et al. 2009; Noriega et al. 2011).

***Life History Informati*on**

The scalloped hammerhead shark gives birth to live young (i.e., "viviparous"), with a gestation period of 9-12 months (Branstetter 1987; Stevens and Lyle 1989), which may be followed by a 1-year resting period (Liu and Chen 1999). Generally, females attain maturity around 6.5-8 ft (2.0-2.5 m) total length (TL), while males reach maturity at smaller sizes (range 4-6.5 ft [1.3-2.0 m] TL). The available information specific to Central and Southwest Atlantic DPSs indicates females attain maturity when they reach around 7.5 ft (greater than 240 cm) TL, while males reach maturity at 6-6.5 ft (1.8-2.0 m) TL (Hazin et al. 2001).

The age at maturity differs by region. In Brazil (part of the Central and Southwest Atlantic DPS), males reach sexual maturity between 6.3 and 8.1 years, females at 15.2 years (Hazin et al. 2001). However, when pupping occurs does not appear to vary by region and may be partially seasonal (Harry et al. 2011a; Harry et al. 2011b), with neonates present year round, but with abundance peaking during the spring and summer months (Adams and Paperno 2007; Bejarano-Álvarez et al. 2011; Duncan and Holland 2006; Harry et al. 2011a; Harry et al. 2011b; Noriega et al. 2011). Females move inshore to birth, with litter sizes anywhere between 1 and 41 live pups. No relationship between

litter size and female shark length was identified by Hazin et al. (2001) for animals off the northeastern coast of Brazil. The DPS-specific information indicates pups are generally greater than 1.2 ft (0.38 m) at birth (Hazin et al. 2001).

While it appears that maturity, age, and growth estimates vary by region, it is unclear whether these differences are truly biological or the result of differences in the interpretations of aging methodology (Piercy et al. 2007). Scalloped hammerhead sharks develop opaque bands on their vertebrae which are used to estimate age. Assuming annual band formation for animals in the Atlantic, and adjusting age maturity estimates from the Pacific accordingly, the average age at maturity for female scalloped hammerheads is around 12.8 years and 8.1 years for males. Based on analysis of the available data, the scalloped hammerhead shark can be characterized as a long-lived (i.e., at least 20-30 years) (Dudley and Simpfendorfer 2006), late-maturing, and relatively slow-growing species (Branstetter 1990). Within the DPS, Kotas et al. (2011) estimate the maximum age of females as 31.5 years and 29.5 years for males.

Status and Population Dynamics

Data from multiple sources indicate that the Atlantic population (including the Central and Southwest Atlantic DPS) of scalloped hammerheads has experienced severe declines over the past few decades. Miller et al. (2013) concluded that abundance numbers for this DPS are unavailable but likely similar to, and probably worse than, those found in the Northwest Atlantic and Gulf of Mexico DPS. It is likely that scalloped hammerheads in the Northwest Atlantic and Gulf of Mexico were overfished beginning in the early 1980s and experienced periodic overfishing from 1983-2005 (Jiao et al. 2011). Other studies have also observed similar decreases in scalloped hammerhead shark populations along the Atlantic coast. For example, (Baum et al. 2003) calculated that the northwest Atlantic population of scalloped hammerhead shark has declined by 89% since 1986; however, this study is controversial due to its sole reliance on PLL logbook data. Off the southeastern U.S. coast, Beerkircher et al. (2002) found significant declines in nominal CPUE for scalloped hammerhead shark between 1981-1983 (CPUE = 13.37 in Berkeley and Campos 1988) and 1992-2000 (CPUE = 0.48).

For the northwest Atlantic and Gulf of Mexico DPS, models estimated the virgin population size to be between 142,000 and 169,000 individuals (range 116,000-260,000) (Hayes et al. 2009). Those models also estimated populations of 24,850-27,900 individuals in 2005 (most recent year estimated) (Hayes et al. 2009).

In a stock assessment for the scalloped hammerhead shark, (Hayes et al. 2009)concluded that the northwestern Atlantic and Gulf of Mexico scalloped hammerhead shark stock has been depleted by approximately 83% since 1981. Miller et al. (2013) concluded that abundance numbers for the Central and Southwest Atlantic DPS are unavailable but likely similar to, and probably worse than, those found in the Northwest Atlantic and Gulf of Mexico DPS. It is likely that scalloped hammerheads in the Central and Southwest Atlantic DPS have experienced at least that level of decline since the early 1980s.

Threats

Scalloped hammerhead sharks are both targeted and taken as bycatch in many global fisheries. They are targeted by semi-industrial, artisanal, and recreational fisheries, and caught as bycatch in pelagic longline (PLL) tuna and swordfish fisheries and purse seine fisheries. There is a lack of information on the fisheries prior to the early 1970s, with only occasional mentions in historical records. Significant catches of scalloped hammerheads have gone, and continue to be, unrecorded in many countries outside the United States. Brazil, the country that reports one of the highest scalloped hammerhead landings in South America, maintains heavy industrial fishing of this species off its coastal waters. In the late 1990s, Amorim et al. (1998) remarked that heavy fishing by longliners led to a decrease in this population off the coast of Brazil. According to the FAO global capture production database, Brazil reported a significant increase in catch of scalloped hammerhead during this period, from 30 metric tons (mt) in 1999 to 508 mt by 2002, before decreasing to a low of 87 mt in 2009. Information from PLL and bottom gillnet fisheries targeting several species of hammerhead sharks off southern Brazil indicates declines of more than 80% in CPUE from 2000 to 2008, with the targeted hammerhead fishery abandoned after 2008 due to the rarity of the species (FAO 2010). Scalloped hammerhead is also commonly landed by artisanal fishers in the Central and Southwest Atlantic, with concentrated fishing effort in nearshore and inshore waters, areas likely to be used as nursery grounds. In the Caribbean, specific catch and landings data are unavailable; however, scalloped hammerhead shark is often a target of artisanal fisheries off Trinidad and Tobago and Guyana, and anecdotal reports of declines in abundance, size, and distribution shifts of sharks suggest significant fishing pressure on overall shark populations in this region (Kyne et al. 2012).

The exploitation of this DPS continues to go largely unregulated. In Brazilian waters, there are very few fishery regulations that help protect hammerhead populations. For example, the minimum legal size for a scalloped hammerhead caught in Brazilian waters is approximately 24 in (60 cm) TL; however, scalloped hammerhead shark pups may range from 15-23 in (38 - 55 cm). As the pup sizes are very close to this minimum limit, the legislation is essentially ineffective, and as such, large catches of both juveniles and neonates have been documented from this region (CITES 2010; Kotas et al. 2008). Lack of enforcement of existing regulations also hamper regulatory effectiveness.

In addition, scalloped hammerheads are likely underreported in catch records as many records do not account for discards (e.g., where the fins are kept, but the carcass is discarded) or reflect dressed weights instead of live weights. Also, many catch records do not differentiate between the hammerhead species, or shark species in general, and thus species-specific population trends for scalloped hammerheads are not readily available.

Although scalloped hammerhead meat is considered essentially unpalatable (due to its high urea concentration), some countries still consume the meat domestically or trade it internationally, including Colombia, Mexico, and Uruguay (CITES 2010; Vannuccini 1999). However, it is thought that the current volume of scalloped hammerhead shark

traded meat and products is insignificant when compared to the volume of its fins in international trade (CITES 2010).

4.0 Environmental Baseline

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

By regulation (50 CFR 402.02), environmental baselines for Biological Opinions include the past and present impacts of all state, federal, or private actions and other human activities in or having effects in, the action area. We identify the anticipated impacts of all proposed federal projects in the specific action area of the consultation at issue, that have already undergone formal or early Section 7 consultation (as defined in 50 CFR 402.11), as well as the impact of state or private actions, or the impacts of natural phenomena, which are 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 states or life history stages, or areas of their ranges, listed individuals or critical habitat features will commonly exhibit, or be more susceptible to, adverse responses to stressors than they would be in other states, stages, or areas within their distributions. These localized stress responses or stressed baseline conditions may increase the severity of the adverse effects expected from the proposed action.

4.1 Status of Species in the Action Area

Sea Turtles

The 5 species of sea turtles that occur in the action area are all highly migratory. Given the large size of the action area, all sea turtle life stages, and associated behaviors (e.g., nesting) occur in the action area. Therefore, the status of the 5 species (or DPS where applicable) of sea turtles in the action area, as well as the threats to these species, are best reflected in their range-wide statuses and supported by the species accounts in Section 3 (Status of Species).

Atlantic Sturgeon

The 5 DPSs of Atlantic sturgeon on the East Coast of the United States mix extensively in marine waters (Erickson et al. 2011; Stein et al. 2004b). During various seasons and portions of their life cycles, individual fish will make migrations into rivers, nearshore

waters, and other areas of the North Atlantic Ocean. Adult and subadult (age 2 years or older) spend a considerable portion of their lives in coastal and marine waters (ASSRT 2007; Collins and Smith 1997; Laney et al. 2007; Munro et al. 2007; Stein et al. 2004b) where they are subject to bycatch mortality by commercial fisheries (Armstrong and Hightower 2002; Collins et al. 1996; Spear 2007; Stein et al. 2004a; Trencia et al. 2002), poor water quality in certain estuaries (Collins et al. 2000a; Dadswell 2006) and other potential threats, such as dams, dredging, and alteration of spawning and foraging habitat (ASSRT 2007; Munro et al. 2007). The status of the 5 DPSs of Atlantic sturgeon in the marine portion of the action area, as well as the threats to these species, are best reflected in their range-wide statuses and supported by the species accounts in Section 3 (Status of Species).

FIM-related activities may also effect riverine portions of the South Atlantic and Carolina DPSs. The South Atlantic DPS includes all Atlantic sturgeon that spawn or are spawned in the watersheds (including all rivers and tributaries) of the Ashepoo, Combahee, and Edisto River (ACE) Basins southward along the South Carolina, Georgia, and Florida coastal areas to the St. Johns River, Florida. Rivers known to have current spawning populations within the range of the South Atlantic DPS include the Combahee, Edisto, Savannah, Ogeechee, Altamaha, Ocmulgee, Oconee, Satilla, and St. Marys Rivers.

The historical spawning population in the St. Johns River, Florida, is believed to be extirpated, and the status of the spawning population in the Broad-Coosawatchie is unknown. The St. Johns river is 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.

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.

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, Neuse, Cape Fear, Pee Dee, Black, Santee, and Cooper Rivers.

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.

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.

Shortnose Sturgeon

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

Smalltooth Sawfish

Smalltooth sawfish greater than 200 cm TL may be found in the southern portion (primarily off Florida) of the action area throughout the year intermittently, spending the rest of their time in shallower waters. The status of smalltooth sawfish in the action area,

as well as the threats to this species, is supported by the species account in Section 3 (Status of the Species).

Scalloped Hammerhead Shark – Central and Southwest Atlantic DPS
The scalloped hammerhead shark is highly mobile and partly migratory (Maguire et al. 2006). Therefore, the status of the species in the action area, as well as the threats to it, are best reflected in the species account in Section 3 (Status of Species).

4.2 Factors Affecting Sea Turtles in the Action Area

As stated in Section 2.3 (Action Area), the proposed action occurs in the U.S. South Atlantic, Gulf of Mexico, the Caribbean EEZ, and adjacent state/territorial waters. The following analysis examines actions that may affect these species or their environments specifically within the action area. The activities that shape the environmental baseline in the action area of this consultation are primarily federal and state fisheries. Other impacts include effects of vessel operations, additional military activities, oil and gas exploration, dredging, permits allowing take under the ESA for scientific research or incidental to non-federal activities, nuclear and coal-fueled generating plants, marine pollution, coastal development, and private vessel traffic.

4.2.1 Federal Actions

NMFS has undertaken a number of Section 7 consultations to address the effects of federally permitted fisheries and other federal actions on threatened and endangered sea turtle species, and when appropriate, has authorized the incidental taking of these species. Each of those consultations sought to minimize the adverse impacts of the action on sea turtles. Similarly, NMFS has undertaken recovery actions under the ESA to address sea turtle captures in the fishing and shipping industries and other activities such as Army Corps of Engineers (USACE) dredging operations. The summary below of federal action and the effects these actions have had on sea turtles includes only those federal actions in the action area that have already concluded or are currently undergoing formal Section 7 consultation.

4.2.1.1 Fisheries

Threatened and endangered sea turtles are adversely affected by several types of fishing gears used throughout the action area. Gillnet, longline, other types of hook-and-line gear, trawl gear, and pot fisheries have all been documented as interacting with sea turtles. Available information suggests sea turtles can be captured in any of these gear types when the operation of the gear overlaps with the distribution of sea turtles. For all fisheries for which there is an FMP or for which any federal action is taken to manage that fishery, impacts have been evaluated under Section 7. Formal Section 7 consultations have been conducted on the following fisheries, occurring at least in part within the action area, found likely to adversely affect threatened and endangered sea turtles: Atlantic bluefish, Atlantic sea scallop, Atlantic swordfish/tuna/billfish, Atlantic shark fisheries, Caribbean reef fish fishery, Caribbean spiny lobster fishery, coastal

migratory pelagic, dolphin/wahoo, Gulf of Mexico reef fish mackerel/squid/butterfish, monkfish, Northeast multispecies, red crab, skate, South Atlantic snapper-grouper, Southeast shrimp trawl, spiny dogfish, summer flounder/scup/black sea bass, and tilefish fisheries. An Incidental Take Statement (ITS) has been issued for the take of sea turtles in each of these fisheries (Appendix C). A brief summary of each fishery is provided below, but more detailed information can be found in the respective Biological Opinions.

Atlantic Bluefish Fishery

The fishery has been operating in the U.S. Atlantic for at least the last half century, although its popularity did not heighten until the late 1970s and early 1980s (MAFMC and ASMFC 1998). The majority of commercial fishing activity in the North Atlantic and mid-Atlantic occurs in the late spring to early fall, when bluefish (and sea turtles) are most abundant in these areas (NEFSC 2005). This fishery is known to interact with loggerhead sea turtles, given the time and locations where the fishery occurs. Gillnets account for the vast majority of bluefish landed in the commercial fishery. In 2011, gillnets accounted for 93.4% of the directed catch of bluefish, while hook gear accounted for 4.5% and other gear categories caught the remaining 2.1% (MAFMC 2013). Aside from gillnets, gear types authorized for use in the commercial bluefish fishery include trawl, longline, handline, bandit, rod and reel, pot, trap, seine, and dredge gear (50 CFR 600.725(v)).

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

Atlantic Sea Scallop Fishery

The Atlantic sea scallop fishery has a long history of operation in mid-Atlantic, as well as New England waters (NEFMC 1982 ; NEFMC 2003). The fishery operates in areas and at times that it has traditionally operated and uses traditionally fished gear (NEFMC 1982 ; NEFMC 2003). Landings from Georges Bank and the mid-Atlantic dominate the fishery (NEFSC 2007a). On Georges Bank and in the mid-Atlantic, sea scallops are harvested primarily at depths of 30-100 m, while the bulk of landings from the Gulf of Maine are from relatively shallow nearshore waters (< 40 m) (NEFSC 2007a). Effort (in terms of days fished) in the mid-Atlantic is about half of what it was prior to implementation of Amendment 4 to the Scallop FMP in the 1990s (NEFSC 2007a).

NMFS completed a Section 7 consultation on the Atlantic sea scallop fishery (NMFS 2008c). The Opinion concluded that the continued authorization of the fishery was likely to adversely affect green, Kemp's ridley, leatherback, and loggerhead sea turtles, but was

not likely to jeopardize their continued existence; an ITS was issued. The sea scallop fishery has a long history of operation in the mid-Atlantic, as well as in New England waters (NEFMC 1982 ; NEFMC 2003). Effort in the mid-Atlantic is about half of what it was prior to implementation of the Scallop FMP in the 1990s (NEFSC 2007a). Green, Kemp's ridley, and loggerhead sea turtles have been reported by NMFS-trained observers as being captured in scallop dredges and trawl gear. Methods used to detect any sea turtle interactions with scallop fishing gear (dredge or trawl gear) were insufficient prior to increased observation coverage in 2001, which now documents that this fishery results in many loggerhead mortalities on an annual basis. Although NMFS was not aware until 2001 of sea turtle interactions with scallop fishing gear, there is no information to suggest that they are new or occurring at a greater rate than what has likely occurred in the past. Therefore, it is likely that the effect of the scallop fishery on sea turtles has been present for decades.

Formal Section 7 consultation on the continued operation of the scallop fishery was issued by NMFS on March 14, 2008; the ITS was amended on February 4, 2009. NMFS determined that the continued operation of the fishery (including the seasonal use of chain-mat modified scallop dredge gear in mid-Atlantic waters) may adversely affect but was not likely to jeopardize the continued existence of loggerhead, leatherback, Kemp's ridley, and green sea turtles.

Consultation was reinitiated to address the listing of 5 DPSs of Atlantic sturgeon in April 2012, as well as additional information available since the last Opinion on the fishery's effects on sea turtles. Reports by Murray (2011) and Warden and Murray (2011) provide new information on the annual number of sea turtle interactions in both the dredge and trawl components of the fishery. In addition, a workshop convened by NMFS to refine methods to determine the levels of serious injury/mortality to sea turtles interacting with Northeast fisheries, and papers by Milliken et al. (2007), Smolowitz et al. (2010) and the Scallop Plan Development Team, provided new information on the levels of serious injury/mortality to sea turtles in the fishery. Additionally, new management measures meant to reduce the impacts of the fishery on sea turtles were implemented since the completion of the last Opinion. Appendix C reports the takes currently authorized for the Atlantic scallop trawl and dredge fisheries.

Caribbean Reef Fish Fishery

NMFS completed an ESA Section 7 consultation on the Caribbean reef fish fishery on October 4, 2011. The reef fish fishery in waters around Puerto Rico and the USVI uses pots and traps, hook and line, longline, and spearguns. The fishery targets snapper and groupers, as well as herbivorous fish (i.e., parrotfish and surgeonfish). The Opinion concluded that the fishery was likely to adversely affect green, hawksbill, and leatherback sea turtles via vessel strikes and entanglements in fishing gear, but it would not jeopardize their continued existence. An ITS was issued authorizing incidental take. Appendix C reports the takes currently authorized for the fishery.

On September 10, 2014, the National Marine Fisheries Service (NMFS) listed 20 new coral species under the ESA. Five of those new species (*Mycetophyllia ferox*,

Dendrogyra cylindrus, Orbicella annularis, Orbicella faveolata, and *Orbicella franksi*) occur in the Caribbean and all of these are listed as threatened. The *Acropora* coral species (*Acropora palmata* and *Acropora cervicornis*) remain protected as threatened. Because of the potential impact of the fishery on the newly-listed species, consultation for this fishery has been reinitiated.

Caribbean Spiny Lobster Fishery

The spiny lobster fishery in waters around Puerto Rico and the USVI occurs with pots and traps, and hand-harvest. Due to the predominance of fishable habitat in state waters, it is assumed that most of the commercial harvest occurs in state waters, but fishery statistics do not allow accurate separation of harvest in the EEZ from harvest in state waters (Matos-Caraballo 2002). NMFS completed a formal consultation on the fishery on December 12, 2011 (NMFS 2011d). The Opinion concluded that the continued operation of the fishery was likely to adversely affect leatherback, green, and hawksbill sea turtles. Those effects were not likely to jeopardize the continued existence of any species, and an ITS for sea turtles was issued. Appendix C reports the takes currently authorized for the fishery.

Coastal Migratory Pelagics Fishery

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

Dolphin/Wahoo Fishery

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

Gulf of Mexico Reef Fish Fishery
The Gulf of Mexico reef fish fishery uses 2 basic types of gear: spear or powerhead, and hook-and-line gear. Hook-and-line gear used in the fishery includes both commercial bottom longline and commercial and recreational vertical line (e.g., handline, bandit gear, rod-and-reel).

Prior to 2008, the reef fish fishery was believed to have relatively moderate levels of sea turtle bycatch attributed to the hook-and-line component of the fishery (i.e., approximately 107 captures and 41 mortalities annually, all species combined, for the entire fishery) (NMFS 2005d). In 2008, SEFSC observer programs and subsequent analyses indicated that the overall amount and extent of incidental take for sea turtles specified in the incidental take statement of the 2005 Opinion on the reef fish fishery had been severely exceeded by the bottom longline component of the fishery (approximately 974 captures and at least 325 mortalities estimated for the period July 2006-2007).

In response, NMFS published an emergency rule prohibiting the use of bottom longline gear in the reef fish fishery shoreward of a line approximating the 50-fathom depth contour in the eastern Gulf of Mexico, essentially closing the bottom longline sector of the reef fish fishery in the eastern Gulf of Mexico for 6 months pending the implementation of a long-term management strategy. The Gulf of Mexico Fishery Management Council (GMFMC) developed a long-term management strategy via a new amendment (Amendment 31 to the Reef Fish FMP). The amendment included a prohibition on the use of bottom longline gear in the Gulf of Mexico reef fish fishery, shoreward of a line approximating the 35-fathom contour east of Cape San Blas, Florida, from June through August; and a reduction in the number of bottom longline vessels operating in the fishery via an endorsement program and a restriction on the total number of hooks that may be possessed onboard each Gulf of Mexico reef fish bottom longline vessel to 1,000, only 750 of which may be rigged for fishing.

On October 13, 2009, SERO completed an Opinion that analyzed the expected effects of the continued operation of the Gulf of Mexico reef fish fishery under the changes proposed in Amendment 31 (NMFS-SEFSC 2009b). The Opinion concluded that sea turtle takes would be substantially reduced compared to the fishery as it was previously prosecuted, and that operation of the fishery would not jeopardize the continued existence of any sea turtle species. Amendment 31 was implemented on May 26, 2010. In August 2011, consultation was reinitiated to address the DWH oil spill event and potential changes to the environmental baseline. Reinitiation of consultation was not related to any material change in the fishery itself, violations of any terms and conditions of the 2009 Opinion, or an exceedance of the incidental take statement. The resulting September 30, 2011, Opinion concluded the continued operation of the Gulf of Mexico reef fish fishery is not likely to jeopardize the continued existence of any listed sea turtles (NMFS 2011d). Appendix C reports the takes currently authorized for the fishery.

HMS-Atlantic Pelagic Fisheries for Swordfish, Tuna, and Billfish
Atlantic pelagic fisheries for swordfish, tuna, and billfish are known to incidentally capture large numbers of sea turtles, particularly in the pelagic longline component.

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

HMS Atlantic Shark and Smoothhound Fisheries

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

The most recent ESA Section 7 consultation was completed on December 12, 2012, on the continued operation of those fisheries and Amendments 3 and 4 to the Consolidated HMS FMP (NMFS 2012h). The consultation concluded the proposed action was not likely to jeopardize the continued existence of sea turtles. An ITS was provided authorizing 18 takes (9 of which could be lethal) of each species for hawksbill and leatherback sea turtles every 3 years. Appendix C reports the takes currently authorized for the fishery.

Mackerel/Squid/Butterfish Fisheries

Atlantic mackerel/squid/butterfish fisheries are managed under a single FMP, which was first implemented on April 1, 1983. Bottom otter trawl gear is the primary gear type used to land *Loligo* and *Illex* squid. Based on NMFS dealer reports, the majority of *Loligo* and *Illex* squid are fished in the mid-Atlantic including waters within the action area of this

consultation where loggerheads also occur. While squid landings occur year round, the majority of *Loligo* squid landings occur in the fall through winter months while the majority of *Illex* landings occur from June through October (MAFMC 2007a); time periods that overlap in whole or in part with the distribution of loggerhead sea turtles in mid-Atlantic waters. Gillnets account for a small amount of landings in the mackerel fishery, and all gillnet gear use by this fishery is subject to the requirements of the Atlantic Large Whale Take Reduction Plan.

Loggerhead sea turtles are captured in bottom-otter trawl gear used in the *Loligo* and *Illex* squid fisheries, and gillnet gear used by the mackerel fishery and may be injured or killed as a result of forced submergence in the gear. The most recent Biological Opinion completed on these federal fisheries was completed 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 mackerel/squid/butterfish fisheries were considered as part of a larger "batched" consultation which evaluated the effects of the (1) Northeast multispecies, (2) monkfish, (3) spiny dogfish, (4) Atlantic bluefish, (5) Northeast skate complex, (6) Atlantic mackerel/squid/butterfish, and (7) summer flounder/scup/black sea bass fisheries. The consultation concluded that the continued operation of the fisheries were likely to adversely affect but not jeopardize the continued existence of any species of sea turtle. Incidental take was authorized.

Monkfish Fishery

The federal monkfish fishery occurs from Maine to the North Carolina/South Carolina border and is jointly managed by the New England Fishery Management Council (NEFMC) and mid-Atlantic Fishery Management Council, under the Monkfish FMP (NMFS 2005g). The current commercial fishery operates primarily in the deeper waters of the Gulf of Maine, Georges Bank, and southern New England, and in the mid-Atlantic. Monkfish have been found in depths ranging from the tide line to 900 m with concentrations between 70 and 100 m and at 190 m. The directed monkfish fishery uses several gear types that may entangle protected species, including gillnet and trawl gear.

Gillnet gear used in the monkfish fishery is known to capture ESA-listed sea turtles. Two unusually large stranding events occurred in April and May 2000 during which 280 sea turtles (275 loggerheads and 5 Kemp's ridleys) washed ashore on ocean facing beaches in North Carolina. Although there was not enough information to specifically determine the cause of the sea turtle deaths, there was information to suggest that the turtles died as a result of entanglement with large-mesh gillnet gear. The monkfish gillnet fishery, which uses a large-mesh gillnet, was known to be operating in waters off North Carolina at the time the stranded turtles would have died. As a result, in March 2002, NMFS published new restrictions for the use of gillnets with larger than 8-in (20.3 cm) stretched mesh, in federal waters (3-200 nmi) off of North Carolina and Virginia. These restrictions were published in an Interim Final Rule under the authority of the ESA (67 FR 13098; March 21, 2002) and were implemented to reduce the impact of the monkfish and other large-mesh gillnet fisheries on endangered and threatened species of sea turtles in areas where sea turtles are known to concentrate. Following review of public comments submitted on

the Interim Final Rule, NMFS published a Final Rule on December 3, 2002, that established the restrictions on an annual basis.

Biological Opinions on the fishery were completed in 2001, 2003, 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 monkfish fishery was considered as part of a larger "batched" consultation which evaluated the effects of the (1) Northeast multispecies, (2) monkfish, (3) spiny dogfish, (4) Atlantic bluefish, (5) Northeast skate complex, (6) Atlantic mackerel/squid/butterfish, and (7) summer flounder/scup/black sea bass fisheries. The consultation concluded that the continued operation of the fishery was likely to adversely affect but not jeopardize the continued existence of any species of sea turtle; incidental take was authorized.

Northeast Multispecies Fishery

The Northeast multispecies fishery operates throughout the year, with peaks in the spring and from October through February. Multiple gear types are used in the fishery including sink gillnet, trawl, and pot/trap gear, which are known to be a source of injury and mortality to right, humpback, and fin whales as well as loggerhead and leatherback sea turtles as a result of entanglement and capture in the gear (NMFS 2001a). The Northeast multispecies sink gillnet fishery has historically occurred from the periphery of the Gulf of Maine to Rhode Island in water as deep as 360 ft. In recent years, more of the effort in the fishery has occurred in offshore waters and into the mid-Atlantic. Participation in this fishery has declined since extensive groundfish conservation measures have been implemented. The exact relationship between multispecies fishing effort and the number of endangered species interactions with gear used in the fishery is unknown. In general, less fishing effort results in less time that gear is in the water and therefore less opportunity for sea turtles or cetaceans to be captured or entangled in multispecies fishing gear.

A Biological Opinion on the fishery were completed in 2001, 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 fishery was considered as part of a larger "batched" consultation which evaluated the effects of the (1) Northeast multispecies, (2) monkfish, (3) spiny dogfish, (4) Atlantic bluefish, (5) Northeast skate complex, (6) Atlantic mackerel/squid/butterfish, and (7) summer flounder/scup/black sea bass fisheries. The consultation concluded that the continued operation of the fishery was likely to adversely affect but not jeopardize the continued existence of any species of sea turtle. Incidental take was authorized.

Red Crab Fishery

Section 7 consultation was completed on the deep-sea red crab fishery during the proposed implementation of the Red Crab FMP (NMFS 2002d). The Opinion concluded that the action was not likely to result in jeopardy to any ESA-listed species under NMFS's jurisdiction. An ITS was provided for leatherback and loggerhead sea turtles. Appendix C reports the takes currently authorized for fishery. The fishery is a pot/trap fishery that occurs in deep waters along the continental slope. The primary fishing zone

for red crab, as reported by the fishing industry, is at a depth of 1,300-2,600 ft along the continental shelf in the Northeast Region and is limited to waters north of 35°15.3'N (Cape Hatteras, North Carolina) and south of the Hague Line.

Skate Fishery

The skate fishery has typically been composed of both a directed fishery and an indirect fishery. Otter trawls are the primary gear used to land skates in the United States, with some landings also coming from sink gillnet, longline, and other gear (NEFSC 2007b). Bottom trawl gear accounted for 94.5% of directed skate landings. Gillnet gear is the next most common gear type, accounting for 3.5% of skate landings.

For Section 7 purposes, NMFS considers the effects to ESA-listed species of the directed skate fishery. Fishing effort that contributes to landings of skate for the indirect fishery is considered during Section 7 consultation on the directed fishery in which skate bycatch occurs. Biological Opinions on the skate FMP were completed in 2003 (NMFS 2003b), 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 monkfish fishery was considered as part of a larger "batched" consultation which evaluated the effects of the (1) Northeast multispecies, (2) monkfish, (3) spiny dogfish, (4) Atlantic bluefish, (5) Northeast skate complex, (6) Atlantic mackerel/squid/butterfish, and (7) summer flounder/scup/black sea bass fisheries. The consultation concluded that the continued operation of the fishery was likely to adversely affect, but not jeopardize, the continued existence of any species of sea turtle. Incidental take was authorized.

South Atlantic Snapper-Grouper Fishery

In 2006, NMFS completed a Section 7 consultation on the South Atlantic snapper-grouper fishery (NMFS 2006b). The fishery uses spear and powerheads, black sea bass pot, and hook-and-line gear. Hook-and-line gear used in the fishery includes commercial bottom longline gear and commercial and recreational vertical line gear (e.g., handline, bandit gear, and rod-and-reel). The consultation found only hook-and-line gear likely to adversely affect, green, hawksbill, Kemp's ridley leatherback, and loggerhead sea turtles. The consultation concluded the proposed action was not likely to jeopardize the continued existence of any of these species, and an ITS was provided.

Southeastern Shrimp Trawl Fisheries

NMFS has prepared Opinions on the Gulf of Mexico shrimp trawling numerous times over the years (most recently 2002 and 2012). The consultation history is closely tied to the lengthy regulatory history governing the use of TEDs and a series of regulations aimed at reducing potential for incidental mortality of sea turtles in commercial shrimp trawl fisheries. The level of annual mortality described in (NRC 1990b) is believed to have continued until 1992-1994, when U.S. law required all shrimp trawlers in the Atlantic and Gulf of Mexico to use TEDs, allowing at least some sea turtles to escape

nets before drowning (NMFS 2002c).[27] TEDs approved for use have had to demonstrate 97% effectiveness in excluding sea turtles from trawls in controlled testing. These regulations have been refined over the years to ensure that TED effectiveness is maximized through proper placement and installation, configuration (e.g., width of bar spacing), flotation, and more widespread use.

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

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

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

existence of any sea turtle species. The ITS maintained the use of anticipated trawl effort and fleet TED compliance as surrogates for numerical sea turtle takes.

Spiny Dogfish Fishery

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

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

Summer Flounder, Scup, and Black Sea Bass Fisheries

In the mid-Atlantic, summer flounder, scup, and black sea bass are managed under a single FMP since these species occupy similar habitat and are often caught at the same time. Bottom otter and beam trawl gear are used most frequently in the commercial fisheries for all 3 species (MAFMC 2007b). Gillnets, handlines, dredges, and pots/traps are also occasionally used (MAFMC 2007b).

Significant measures have been developed to reduce the incidental take of sea turtles in summer flounder trawls and trawls that meet the definition of a summer flounder trawl (which includes gear used in fisheries for other species like scup and black sea bass). TEDs are required throughout the year for trawl nets fished from the North Carolina/South Carolina border to Oregon Inlet, North Carolina, and seasonally (March 16-January 14) for trawl vessels fishing between Oregon Inlet, North Carolina, and Cape Charles, Virginia. Effort in the summer flounder, scup, and black sea bass fisheries has also declined since the 1980s and since each fishery became managed under the FMP. Therefore, effects to sea turtles are expected, in general, to have declined as a result of the decline in fishing effort. Nevertheless, the fisheries primarily operate in mid-Atlantic waters in areas and times when sea turtles occur. Thus, there is a continued risk of sea turtle captures causing injury and death in summer flounder, scup, and black sea bass fishing gear.

Biological Opinions on the continued operation of the fishery under the Summer Flounder, Scup and Black Sea Bass FMP were completed in 2008, 2010, and most recently in December 2013. The 2013 consultation included an evaluation of the effects of the fishery on ESA-listed whales, sea turtles, and the newly listed Atlantic sturgeon. The monkfish fishery was considered as part of a larger "batched" consultation which evaluated the effects of the (1) Northeast multispecies, (2) monkfish, (3) spiny dogfish, (4) Atlantic bluefish, (5) Northeast skate complex, (6) Atlantic mackerel/squid/butterfish, and (7) summer flounder/scup/black sea bass fisheries. The consultation concluded that the continued operation of the fishery was likely to adversely affect but not jeopardize the continued existence of any species of sea turtle. Incidental take was authorized.

Mid-Atlantic Tilefish Fishery

The effects of the Northeast and mid-Atlantic tilefish fishery on ESA-listed species were considered during formal consultation on the implementation of a new tilefish FMP, concluded on March 13, 2001, with the issuance of a non-jeopardy Biological Opinion. The Opinion included an ITS for leatherback and loggerhead sea turtles (NMFS 2001c). The management unit for the tilefish FMP is all golden tilefish under U.S. jurisdiction in the Atlantic Ocean north of the Virginia/North Carolina border. Tilefish have some unique habitat characteristics and are found in a warm-water band (8º-18ºC) approximately 250-1,200 ft deep on the outer continental shelf and upper slope of the U.S. Atlantic coast. Because of their restricted habitat and low biomass, the tilefish fishery in recent years has occurred in a relatively small area in the mid-Atlantic Bight, south of New England and west of New Jersey. Bottom longline gear equipped with circle hooks is the primary gear type used in the tilefish fishery.

4.2.1.2 Federal Military Activities

Potential sources of adverse effects in the action area include operations of the U.S. Department of Defense (DoD).

Formal consultations on overall United States Navy (USN) activities in the Atlantic have been completed, including USN's Activities in East Coast Training Ranges (NMFS 2011f); USN Atlantic Fleet Sonar Training Activities (AFAST); USN AFAST LOA 2012-2014 - USN active sonar training along the Atlantic Coast and Gulf of Mexico (NMFS 2011g); USN Activities in GOMEX Range Complex from November 2010 to November 2015. These Opinions concluded that although there is a potential from some USN activities to effect sea turtles, those effects were not expected to impact any species on a population level. Therefore, the activities were determined to be not likely to jeopardize the continued existence of any ESA-listed sea turtle species.

Military testing and training may also affect listed species of sea turtles. The air space over the Gulf of Mexico is used extensively by the DoD for conducting various air-to-air and air-to-surface operations. Nine military warning areas and 5 water test areas are located within the Gulf of Mexico. The western Gulf of Mexico has 4 warning areas that are used for military operations. The areas total approximately 21 million ac or 58% of the area. In addition, 6 blocks in the western Gulf of Mexico are used by the Navy for

mine warfare testing and training. The central Gulf of Mexico has 5 designated military warning areas that are used for military operations. These areas total approximately 11.3 million ac. Portions of the Eglin Water Test Areas (EWTA) comprise an additional 0.5 million ac in the Central Planning Area (CPA). The total 11.8 million ac is about 25% of the area of the CPA.

A consultation evaluating the impacts from USAF search-and-rescue training operations in the Gulf of Mexico was completed in 1999. NMFS completed 4 consultation on Eglin Air Force Base testing and training activities in the Gulf of Mexico. These consultations concluded that the incidental take of sea turtles is likely to occur. These Opinions have issued incidental take for these actions: Eglin Gulf Test and Training Range (NMFS 2004b), the Precision Strike Weapons Tests (NMFS 2005c), the Santa Rosa Island Mission Utilization Plan (NMFS 2005f) and Naval Explosive Ordnance Disposal School (NMFS 2004b). These consultations determined the training operations would adversely affect sea turtles but would not jeopardize their continued existence.

4.2.1.3 Oil and Gas Exploration

The USACE and BOEM of the Department of Interior issue permits for oil and gas exploration, well development, production, and abandonment/rig removal activities that o may adversely affect turtles. Both these agencies have consulted with NMFS on these activities which include the use of seismic arrays for oil and gas exploration in the Gulf of Mexico, and the explosive removal of offshore structures, and on seismic surveys off the Atlantic coast. Impacts are expected to continue to listed species from vessel strikes, noise, marine debris, and the use of explosives to remove oil and gas structures in the Gulf of Mexico. In 2007, NMFS issued a biological opinion to the Minerals Management Service (predecessor agency to BOEM) for oil and gas leasing activities in the western and central planning areas of the Gulf of Mexico, under the 2007-2012 lease sale.

DWH Oil Spill and Response

On April 20, 2010, while working on an exploratory well approximately 50 miles offshore Louisiana, the semi-submersible drilling rig *Deepwater Horizon* experienced an explosion and fire. The rig subsequently sank and oil and natural gas began leaking into the Gulf of Mexico. Oil flowed for 86 days, until the well was finally capped on July 15, 2010. Millions of barrels of oil were released into the Gulf of Mexico. Oil spread from the deep ocean to the surface and nearshore environment, from Texas to Florida. In response to this uncontrolled oil discharge, approximately 1.84 million gallons of chemical dispersant was applied both subsurface and on the surface to attempt to break down the oil. Further response activities included hundreds of oil patches burned at the sea surface, synthetic-based drilling muds released on the sea floor, deployment of boom and construction of berms to prevent oil from reaching the shore, and disruptive mechanical collection and removal of oil that reached the shore. Each of these activities resulted in additional environmental consequences (DWH Trustees 2015).

The investigation conducted under the National Resource Damage Assessment regulations under the Oil Pollution Act (33 U.S.C. 2701 *et seq.*) assessed natural resource damages stemming from the DWH oil spill. The investigation evaluated whether a pathway could be established from the discharge to the exposed resources (e.g., the ESA-listed species), whether the resources had been exposed to the oil or chemical dispersants, and the injury caused by that exposure. The oil released into the environment was found to be toxic to a wide range of organisms, including fish, invertebrates, plankton, birds, and mammals, causing a wide array of toxic effects including death, disease, reduced growth, impaired reproduction, and physiological impairments that reduce the fitness of organisms (their ability to survive and reproduce). In addition to direct injuries to individual organisms, the DWH incident resulted in injuries to habitats used by ESA-listed species including marsh habitats, shoreline beaches, floating *Sargassum* habitats offshore, and submerged aquatic vegetation. Further details on the findings of this assessment for each specific sea turtle species are discussed in Section 3.3 (Status of Species). Information about DWH early restoration can be found below, in Section 5.2.5.6.

Due to the unanticipated event and effects of the Deepwater Horizon incident, NMFS and BOEM reinitiated the 2007 consultation. Consultation is ongoing on a programmatic approach to all oil and gas leasing activities under the Outer Continental Shelf Lands Act in the Gulf of Mexico.

4.2.1.4 Dredging

Marine dredging vessels are common within U.S. coastal waters. Although the underwater noises from dredge vessels are typically continuous in duration (for periods of days or weeks at a time) and strongest at low frequencies, they are not believed to have any long-term effect on sea turtles. However, the construction and maintenance of federal navigation channels and dredging in sand mining sites ("borrow areas") have been identified as sources of sea turtle mortality. Hopper dredges in the dredging mode are capable of moving relatively quickly compared to sea turtle swimming speed and can thus overtake, entrain, and kill sea turtles as the suction draghead(s) of the advancing dredge overtakes the resting or swimming turtle. Entrained sea turtles rarely survive. NMFS completed a regional Opinion on the impacts of USACE's hopper-dredging operation in 2003 for operations in the Gulf of Mexico (NMFS 2007c). NMFS determined that (1) Gulf of Mexico hopper dredging would adversely affect Gulf sturgeon and 4 sea turtle species (i.e., green, hawksbill, Kemp's ridley, and loggerheads) but would not jeopardize their continued existence and (2) dredging in the Gulf of Mexico would not adversely affect leatherback sea turtles, smalltooth sawfish, or ESA-listed large whales. An ITS for those species adversely affected was issued.

NMFS also completed a regional Opinion on the impacts of USACE's hopper-dredging in the South Atlantic in 1997 (NMFS 1997a). NMFS determined that (1) hopper dredging in the South Atlantic would adversely affect shortnose sturgeon and 4 sea turtle species (i.e., green, hawksbill, Kemp's ridley, and loggerheads), but would not jeopardize their continued existence, and (2) South Atlantic dredging would not adversely affect

leatherback sea turtles or ESA-listed large whales. An ITS for those species adversely affected was issued. The USACE requested reinitiation of consultation in 2007 to: (1) consider species and critical habitat, that may be affected by the action, which had not been listed at the time of the previous opinion and were not considered (e.g., smalltooth sawfish, ESA-listed corals, *Acropora* critical habitat); (2) update the areas, channels, and dredge techniques that the USACE wanted considered, and (3) to include BOEM as a co-action agency. NMFS is currently working on drafting an Opinion.

Numerous other Opinions have been produced that analyzed hopper dredging projects that did not fall under the scope of actions contemplated by these regional Opinions. For example, in the Gulf of Mexico in 1998, the Houston-Galveston Navigation Channel dredging project was a major port improvement dredging project that required consultation. Numerous other Opinions have been issued in the Gulf of Mexico since 2003, covering navigation channel improvements and beach restoration projects, including: dredging of Ship Shoal in the Gulf of Mexico Central Planning Area for coastal restoration projects (NMFS 2005b), Gulfport Harbor Navigation Project (NMFS 2007a), East Pass dredging, Destin, Florida (NMFS 2009c), Mississippi Coastal Improvements Program (federal restoration project) dredging and disposal of sand along Ship Island barrier island (NMFS 2011b), and dredging of City of Mexico beach canal inlet [to USACE in 2012 (NMFS 2012a).

Similarly, in the South Atlantic, Opinions issued for dredging and beach nourishment projects outside the scope of the SARBO include: Savannah Harbor Federal Navigation Project (channel widening and deepening for Post-Panama vessels) (NMFS 2011h), use of Canaveral Shoals borrow area for a beach renourishment and protection project at Patrick Air Force Base, Cocoa Beach, Florida (NMFS 2010e), channel dredging for homeporting of carrier group surface ships at U.S. Naval Station Mayport (NMFS 2009b), and Boca Raton Inlet Dredging Project (NMFS 2008a), among others. Each of the above free-standing Opinions had its own ITS which determined that hopper dredging during the proposed action would not adversely affect any species of sea turtles or other listed species, or destroy or adversely modify critical habitat of any listed species.

On April 22, 2015, NMFS completed a consultation on the USACE's proposed deepening of the Charleston Harbor. The Opinion considered the effects to sea turtles from: the hopper dredging, post-dredging bed leveling, the disposal of dredged material, changes in salinity, changes in dissolved oxygen, and relocation trawling. The Opinion concluded that the relocation trawling and dredging portions of the project were likely to adversely affect sea turtles, but would not jeopardize their continued existence. An ITS was issued for the total nonlethal capture of up to 719 loggerheads, 3 greens, 18 Kemp's ridley sea turtles. Of those, 235 may be captured and relocated, without injury, during relocation trawling.

4.2.1.5 Licensing and Construction of Nuclear and Coal-Fueled Generating Power Plants

The Nuclear Regulatory Commission licenses the construction and operation of nuclear generating plants, which have been found to impact sea turtles in past consultations. Sea turtles entering coastal or inshore areas have been affected by entrainment in the cooling-water systems of coal-fueled and nuclear-fueled generating plants, though it is important to note that the majority of sea turtles caught are released alive.

Crystal River Energy Complex
NMFS has conducted Section 7 consultations on the operation of the Crystal River Energy Complex's cooling water intake system located near the Gulf of Mexico in Citrus County, Florida. The most recent Opinion, dated August 8, 2002, concluded the proposed action is not likely to jeopardize the continued existence of loggerhead, Kemp's ridley, green, hawksbill, and leatherback sea turtles (NMFS 2002b). NMFS anticipates an annual incidental take of up to 75 live sea turtles and 3 sea turtles killed as a result of Crystal River Energy Complex operations. Most these of takes are expected to be loggerhead, Kemp's ridley, and green sea turtles.

St. Lucie Nuclear Power Plant
A 2001 Opinion (NMFS 2001b) evaluated the impacts of the operation of the St. Lucie nuclear power plant at Hutchinson Island, Florida, due to documented sea turtle entrainment in the cooling-water systems at this electrical generating plant. NMFS anticipated up to 1,000 green and loggerhead sea turtles may have be taken during a 10-year period. Additionally, 2 Kemp's ridleys and 1 hawksbill or leatherback sea turtle, would be taken every 2 years over a 10-year period. Since most of the turtles are caught and released alive, NMFS estimates the survival rate at 98.5% or greater. The Opinion stated that the continued operation of the plant was likely to adversely affect sea turtles, but not jeopardize their continued existence.

In October 2006, Florida Power and Light notified NMFS of the unexpected take of 24 loggerhead turtle hatchlings. A female loggerhead sea turtle had successfully entered the St. Lucie nuclear power plant intake canal and, undetected, successfully laid her eggs on its banks. Twenty-four hatchlings were located near the intake wells, 21 were dead and 3 were sent to rehabilitation facilities and later released. This unforeseen hatchling take resulted in the St. Lucie nuclear power plant's exceeding their authorized lethal take limit of sea turtles for 2006. Consultation was reinitiated and is ongoing.

Brunswick Steam Electric Plant
The January 2000 Biological Opinion on the operations at the Brunswick Steam Electric Plant in Brunswick, North Carolina, estimated that up to 50 sea turtles may be taken, in any combination, annually, and all will be released alive. NMFS estimated the lethal take of an additional 6 loggerhead, 2 Kemp's ridley, and 3 green sea turtles would occur annually (NMFS 2000a).

4.2.1.6 Construction and Operation of Public Fishing Piers

Since the active hurricane seasons of 2004 and 2005, a number of fishing piers have either been built or rebuilt along the Gulf Coast, particularly in Florida and Mississippi. The USACE permits the building of these structures and, in some cases, FEMA provides the funding for these projects to occur. For each pier listed in Table 4.2 and 4.3, we determined that the activities associated with their demolition/reconstruction/repair was not likely to adversely affect any ESA-listed species. However, we did conclude that the fishing likely to occur following the completion of each pier project was likely to adversely affect certain species of sea turtles, but it was not likely to jeopardize their continued existence. Table 4.2 and 4.3 lists each fishing pier with a Biological Opinion, the action agency, the authorized number of sea turtle takes, and date of issuance in Florida and Mississippi, respectively. Appendix B provides further description of the consultation.

Table 4.2. Annual Authorized Incidental Captures at Florida Fishing Piers

Fishing Pier	Action Agency	Biological Opinion Completion Date	Sea Turtle Species			
			Green (CM)	Loggerhead (CC)	Kemp's ridley (LK)	Hawksbill (EI)
Jacksonville Fishing Pier, Duval County	USACE	May 9, 2003	N/L – 3 or 2	N/L - 10	N/L – 2 or 1	0
			L - 0 or 1 (See CC entry)	L –Up to 2 CC or 1 CC & 1 of either CM or LK	L - 0 or 1 (See CC entry)	
Navarre Beach Fishing Pier, Santa Rosa County	USACE	November 17, 2008	0	N/L 4 or 3	2 or 1 See CC entry	0
				L - 1 CC or 1 LK mortality		
City of Mexico Beach, Fishing Pier Ext., Bay County	USACE	March 23, 2009	0	N/L – 4	N/L – 2	0
				L – 1 CC or 1 LK		
M.B. Miller Fishing Pier, Bay County	USACE	May 1, 2009	0	N/L – 4	N/L – 2	0
				L – 1 CC or 1 LK		
Flagler Beach Pier, Flagler County	FEMA	June 26, 2012	N/L - 2	N/L - 2 or 1 Up to 2 CC or 1 CC and 1 LK	0 or 1 See CC entry	0
			L – 1 CC or 1 CM		L – 0	
Newport Fishing Pier, City of Sunny Isles Beach, Miami-Dade County	USACE	August 15, 2011	N/L - 5	N/L – 2 or 1 Up to 2 CC N/L takes; or 1 CC take and 1 LK or EI;	N/L – 0 or 1 If 2 CC captures occur, 0 LK or EI takes authorized	N/L – 0 or 1 If 2 CC captures occur, 0 LK or EI takes authorized
			L - 1 Up to 1 additional CC or CM mortality is authorized		L - 0	L - 0
Lantana Fishing Pier, Palm Beach County	USACE	June 8, 2012	N/L - 5	N/L - 2 or 1 Up to 2 CC N/L takes; or 1 CC take and 1 EI or LK	N/L - 0 or 1 (See CC entry)	

Fishing Pier	Action Agency	Biological Opinion Completion Date	Sea Turtle Species			
			Green (CM)	Loggerhead (CC)	Kemp's ridley (LK)	Hawksbill (EI)
			L – 1 CC or 1 CM		L – 0	
South Pointe Park Fishing Pier, City of Miami Beach, Miami-Dade County	USACE	September 4, 2012	N/L - 6	N/L – 2 or 1 Up to 2 CC N/L takes; or 1 CC take and 1 LK or EI;	N/L – 0 or 1 If 2 CC captures occur, 0 LK or EI takes authorized	
			L - 2	L - 0		
Melody Lane Fishing Pier, Fort Pierce, St. Lucie County	USACE	June 28, 2013	N/L – 3 or 2		0	
			L – 1 Up to 1 CM or CC mortality is authorized			
Englewood Marine Center Fishing Pier, Sarasota County	USACE	September 11, 2013	N/L – 1 Up to 1 CM or CC or LK may be taken annually			0
			L – 1 Up to 1 CM or CC or LK mortality may occur every 6 yrs			
Smyrna Dunes and Riverside Park Fishing Piers, Volusia County	USACE	April 16, 2014	N/L – 28 over 3 years	N/L – 11 over 3 years	0	
			L – 5 or 4 over 3 years 5 CM or 4 CM & 1 CC over 3 years	L – 1 or 2 over 3 years		
Sunshine Key RV Park, Monroe County	USACE	April 21, 2014	N/L – 6 over 3 years	N/L – 4 over 3 years	0	N/L – 1 over 3 years
			L – 1 over 3 years	L – 1 over 3 years		L – 0

N/L = Number of nonlethal takes authorized
L = Number of lethal takes authorized

Table 4.3. Annual Authorized Incidental Captures at Mississippi and Texas Fishing Piers

Fishing Pier	Action Agency	Biological Opinion Completion Date	Sea Turtle Species		
			Kemp's ridley (LK)	Loggerhead (CC)	Green (CM)
Clermont Harbor Fishing Pier, Hancock County, MS	USACE	January 4, 2010	N/L – 2/1 Up to 2 CC or 2 LK; or 1 CC & 1 LK		0
			L – 0/1 Up to 1 of the total 2 takes may be lethal		
Washington Street Fishing Pier, Hancock County, MS	USACE	June 30, 2010	N/L – 2/1 Up to 2 CC or 2 LK; or 1 CC & 1 LK		0
			L – 0/1 Up to 1 of the total 2 takes may be lethal		
Coliseum Pier, City of Biloxi, Harrison County, MS	USACE	May 28, 2009	N/L – 2/1 Up to 2 CC or 2 LK or 1 CC & 1 LK		0
			L – 0/1 Up to 1 of the total 2 takes may be lethal		
Rutherford Fishing Pier, City of Bay St. Louis, Hancock County, MS	USACE	January 18, 2011	N/L –Up to 3 CC or LK in combination		0
			L – Up to 1 mortality of CC or LK		
Old Highway 90 Fishing Pier, City of Biloxi Harrison County, MS	USACE	January 11, 2012	N/L – 7/6 Up to 7 LKs or 6 LKs and 1 CC or CM		N/L - 0/1 See LK entry
			L - 1		L - 0
West Side Fishing Pier, Ken Combs Fishing Pier, Moses Fishing Pier, and Urie Fishing Piers 1 and 2, City of Gulfport, Hancock County, MS	FEMA & USACE	March 7, 2014	N/L – 19 over 3 years	N/L – 3/2 Up to 3 CC or CM in combination	
			L – 21 over 3 years	L – 0/1 Up to 1 CC or CM mortality may occur of 3 anticipated	
Small Craft Harbor Fishing Pier, City of Pass Christian, Hancock County, MS	FEMA	September 17, 2014	N/L – 76 over 3 years	N/L or L – 1 over 3 years	N/L – 5 over 3 years
			L – 45 over 3 years		L – 3 over 5 years
Garfield Ladner Memorial Fishing Pier, City of Waveland, Hancock County, MS	FEMA	September 17, 2014	N/L – 100 over 3 years	N/L or L – Either 1 CC or 1 CM every 3 years	
			L – 52 over 3 years		
Clayton' s Beach Bar and Grill Fishing Pier, South Padre Island, Cameron County, TX	USACE	December 3, 2014	0	N/L or L – 1 over 3 years	N/L or L – 2 over 3 years

4.2.1.7 ESA Section 10 Permits

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

Sea turtles are the focus of research activities in the action area for which take is authorized by Section 10 permits under the ESA. As of February 2016, there were 28 active scientific research permits directed toward sea turtles that are applicable to the action area of this Biological Opinion. Authorized activities range from photographing, weighing, and tagging sea turtles incidentally taken in fisheries, to blood sampling, tissue sampling (biopsy), and performing laparoscopy on intentionally captured sea turtles. The number of authorized takes varies widely depending on the research and species involved but may involve the taking of hundreds of sea turtles annually. Most takes authorized under these permits are expected to be nonlethal. Before any research permit is issued, the proposal must be reviewed under the permit regulations (i.e., must show a benefit to the species). In addition, since issuance of the permit is a federal activity, Section 7 analysis is also required to ensure the issuance of the permit is not likely to result in jeopardy to the species.

As of February 2016, there is 1 active Section 10(a)(1)(B) permit for sea turtles in the action area. The permit was issued to the North Carolina Department of Marine Fisheries (NCDMF) and authorizes the incidental take of listed sea turtles in specified inshore and estuarine large- and small-mesh gillnet fisheries; the permit expires in 2023. The permit reviewed the potential impacts of the fisheries on sea turtles and determined its continued operation would not jeopardize the continued existence of any of those species. Because of that determination incidental take could be authorized in the large- and small-mesh gillnet fisheries so long as certain conditions of a conservation plan are met. The NCDMF developed such a plan that included: (1) restrictions on these fisheries (e.g., soak times, area closures), (2) NCDMF enforcement of those fishery restrictions, (3) requirements for NCDMF to monitor these fisheries, (4) sea turtle take reporting requirements, (5) adaptive management (i.e., modifications of the previous noted requirements), (6) sea turtle handling and resuscitation requirements, (7) sea turtle tagging and stranding monitoring.

4.2.1.8 Aquaculture

On June 24, 2015, NMFS completed a Section 7 consultation on the final rule for the FMP for Regulating Offshore Marine Aquaculture in the Gulf of Mexico (Aquaculture FMP). The consultation considered, among other things, risk of entanglement and potential impacts to water quality from the permitting of up to 20 offshore aquaculture operations in federal waters of the Gulf of Mexico over a 10 year period. The consultation concluded that the Aquaculture FMP was not likely to adversely affect listed species or designated critical habitat under NMFS's purview. With respect to entanglement risks, entanglement can be greatly reduced through the use of rigid, durable

materials and by keeping lines taut, and that in practice, most offshore marine aquaculture facilities are constructed under these specifications. The Aquaculture FMP requires applicants to provide documentation sufficient to evaluate a system's ability to withstand physical stresses and that there is anecdotal evidence that supports the conclusion that interactions are rare. On January 11, 2016, NOAA published the final rule implementing the Aquaculture FMP, the nation's first regional regulatory program for offshore aquaculture in federal waters.

4.2.2 State or Private Actions

4.2.2.1 State Fisheries

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

Gillnet Fisheries

A detailed summary of the state gillnet fisheries currently operating along the mid and southeast U.S. Atlantic coastline, and Gulf of Mexico, which are known to incidentally capture sea turtles, can be found in the TEWG reports (TEWG 1998a; TEWG 2000c; TEWG 2009a). Georgia and South Carolina prohibit gillnets for all but the shad fishery. No adverse effects to sea turtles or any other protected species group were observed during the season the NMFS SEFSC observed this fishery in South Carolina (McFee et al. 1996). Florida has banned all but very small nets in state waters, as has Texas. Louisiana, Mississippi, and Alabama have also placed restrictions on gillnet fisheries within state waters such that very little commercial gillnetting captures place in Southeast waters, with the exception of North Carolina. Some illegal gillnet incidental captures have been reported in South Carolina, Florida, Louisiana, and Texas (NMFS-SEFSC 2001).

Gillnetting is more prevalent in North Carolina state waters. Incidental captures in gillnet fisheries (both lethal and nonlethal) of loggerhead, leatherback, green and Kemp's ridley sea turtles have been reported. For example, gillnetting activities in North Carolina associated with the southern flounder fishery had been implicated in large numbers of sea turtle mortalities. The Pamlico Sound portion of that fishery was closed and has subsequently been reopened under Section 10(a)(1)(B) permits. Since 2006, the observed and estimated sea turtle interactions with Pamlico Sound gillnet fishing activities have increased significantly. As a result, the gillnet fishing season has closed early for several years to ensure that take levels of authorized under the Section 10(a)(1)(B) permit are not exceeded. In mid-2013, North Carolina received 2 Section 10(a)(1)(B) permits,1 of which authorized the incidental capture of sea turtles for a 10-year period for all inshore state gillnetting (the other authorized incidental capture of sturgeon). The permit authorized 513 green (165 dead/330 live/18 live or dead), 8 hawksbill (8 live or dead),

159 Kemp's ridley (49 dead/98 live/12 live or dead), 8 leatherback (8 live or dead), 24 loggerhead (24 live or dead).

Trawl Fisheries

In North Carolina, a high opening bottom trawl locally known as a "flynet" is used to target Atlantic croaker and weakfish. The North Carolina Observer program documented 33 flynet trawl trips from November through April of 1991-1994 and recorded no sea turtles caught in 218 hours of trawl effort. However, in 1994, NMFS's Northeast Fisheries Observer Program (NEFOP) documented sea turtle bycatch in the Atlantic croaker and weakfish trawl fishery off North Carolina. During 9 tows targeting Atlantic croaker, a flynet without a TED took 7 loggerheads. On a previous trip, the same vessel took 12 loggerheads in 11 out of 13 observed flynet tows. In 1998, the SEFSC began developing a TED for flynets. In 2007, the Flexible Flatbar Flynet TED was developed for the fishery and catch retention trials and usability testing was completed (Gearhart 2010).

Another state bottom trawl fishery that is suspected of incidentally capturing sea turtles is the whelk trawl fishery in South Carolina (S. Murphy, SCDNR, pers. comm. to J. Braun-McNeill, SEFSC, November 27, 2000) and Georgia (M. Dodd, GADNR, pers. comm. to J. Braun-McNeill, SEFSC, December 21, 2000). In South Carolina, the whelk trawling season opens in late winter and early spring when offshore bottom waters are < 55ºF. One criterion for closure of this fishery is water temperature: whelk trawling closes for the season and does not reopen throughout the state until 6 days after water temperatures first reach 64ºF in the Fort Johnson boat slip. Based on the SCDNR Office of Fisheries Management data, approximately 6 days will usually lapse before water temperatures reach 68ºF, the temperature at which sea turtles move into state waters. From 1996-1997, observers onboard whelk trawlers in Georgia reported a total of 3 Kemp's ridley, 2 green, and 2 loggerhead sea turtles captured in 28 tows for a CPUE of 0.3097 sea turtles/100 ft net hour. Since December 2000, TEDs have been required in Georgia state waters when trawling for whelk. There has also been 1 report of a loggerhead captured in a Florida try net (NMFS 2012j). Trawls for cannonball jellyfish may also be a source of interactions.

Trap Fisheries

Another potential state fishery impact to sea turtles is via entanglement in trap fisheries. The State of Florida's stone crab fishery is an example of a state trap fishery that may interact with sea turtles. On October 15, 2011, NMFS repealed the federal FMP for stone crab. Prior to the repeal, NMFS prepared a Biological Opinion on the continued authorization of the federal fishery. The Opinion concluded the federal stone crab fishery was likely to adversely affect sea turtles, but it was not likely to jeopardize their continued existence. The State of Florida now exclusively manages the stone crab fishery, even vessels fishing in the EEZ. The State of Florida has actively managed the fishery since 1929; the federal FMP was implemented in 1979 to address gear conflicts. The federal fishery was managed primarily by issuing regulations complimentary to those promulgated by the State of Florida. Since the State of Florida has essentially been the lead management agency for the state and federal fishery for some time, little change in how the fishery operates or amount of the effort occurring in the fishery is expected

because of the repeal of the federal FMP. Therefore, the anticipated adverse effects described in the Biological Opinion completed before the repeal of the federal FMP are expected to continue to occur to those ESA-listed species.

Fixed Net Fisheries

Stationary pound net gear is known to incidentally capture loggerhead sea turtles in North Carolina (Epperly et al. 2000). Although pound nets are not a significant source of mortality for loggerheads in North Carolina (Epperly et al. 2000), they have been implicated in the stranding deaths of loggerheads in the Chesapeake Bay from mid-May through early June (Bellmund et al. 1987). The sea turtles were reported entangled in the large mesh (> 8 in) pound net leads (NMFS-SEFSC 2001).

The fishing activities discussed above may be correlated to regular pulses of greatly elevated sea turtle strandings along North Carolina in the late fall/early spring, coincident with their migrations. For example, in the last weeks of April through early May 2000, approximately 300 sea turtles, mostly loggerheads, stranded north of Oregon Inlet, North Carolina. Gillnets were found with 4 of the carcasses. These strandings were likely caused by state fisheries as well as federal fisheries, although no single fishery has been identified as the major cause. Fishing effort data indicate that fisheries targeting monkfish, dogfish, and bluefish were operating in the area of the strandings. Strandings in this area represent, at best, 7-13% of the actual nearshore mortality (Epperly et al. 1996).

Beyond commercial fisheries, observations of state recreational fisheries have shown that loggerhead, leatherback, Kemp's ridley, and green sea turtles are known to bite baited hooks, and loggerheads and Kemp's ridleys frequently ingest the hooks. Data reported through Marine Recreational Fishery Statistical Survey/Marine Recreational Information Program and the Sea Turtle Stranding and Salvage Network (STSSN) show recreational fishers have hooked sea turtles when fishing from boats, piers, and beach, banks, and jetties.

Although few of these state regulated fisheries are currently authorized to incidentally take listed species, several state agencies have approached NMFS to discuss applications for a Section 10(a)(1)(B) incidental take permit. Since NMFS's issuance of a Section 10(a)(1)(B) permit requires formal consultation under Section 7 of the ESA, any fisheries that come under a Section 10(a)(1)(B) permit in the future will likewise be subject to Section 7 consultation. Although the past and current effects of these fisheries on listed species have not been quantified, NMFS believes that ongoing state fishing activities may be responsible for seasonally high levels of observed strandings of sea turtles on both the Atlantic and Gulf of Mexico coasts.

4.2.3 Other Potential Sources of Impacts in the Environmental Baseline

Coastal Development

Beachfront development, lighting, and beach erosion control all are ongoing activities along the mid-Atlantic and south Atlantic coastlines of the United States. These activities potentially reduce or degrade sea turtle nesting habitats or interfere with hatchling movement to sea. Nighttime human activities along nesting beaches may also discourage sea turtles from nesting sites. The extent to which these activities reduce sea turtle nesting and hatchling production is unknown. However, more and more coastal counties are adopting stringent protective measures to protect hatchling sea turtles from the disorienting effects of beach lighting.

Maritime Industry

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

Marine Pollution (Other than the DWH Oil Spill)

While some sources of marine pollution are difficult to attribute to a specific federal, state, local or private action, they may indirectly affect sea turtles in the action area. Sources of pollutants include atmospheric loading of pollutants such as PCBs and stormwater runoff from coastal towns and cities into rivers and canals emptying into bays and the ocean (e.g., Mississippi River). There are studies on organic contaminants and trace metal accumulation in green, leatherback, and loggerhead sea turtles (Aguirre et al. 1994; Caurant et al. 1999; Corsolini et al. 2000). McKenzie et al. (1999) measured concentrations of chlorobiphenyls and organochlorine pesticides in sea turtles tissues collected from the Mediterranean (Cyprus, Greece) and European Atlantic waters (Scotland) between 1994 and 1996. Omnivorous loggerhead turtles had the highest organochlorine contaminant concentrations in all the tissues sampled, including those from green and leatherback turtles (Storelli et al. 2008b). It is thought that dietary preferences were likely to be the main differentiating factor among species. Decreasing lipid contaminant burdens with sea turtle size were observed in green turtles, most likely attributable to a change in diet with age. (Sakai et al. 1995) documented the presence of metal residues occurring in loggerhead sea turtle organs and eggs. Storelli et al. (1998)

analyzed tissues from 12 loggerhead sea turtles stranded along the Adriatic Sea (Italy) and found that characteristically, mercury accumulates in sea turtle livers while cadmium accumulates in their kidneys, as has been reported for other marine organisms like dolphins, seals, and porpoises (Law et al. 1991a). No information on detrimental threshold concentrations is available and little is known about the consequences of exposure of organochlorine compounds to sea turtles. Research is needed into how chlorobiphenyl, organochlorine, and heavy-metal accumulation effect the short- and long-term health of sea turtles and what effect those chemicals have on the number of eggs laid be females.

Nutrient loading from land-based sources, such as coastal communities and agricultural operations, stimulate plankton blooms in closed or semi-closed estuarine systems. The effects on larger embayments are unknown. An example is the large area of the Louisiana continental shelf with seasonally depleted oxygen levels (< 2 mg/liter) is caused by eutrophication from both point and non-point sources. The oxygen depletion, referred to as hypoxia, begins in late spring, reaches a maximum in mid-summer, and disappears in the fall. Since 1993, the average extent of mid-summer, bottom-water hypoxia in the northern Gulf of Mexico has been approximately 16,000 km^2, approximately twice the average size measured between 1985 and 1992. The hypoxic zone attained a maximum measured extent in 2002, when it was about 22,000 km^2 – larger than the state of Massachusetts. This zone was predicted to reach its largest area in 2011 (Rabalais et al. 2010), between 22,253 km^2 and 26,515 km^2 (average 24,400 km^2; 9,421 mi^2) of the bottom of the continental shelf off Louisiana and Texas. Data on the 2011 season is still being collated. The hypoxic zone negatively impacts sea turtles' habitats, prey availability, and survival and reproductive fitness.

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

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

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

NMFS has implemented a series of regulations aimed at reducing potential for incidental mortality of sea turtles from commercial fisheries in the action area. These include sea turtle release gear requirements for the Atlantic HMS, South Atlantic snapper-grouper, and Gulf of Mexico reef fish fisheries, TED requirements for the Southeast shrimp trawl

and North Carolina flynet fisheries, mesh size restrictions in the North Carolina gillnet fishery and Virginia's gillnet and pound net fisheries, and area closures in the North Carolina gillnet fishery. In addition to regulations, outreach programs have been established and data on sea turtle interactions with recreational fisheries has been collected through the Marine Recreational Fishery Statistical Survey (MRFSS)/Marine Recreational Information Program. The summaries below discuss all of these measures in more detail.

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

NMFS published Final Rules to implement sea turtle release gear requirements and sea turtle careful release protocols in the Gulf of Mexico reef fish (August 9, 2006; 71 FR 45428) and South Atlantic snapper-grouper fisheries (November 8, 2011; 76 FR 69230). These measures require owners and operators of vessels with federal commercial or charter vessel/headboat permits for Gulf reef fish and South Atlantic snapper-grouper to comply with sea turtle (and smalltooth sawfish) release protocols and have on board specific sea turtle-release gear.

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

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

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

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

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

Use of a Chain-Mat Modified Scallop Dredge in the Mid-Atlantic
In response to the observed capture of sea turtles in scallop dredge gear, including serious injuries and sea turtle mortality because of capture, NMFS proposed a modification to scallop dredge gear (70 FR 30660, May 27, 2005). The rule was finalized as proposed (71 FR 50361, August 25, 2006) and required federally permitted scallop vessels fishing with dredge gear to modify their gear by adding an arrangement of horizontal and vertical chains (hereafter referred to as a "chain mat") between the sweep and the cutting bar when fishing in mid-Atlantic waters south of 41°9'N from the shoreline to the outer boundary of the EEZ during the period of May 1-November 30 each year. In November 2007, NMFS re-proposed the chain-mat modified dredge requirements in the sea scallop fishery, with some modifications (72 FR 63537). That action added a transiting provision and clarified the regulatory text regarding the chain mat-modified gear including specifying that the spaces formed by the intersecting chains must have no more than 4 sides and the length of each side of the opening must be less than or equal to 14 inches (73 FR 18984, April 8, 2008). In 2009, the chain mat regulations were further modified

by NMFS in a Rule that (a) clarified where on the dredge the chain mat should be hung, (b) excluded the sweep from the requirement that the side of each opening in the chain mat be less than or equal to 14 inches, and (c) added definitions of the sweep and the diamonds, which are terms used to describe parts of the scallop dredge gear (74 FR 46930; September 14, 2009).

4.2.5 State Actions to Conserve Sea Turtles

State actions to regulate fisheries within their jurisdiction include the 1998 implementation of the Year 1 requirements of Amendment 3 to the Atlantic States Marine Fisheries Commission's Coastal Fishery Management Plan for American Lobster. Regulations are geared toward reducing lobster fishing effort by 2005 to reverse the overfished status of the resource. States in the 6 coastal areas must implement regulations according to a compliance schedule established in Amendment 3. Several states implemented trap caps for 1998. Further trap limits will generate some localized risk reduction for protected species in those areas. If all states elect to implement a significant trap reduction program, the overall entanglement risk would be substantially reduced.

The North Carolina Division of Marine Fisheries (NCDMF) took more unilateral conservation measures on October 27, 2000, when it closed waters in the southeastern portion of the Pamlico Sound as a result of elevated captures by the commercial large-mesh flounder gillnet fishery. The fishery was closed when anticipated incidental take levels were met for green sea turtles. The NCDMF estimated that there were 50 loggerheads captured at the time of closure and that 44 of those had been drowned (NMFS-SEFSC 2001). The fishery was subsequently reopened under a Section 10(a)(1)(B) permit, and NCDMF is currently working to renew that permit.

In 2001, the Commonwealth of Virginia implemented restrictions on gillnets to reduce interactions with sea turtles. Specifically, from May 1 through June 30, each operation was limited to 8,400 ft of gillnet and the use of tie-downs was prohibited in the main stem of the Chesapeake Bay and territorial sea. From June 1-30, large mesh gillnets were prohibited south of Smith Island Light. On May 1, 2005, Virginia enacted a series of further restrictions on large-mesh gillnets which effectively precludes the development of a large-mesh gillnet monkfish fishery in state waters and adding additional restrictions to the other large-mesh gillnet fisheries (striped bass and black drum).

4.2.6 Other Sea Turtle Conservation Efforts

Sea Turtle Handling and Resuscitation Techniques

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

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

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

Other Actions
The second revision to the recovery plan for the loggerhead sea turtle was completed January 11, 2009 (NMFS and USFWS 2009). The recovery plan for the Kemp's ridley sea turtle was published 2011 (NMFS et al. 2011b). Recovery teams comprised of sea turtle experts have been convened and are currently working towards revising these plans based upon the latest and best available information. Five-year status reviews were completed in 2007 for green, hawksbill, Kemp's ridley, and leatherback sea turtles. A review of the loggerhead sea turtle's status was conducted in 2009 (Conant et al. 2009). These reviews were conducted to comply with the ESA mandate for periodic status evaluation of listed species to ensure that their threatened or endangered listing status remains accurate. The reviews for green, hawksbill, Kemp's ridley, and leatherback sea turtles determined that no delisting or reclassification of a species status (i.e., threatened or endangered) was warranted at this time. However, further review of species data for the green, hawksbill, and leatherback sea turtles was recommended, to evaluate whether DPS should be established for these species (NMFS and USFWS 2007a; NMFS and USFWS 2007b; NMFS and USFWS 2007f).

4.3 Factors Affecting Smalltooth Sawfish within the Action Area

The following analysis examines actions that may affect this species and its environment specifically within the action area. The activities that shape the environmental baseline in the action area of this consultation are primarily federal fisheries. Other environmental impacts include effects of permits allowing take under the ESA, marine pollution, and coastal development.

4.3.1 Federal Actions

In recent years, NMFS has undertaken Section 7 consultations to address the effects of federally permitted fisheries and other federal actions on smalltooth sawfish, and when appropriate, has authorized the incidental taking of this species. Each of those

consultations sought to minimize the adverse impacts of the action on smalltooth sawfish. The following sections summarize anticipated sources of incidental take of smalltooth sawfish in the action area that have already concluded formal Section 7 consultation.

4.3.1.1 Federal Fisheries

HMS Shark and Smoothhound Fisheries

These fisheries include commercial shark bottom longline and gillnet fisheries and recreational shark fisheries under the FMP for Atlantic Tunas, Swordfish, and Sharks (HMS FMP). NMFS has formally consulted 3 times on the effects of HMS shark fisheries on smalltooth sawfish (NMFS 2003b; NMFS 2008e; NMFS 2012h). NMFS also began authorizing a federal smoothhound fishery that will be managed as part of the HMS shark fisheries. NMFS (2012h) considered the potential adverse effects from the smoothhound fishery on smalltooth sawfish for the first time. Both bottom longline and gillnet are known to adversely affect smalltooth sawfish. From 2007-2011, the sandbar shark research fishery had 100% observer coverage and with 4-6% observer coverage in the remaining shark fisheries. During that period, smalltooth sawfish were only observed taken in bottom longline gear. Sixteen smalltooth sawfish captures were observed in the sandbar shark research fishery and 6 were taken outside the research fishery (Carlson and Richards 2011); 1 take in the shark bottom longline fishery resulted in mortality. The 6 non-research fishery captures were extrapolated to the entire fishery, providing an estimate of 17.3 total smalltooth sawfish captures for non-sandbar shark research fishery. Since the research fishery has a 100% observer-coverage requirement those observed captures were not extrapolated (Carlson and Richards 2011). No captured smalltooth sawfish have been observed in the smoothhound fishery.

The most recent ESA Section 7 consultation was completed on December 12, 2012, on the continued operation of HMS shark fisheries and Amendments 3 and 4 to the Consolidated HMS FMP (NMFS 2012h). The consultation concluded the proposed action was not likely to jeopardize the continued existence of the smalltooth sawfish. Appendix A reports the smalltooth sawfish incidental takes authorized for this fishery.

Gulf of Mexico Reef Fish Fishery

NMFS completed a Section 7 consultation on the continued authorization of the fishery on October 13, 2009 (NMFS 2009f)). The fishery uses 3 basic types of gear: spear and powerhead, trap, and hook-and-line gear. Hook-and-line gear used in the fishery includes both commercial bottom longline and commercial and recreational vertical line (e.g., handline, bandit gear, rod and reel). The Biological Opinion concluded that smalltooth sawfish may be adversely affected by operation of the fishery. However, the proposed action was not expected to jeopardize the continued existence of this species. In August 2011, consultation was reinitiated to address the DWH oil release event and potential changes to the environmental baseline. Reinitiation of consultation was not related to any material change in the fishery itself, violations of any terms and conditions of the 2009 Opinion or an exceedance of the incidental take statement. The resulting September 11, 2011 Opinion concluded the continued operation of the Gulf of Mexico reef fish fishery is not likely to jeopardize the continued existence of the smalltooth sawfish and an ITS

was issued (NMFS 2011d). Appendix A reports the smalltooth sawfish incidental takes authorized for this fishery.

Southeastern U.S. Shrimp Fisheries

NMFS has also conducted Section 7 consultations on the impacts to smalltooth sawfish from the shrimp fisheries in the Gulf of Mexico (NMFS 2006a) and the South Atlantic (NMFS 2005e). Both of these consultations found these fisheries likely to adversely affect smalltooth sawfish, but not likely jeopardize its continued existence. The ITS provided in those Biological Opinions anticipated the lethal take of up to 1 smalltooth sawfish annually in each of these 2 fisheries. Between May 2009 and March 2010, NMFS requested reinitiation of Section 7 consultation on the South Atlantic and Gulf of Mexico shrimp fisheries to analyze their effects on smalltooth sawfish, because new observer data indicated that the incidental take statements of the respective Biological Opinions had been exceeded. On May 9, 2012, NMFS completed the new Opinion which analyzed the continued implementation of the Southeast U.S. shrimp fisheries in federal waters under the Magnuson-Stevens Fisheries Conservation and Management Act. 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 was not likely to jeopardize the continued existence of smalltooth sawfish. An ITS was provided.

On November 21, 2012, NMFS determined that a Final Rule requiring TEDs in skimmer trawls, pusher-head trawls, and wing nets was not warranted and withdrew the proposal. The decision to not implement the Final Rule created a change to the proposed action analyzed in the 2012 Opinion and triggered the need to reinitiate consultation. Consequently, NMFS reinitiated consultation on November 26, 2012. Consultation was completed in April 2014, and NMFS determined the continued implementation of the sea turtle conservation regulations and the continued authorization of the southeast U.S. shrimp fisheries in federal waters under the Magnuson-Stevens Act was not likely to jeopardize the continued existence smalltooth sawfish. An ITS was issued and Appendix A reports the smalltooth sawfish incidental takes authorized for this fishery.

Coastal Migratory Pelagic Fishery

NMFS recently completed a Section 7 consultation on the continued authorization of the coastal migratory pelagic fishery in the Gulf of Mexico and South Atlantic (NMFS 2007b). In the Gulf of Mexico, hook-and-line, gillnet, and cast net gears are used. Gillnets are the primary gear type used by commercial fishers in the South Atlantic, while the recreational sector uses hook-and-line gear. The Biological Opinion concluded that smalltooth sawfish may be adversely affected by operation of the fishery. However, the proposed action was not expected to jeopardize its continued existence, and an ITS was provided. Appendix A reports the smalltooth sawfish incidental takes authorized for this fishery.

South Atlantic Snapper-Grouper Fishery
A Section 7 consultation on the fishery was completed by NMFS on June 7, 2006 (NMFS 2006b). The fishery uses spear and powerhead, black sea bass pot, and hook-and-line gear. Hook-and-line gear used in the fishery includes both commercial bottom longline and commercial and recreational vertical line (e.g., handline, bandit gear, rod and reel). The consultation concluded the hook-and-line component of the fishery was likely to adversely affect smalltooth sawfish, but was not likely to jeopardize its continued existence. An ITS was issued for takes in the hook-and-line component of the fishery.

Spiny Lobster Fishery
NMFS completed a Section 7 consultation on the Gulf and South Atlantic Spiny Lobster FMP on August 27, 2009 (NMFS 2009e). The commercial component of the fishery consists of diving, bully net and trapping sectors; recreational fishers are authorized to use bully net, and hand-harvest gears. Of the gears used, traps are expected to result in adverse effects on smalltooth sawfish. The consultation determined the continued authorization of the fishery would not jeopardize any listed species. An ITS was issued for takes in the commercial trap sector of the fishery.

4.4.1.2 Construction and Operation of Public Fishing Piers

NMFS has also consulted with the USACE on the construction and operation of a number of fishing piers that may have adverse effects to smalltooth sawfish. The Opinions evaluated the potential impacts of recreational fishing from these piers on smalltooth sawfish.

Lantana Fishing Pier, Palm Beach County, Florida
NMFS issued a Biological Opinion on June 8, 2012, to the Palm Beach County Board of County Commissioner's Engineering and Public Works Department (NMFS 2012c) to construct a new 3,092-ft^2 concrete fishing pier. The Opinion concluded the project was likely to adversely affect smalltooth sawfish, but it was not likely to jeopardize their continued existence. The Opinion authorized the nonlethal take of 2 smalltooth sawfish a year.

Flagler Beach Pier, Flagler County, Florida
NMFS issued a Biological Opinion on June 26, 2012, to the City of Flagler Beach to repair and operate the Flagler Beach Pier using FEMA funds (NMFS 2012b). The Opinion concluded that while the project was likely to adversely affect smalltooth sawfish, it was not likely to jeopardize its continued existence. The Opinion authorized 1 nonlethal smalltooth sawfish capture every 2 years.

Newport Fishing Pier, City of Sunny Isles Beach, Miami-Dade County, Florida
NMFS issued a Biological Opinion to the USACE on August 15, 2011, for the subject project (NMFS 2011e). The City of Sunny Isles Beach proposed to build a public fishing pier and restaurant to be used for fishing and recreational activities in conjunction with an upland public beachfront park. The project required demolition of the existing Newport Fishing Pier and restaurant that have been closed since June 2007 due to general

deterioration and damage from Hurricane Wilma in 2005. The new pier was to be built in the approximate footprint of the current pier and measure approximately 750-ft long. The Opinion concluded that while the project was likely to adversely affect smalltooth sawfish, it was not likely to jeopardize their continued existence. The Opinion authorized 2 nonlethal smalltooth sawfish takes each year.

South Pointe Park Fishing Pier, City of Miami Beach, Miami-Dade County, Florida
NMFS issued a Biological Opinion to the USACE on September 4, 2012, for the subject project (NMFS 2012d). The City of Miami Beach proposed to demolish an existing 10,083-ft^2 public fishing pier at South Pointe Park, including the removal of 82 existing concrete piles, and install a new 10,095-ft^2 fishing pier with 61 reinforced concrete piles. The Opinion concluded that while the project was likely to adversely affect smalltooth sawfish, it was not likely to jeopardize their continued existence. The Opinion authorized 2 nonlethal smalltooth sawfish takes each year.

City of Bradenton Fishing Pier and Docking Facility, Manatee County, Florida
NMFS issued a Biological Opinion to the USACE on January 20, 2012, for the subject project (NMFS 2012e). The City of Bradenton proposed to improve a public waterfront park by constructing a day-use boat slip dock and replacing an existing dilapidated fishing pier. The Opinion concluded that while the project was likely to adversely affect smalltooth sawfish, it was not likely to jeopardize its continued existence. The Opinion authorized 1 nonlethal smalltooth sawfish take over consecutive 4-year periods.

Sunshine Key RV Park Fishing Pier, Monroe County, Florida
NMFS issued a Biological Opinion to the USACE on April 21, 2014, for the subject project (NMFS 2014f). The Sunshine Key RV Park proposed to rebuild a previously existing fishing pier. The Opinion concluded that while the project was likely to adversely affect smalltooth sawfish, it was not likely to jeopardize their continued existence. The Opinion authorized 3 nonlethal smalltooth sawfish take over consecutive 3-year periods.

4.4.1.3 ESA Section 10 Permits

Section 10(a)(1)(A) of the ESA allows NMFS to issue permits for the taking of ESA-listed species for scientific research or enhancement purposes. NMFS consults with itself to ensure that its issuance of these permits can be done in compliance with Section 7 of the ESA. There are currently 3 active research permits issued for smalltooth sawfish. The permit allows researchers to capture, handle, collect tissue and blood samples, and tag smalltooth sawfish. Although the research may result in disturbance and injury of smalltooth sawfish, the activities are not expected to affect the reproduction of the individuals that are caught, nor result in mortality. No Section 10 (a)(1)(B) have ever been issued for the capture of smalltooth sawfish.

Research on smalltooth sawfish is currently being conducted by NMFS's SEFSC and the FWCC, Fish and Wildlife Research Institute, and the Florida Museum of Natural History at the University of Florida. Surveys are conducted with longlines, gillnets, and seine

nets in southwest Florida, as well as in South Florida and the northern Indian River Lagoon. Cooperating fishers, guides, and researchers are also reporting smalltooth sawfish they encounter. Data collected are providing new insight on the species' current distribution, abundance, and habitat use patterns.

4.3.2 State or Private Actions

A significant proportion of the Florida coast has been degraded by inland hydrological projects, urbanization, agricultural activities, and other anthropogenic activities such as dredging, canal development, sea wall construction, and mangrove clearing. These activities have led to the loss and degradation of smalltooth sawfish habitat and may adversely affect their recovery.

Entanglement in state trap/pot fisheries is another potential route of effect to smalltooth sawfish. The State of Florida's stone crab fishery is an example of a state trap fishery that may interact with smalltooth sawfish. On October 15, 2011, NMFS repealed the federal FMP for stone crab. Prior to the repeal, NMFS prepared a Biological Opinion on the continued authorization of the federal fishery. The Opinion concluded the federal stone crab fishery was likely to adversely affect smalltooth sawfish, but it was not likely to jeopardize their continued existence. The State of Florida now exclusively manages the stone crab fishery, even vessels fishing in the EEZ. The State of Florida has actively managed the fishery since 1929; the federal FMP was implemented in 1979 to address gear conflicts. The federal fishery was managed primarily by issuing regulations complimentary to those promulgated by the State of Florida. Since the State of Florida has essentially been the lead management agency for the state and federal fishery for some time, little change in how the fishery operates or amount of the effort occurring in the fishery is expected because of the repeal of the federal FMP. Therefore, the anticipated adverse effects described in the Biological Opinion completed before the repeal of the federal FMP are expected to continue to occur to smalltooth sawfish.

The incidental capture of sawfish by private recreational fishers has been documented in the action area and adjacent nearshore areas. Additionally, lost fishing gear such as line cut after snagging on rocks, or discarded hooks and line, can also pose an entanglement threat to smalltooth sawfish in the area.

4.3.3 Other Potential Sources of Impacts in the Environmental Baseline

Marine Pollution

Smalltooth sawfish have been encountered with polyvinyl pipes and fishing gear entangled on their toothed rostrum (Seitz and Poulakis 2006). The same sources of pollutants described previously for sea turtles (see Section 4.2.3.4) may also adversely affect smalltooth sawfish. The impacts of the DWH oil spill on smalltooth sawfish are unknown. Smalltooth sawfish may be adversely affected by oil, but at this time, there is no evidence documenting effects on smalltooth sawfish from the DWH oil spill.

4.3.4 Conservation and Recovery Actions Shaping the Environmental Baseline

Regulations restricting the use of gear known to incidentally catch smalltooth sawfish may benefit the species by reducing their incidental capture and/or mortality in these gear types. In 1994, entangling nets (including gillnets, trammel nets, and purse seines) were banned in Florida state waters. Although intended to restore the populations of inshore gamefish, this action removed possibly the greatest source of fishing mortality on smalltooth sawfish (Simpfendorfer 2002). Florida's ban of the use of shrimp trawls within 3 nmi of the Gulf Coast may also aid recovery of this species.

Public Outreach

Public outreach efforts are also helping to educate the public on smalltooth sawfish status and proper handling techniques and helping to minimize interaction, injury, and mortality of encountered smalltooth sawfish. Information regarding the status of smalltooth sawfish and what the public can do to help the species is available on the websites of the Florida Museum of Natural History,[28] NMFS,[29] and the Ocean Conservancy.[30] Reliable information is also available at websites maintained by noted sawfish expert Matthew McDavitt.[31] These organizations and individuals also educate the public about sawfish status and conservation through regular presentations at various public meetings.

Smalltooth Sawfish Recovery Plan

In September 2003, NMFS convened a smalltooth sawfish recovery team. Under Section 4(f)(1) of the ESA, NMFS is required to develop and implement recovery plans for the conservation and survival of endangered and threatened species. The final smalltooth sawfish recovery plan published on January 21, 2009 (74 FR 3566). The recovery plan is available at http://sero.nmfs.noaa.gov/pr/SmalltoothSawfish.htm.

Designation of Critical Habitat

On September 2, 2009, NMFS designated critical habitat for smalltooth sawfish (74 FR 45353). The designated critical habitat comprises 2 units off southwestern Florida – the Charlotte Harbor Estuary and the Ten Thousand Island/Everglades unit – comprising approximately 619,013 ac. These areas contain the physical and biological features deemed essential for the conservation of the species because they provide nursery habitat functions for juvenile smalltooth sawfish.

4.4 Factors Affecting Shortnose Sturgeon in the Action Area

The following analysis examines actions that may affect the shortnose sturgeon or its environment specifically within the action area. The environmental baseline for this Opinion includes the effects of several activities affecting the survival and recovery of

[28] http://www.flmnh.ufl.edu/fish/Sharks/Sawfish/SRT/srt.htm
[29] http://www.sero.nmfs.noaa.gov/pr/SmalltoothSawfish.htm
[30] http://www.oceanconservancy.org/site/PageServer?pagename=fw_sawfish
[31] http://hometown.aol.com/nokogiri/

the shortnose sturgeon. The activities that shape the environmental baseline in the action area of this consultation are primarily dams and hydroelectric projects. Other environmental impacts include effects of dredging, permits allowing take under the ESA, state fisheries, and riverine pollution.

4.4.1 Federal Actions

Dams/Hydropower Project

There are several dam/hydropower projects within the southeast region that impact sturgeon. In 2007, FERC submitted to NMFS their Final Environmental Impact Statement and requested formal consultation regarding the re-licensing of the Santee Cooper Hydroelectric Project, because renewing the license was likely to adversely affect the shortnose sturgeon. In July 2010, a draft Biological Opinion containing a reasonable and prudent alternative to reduce the effects of Santee Cooper Project was issued. NMFS supplied FERC with a copy of the draft Biological Opinion for review. NMFS is currently working with the license applicant and FERC on requirements for a final Biological Opinion.

On July 8, 2013, NMFS completed formal consultation on the Federal Energy Regulatory Commission proposal to issue a 40-year operating license to Duke Energy Carolinas, LLC for the Catawba-Wateree Hydroelectric Project. The Opinion determined the project would increase water flows to an extent that downstream foraging and spawning habitat in the future would be greater than today. It also determined newly installed aerating hydro units would improve downstream water quality and spawning habitat. However, migrating shortnose and Atlantic sturgeon in the Wateree River will be unable to access upstream habitat beyond the Wateree Dam. Ultimately, the Opinion concluded the project would adversely affect, but not jeopardize, the continued existence of shortnose or Atlantic sturgeon. An ITS was issued (NMFS 2013c).

On April 29, 2013, NMFS completed formal consultation on the Federal Energy Regulatory Commission proposal to issue a 40-year operating license to Duke Energy Carolinas, LLC for the Yadkin-Pee Dee Hydroelectric Project. The Opinion determined the proposed water flows were likely to increase the amount and suitability of spawning habitat downstream of Blewett Falls Dam and the amount of time that habitat could be used. However, the project would still reduce peak flow rates, riverine flushing, floodplain inundation, foraging habitat quality and quantity, and spawning habitat quantity and quality. All of these will adversely affect sturgeon. Ultimately, the Opinion concluded the project would adversely affect, but not jeopardize, the continued existence of shortnose or Atlantic sturgeon. The applicant challenged the legality of the Opinion and as a result of a settlement, NMFS issued a revised Opinion in 2015 that includes different monitoring methods and requirements. The Opinion includes surrogate measures for take of sturgeon that is not practical to detect directly.

ESA Permits
Through issuance of ESA Section 10(a)(1)(A) permits, scientific and enhancement studies are conducted by researchers on captive shortnose sturgeon maintained at various quarantined research facilities. Researchers employed by USFWS, USGS, the University of Florida, and 1 private facility are currently authorized to study captive shortnose sturgeon. These captive individuals are periodically conditioned and spawned. The resulting gametes and progeny are used for scientific studies, such as cryogenics, disease transmission, nutrition, genetics, toxicology, fish passage, and fish culture techniques.

There are currently 17 Section 10(a)(1)(A) scientific research permits issued to study shortnose sturgeon in the rivers of the United States. The studies near or within the action area are described in Table 4.4. Each permit authorizes sampling of adult/juvenile shortnose sturgeon, and some authorize collection of early life stages (ELS). Individual permits have varying objectives, depending on the research objectives of researchers. Each permit approves sampling methodology and authorizes incidental take.

Table 4.4. Current ESA Section 10(a)(1)(A) Permits for Shortnose Sturgeon Research in the Action Area

Permit Number	Location	Authorized Take	Research Activity
10115	Satilla & Saint Marys Rivers, GA & FL	85 adults/juveniles 20 ELS	Capture, handle, measure, weigh, PIT tag, tissue sample, collect ELS
14394	Altamaha River and Estuary, GA	500 adults/juveniles (1 lethal), 100 ELS	Capture, handle, weigh, measure, PIT tag, transmitter tag, tissue sample, anesthetize, laparoscopy, blood collection, fin ray section, collect ELS
10037	Ogeechee River and Estuary, GA	150 adults/juveniles (2 lethal), 40 ELS	Capture, handle, measure, weigh, PIT tag, tissue sample, fin-ray section, anesthetize, laparoscopy, blood collection, radio tag, collect ELS
15677	South Carolina Rivers and Estuaries	154 adults/juveniles, 100 ELS	Capture with gill & trammel net or trawl, measure, weigh, photograph/video, dart tag, PIT tag, genetic tissue sample, anesthetize, laparoscopy, gonadal biopsy, blood sample; collect ELS
14759	North Carolina Rivers	70 adults/juveniles	Capture, handle, weigh measure, Floy tag, PIT tag, genetic tissue sample; anesthetize acoustic tag
ELS = Early life stage individuals			
PIT Tag = Passive Integrated Transponder			

Dredging
Riverine, nearshore, and offshore areas are often dredged to support commercial shipping, recreational boating, construction of infrastructure, and marine mining. Dredging activities can pose significant impacts to sturgeon through direct capture. Environmental impacts of dredging that could also impact sturgeon include the

following: (1) direct removal/burial of organisms; (2) turbidity/siltation effects; (3) contaminant resuspension; (4) noise/disturbance; (5) alterations to hydrodynamic regime and physical habitat; and (6) loss of riparian habitat (Chytalo 1996; Winger et al. 2000).

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

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

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

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

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

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

other federal and state resource agencies to help insure the success of all mitigative measures including the fish passage facility.

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

On September 19, 2012, NMFS completed a consultation on the USACE's proposed deepening of the Wilmington Harbor. The Opinion considered the following effects: the blasting and dredging, sedimentation, the disposal of dredged material, dredging-related vessel traffic, dredging on sturgeon prey species, changes in salinity, changes in dissolved oxygen, and changes to sturgeon spawning. The Opinion concluded that only the blasting and dredging portions of the project were likely to adversely affect sturgeon, but would not jeopardize their continued existence. An ITS was issued for the nonlethal incidental capture (n = 20) and non-injurious harassment (n = 2) of shortnose sturgeon.

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

4.4.2 State Actions or Private Actions

Fisheries

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

The commercial shad fisheries in Georgia incidentally capture shortnose sturgeon. Georgia implemented regulations restricting fishing to the lower portions of the Savannah, Ogeechee, and Altamaha Rivers and close the fishery in the Satilla and St. Marys River to reduce sturgeon bycatch. The Georgia shad fishery is open from January 1 to as late as April 30 each year, but would typically end March 31. Georgia applied for, and received, an Incidental Take Permit from NMFS in 2013. The biological opinion evaluating the permit request determined the continued operation of the fishery was likely to adversely affect shortnose sturgeon but would not jeopardize its continued existence. NMFS determined that incidental capture by fisherman will not exceed 140 shortnose sturgeon per year (no more than 420 in a 3-year period) in the Altamaha River, 70 shortnose sturgeon per year (no more than 210 in a 3-year period) in the Savannah River, and 5 shortnose sturgeon per year (no more than 20 in a 3-year period) in the Ogeechee River. The biological opinion anticipated a mortality rate of approximately 2.3% is anticipated (NMFS 2013e).

In North Carolina, interactions between shortnose sturgeon and state fisheries appear to be rate. The 2010 shortnose sturgeon biological assessment (NMFS 2010) reports that a majority of river systems in North Carolina likely do not presently support shortnose sturgeon populations. The biological assessment also indicates the last report of shortnose sturgeon in North Carolina came from fishery observers monitoring commercial gillnet fisheries in Pamlico Sound, in 2005. However, no documentation for these specimens (tissue, photographs, or preserved specimens) exists and presently it is thought to be a misidentified Atlantic sturgeon given location and timing (NMFS 2010). North Carolina has not applied for an Incidental Take Permit to address shortnose sturgeon takes in their commercial fisheries.

Captures of shortnose sturgeon have been documented in the commercial shad gillnet fishery in South Carolina. South Carolina has not applied for an Incidental Take Permit to address shortnose sturgeon takes in their commercial fisheries. American shad are found in at least 19 rivers of South Carolina (Waccamaw, Great Pee Dee, Little Pee Dee, Lynches, Black, Sampit, Bull Creek, Santee, Cooper, Wateree, Congaree, Broad, Wando, Ashley, Ashepoo, Combahee, Edisto, Coosawhatchie, and Savannah rivers), many of which also support shortnose sturgeon. Because of collapsing shad stocks, the ASMFC amended their existing Interstate Fishery Management Plan for Shad and River Herring in February 2010. The Amendment prohibited commercial and recreational fisheries shad fisheries state waters beginning January 1, 2013, unless State's developed a management plan approved by the ASMFC. South Carolina developed such a plan. Included within the plan were specific measures meant to address sturgeon bycatch including: reductions in length of individual nets, reductions in the number nets allowed per fishing license, increased net check frequency, area restrictions, and seasonal restrictions (SCDNR 2012). Table 4.5 provides a summary of self-reported effort and incidental bycatch of shortnose sturgeon by commercial shad gill net fishery in the Santee River, South Carolina, as reported to the Atlantic States Marine Fisheries Commission. Mandatory reporting began in 2000. There are no data to separate total number of sturgeon into unique and recaptured individuals.

Table 4.5 Self-Reported Effort and Incidental Bycatch of Shortnose Sturgeon by Commercial Shad Gillnet Fishery in the Santee River, South Carolina.

Year	Annual Number of Trips	No. of Shortnose Sturgeon
2009	712	9
2008	607	25
2007	590	25
2006	466	12
2005	577	0
2004	696	3
2003	538	1
2002	676	9
2001	727	2
2000	903	10

4.4.3 Conservation Activities Benefitting Shortnose Sturgeon

Federal Actions
NMFS finalized the Recovery Plan for the Shortnose Sturgeon in 1998 as required by ESA Section 4. The Recovery Plan identified 19 discrete riverine populations of shortnose sturgeon (NMFS 1998c). The 1998 Shortnose Sturgeon Recovery Plan also identified 4 main recovery actions: (1) establish listing criteria for shortnose sturgeon population segments; (2) protect shortnose sturgeon and their habitats; (3) rehabilitate shortnose sturgeon populations and habitats; and (4) implement recovery tasks. To rehabilitate shortnose sturgeon habitats and population segments, the Recovery Plan specifically calls for actions to restore access to habitats, spawning habitat and conditions, and foraging habitat (NMFS 1998c).

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

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

4.5 Factors Affecting Atlantic Sturgeon in the Action Area

4.5.1 Federal Actions

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

4.5.1.1 Fisheries

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

Atlantic Bluefish Fishery

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

Coastal Migratory Pelagic Resources Fisheries

NMFS completed a Section 7 consultation on the continued authorization of the coastal migratory pelagic resources fishery in the Gulf of Mexico and South Atlantic (NMFS 2015a). 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 2015a). The consultation concluded that the continued operation of the coastal migratory pelagic resources fishery in the Gulf of Mexico and South Atlantic was likely to adversely affect, but not jeopardize, the continued existence of any DPS of Atlantic sturgeon. Incidental take was authorized.

Mackerel/Squid/Butterfish Fisheries
Atlantic mackerel/squid/butterfish fisheries are managed under a single FMP, which was first implemented on April 1, 1983. Trawl gear is the primary fishing gear for these fisheries, but several other types of gear may also be used, including hook-and-line, pot/trap, dredge, pound net, and bandit gear. The most recent consultation on the fishery was completed in December 2013 as part of the larger batched consultation (described above). The consultation concluded that the continued operation of the mackerel/squid/butterfish fisheries were likely to adversely affect, but not jeopardize, the continued existence of any DPS of Atlantic sturgeon. Incidental take was authorized.

Monkfish Fishery
The federal monkfish fishery occurs from Maine to the North Carolina/South Carolina border and is jointly managed by the New England Fishery Management Council (NEFMC) and Mid-Atlantic Fishery Management Council, under the Monkfish FMP (NEFSC 2005). Monkfish are primarily caught with bottom trawls and gillnets. Dredges also account for a small percentage of landings. The majority (73%) of all Atlantic sturgeon bycatch mortality in New England and mid-Atlantic waters is attributed to the monkfish sink gillnet fishery (Shepherd et al. 2007) . Observer data from 2001-2006 shows 224 recorded interactions between the monkfish fishery and Atlantic sturgeon, with 99 interactions resulting in death, a 44% mortality rate for Atlantic sturgeon that are taken as bycatch. The most recent consultation on the fishery was completed in December 2013 as part of the larger batched consultation (described above). The consultation concluded that the continued operation of the monkfish fishery was likely to adversely affect, but not jeopardize, the continued existence of any DPS of Atlantic sturgeon. Incidental take was authorized.

Northeast Multi-species Fishery
The fishery includes the following species: American plaice, Atlantic cod, Atlantic halibut, Atlantic wolffish, haddock, ocean pout, offshore hake, pollock, redfish, red hake, silver hake, white hake, windowpane flounder, winter flounder, witch flounder, and yellowtail flounder. The Northeast multispecies sink gillnet fishery has historically occurred from the periphery of the Gulf of Maine to Rhode Island in water as deep as 360 ft. In recent years, more of the effort in the fishery has occurred in offshore waters and into the mid-Atlantic. Participation in this fishery has declined because extensive groundfish conservation measures have been implemented, the latest of these occurring under Amendment 13 to the Multispecies Fisheries Management Plan (NEFMC 2009). A significant reduction in effort in the fishery is expected because of the Amendment 13 measures. The most recent consultation on the fishery was completed in December 2013 as part of the larger batched consultation (described above). The consultation concluded that the continued operation of the fishery was likely to adversely affect, but not jeopardize, the continued existence of any DPS of Atlantic sturgeon; incidental take was authorized.

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

Skate Fishery
The skate fishery has typically been composed of both a directed fishery and an incidental fishery. Otter trawls are the primary gear used to land skates in the United States, with some landings also coming from sink gillnet, longline, and other gear (NEFSC 2007b). For Section 7 purposes, NMFS considered the effects to ESA-listed species of the directed skate fishery. Fishing effort that contributes to landings of skate for the incidental fishery is considered during Section 7 consultation on the directed fishery in which skate bycatch occurs. The most recent consultation on the fishery was completed in December 2013 as part of the larger batched consultation (described above). The consultation concluded that the continued operation of the skate fishery was likely to adversely affect, but not jeopardize, the continued existence of any DPS of Atlantic sturgeon; incidental take was authorized.

Southeastern Shrimp Trawl Fisheries
On December 2, 2002, NMFS completed an Opinion for shrimp trawling in the southeastern United States (NMFS 2002a) under proposed revisions to the TED regulations (68 FR 8456, February 21, 2003). On May 9, 2012, NMFS completed the new Biological Opinion on the southeastern shrimp fisheries, which included an evaluation of the potential impacts of the fisheries on Atlantic sturgeon. Information considered in the Opinion included the North Carolina Division of Marine Fisheries reporting that no Atlantic sturgeon were observed in 958 observed tows conducted by commercial shrimp trawlers working in North Carolina waters (L. Daniel, NCDMF, pers. comm., via public comment on the proposed rule to list Atlantic sturgeon, 2010). Nine Atlantic sturgeon have been reported captured in the South Atlantic shrimp trawl fisheries. Seven Atlantic sturgeon were captured by a single shrimp trawler off Winyah Bay, South Carolina, from October 27-29, 2008). Six were caught in the main otter trawl gear and 1 was captured in the try net: 6 were released alive, 1 was released dead (NMFS 2014d). One Atlantic sturgeon was captured by a shrimp trawler off South Carolina near Kiawah Island, South Carolina, on December 13, 2011, and it was released alive. Two Atlantic sturgeon were captured by a shrimp trawler near Sapelo Island, Georgia, from December 27-29, 2011. Both were approximately 2 ft long, and both were released alive. No Atlantic sturgeon have been observed caught since 2011 (NMFS 2014d). Collins et al. (1996) did a study of commercial bycatch of shortnose and Atlantic sturgeon. Based on this and additional information, the 2012 Biological Opinion concluded that

interactions between shrimp trawls and Atlantic sturgeon were likely but many of the animals were likely to survive the interactions. Ultimately, the Biological Opinion concluded that the proposed action was likely to adversely affect Atlantic sturgeon, but would not jeopardize the continued existence of any Atlantic sturgeon DPS; incidental take was authorized.

Spiny Dogfish Fisheries

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

Summer Flounder, Scup, and Black Sea Bass Fisheries

In the mid-Atlantic, summer flounder, scup, and black sea bass are managed under a single FMP since these species co-occur and are often caught together. Otter trawl gear is used in the commercial fisheries for all 3 species. Floating traps and pots/traps are used in the scup and black sea bass fisheries, respectively (MAFMC 2007b). The most recent consultation on the fishery was completed in December 2013 as part of the larger batched consultation (described above). The consultation concluded that the continued operation of the fisheries were likely to adversely affect, but not jeopardize, the continued existence of any DPS of Atlantic sturgeon. Incidental take was authorized.

4.5.1.2 Dredging

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

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

Although the potential for significant numbers of adult and juvenile sturgeon's being hit by a hydraulic cutterhead dredge is fairly low, 1 Atlantic sturgeon take may have occurred by this dredging method, but it could not be confirmed (Dickerson 2011). Adult and juvenile sturgeon are believed to be very mobile, even when occupying resting areas during the summer months (deep holes and other deep areas). However, the eggs and larvae of sturgeon are not as mobile. Most of those life stages occur over 150 river miles upstream from where hydraulic dredges are typically proposed for use.

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

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

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

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

On September 19, 2012, NMFS completed a consultation on the USACE's proposed deepening of the Wilmington Harbor. The Opinion considered the effects from: the blasting and dredging, sedimentation, the disposal of dredged material, dredging-related vessel traffic, dredging on sturgeon prey species, changes in salinity, changes in dissolved oxygen, and changes to sturgeon spawning. The Opinion concluded that only the blasting and dredging portions of the project were likely to adversely affect sturgeon, but these construction methods would not jeopardize their continued existence. An ITS was issued for the nonlethal incidental capture (n = 40) and non-injurious harassment (n = 4) of Atlantic sturgeon.

On April 22, 2015, NMFS completed a consultation on the USACE's proposed deepening of the Charleston Harbor. The Opinion considered the effects from: the hopper dredging, post-dredging bed leveling, the disposal of dredged material, changes in salinity, changes in dissolved oxygen, relocation trawling, and changes to sturgeon

spawning, and juvenile and adult habitat impacts. The Opinion concluded that the relocation trawling and dredging portions of the project were likely to adversely affect sturgeon, but would not jeopardize their continued existence. An ITS was issued for the nonlethal captures of Atlantic sturgeon during relocation trawling (n = 23) and lethal takes during hopper dredging (n = 4).

4.5.2 State or Private Actions

4.5.2.1 State Fisheries

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 Section 4.5.1.1

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. NCDMF 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 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 biological opinion determined the continued operation of the fisheries was likely to adversely affect Atlantic sturgeon DPSs but would not jeopardize their continued existence. The biological opinion stated that the sizes of Atlantic sturgeon reported captured indicated they would be juveniles to small sub-adults. Because of this, the biological opinion determined that as many as 75% of the sturgeon bycaught in the inshore North Carolina gill net fishery could be from Carolina DPS. This is because approximately half of the Atlantic sturgeon captured will be juvenile sturgeon and half of the sub-adult sturgeon will likely be from the Carolina DPS. That percentage during any given year however could be lower due to a small juvenile population and a higher percentage of sub-adult fish present from other areas.

The number of incidental takes authorized are reported in Tables 4.6 and 4.7. It is important to note that the biological opinion indicated the “Total” annual take estimated cannot be exceed; however the DPS make-up of that total take may fluctuate annually (NMFS 2014e). For the first year of the permit (2015-2016), the number of reported mortalities is far below the numbers anticipated in the biological opinion. For the large

mesh portion of the fishery 521 nonlethal captures were reported; 2,203 were authorized. Twenty six mortalities were also reported though 101 were authorized. For the small mesh fishery, 133 nonlethal incidental captures were reported; 724 were authorized. One mortality was also reported though 68 were authorized. Assuming 75% of those mortalities were from the Carolina DPS indicates 21 Atlantic sturgeon were killed in 2015.

Table 4.6 Number of Annual Nonlethal Takes of Juveniles and Small Subadults Anticipated in North Carolina Gillnet Fisheries

DPS	Annual Take in Small-Mesh Gillnet Fishery	Annual Take in Large-Mesh Gillnet Fishery
Total – All DPSs	724	2,203
Carolina	No More than 543 of 724	No More than 1,653 of 2,203
Chesapeake Bay	No More than 290 of 724	No More than 882 of 2,203
South Atlantic	No More than 290 of 724	No More than 882 of 2,203
New York Bight	No More than 73 of 724	No More than 221 of 2,203
Gulf of Maine	No More than 22 of 724	No More than 67 of 2,203

Table 4.7 Number of Annual Mortalities of Juveniles and Small Subadults Anticipated in North Carolina Gillnet Fisheries

DPS	Annual Take in Small-Mesh Gillnet Fishery	Annual Take in Large-Mesh Gillnet Fishery
Total – All DPSs	68	101
Carolina	No More than 51 of 68	No More than 76 of 101
Chesapeake Bay	No More than 28 of 68	No More than 41 of 101
South Atlantic	No More than 28 of 68	No More than 41 of 101
New York Bight	No More than 7 of 68	No More than 11 of 101
Gulf of Maine	No More than 3 of 68	No More than 4 of 101

The commercial shad fisheries in Georgia incidentally capture Atlantic sturgeon. Georgia implemented regulations restricting fishing to the lower portions of the Savannah, Ogeechee, and Altamaha Rivers and close the fishery in the Satilla and St. Marys River to reduce sturgeon bycatch. The Georgia shad fishery is open from January 1 to as late as April 30 each year, but would typically end March 31. Georgia applied for, and received, an Incidental Take Permit from NMFS in 2013. The biological opinion evaluating the permit request determined the continued operation of the fishery was likely to adversely affect Atlantic sturgeon but would not jeopardize its continued existence. NMFS determined that incidental capture by fisherman will not exceed 140 Atlantic sturgeon per year (no more than 420 in a 3-year period) in the Altamaha River, 35 Atlantic sturgeon per year (no more than 110 in a 3-year period) in the Savannah River, and 5 Atlantic sturgeon per year (no more than 20 in a 3-year period) in the Ogeechee River; the animals will be juveniles and subadults. The biological opinion anticipated the maximum intercept rate for each Atlantic sturgeon DPS to be: South Atlantic DPS 95%; Chesapeake Bay DPS 20%; Carolina DPS 15%; New York Bight DPS 10%; and Gulf of Maine DPS 2% of the total number of incidental capture, and a mortality rate of 1% (NMFS 2013e). Two years of data indicates that the number of incidental captures in Georgia's shad fisheries is less than anticipated. Twenty Atlantic sturgeon were captured

in 2015 and 7 were captured in 2014 with no mortalities reported in either year; 175 were authorized. Subsequent, to the completion of the biological opinion, the Ogeechee River was closed to commercial shad fishing in 2014.

South Carolina has not applied for an Incidental Take Permit to address the capture of Atlantic sturgeon in its state fisheries. Collins et al. (1996) reported fishermen using sink and drift gillnets to fish for American shad in Winyah Bay, South Carolina. At the time, this fishery has an estimated bycatch of 158 Atlantic sturgeon per year, of which 16% (25 fish) die and another 20% are reported injured to some degree. Shad fishers also operate within the rivers, but neither fishing effort nor average numbers of Atlantic sturgeon encountered are known. Poaching of adult Atlantic sturgeon has been reported from the Winyah Bay area in recent years. Carcasses of large females have been found with the ovaries (caviar) removed. The mouth of the Santee River, just south of Winyah Bay, South Carolina has the largest shad landings in the Southeast (ASSRT 2007), likely resulting in similar mortality and injury of sturgeon to those captured in the Winyah Bay shad fishery. Upriver bycatch levels are unknown. The Cooper River also has a hook-and-line shad fishery because gillnets are restricted (ASSRT 2007).

Captures of Atlantic sturgeon have been documented in the commercial shad gillnet fishery in South Carolina. As discussed in Section 4.4.2, South Carolina has developed a fishery management plan for shad and herring that allows the fishery to remain open. The plan provides specific measures to address sturgeon (including Atlantic sturgeon) bycatch including: reductions in length of individual nets, reductions in the number nets allowed per fishing license, increased net check frequency, area restrictions, and seasonal restrictions. Table 4.8 provides a summary of self-reported effort and incidental bycatch of Atlantic sturgeon by commercial shad gill net fishery in the Santee River, South Carolina, as reported to the Atlantic States Marine Fisheries Commission. Mandatory reporting began in 2000.

Table 4.8 Self-Reported Effort and Incidental Bycatch of Atlantic Sturgeon by Commercial Shad Gillnet Fishery in the Santee River, South Carolina.

Year	Annual Number of trips	Number of Atlantic sturgeon
2009	712	174
2008	607	74
2007	590	162
2006	466	225
2005	577	0
2004	696	11
2003	538	16
2002	676	40
2001	727	105
2000	903	40

4.5.2.2 Scientific Research

Twelve Section 10(a)(1)(A) scientific research permits are currently issued to study Atlantic sturgeon in the rivers of the United States (Table 4.9). Each permit approves sampling methodology and authorizes take. The specific stressors to fish subject to NMFS-issued ESA permit conditions are capture in nets; handling and restraint during examinations; tagging using passive integrated transponder (PIT), internal, and external tags; tissue sampling; anesthetizing; laparoscopy; blood sampling; and gonad biopsy.

Table 4.9. Existing ESA Section 10(a)(1)(A) Permits to Study Atlantic Sturgeon

Permit Number	Location	Authorized Take	Research Activity
16375 Expires: 4/5/2017	North Carolina Albemarle Sound & Rivers & Cape Fear River (Carolina DPS)	200 adult/subadult/juveniles	Investigate population dynamics and migration of Atlantic sturgeon captured in North Carolina rivers and coastal waters through mark-recapture and telemetry techniques.
16442 Expires: 4/5/2017	South Carolina Rivers (Carolina & South Atlantic DPS)	350 adult/subadult/juveniles 100 ELS	Investigate population dynamics and migration of Atlantic sturgeon captured in South Carolina rivers and coastal waters through mark-recapture and telemetry techniques.
16482 Expires: 4/5/2017	Georgia Rivers & Coastal Waters (South Atlantic DPS)	3474 adult/subadult/ juveniles (5 lethal juveniles/1 adult) 250 ELS	Study of abundance, population dynamics, seasonal movement, diet, general ecology and environmental tolerance of Atlantic sturgeon captured in Georgia rivers and coastal waters.
16508 Expires: 4/5/2017	Florida/Georgia Rivers (South Atlantic DPS)	60 adult/subadult/juveniles	Determine presence and population status of Atlantic sturgeon in Florida and Georgia coastal rivers, and use telemetry to determine movement patterns and habitat use.
ELS = Early life stage individuals			

4.5.3 Other Potential Sources of Impacts in the Environmental Baseline

Marine Pollution and Environmental Contamination

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

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

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

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

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

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

The EPA published its second edition of the National Coastal Condition Report (NCCR II) in 2004, which is a "report card" summarizing the status of coastal environments

along the coast of the United States (EPA 2005). The report analyzes water quality, sediment, coastal habitat, benthos, and fish contaminant indices to determine status. In contrast to the Northeast (Virginia - Maine), which received an overall grade of F, the Southeast region (North Carolina - Florida) received an overall grade of B-, which is the best rating in the nation with no indices below a grade of C. Areas of concern that had poor index scores within the action area include were the Pamlico Sound and the ACE Basin for water quality, and St. Johns River for sediment. There was also a mixture of poor benthic scores scattered along the Southeast region.

4.5.4 Conservation and Recovery Actions Benefitting Atlantic Sturgeon

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

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

4.6 Factors Affecting Scalloped Hammerhead Sharks in the Action Area

4.6.1 Federal Actions

Presently, there are no formal consultations evaluating the effects of a federal actions on the Central and Southwest Atlantic DPS of scalloped hammerhead sharks. However, the species susceptibility to capture in fishing gear (particularly hook-and-line and gillnet gear) indicates that federally managed fisheries in the Caribbean (i.e., HMS fisheries and Caribbean Reef Fish fisheries) may adversely affect the species. The Final Listing Rule

(79 FR 38213, July 3, 2014) also identified the following additional federal activities that could potentially affect the species:

- Military activities
- Alternative energy projects
- Dredging in known scalloped hammerhead nursery grounds
- Point and non-point source discharge of persistent contaminants in known nursery grounds
- Toxic waste and other pollutant disposal in known nursery grounds
- Shoreline development in known nursery grounds

While the Final Listing Rule identified federal activities that may adversely affect Central and Southwest Atlantic DPS of scalloped hammerhead sharks, many of those activities, if conducted by state or private entities, are also likely to adversely affect the species.

4.6.2 State or Private Actions

Significant proportions of Puerto Rico and/or the USVI coasts have been degraded by inland hydrological projects, urbanization, agricultural activities, and other anthropogenic activities such as dredging, canal development, sea wall construction, and mangrove clearing. These activities have led to the loss and degradation of habitats potentially important to scalloped hammerhead sharks.

The capture of scalloped hammerhead sharks by anglers operating in Commonwealth of Puerto Rico and Territorial Waters of the USVI is allowed. These activities may potentially impact scalloped hammerheads.

5.0 Effects of the Action

In this section of the Opinion, we assess the probable effects on ESA-listed species from NMFS's integrated FIM activities in the Southeast Region. Effects of the action include direct and indirect effects of the action under consultation. Indirect effects are those that result from the proposed action, occur later in time (i.e., after the proposed action is complete), but are still reasonably certain to occur. The analyses in this section form the foundation for our jeopardy analysis in Section 7.0.

Basic Approach to the Assessment

NMFS's integrated FIM activities in the Southeast Region are known to have adversely affected ESA-listed species in the past; thus, we believe future activities may also adversely affect them. The following analyses use past take data to estimate the number of potential future takes. Those future take estimates are then evaluated in Section 7.0 of this Opinion to determine if the proposed action is likely to jeopardize the continued existence of listed species.

In Section 5.1, we discuss why we believe only the FIM hook-and-line, bottom trawl, and gillnet projects are likely to adversely affect smalltooth sawfish, Gulf, Atlantic, shortnose sturgeon, and scalloped hammerhead sharks ("ESA-listed fish") and sea turtles in the future. In Section 5.2, we describe the potential effects we anticipate would occur if these gear types and those species interact.

In Sections 5.3-5.10, we synthesize the available incidental catch data, by region and gear type, to quantify the impacts of past FIM activities on ESA-listed species observed taken. In Section 5.11, we qualitatively discuss and then quantify the likelihood of future take of sea turtles, smalltooth sawfish, scalloped hammerhead shark, Gulf, Atlantic, and shortnose sturgeon in FIM projects that have never documented a capture of those species.

5.1 FIM Techniques/Gears Not Likely to Adversely Affect ESA-Listed Species

Visual Surveys

We believe visual surveys associated with FIM could cause changes in behavior of sea turtles, smalltooth sawfish, Atlantic sturgeon, shortnose sturgeon, or scalloped hammerhead sharks. However, we believe any behavioral changes to sea turtles or smalltooth sawfish from the presence of divers conducting visual surveys are anticipated to be insignificant. Anecdotal information from encounters indicates some sea turtles and smalltooth sawfish voluntarily change their route to avoid coming in close proximity to divers, whereas others appear unaware of the presence of divers. There are no reports of sea turtles or smalltooth sawfish being adversely affected during visual surveys.

We also believe any behavior changes by ESA-listed sturgeon or scalloped hammerhead sharks will be insignificant. While no data on the impacts of the visual surveys to these species are available, we anticipate any type of response from an animal would be similar to those mentioned above for sea turtles and smalltooth sawfish. As with those species, Atlantic sturgeon, shortnose sturgeon, and scalloped hammerhead sharks encountering divers would most likely react by changing direction or stay where they are. There are also no reports of Atlantic sturgeon, shortnose sturgeon, or scalloped hammerhead sharks suffering adverse effects of any kind during visual surveys.

Dip Nets

The projects using dip nets (Intraspecific Diversity in Pink Shrimp Survey – NMFS and Environmental Influences of Pink Shrimp - NMFS) do not occur within the range of Atlantic sturgeon, shortnose sturgeon, or scalloped hammerhead sharks and will not affect them. We believe sea turtles and smalltooth sawfish may be affected by coming into physical contact with dip net gear. However, we believe this route of effect is extremely unlikely to occur and is discountable. Because of the way dip nets are used, researchers constantly tend the net. Dip nets are used in shallow water, which greatly improves a researcher's ability to avoid incidentally taking sea turtles, or smalltooth sawfish,. This makes it extremely unlikely that these species would become entangled in these gears.

Fish Traps

Fish traps could affect ESA-listed fish and sea turtles via entanglement in trap lines. We believe this route of effect is extremely unlikely to occur and is discountable. Sea turtles, particularly loggerheads, may be attracted to traps and epibonts growing on traps, trap lines, and floats (NMFS and USFWS 1991c). Sea turtles most commonly become entangled in commercial trap gear that often have relatively long soak times (i.e., several hours to several days). This length of time also increases the likelihood that epibonts will grow on trap lines, attracting sea turtles. Commercial fish traps are prohibited in the Gulf of Mexico. However, commercial spiny lobster and stone crab traps are authorized in the Gulf of Mexico and South Atlantic and by far represent the greatest number of traps.

Tables 5.1a and 5.1b report the number of traps, minimum soak time, estimated sea turtle entanglements, and sea turtle capture rates for both fisheries over the last few years. We know that not all sea turtle strandings are reported and TEWG (1998) estimates sea turtle strandings may represent as little as 5-6% of actual at-sea nearshore-mortality events. Therefore, we also estimated the number of possible sea turtle interactions assuming the strandings data only captured 5% of all events. The sea turtle capture rate per trap hour was the highest during the 2010-2011 fishing year in the spiny lobster trap fishery. Spiny lobster and stone crabs are both prey species of loggerhead sea turtles, which may increase the interaction.

Table 5.1a. Traps, Soak Times, and Estimated Sea Turtle Entanglements in the Commercial Spiny Lobster Fishery

Fishing Year	Number of Traps	Minimum Soak Time (Hrs)[a]	Minimum Trap Hrs[b]	Estimated Number of Entanglements[c]	Entanglements Assuming 5% Reporting[d]	Sea Turtle Capture Rate/Trap Hour[e]
2009-2010	492,253	192	94,512,576	5	100	1×10^{-6}
2010-2011	492,188	192	94,500,096	7	140	2×10^{-6}

[a] Matthews 2001
[b] Minimum Trap Hours = Minimum Soak Time in Hours x Number of traps
[c] Entanglements estimate from sea turtle stranding data (NMFS unpublished data)
[d] Entanglement assuming 5% Underreporting = Estimated Number of Entanglements ÷ 0.05
[e] Sea Turtle Capture Rate per Trap Hour = Entanglements Assuming 5% Under reporting ÷ (Number of Traps x Minimum Soak Time)

Table 5.1b. Traps, Soak Times, and Estimated Sea Turtle Entanglements in the Commercial Stone Crab Fishery

Fishing Year	Number of Traps	Minimum Soak Time (Hrs)[f]	Minimum Trap Hrs[g]	Estimated Number of Entanglements[h]	Entanglements Assuming 5% Reporting[i]	Sea Turtle Capture Rate/Trap Hour[j]
2009-2010	1,191,209	168	200,123,112	5	100	5×10^{-7}
2010-2011	1,228,982	168	206,468,976	5	100	5×10^{-7}

[f] R. Gandy, Florida Fish and Wildlife Conservation Commission to A. Herndon, NMFS, pers. comm. June 2014 provided information on stone crab pot soak times
[g] Minimum Trap Hours = Minimum Soak Time in Hours x Number of traps
[h] Entanglements estimate from sea turtle stranding data (NMFS unpublished data)
[i] Entanglement assuming 5% Underreporting = Estimated Number of Entanglements ÷ 0.05
[j] Sea Turtle Capture Rate per Trap Hour = Entanglements Assuming 5% Underreporting ÷ (Number of Traps x Minimum Soak Time)

In comparison to those commercial trap fisheries, only a relative few number of fish traps are used during FIM-related projects in the Gulf of Mexico (i.e., 1,050 per year; 5,250 per 5 years), South Atlantic (i.e., 2,172 per year; 10,860 per 5 years), Caribbean regions (100 per year; 500 per 5 years). The soak times for FIM-related fish traps are no more than 90 minutes. Even if we conservatively apply the highest sea turtle entanglement rate per trap hour from Table 5.1a (2×10^{-6} sea turtles/trap hours) to the FIM-related fish traps, the greatest number of animals captured would be 0.0144 animals every 5 years (or 1 every 69 years). For this reason, we believe the likelihood of a sea turtle becoming entangled in a FIM-related fist trap line is extremely unlikely to occur.

Table 5.2. Estimated Sea Turtle Entanglements in FIM-Related Fish Trap Gear

Region	Trap Project	Number of Traps	Soak Time (hours)	Total Trap Hours*	Estimated Sea Turtle Captures
South Atlantic	MARMAP/SEAMAP Reef Fish Survey (SCDNR)	1 yr = 600	1.5	900	0.00144
		5 yr = 3,000	1.5	4,500	0.00720
	SEFIS Reef Fish Survey (NMFS)	1 yr = 1,200	1.5	1,800	0.00288
		5 yr = 6,000	1.5	9,000	0.01440
	IBBEAM (NMFS)	1 yr = 372	0.08	30	0.00005
		5 yr = 1,860	0.08	149	0.00024
Gulf of Mexico	SEAMAP-GOM Reef Fish Monitoring (FFWCC)	1 yr = 450	1.5	675	0.00108
		5 yr = 2,250	1.5	3,375	0.00540
	SEAMAP-GOM Reef Fish Survey (NMFS)	1 yr = 200	1.0	200	0.00032
		5 yr = 1,000	1.0	1,000	0.00160
	Panama City Laboratory Reef Fish Survey (NMFS)	1 yr = 400	1.5	600	0.00096
		5 yr = 2,000	1.5	3,000	0.00480
Caribbean	Caribbean Reef Fish Survey (NMFS)	1 yr = 100	1.0	100	0.00016
		5 yr = 500	1.0	500	0.00080

*Total Trap Hours = Number of Traps x Soak Time

Only 6 smalltooth sawfish have ever been documented in commercial stone crab or spiny lobster trap gear in the last 10 years. Based on the number of trap hours in those

fisheries, we believe entanglement in commercial trap lines are a very rare occurrence. The number of trap hours from FIM-related fish traps are orders of magnitude lower than the commercial fisheries. Additionally, only 5 of the 7 projects using fish traps even occur in areas that might overlap the range of smalltooth sawfish, reducing the exposure to an already low number of FIM-related fish trap hours. For these reasons, we believe the likelihood of a smalltooth sawfish becoming entangled in a FIM-related fist trap line is extremely unlikely to occur.

There has never been a documented interaction between any sturgeon species or scalloped hammerhead shark and FIM-related trap/pot gear of any kind. The short soak times and relatively few numbers of traps deployed, leads us to believe fish trap interactions with ESA-listed fish species and sea turtles are extremely unlikely to occur and are discountable during 1 year or over the course of 5 years.

Underwater Cameras

Underwater cameras could affect ESA-listed fish and sea turtles via entanglement in lines/camera housing(s). However, we believe this route of effect is extremely unlikely to occur and is discountable. Atlantic mackerel or squid are used to bait underwater cameras. Since the bait used is not a prey species of smalltooth sawfish or Gulf, Atlantic, or shortnose sturgeon, it is unlikely these animals would be attracted to a camera pod. Scalloped hammerheads and sea turtles, particularly loggerheads, could be attracted to the pod because of the bait. However, no hooks are used and the pods are designed such that entanglement in the camera apparatus is extremely unlikely. Cameras are completely enclosed inside the pod and short soak times make it unlikely that entanglement in float lines would occur. Towed cameras are tethered to the vessel using a wire cable that remains taut during operation, minimizing the likelihood of entanglement. For all these reasons, we believe underwater camera interactions with ESA-listed fish species and sea turtles are extremely unlikely to occur.

Acoustic Equipment and ROV Deployments

ROVs are not deployed within the range of scalloped hammerhead sharks and will not affect them. Sea turtles and ESA-listed fish may be affected by ROV deployments if they come into physical contact with the equipment or become entangled in the tether line. We believe this route of effects is extremely unlikely to occur and is discountable. There has never been a documented interaction between FIM-related ROVs and ESA-listed species. ROVs are unbaited and are unlikely to attract any ESA-listed species. The ROV tether is relatively short (i.e., no more than 100 ft), has no hooks, and is constantly monitored (i.e., someone is always monitoring it via a video feed). For all these reasons, we believe ROV interactions with ESA-listed fish species and sea turtles are extremely unlikely to occur.

Acoustic equipment used during FIM projects is described in Table 5.3. The projects using these pieces of equipment will not affect ESA-listed sea turtles or fish. The hearing range for each group of listed species is presented in Table 5.4. All the frequencies used are completely outside the hearing range of sea turtles and ESA-listed fish; therefore, these projects will have no effect on these species.

Table 5.3. Acoustic Equipment and Frequencies Used During FIM Projects

Equipment	Frequencies Used
Simrad ME70 Multi-Beam Echosounder	70,000-120,000 Hz (70-120 kHz)
EK 60 Multi-Frequency Single-Beam Active Acoustics	18,000 Hz; 38,000 Hz; 70,000 Hz; 120,000 Hz; 200,000 Hz (18, 38, 70, 120, 200 kHz)
Acoustic Doppler Current Profiler	333,000 Hz (333 kHz)

Table 5.4. General Hearing Ranges of ESA-Listed Species in the Southeast

Species or Group	Hearing Range	Suggested References
Sea turtles	100-2,000 Hz	Lenhardt 1994, Lenhardt et al. 1996, McCauley et al. 2000a and 2000b, Moein et al. 1994, O'Hara and Wilcox 1990, Ketten and Bartol 2006
Sturgeon	100-2,000 Hz	Fay and Popper 2000, Lovell et al. 2005, Meyer and Popper 2002, Meyer et al. 2003
Scalloped hammerhead shark and Smalltooth sawfish*	< 1,000 Hz	Casper et al. 2003.

*The actual hearing range for scalloped hammerhead shark and smalltooth sawfish have not been measured; these levels are based on the hearing range for fish without swim bladders

Artificial Habitat Aggregation Structures

Artificial habitat aggregation structures are used by projects that do not operate within the range of ESA-listed sturgeon or smalltooth sawfish and will not affect them. Artificial habitat aggregation structures could adversely affect sea turtles and scalloped hammerhead sharks via entrapment. We believe entrapment is extremely unlikely to occur and is discountable. These habitats are unbaited and attract reef fish and invertebrates because of the shelter they provide. Trained scientists construct the habitats underwater after carrying all the building materials to the sites by hand. Once in place, the habitats are stationary with no entangling gear attached (i.e., netting, hooks, or lines). The spaces between the blocks used to create these habitats are too narrow (approximately 4.5 in wide x 6 in high) for sea turtles and scalloped hammerhead sharks to enter and get caught. For these reasons, the likelihood of artificial habitats used in association with FIM adversely affecting these species is extremely unlikely to occur.

Plankton Sampling (Trawls and Fixed Platform)

FIM plankton sampling via trawl or fixed platform may affect ESA-listed species via entanglement in nets or contact with other portions of the gear (e.g., trawl frames). We believe these routes of effects are extremely unlikely to occur and are discountable. Plankton trawl sampling uses fine-mesh (i.e., microns) bongo and neuston nets, measuring 5 ft or less, trawled at the surface for approximately 10 minutes to collect fish larvae samples. Fixed-platform sampling involves small nets or screens that are not towed in the water, but attached to fixed locations that require water flow to move larvae across or into the sampling device. In the last 30 years, no ESA-listed species other than sea turtles have been captured in plankton trawl sampling gear. In those 30 years, only 2

sea turtles have ever been captured in plankton trawl sampling gear. One was captured in the 1980s and another captured in 2013; however, the animal captured in 2013 had significant damage to its rear flippers (unrelated to capture), which likely impaired its ability to move and avoid the slowly trawled gear. Because of the small mesh size and short tow times, even with the recent capture of a sea turtle, we believe it is still extremely unlikely that these gears will capture ESA-listed species in the future, even over the course of several years.

Seines

Seines are only used to sample in the Gulf of Mexico, outside the range of the scalloped hammerhead shark, shortnose sturgeon, and any DPS of the Atlantic sturgeon, and will not affect these species. Two projects use seines, IJA Biloxi Bay Seine Survey (MDMR) and IJA Shoreline Shellfish Bag Seine Survey (TPWD). The Texas project occurs outside the range of all ESA-listed species other than sea turtles. The Mississippi project occurs outside the range of all species other than sea turtles. These seines are small (i.e., 5-6 ft in width or height), deployed in shallow water (less than 6 ft deep) and pulled by hand. Seines are not pulled fast enough to capture a swimming sea turtle. Additionally, since they are pulled by hand it is quite likely that any sea turtle in the vicinity of the net could be identified and avoided. Based on the history of no captures and the reasons just described, we believe any adverse effects to sea turtles are extremely unlikely occur.

Hook-and-Line Gear/ESA-Listed Fish

Hook-and-line gear could affect ESA-listed sturgeon via hooking and/or entanglement. We believe these routes of effects are extremely unlikely to occur and are discountable. Because of their diet and feeding mechanism, ESA-listed sturgeons are not likely to feed on baited hooks. Atlantic and shortnose sturgeon have been described as opportunistic bottom feeders that eat anything; their guts generally contain benthic marine invertebrates including amphipods, lancelets, polychaetes, gastropods, shrimp, isopods, mollusks, and crustaceans (Carr et al. 1996; Fox et al. 2000); Fox et al. (2002); (Huff 1975a; Mason and Clugston 1993; Scott and Crossman 1973a). These species are not used as bait during FIM sampling. The feeding habits of Gulf, Atlantic, and shortnose sturgeon lead us to believe adverse effects from this gear are extremely unlikely to occur.

No smalltooth sawfish captures have ever been documented during FIM hook-and-line sampling. The lack of interaction is likely due to the fact that very few FIM hook-and-line projects operate within the range of smalltooth sawfish. The range of the smalltooth sawfish is peninsular Florida, with a “core area” specifically in south Florida and the Florida Keys. Only 2 FIM hook-and-line projects (SEAMAP-GOM Reef Fish Survey – NMFS and Shark and Red Snapper Bottom Longline Survey – NMFS) conduct any sampling within the core range of the species. Two additional projects (HMS – GULFSPAN Bottom Longline Survey – University of West Florida; HMS – GULFSPAN Bottom Longline Survey – Florida State University) conduct some sampling within the known range of smalltooth sawfish, but operate outside the core area of the species. Hook-and-line fisheries (i.e., bottom longline and vertical line) targeting sharks in the Gulf of Mexico and South Atlantic have been known to capture smalltooth sawfish. For example, from 2007-2014, the bottom longline fishery for sharks captured 30 smalltooth

sawfish (2 dead, 28 released alive) (NMFS 2015b). Those fisheries soaked their gear between 3,886.5 hours and 5,660.5 hours annually (NMFS 2015b). Conversely, the maximum soak time for those 4 projects combined is approximately 434.5 hours. While interactions between FIM hook-and-line gear and smalltooth sawfish are possible, because FIM projects effectively have 100% observer coverage and no adverse effects to smalltooth sawfish have ever been documented during FIM hook-and-line monitoring, it is likely that none have occurred. Thus, the lack of any previous interactions and the low amount of effort leads us to believe interactions between FIM hook-and-line sampling and smalltooth sawfish are extremely unlikely to occur and are discountable.

Bottom Trawls/Hawksbill Sea Turtles and Shortnose Sturgeon

There has never been a documented interaction between hawksbill sea turtles and FIM-related bottom trawl gear. However, we know they are captured in commercial trawl fisheries. The best available information regarding hawksbill sea turtle interactions with bottom trawl gear comes for the 2014 biological opinion on the continued authorization of the commercial shrimp fisheries (NMFS 2014h). NMFS (2014h) indicates that out of 528 hawksbill strandings reported from 1999-2010, 255 could reasonably be attributed to shrimp fisheries. Annual strandings that might be attributable to the shrimp fishery ranged from as few as 12 to as many as 40, and averaged 21 per year over the entire time period. Strandings data likely underrepresent the actual number of interactions between the fishery and hawksbills, but they are best data available. The total annual commercial shrimp fishing effort is still vastly greater that what is proposed during FIM sampling. The annual FIM bottom trawl sampling in both the South Atlantic and Gulf of Mexico combined is approximately 800 tow hours. By comparison, NMFS (2014h) reports commercial shrimp fishing effort was: 2.6 million hours in 2009, 2 million hours in 2010, 2.3 million hours in 2011, and 2.3 million hours in 2012; approximately 2,000-3,000 times more effort than proposed under FIM sampling. Even at this far higher level of fishing effort, the number of hawksbill strandings likely attributable to the fishery was never more than 40 in a given year and averaged 21 over 12 years. We acknowledge the similarity of FIM bottom trawl gear to those known to hawksbill sea turtles, and the proximity of FIM sampling to areas where they might occur lead to an interaction. However, since FIM projects effectively have 100% observer coverage and no adverse effects to hawksbill sea turtles have ever been documented during FIM bottom trawl monitoring, it is likely that none have occurred. The lack of any previous interactions, the relatively short tow times, and relatively low total tow hours leads us to believe FIM bottom trawl interactions with hawksbill sea turtles are extremely unlikely to occur and are discountable.

For reasons very similar to those described previously for hawksbill sea turtles, we believe FIM bottom trawling is not likely to adversely affect shortnose sturgeon. There has never been a documented interaction between shortnose sturgeon and FIM-related bottom trawl gear. Shortnose sturgeon really only interact with shrimp fisheries that occur in and around estuaries; these interactions very rarely occur in areas where federal commercial shrimping occurs. As noted previously, FIM bottom trawl sampling effort is miniscule relative to commercial shrimp fishing effort. We acknowledge the similarity of FIM bottom trawl gear to trawl types known to take shortnose sturgeon, and the

proximity of FIM sampling to areas where they might occur could lead to an interaction. However, since FIM projects effectively have 100% observer coverage and no adverse effects to shortnose sturgeon have ever been documented during FIM bottom trawl monitoring, it is likely that none have occurred. The lack of any previous interactions, the relatively short tow times, and relatively low total tow hours leads us to believe FIM bottom trawl interactions with shortnose sturgeon are extremely unlikely to occur and are discountable.

Fyke Nets

Fyke nets used during FIM are also not likely to adversely affect ESA-listed species. This gear is only deployed in Goose Creek Reservoir off the Cooper River (approximately 25 miles upriver from Charleston, South Carolina), and in very small, dead-creeks in the tributaries of the Altamaha Sound, Georgia. These locations mean no sea turtles, smalltooth sawfish, or scalloped hammerheads are likely to encounter this gear and it will have no effect on these species. No Atlantic or shortnose sturgeon have ever been captured during fyke net sampling (A. Dukes, SCDNR, pers. comm. to A. Herndon, NMFS, October 2012). These nets use extremely small mesh sizes (i.e., approximately 1/8-inch, or the height of 2 stacked pennies) that are very unlikely to entangle Atlantic or shortnose sturgeon. Because of their limited deployment in very small creeks it is very unlikely that either species would even occur there. Additionally, the very small mesh size also makes captures extremely unlikely. For these reasons, we believe any adverse effects to Atlantic or shortnose sturgeon are extremely unlikely to occur and discountable, even over the course of several years.

Gillnets/Scalloped Hammerhead Shark and Smalltooth Sawfish

The FIM gillnet projects in Gulf of Mexico are described in Section 5.6.3 (see Table 5.33). Generally, gillnets use 3.0- to 5.5-in stretch mesh or less and are 600 to 1,200 ft in length. Some nets use several mesh sizes at once. Since FIM gillnet sampling projects in the South Atlantic occur outside of the known range of smalltooth sawfish, those projects are not considered here. Likewise, since there are no FIM gillnet projects within the range of scalloped hammerhead sharks, they will have no effect on this species.

No incidental takes of smalltooth sawfish have ever been documented during FIM gillnet projects. As noted elsewhere, since FIM projects effectively have 100% observer coverage, we believe it is likely that no FIM gillnet projects have ever captured smalltooth sawfish. Smalltooth sawfish are vulnerable to entanglement in gillnet gear because of their toothed rostrum. Interactions with FIM gillnet projects are possible, particularly the HMS-GULFSPAN Gillnet Survey - Mote Marine Lab since some of its sampling will take place with the core area of the smalltooth sawfish's range. That being said, the best available information regarding smalltooth sawfish interactions with gillnet gear (not specifically trying to capture smalltooth sawfish) comes from commercial fisheries information. The existing information suggests that interactions are uncommon. In the commercial shark gillnet fishery, only 1 smalltooth sawfish capture has been documented since 2003 (NMFS 2015b). Likewise, the only evidence of a smalltooth sawfish becoming entangled in the commercial mackerel fishery is a single anecdotal report from late 1970s to early 1980s (NMFS 2007b). Aside from these 2 reports, there is

no additional information indicating smalltooth sawfish captures in commercial gillnet fisheries. We acknowledge it is possible that some interactions with gillnets and smalltooth sawfish go unreported, but the best available information indicates that interactions with commercial fisheries are rare.

Commercial fisheries use more gear that /soaks longer than the FIM gillnet gear. For example, (NMFS 2015b) reports that in 2012, the average length of a gillnet used to target sharks in Gulf of Mexico was approximately 4,330 ft, and the total for all shark gillnets in Gulf of Mexico was 945 hours. Conversely, the gillnets used during FIM sampling are 600 ft, with exception of one net that is 1,200 ft. The combined annual soak time for all FIM gillnet projects is in the Gulf of Mexico 383 hours. Since commercial fisheries use longer nets that cumulatively soak for much longer periods of time, we believe it is reasonable to assume that these gears would be more likely to capture smalltooth sawfish. Yet, as noted previously, interactions are rare. Based on this and the lack of any previous smalltooth sawfish interactions with FIM gillnet gear we believe any adverse effects from this gear type are extremely unlikely to occur and are discountable.

Electrofishing

FIM-related electrofishing is not likely to adversely affect ESA-listed species. This gear is only used in Winyah Bay and the Ashley, Cooper, Combahee, and Edisto Rivers, South Carolina. These locations mean no smalltooth sawfish, or scalloped hammerheads are likely to encounter this gear and it will have no effect on these species. No sea turtles. Atlantic or shortnose sturgeon have ever been captured during electrofishing (S. Arnott, SCDNR, pers. comm. to A. Herndon, NMFS, May 2015).

Electrofishing uses an electric field in the water to induce some form of forced swimming and/or immobilization of fish. Generally, electric circuits are completed using wires. Electrofishing uses a waterbody to create a complete circuit instead of wire. When electricity flows into the water, it spreads out in constant voltage lines, similar to the way magnetic field lines surround a bar magnet. The electricity flows from all surfaces of an electrode(s) (“cathode”) and radiates out into the water before converging and flowing back into another electrode (“anode”). As the distance increases from the cathode, the voltage drops. Figure 5.1 illustrates how the voltage drops off as distance increases.

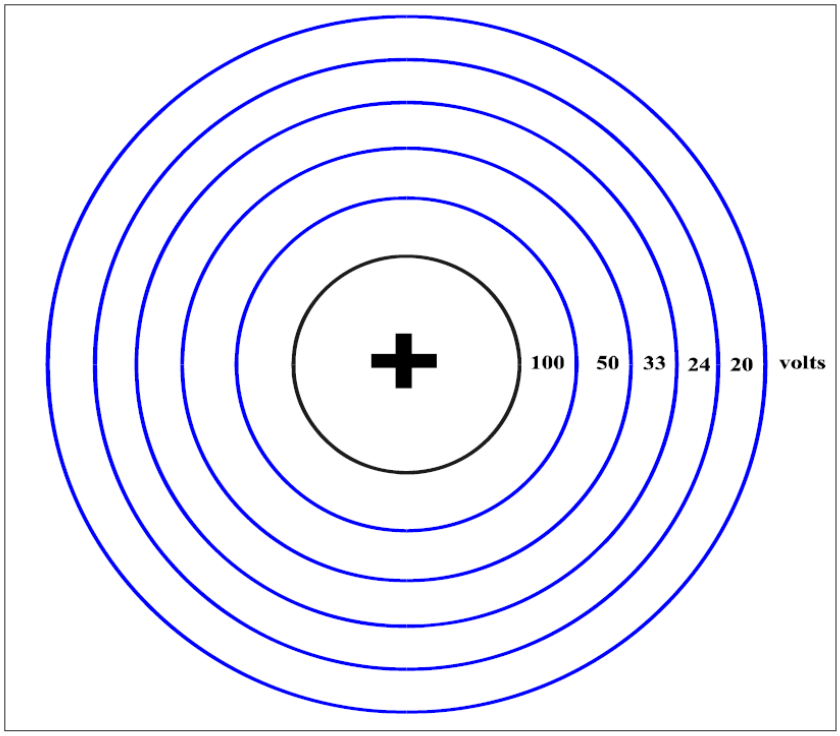

Figure 5.1. Illustration of constant voltage lines
Adapted from: Scottish Fisheries Co-Ordination Centre (2007)

A fish only notices an electric current if a detectable difference in voltage exists between one end of it and the other. The greater the voltage difference between one end of a fish and another, the greater the response. Figure 5.2 shows an anode with 2 fish, one further away than the other. Because the electric field dissipates with distance from its source, the closer fish experiences a greater potential difference across its body (50 volts) than the one further away (4 volts). The amount of current flowing through an animal dictates its behavioral response. In this example, the fish closer to the anode will display a different, and more substantial behavioral response that the fish further away. Eventually the fish will be completely outside the zone with voltage sufficient to stimulate the fish. The zone with enough voltage to affect fish behavior is called the sphere of influence or the effective electrofishing range. The vast majority of past of FIM-related electrofishing (99.8%) has occurred at or shallower than 6 ft. Electrofishing is usually conducted in water 6 ft or shallower because beyond that depth the electric field dissipates to a level that does not induce behavioral changes in fish.

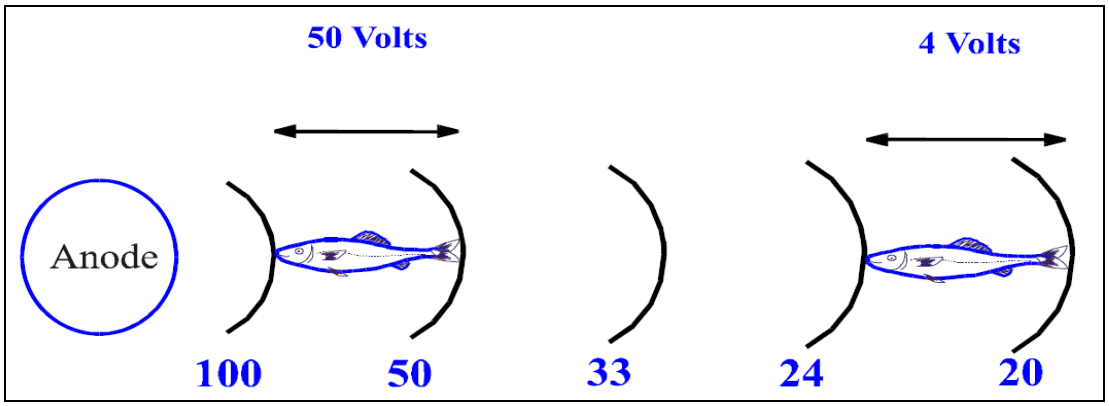

Figure 5.2 Illustration of voltage changes across fish based on distance from the anode
Adapted from: Scottish Fisheries Co-Ordination Centre (2007)

From 2000-2015, 3,333 FIM-related electrofishing trips took place; depth was recorded for 3,306 trips. Generally, electrofishing occurs in waters 6 ft or shallower, but in rare cases (5 of 3,306 trips) may occur deeper (i.e., 6.5-8 ft). Because the vast majority (99.85%) of electrofishing trips take place in waters 6 ft or shallower, we will assume that the trips where no depth was recorded also occurred in waters shallower than 6 ft.

Shortnose sturgeon have never been captured during FIM-related electrofishing (S. Arnott, SCDNR, pers. comm. to A. Herndon, NMFS, July 2015). Shortnose sturgeon do not occur in the Ashley River and will not be affected by electrofishing in the river. Specific information on the depth preferences of shortnose sturgeon in the Cooper, Combahee, Edisto, Sampit, and Waccamaw Rivers is not available. Information from other rivers in the Southeast indicates juvenile and adult shortnose sturgeon prefer to remain within river channels at depths ranging from 7-30 ft (2.1-10.7 m) (Collins et al. 2002, Hall et al. 1991, Collins et al. 2003). YOY appear to prefer deeper habitats, 30-65 ft (10-20 m) (Dadswell 1979, Carlson and Simpson 1987). At these depths, shortnose sturgeon are likely to show indifference to electrofishing because they will be outside of the effective electrofishing depth. For this reason, we believe any adverse effects to shortnose sturgeon from electrofishing are extremely unlikely to occur and are discountable.

Atlantic sturgeon have never been captured during FIM-related electrofishing. Atlantic sturgeon do not occur in the Ashley River and will not be affected by electrofishing in the river. Specific information on the depth preferences of Atlantic sturgeon in the Cooper, Combahee, Sampit, and Waccamaw Rivers is not available. Information from other rivers indicate juveniles prefer deeper habitats than those fished during electrofishing (Moser and Ross 1995, Savoy and Pacileo 2003, B. Post, SCDNR, pers. comm. to A. Herndon, NMFS, July 2015).[32] Adults spend the majority of their time in the marine

[32] Moser and Ross (1995) indicated juvenile Atlantic sturgeon preferred deep areas (> 10 m); Savoy and Pacileo (2003) state "[i]mmature Atlantic sturgeon were collected every year from 1988 to 2000 in discrete, deep-water areas in the estuarine portion of the Connecticut River"; B. Post (SCDNR) indicates that juvenile Atlantic sturgeon in the Edisto river were found between 17-23 ft.

environment, and only occupy rivers during spawning years. During their spawning runs they remain in the deeper portions (greater than 4 ft) of the river mainstem and travel quickly to the spawning grounds (S. Bolden, NMFS, and B. Post, SCDNR, pers. comm. to A. Herndon, NMFS, July 2015). As noted previously, a vast majority (i.e., ~99%) of sampling occurs in 6 ft or less; yet large amounts of sampling (~88%; 2,917 of 3,306 trips) also occur shallower than 4 ft, outside the preferred depth range of Atlantic sturgeon. Electrofishing only occurs for approximately 15 minutes at each station. The total area electrified is small relative to the rest of the river and juvenile/adult sturgeon prefer to remain in the deeper mainstem of the channel (Figure 5.3). Figure 5.3 provides perspective regarding the maximum area electrified during electrofishing. It is important to note that the electrofishing boat drifts with the current so the total area exposed to electricity during a trip would be larger than circle depicted below. However, this circle accurately reflects the maximum area exposed to electricity at any given time. For these reasons, we believe it is likely juvenile and adult Atlantic sturgeon will be outside of the effective electrofishing depth.

YOY Atlantic sturgeon are also not likely to be adversely affected by electrofishing. Unlike shortnose sturgeon, the preferred depth range of YOY Atlantic sturgeon is not known. But given the similarity between shortnose and Atlantic sturgeon and juvenile Atlantic sturgeons' preference for deeper water, we believe it is likely YOY would also remain in the deeper reaches of a river. Also, as noted previously, it is the potential electrical difference across a fish's body that induces a potential behavior change. Because of their small size (0.28 in-20 in), an individual fish would have to be very close to an electrofishing vessel when it was active for the voltage difference across it to even be detectable. For this reason, we believe any adverse effects to any life stage of Atlantic sturgeon from electrofishing are extremely unlikely to occur and are discountable.

Figure 5.3. Electrofishing Zone of Influence (yellow circle) (© 2015 Google)

No sea turtle has even been captured during FIM-related electrofishing (S. Arnott, SCDNR, pers. comm. to A. Herndon, NMFS, March 2016). Sea turtles do not occur in the rivers sampled with electrofishing. They could occur in Winyah Bay, South Carolina, but we believe it is extremely unlikely they will overlap spatially with FIM-electrofishing. When non-electrofishing sampling conducted by the SCDNR has encountered sea turtles in Winyah Bay, it has been generally high salinity areas near the its mouth. Because the efficiency of electrofishing gear is reduced as salinity increases, it occurs well upstream from the mouth of Winyah Bay in much lower salinities (S. Arnott, SCDNR, pers. comm. to A. Herndon, NMFS, March 2016). Additionally, unlike fish, sea turtles spend the majority of their time at the surface. Since electrofishing vessels drift while they sample, and sampling only occurs during the day, researchers are likely to see a sea turtle at the surface and turn off any active equipment. Also, previously discussed, electrofishing only occurs for brief periods of time, and only relatively small areas are electrified compared to the surrounding rivers/bays. For these reasons, we believe it is extremely unlikely sea turtles will be exposed to electrofishing and any adverse effects are discountable. Table 5.5 summarizes the effect determination for each of the previously discussed techniques/gears.

Vessel Operations/ESA-Listed Fish and Sea Turtles

There has never been a documented interaction between a FIM-related vessel and a smalltooth sawfish, shortnose sturgeon, and Atlantic sturgeon. These species spend most of their time at or near the seafloor, where they are not subject to vessel interactions. Vessel interactions have been identified as potential threats to Atlantic sturgeon, but only

in rivers, and only for animals from the New York Bight and Chesapeake Bay DPS. Only 1 FIM project operates in what could be considered the riverine portions of the range of CB DPS Atlantic sturgeon but operates only 1 sampling trip a month. None of the projects operate in the riverine portions of the range of NYB DPS Atlantic sturgeon. For these reasons, we believe adverse effects to smalltooth sawfish, shortnose sturgeon, and Atlantic sturgeon from FIM-related vessels is extremely unlikely to occur and is discountable.

There has never been a documented interaction between a FIM-related vessel and a scalloped hammerhead shark. ESA-listed scalloped hammerhead sharks only occur in the Caribbean, where relatively little FIM-related sampling occurs. Scalloped hammerhead sharks do not bask (i.e., remain motionless at the surface). Additionally, FIM-related research vessels have shallow drafts compared to the entire water column in which scalloped hammerhead sharks are found, meaning interactions between this species and vessels is extremely unlikely. For these reasons, we believe adverse effects to scalloped hammerhead sharks from FIM-related vessels is extremely unlikely to occur and is discountable.

Sea turtles near the surface of the water can be adversely affected when struck by moving vessels. Vessel strikes can cause injury to sea turtles via concussive impact. Depending on the type of vessel, the running gear (including the propeller and skeg of an outboard motor) may also cause cutting/slashing injuries. We believe the vessel activities associated with the proposed action are not likely to adversely affect sea turtles.

High-speed, planing hull, vessels are of the greatest concern for striking and injuring sea turtles. Planing hulls are most common in smaller (e.g., 18-27 ft in length) recreational vessels and are designed to run on top of the water (i.e., on plane) at high speeds. Because most of the hull is out of the water, the running gear of a planing hull vessel traveling at high speed becomes a significant cutting/slashing threat. These threats would be compounded by twin or triple engines, which are fairly common in small- to medium-sized (e.g., 25-34 feet in length) recreational vessels. Cutting/slashing threats are in addition to potential concussive effects from a collision with the hull itself.

Conversely, displacement hulls push through the water, as they have no hydrodynamic lift, and the boat does not rise out of the water as speed increases. Vessels with displacement hulls are generally larger than recreational vessels and travel slower, but extend deeper, into the water column. Because these vessels do not ride on top of the water, the risks these vessels pose to sea turtles is largely limited to a concussive impact from the hull. However, it is possible a sea turtle may avoid significant impact by being pushed away by the hydrodynamic bow wake of a large vessel and, therefore, be allowed to escape before incurring an injury.

There has never been a documented interaction between a FIM-related vessel and a sea turtle. While actively sampling, vessels move very slowly (i.e., 2-3 knots) or remain idle. Thus, we believe it is extremely unlikely a sea turtle would be struck during these activities. Vessels transiting to and from port or between sampling stations could travel

at greater speeds. The majority of vessels conducting FIM-related research are larger vessels with displacement hulls. As noted previously, these hulls pose less of a potential risk than planing hulls. Additionally, the captain and/or crew keep an eye out for objects, including sea turtles, in the path of a vessel. If one is detected, the vessel's course can be immediately altered or speed reduced to avoid incidental collisions. Given the lack of any previous documented interactions, the types of vessels, and monitoring for protected species anytime the vessel is moving, we believe that adverse effects from FIM-related vessel operations to sea turtles are extremely unlikely to occur and are discountable.

Table 5.5. Summary of FIM Techniques/Gears Effects Determinations for Sea Turtles and ESA-Listed Fish

Species	**Gear Type**					
	Visual Surveys	*Fish Traps*	*U/W Cameras*	*ROV*	*Acoustic Equipment*	*Artificial Habitat*
Sea Turtles	NLAA	NLAA	NLAA	NLAA	NE	NLAA
Smalltooth Sawfish	NLAA	NLAA	NLAA	NLAA	NE	NE
Atlantic Sturgeon	NLAA	NLAA	NLAA	NLAA	NE	NE
Shortnose Sturgeon	NLAA	NLAA	NLAA	NLAA	NE	NE
Scalloped Hammerhead Shark	NLAA	NLAA	NLAA	NE	NE	NLAA

Species	**Gear Type**						
	Plankton Sampling (Trawls and Fixed Platform)	*Seines*	*Hook-and-Line Gear*	*Bottom Trawling*	*Fyke Nets*	*Electrofishing*	*Gillnets*
Sea Turtles	NLAA	NLAA	LAA	LAA*	NE	NE	LAA
Smalltooth Sawfish	NLAA	NLAA	NLAA	LAA	NE	NE	NLAA
Atlantic Sturgeon	NLAA	NE	NLAA	LAA	NLAA	NLAA	LAA
Shortnose Sturgeon	NLAA	NE	NLAA	NLAA	NLAA	NLAA	LAA
Scalloped Hammerhead Shark	NLAA	NE	LAA	NE	NE	NE	NE
*Bottom trawls are NLAA hawksbill sea turtles							

5.2 FIM Techniques/Gears Likely to Adversely Affect ESA-Listed Species

Many of the gears used during FIM are not likely to adversely affect ESA-listed species. However, hook-and-line gear, bottom trawls, and gillnet gear are known to adversely affect listed species. In the following sections, we describe the types of interactions and resulting effects we anticipate may occur to sea turtles, smalltooth sawfish and sturgeons (i.e., Gulf, Atlantic, and shortnose sturgeon) from interacting with these gears.

5.2.1 Types of Interactions with Sea Turtles

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

Observers and naked net studies have not indicated that otter trawl nets cause injuries to sea turtles. However, bottom trawl gear and bottom longline gear can adversely affect sea turtles via forced submergence. Captured sea turtles can be released alive or may be found dead upon retrieval of the gear because of forced submergence. The following discussion summarizes in greater detail the available information on how individual sea turtles are likely to respond to interactions with all type of fishing gear.

Entanglement

Sea turtles are particularly prone to entanglement because of their body configuration and behavior. Records of stranded or entangled sea turtles reveal that hook-and-line gear can wrap around the neck, flipper, or body of a sea turtle and severely restrict swimming or feeding. If the sea turtle is entangled when young, the fishing line becomes tighter and more constricting as the sea turtle grows, cutting off blood flow and causing deep gashes, some severe enough to remove an appendage.

Sea turtles have been found entangled in branchlines (gangions), mainlines, and float lines of longline gear. Observer data from the shark bottom longline fishery indicate sea turtles entangled in longline are most often entangled around the neck and fore flippers (NMFS unpublished data). Entangling gear can interfere with a sea turtle's ability to swim or impair its feeding, breeding, or migration and prevent its surfacing, causing it to drown.

Hooking

In addition to being entangled in hook-and-line gear, sea turtles are also injured and killed by being hooked. Sea turtles are either hooked externally in the flippers, head, shoulders, armpits, or beak or internally inside the mouth or when the animal has swallowed the bait (Balazs et al. 1995). Observer data indicates entanglement and foul-hooking are the primary forms of interaction between leatherback sea turtles and longline gear, whereas internal hooking is much more prevalent in hardshell sea turtles, especially loggerheads (NMFS unpublished data). Internal hooking of leatherback sea turtles is much rarer. Almost all interactions with loggerheads result from taking the bait and hook; only a very small percentage of loggerheads are foul-hooked externally or entangled.

Hooks swallowed by sea turtles are of the greatest concern. Their throats are lined with strong cone-shaped papillae directed towards the stomach (White 1994). The presence of

these papillae in combination with an S-shaped bend in the throat makes it difficult to see swallowed hooks when looking through a sea turtle's mouth. Because of the shape of a sea turtle's digestive tract, deeply swallowed hooks are also very difficult to remove without seriously injuring the turtle. A sea turtle's throat is attached firmly to underlying tissue; thus, if a sea turtle swallows a hook and tries to free itself or is hauled on board a vessel, the hook can pierce the sea turtle's throat or stomach and can pull organs from their connective tissue. These injuries can cause internal bleeding or infections, both of which can kill the sea turtle.

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

Trailing Line

Line left on a sea turtle after it has been captured and released, particularly line from a swallowed hook, poses a serious risk to sea turtles. Line trailing from a swallowed hook is also likely to be swallowed, which may irritate the lining of the digestive system. The line may cause the intestine to twist upon itself until it twists closed, creating a blockage ("torsion"), or it may cause a part of the intestine to slide into another part of intestine like a telescopic rod ("intussusception") also leading to blockage. In both cases, death is a likely outcome (Watson et al. 2005). Trailing line may also prevent or hamper the search for food, eventually leading to death. Trailing line may also get snagged on a floating or fixed object. When this happens, sea turtles can get even more entangled leading to impaired movement, constriction, and potentially death. Trailing line may even slice a sea turtle's flippers and affect its ability to swim, feed, avoid predators, or reproduce. Trailing line can snag on the bottom, or has the potential to snag, thus anchoring sea turtles in place (Balazs et al. 1995).

Forced Submergence

Generally, when sea turtles dive, their bodies create energy for their cells in a process that uses oxygen from their lungs. Sea turtles that are stressed from being forcibly submerged due to entanglement, eventually use up all their oxygen stores. Since they must continue to create energy with or without oxygen, when their oxygen stores are used up, they begin to create energy via a process that does not require oxygen (i.e., anaerobic glycolysis). However, this process can significantly increase the level of a certain type of lactic acid in a sea turtle's blood (Lutcavage and Lutz 1997); if the level gets too high it can cause death.

Numerous factors affect the survival rate of forcibly submerged sea turtles. It is likely that the speed at which physiological changes occur and how long they last are related to the intensity of struggling and how long the animal is underwater (Lutcavage and Lutz 1997). The size, activity level, and condition of the sea turtle; the ambient water temperature; and if multiple forced submergences have recently occurred all affect how

badly an animal may be injured by forced submergence. Disease factors and hormonal status may also influence survival during forced submergence. Larger sea turtles are capable of longer voluntary dives than small sea turtles, so young sea turtles may be more vulnerable to the stress from forced submergence. The normal process for creating cellular energy happens more quickly during the warmer months. Since this process takes place more quickly, oxygen stores are also used more quickly, and anaerobic glycolysis may begin sooner. Subsequently, the negative effects from forced submergence may occur more quickly during warm months. With each forced submergence event, the level of lactic acid in the blood increases and can require a long (up to 20 hours) time to recover to normal levels. Sea turtles are probably more susceptible to dying from high levels of lactic acid if they experience multiple forced submergence events in a short period of time. Recurring submergence does not allow sea turtles to get rid of high levels of lactic acid (Lutcavage and Lutz 1997). Stabenau and Vietti (2003) illustrated that sea turtles given time to stabilize their pH level after being forcibly submerged have a higher survival rate. How quickly this happens depends on the overall health, age, size, etc. of the sea turtle, time of last breath, time of submergence, environmental conditions (e.g., sea surface temperature, wave action), and the nature of any sustained injuries at the time of submergence (NRC 1990b).

Tow times have been identified as a significant factor in trawl-related mortalities of sea turtles caused by forced submergence (NRC 1990b). Henwood and Stuntz (1987) concluded that tow times less than 60 minutes had mortality rates of less than 1%. Based on these findings, exemptions to TED requirements were created for vessels that would normally be required to use TEDs so long as they limited their tow times. Tow-time requirements for vessels exempted from TED use are limited to 55 minutes from April through October and to 75 minutes from November through March (50 CFR 223.206(d)((3)). The regulatory tow time limits include a 15-minute allowance for setting and retrieving gear, since the NRC analysis of tow times looked at bottom time only.

5.2.2 Types of Interactions with Smalltooth Sawfish

Hook-and-line gear is known to adversely affect smalltooth sawfish via hooking. Hook-and-line gear and bottom trawls can also adversely affect smalltooth sawfish by entanglement. Hooking and entanglement can lead to cuts, puncture wounds, or lost rostral teeth. Hooked or entangled smalltooth sawfish may also suffer impaired swimming or foraging abilities, altered migratory behavior, and altered breeding or reproductive patterns. However, observer data indicate that regardless of the type of interaction, the vast majority of incidentally taken smalltooth sawfish are released alive and in good condition. The following discussion summarizes in greater detail the available information on how individual smalltooth sawfish are likely to respond to interactions with FIM gear.

Hooking

Based on hooking observation data from Mote Marine Laboratory bottom longline research surveys and reported recreational rod-and-reel fishing encounters, the vast majority of smalltooth sawfish are hooked in the mouth (ISED 2014). Foul-hooking reports are not nearly as frequent, but do occasionally occur. There is only a single report of a smalltooth sawfish deeply hooked (ISED May 2009). Once hooked, the gangion or leader frequently gets wrapped around the animal's saw. This may result from slashing during the fight, spinning on the line as it is retrieved, or any other action bringing the rostrum in contact with the line.

Based on available data, all smalltooth sawfish caught on vertical lines and the vast majority of smalltooth sawfish caught on bottom longline gear survive the encounter. Between 2007 and 2011, 22 smalltooth sawfish were observed caught in shark bottom longline gear in the Atlantic and Gulf of Mexico. One of the captured animals died from getting tangled in the gangion and mainline in 2007. The remaining captured animals were documented as very active when reaching the water's surface and were released in apparent good health (Carlson and Richards 2011). Soak times do not seem to be a factor for smalltooth sawfish mortality. Dr. Simpfendorfer speculates this is because the animal's natural habit consists of lying on the sea floor and using its spiracles to breathe (Simpfendorfer et al. 2010b). Thorson (1982) reports that largetooth sawfish caught by fishers at night or when no one was present to tag them were left tethered in the water with a line tied around the rostrum for several hours with no apparent harmful effects. Additional information comes from Dr. Simpfendorfer and Tonya Wiley of Mote Marine Laboratory, who conducted smalltooth sawfish surveys from 2000-2008, using bottom longline, nets, and rod and reel. Dr. Simpfendorfer and Ms. Wiley captured and handled over 130 individuals ranging in size from 62 cm to 496 cm, 21 of which were caught on bottom longlines (T. Wiley-Lescher, Haven Worth Consulting, pers. comm. to S. Norton, NMFS, July 2013). All of these fish were alive upon capture and safely released with no apparent harm to the fish.

There are no studies on the post-release mortality of smalltooth sawfish. Based on their lively condition at capture and Mote Marine Laboratory tagging recapture data, post-release mortality is expected to be extremely rare. However, sublethal effects on smalltooth sawfish may occur. Rare reports from recreational fishers indicate a smalltooth sawfish can damage its rostrum by hitting it against the vessel or other nearby objects (e.g., piling, bridge) while the fishers are preparing to release the fish. Reported damage ranges from broken rostral teeth to broken rostrums. Smalltooth sawfish have been caught missing their entire rostrum, otherwise appearing healthy, so some individuals appear to be able to survive without it. However, given the rostrum's role in smalltooth sawfish's feeding activities, damage to their rostrum, depending on the extent, could hinder their ability to feed and ultimately impact the affected animal's growth.

Entanglement

Smalltooth sawfish have been caught as bycatch in bottom trawls (NMFS 2012i) and are particularly vulnerable to entanglement in gillnets. The long, toothed rostrum easily penetrates netting, causing the animal to become entangled when it attempts to escape. Early literature accounts document smalltooth sawfish as being frequently caught by shrimp trawls and cite capture in gillnet gear as one of the primary causes of the species' decline.

The toothed rostrum also makes it very difficult to disentangle a smalltooth sawfish without harming the animal. Entangled animals frequently have to be cut free, causing extensive damage to nets. The entangled smalltooth sawfish can also endanger fishers if brought onboard a vessel. For these reasons, many historical records of smalltooth sawfish catches note they were either killed or released after their saws had been removed (e.g., (Bigelow and Schroeder 1953a; Evermann and Bean 1898a; Henshall and United States Fish Commission 1891). Bigelow and Schroeder (1953a) noted smalltooth sawfish were of "considerable concern to fishermen as nuisances because of the damage they do to drift- and turtle-nets, to seines, and to shrimp trawls in which they often become entangled" and because of the difficulty of disentangling them without being injured by their saws.

The monofilament mesh of gillnets can cause scrapes, cuts, and bleeding, and hinder feeding behavior. Even a few strands of monofilament can cause significant damage (Seitz and Poulakis 2006) (Figure 5.4).

Figure 5.4. Example of a smalltooth sawfish injury from gillnet gear (Photo credit: C. Simpfendorfer)

5.2.3 Types of Interactions with Sturgeon

The diet of shortnose and Atlantic sturgeon makes it extremely unlikely they would be affected by hook-and-line gear. However, sturgeon are susceptible to capture in gillnets. Sturgeons can be wedged (i.e., held by a mesh or meshes around the body) or become entangled when teeth, maxillae, scutes, snout, or other projections become entangled in netting (Hamley 1975). Entanglement of this type often leads to struggling that subsequently wraps the animal in additional webbing. A sturgeon's cone-shaped snout allows meshes to pass over the head and along the body, which allows gilling and wedging to occur rapidly. Their bony scutes also increase the likelihood of entanglement and wedging. Larger fish may get wrapped in nets once entangled while they struggle to free themselves. Smaller fish may be entangled by a single monofilament strand hung around a scute (Damon-Randall et al. 2010). The mesh of gillnets can also cause cuts, scrapes, bleeding, and hinder feeding behavior.

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

5.3 Documented Past and Anticipated Future Listed Species Interactions with FIM Projects

Approach to the Analysis

In the subsections below, we describe the number of listed species incidentally captured in the past during FIM projects, and then we estimate the number likely to be incidentally taken in the future. Since researchers act as observers, FIM activities effectively have 100% observer coverage and we feel confident that all past ESA-listed species captures were documented. Only the capture of sea turtles, smalltooth sawfish, Atlantic sturgeon, and shortnose sturgeon have been documented during FIM projects. For sea turtles, smalltooth sawfish, Atlantic sturgeon, and shortnose sturgeon we use the available data on past incidental takes during FIM activities to estimate the likely number of future takes.

Our estimates of potential future take are calculated by region and gear type (e.g., South Atlantic trawl takes). This approach essentially creates a "pool" of takes derived from specific analyses conducted in the remainder of this section. We believe this approach is appropriate for several reasons. First, as we described previously in Section 5.2, we believe the anticipated routes of adverse effects to species are generally the same for specific gear types. For example, the adverse effects suffered by an incidentally hooked sea turtle are likely to be the same regardless of whether that hook was in the water as part of a project conducted by NMFS or a state resource agency. Secondly, our approach considers potential adverse impacts regionally. By evaluating the potential adverse effects this way, we also account for differences in species abundance between the South Atlantic, Gulf of Mexico, and Caribbean. Finally, estimating takes for individual projects

is not a useful metric for estimating or monitoring the potential adverse effects of the action on listed species due to low overall capture numbers and relatively low research effort, and high interannual variability in levels of take. In many cases, projects may be likely to capture ESA-listed species based on their location and gear types used (e.g., otter trawls used in the Gulf of Mexico), but because the total overall effort is very low, no captures have been documented.

Estimating takes for low effort projects creates problems when those take numbers are rounded up. For example, in the South Atlantic, the greatest number of sea turtles taken in any single year by longline gear was 6. Those takes occurred during FIM-related hook-and-line sampling that totaled 102, 900 hook hours collectively. The MARMAP/SEAMAP- Reef Fish Survey (Short Bottom Longline) survey accounted for 4,000 of those hook hours. Based on documented sea turtle takes and total effort, the MARMAP/SEAMAP-Reef Fish Survey (Short Bottom Longline) would be expected to take 0.23 sea turtles annually.[33] Following conventional rounding techniques, we would estimate that the project would not take a sea turtle. However, we know that the project operates in a location where sea turtles occur and where hook-and-line gear similar to that used in the project have incidentally captured sea turtles in the past. Conversely, if we round the 0.23 estimate up, the rounding up represents an increase of approximately 430%. Rounding up also means that this project would account for 17% of all the sea turtles taken even though the project only accounts for 3.9% of the total effort. Similar situations arise when trying to authorize takes for other individual projects.

As noted previously, our solution to this issue was to estimate takes by gear and region. We estimated future takes based on the average number of takes over previous years. In some instances, a single or few specific projects accounted for the vast majority (i.e., 75% or more) of the total takes observed in certain gear in a region. In those cases, we estimate future take for that specific project(s), based on its average past captures. We then do the same for the remaining projects. We then combine both those sets of estimates to create a gear-based estimate for each region. We believe this approach most accurately assess the likelihood of interactions between species and FIM-related fishing gear.

As described in Section 3.3, the populations of the sea turtles most likely to encounter FIM-related gear have generally been increasing. For this reason, we based our future takes of sea turtles estimates on the takes reported from 2009-2013. We believe this approach most accurately captures the number of interactions that likely occurred with increasing sea turtle populations.

FIM projects are generally designed to reduce the potential for incidental capture of non-target species. FIM participants are often willing to disentangle/dehook an incidentally captured animal, which greatly improves its chances for survival. As a result, very few

[33] Based on 6 sea turtles ÷ 102,900 (total amount of hook-and-line effort for the region) = 0.000058; 0.000058 x MARMAP/SEAMAP- Reef Fish Survey (Short Bottom Longline) (4,000) = 0.23 sea turtles

projects have ever reported the mortality of an ESA-listed species. However, we believe it is prudent and conservative to assume that some level of FIM-related mortality could occur in the future. Because we did not have FIM project-specific mortality rates, in most cases we used ESA-listed species mortality rates from analogous projects or commercial fisheries. While we acknowledge that protected species mortality rates associated with commercial fishing may be higher than FIM activities, we believe using those rates is prudent and conservative toward species.

The capture data indicate the number of captures occurring annually is highly variable. The number of captures in any given year can also be influenced by sea temperatures, species abundances, and other factors that cannot be predicted. As a result, monitoring FIM projects using 1-year estimated take levels is largely impractical. For these reasons, and based on our experience monitoring other fishing, we believe a 5-year time period is appropriate for meaningful monitoring. In this approach, takes are set as 5-year running sums (total for any consecutive 5-year period) and not for static 5-year periods (i.e., 2014-2018, 2015-2019, 2016-2020, and so on, as opposed to 2014-2018, 2019-2023, 2024-2028). This approach reduces the likelihood reinitiation of ESA consultation will be required unnecessarily because of inherent variability in take levels, while still allowing for an accurate assessment of how the proposed actions are performing versus our expectations.

Estimating Future Immediate Mortalities of Sea Turtles

Sea turtles captured in FIM-related fishing gear are likely to experience 3 possible outcomes: (1) they are released alive and ultimately survive the interaction, (2) they are released alive but ultimately die as a result of the interaction (i.e., "post-interaction mortality"), or (3) die immediately as a result of the interaction (i.e., "immediate mortality"). No FIM project reporting an incidental capture of a sea turtle has ever reported a mortality. Based on these data, we anticipate a high survival rate for any sea turtles taken in the future. Thus, we anticipate no immediate mortalities associated with FIM-related trawling.

Estimating Future Post-Interaction Mortalities of Sea Turtles

In January 2004, NMFS convened a workshop of experts to develop criteria for estimating post-release mortality of sea turtles caught in the pelagic longline fishery. In 2006, those criteria were revised and finalized (Ryder et al. 2006). In February 2012, the SEFSC updated the 2006 criteria by adding 3 additional hooking scenarios. Overall mortality ratios are dependent upon the type of interaction (hooking, entanglement, etc.), the location of hooking, if applicable (hooked externally, hooked in the mouth, etc.), and the amount/type of gear remaining on the animal at the time of release (i.e., hook remaining, amount of line remaining, entangled or not). Therefore, the experience, ability, and willingness of the crew to remove the gear, and the availability of gear-removal equipment, are very important factors influencing post-release mortality. The new criteria also take into account differences in post-release mortality between hardshell sea turtles and leatherback sea turtles, with slightly higher rates of post-release mortality assigned to leatherbacks. No specific criteria for bottom longline gear is currently available. In Section 5.5, we estimate future sea turtle captures during FIM hook-and-

line sampling. We will use these revised criteria to estimate the number of those incidental takes that may result in post-release mortality.

In August 2015, NMFS convened a workshop of experts to develop criteria for estimating post-interaction mortality (PIM) of sea turtles caught in trawl, gillnet and trap fishing gear (Stacy et al. 2016). Sea turtles caught in fishing gear that are alive upon discovery exhibit a range of outward effects, from seemingly normal behavior and activity to complete unresponsiveness. Because in most instances it is difficult to measure whether a sea turtle lived or died after being captured in fishing gear, the likelihood of mortality is best determined by activity level and the presence or absence of any abnormal behavior or injuries. There is inherent variability in the conditions under which observations are made and the amount of time sea turtles are available for examination due to factors such as fishing operations, sea state, weather, and time of day. Thus, one of the primary purposes of the workshop was to develop criteria for determining the likelihood of PIM for animals based on an array of behavior/injuries. The workshop participants worked on developing these criteria by using data from published studies, their expert opinions, discussions during the meeting, or a combination thereof.

In general, the workshop considered the likelihood of PIM as: low (20% chance of mortality), medium (50% chance of mortality), or high (80% chance of mortality), depending on the injury or behavior. In addition, injuries or conditions that are incompatible with survival were considered deaths (100% mortality). The mortality percentages applied to these risk categories were derived from a combination of expert opinion and available studies pertinent to post-interaction mortality.

Based on the workshop proceedings, NMFS's Office of Protected Resources has produced draft national criteria for evaluating PIM. These draft criteria are currently undergoing peer review. While the draft criteria undergo review, we decided to act conservatively and incorporate an additional 20% mortality rate to trawl and gillnet captures during FIM projects. The proceedings indicate this 20% chance of mortality is relevant to any fisheries interaction, which includes apparently uninjured sea turtles that exhibit normal behavior and activity, those with slight alterations in behavior or activity that may still be considered within the bounds of normal, and sea turtles with minor, non-life threatening injuries. Based on past data, this accounts for the vast majority of sea turtles captured alive by FIM projects.

5.4 Documented Past and Anticipated Future Sea Turtle and Smalltooth Sawfish Takes During FIM Trawls Projects

5.4.1 South Atlantic Trawl Sea Turtle Captures

For reference, we summarized the maximum amount of annual fishing effort for each trawl project in the South Atlantic in Table 5.6.

Table 5.6. Maximum Annual FIM Trawl Effort in the South Atlantic

Project	Trawl Type	Number Nets/Season	Headrope Length (ft)	Max. Tow Time (hr)	Tow Hr/100-ft Headrope
SEAMAP-SA Coastal Survey (SCDNR	Otter	700	86	0.33	200.67
SEAMAP-SA Pamlico Sound Survey (NCDENR)	Otter	216	30	0.33	21.60
Atlantic Striped Bass Tagging Survey (NMFS/USFWS)	Otter	700	65	0.50	227.50
TOTAL For All Projects	--	1,616	--	--	449.77

Table 5.7 reports the sea turtle captures from 2009-2014, in South Atlantic FIM trawl gear. During that period there were 277 total captures in the South Atlantic across 3 projects; none were lethal.

Table 5.7. South Atlantic FIM Trawl Sea Turtle Captures (2009-2014)

Project	Year						Total Captures by Project	Average Capture by Project(s)	Percentage of All Captures by Project(s)
	2009	2010	2011	2012	2013	2014			
SEAMAP-SA Coastal Trawl Survey (SCDNR)	30	57	51	46	46	46	276	46	99.64%
SEAMAP-SA North Carolina Pamlico Sound Trawl Survey (NCDENR)	0	0	1	0	0	0	1	0.17	0.36%
USFWS Atlantic Striped Bass Cruise	0	0	0	0	0	0	0	0	0.0%

Since the SEAMAP-SA Coastal Trawl Survey (SCDNR) project accounted for such a large proportion of the total captures, we estimated future captures for this project and the remaining 2 projects separately, based on their average captures from 2009-2014 (Table 5.7). We were concerned that basing our future take estimates on an average across all projects would underestimate the likely captures from the SEAMAP-SA Coastal Trawl Survey (SCDNR), while overestimating the likely captures by remaining projects. Sea turtle captures by species, project, and the relative species compositions are noted in Table 5.8. Based on the average captures in the past, we anticipate 231 future captures by the SEAMAP-SA Coastal Trawl Survey (SCDNR) during future 5-year periods, and 1 sea turtle capture in the other 2 trawl projects during the same period. In Table 5.9, we reported the likely number and species of our anticipated future trawl takes, rounded up to the nearest whole number.

Table 5.8. South Atlantic FIM Trawl Sea Turtle Captures by Species, Project, and Year

Year	Project	Species				Total All Species (2009-2014)
		Loggerhead	Kemp's ridley	Green	Leatherback	
2009	SEAMAP-SA Coastal Trawl Survey (SCDNR)	22	8	0	0	30
2010		42	15	0	0	57
2011		33	17	0	1	51
2012		23	21	2	0	46
2013		26	20	0	0	46
2014		33	10	2	1	46
2009-2014		179	92	2	2	277
Avg. 2009-2013		29.83	15.33	0.67	0.33	46.17
Percent of 6-Year Total		64.62%	33.21%	1.44%	0.72%	--
2009	Remaining 2 Projects	0	0	0	0	0
2010		0	0	0	0	0
2011		0	1	0	0	1
2012		0	0	0	0	0
2013		0	0	0	0	0
2014		0	0	0	0	0
2009-2014		0	1	0	0	0
Avg. 2009-2014		0	0.2	0	0	0.17
Percent of 6-Year Total		0.0%	100%	0.0%	0.0%	--

Table 5.9. Anticipated Future South Atlantic FIM Trawl Sea Turtle Captures by Species[34]

Project	Species				Total All Species
	Loggerhead	Kemp's ridley	Green	Leatherback	
SEAMAP-SA Coastal Trawl Survey (SCDNR)	150	77	4	2	233
Remaining Projects	0	1	0	0	1
Total	150	78	4	2	234

In some cases, the estimated number of takes is so low that when we multiplied that number by 20% PIM rate and followed conventional rounding techniques, we still ended up with no mortalities.[35] In these cases, we acted conservatively and rounded our lethal take estimates up to the nearest whole number, even though a nonlethal take is possible. This often meant the only anticipated take would be lethal. Table 5.10 reports the number and outcome of each anticipated incidental take. Because of rounding the numbers in Table 5.10 are slightly higher than the ones reported in Table 5.9.

Table 5.10. Anticipated South Atlantic FIM Trawl Takes and Mortalities[36]

Project(s)	Take Type	Species			
		Loggerhead	Kemp's ridley	Green	Leatherback
SEAMAP-SA Coastal Trawl Survey (SCDNR)	Lethal	30	16	1	1
	Nonlethal	120	62	3	1
Remaining Projects	Lethal	0	1	0	0
	Nonlethal	0	0	0	0
Total	Lethal	30	16	1	1
	Nonlethal	120	62	3	2

[34] *SEAMAP-SA Coastal Trawl Survey*: 231 future takes x 64.62% loggerhead captures = 149.27 loggerhead captures; 231 future takes x 33.21% Kemp's ridley captures = 76.72 Kemp's ridley captures; 231 future takes x 1.44% green captures = 3.33 green captures; 231 future takes x 0.72% leatherback captures = 1.66 leatherback captures
Remaining Projects: 1 future takes x 100% Kemp's ridley captures = 1 Kemp's ridley captures.
[35]For example, 2 leatherback sea turtle captures x 20% mortality = 0.4 mortalities; conventional rounding rounds down to 0 mortalities.
[36] *SEAMAP-SA Coastal Trawl Survey (SCDNR)*: 150 loggerhead takes x 20% mortality rate = 30 loggerhead mortalities; 78 Kemp's ridley takes x 20% mortality rate = 15.6 Kemp's ridley mortalities; 4 green takes x 20% mortality rate = 0.8 green mortalities; 2 leatherback takes x 20% mortality rate = 0.4 leatherback mortalities.
Remaining Projects: 1 Kemp's ridley take x 20% mortality rate = 0.2 Kemp's ridley mortalities

5.4.2 Gulf of Mexico Trawl Sea Turtle Captures

For reference, we summarize the maximum amount of annual fishing effort for each trawl project in the Gulf of Mexico in Table 5.11.

Table 5.11. Maximum Annual FIM Trawl Effort in the Gulf of Mexico

Project	Number of Nets/Season	Headrope Length (ft)	Max. Tow Time (hr)	Tow Hr/100-ft Headrope
SEAMAP-GOM Shrimp/Groundfish Trawl Survey (Summer) (FFWCC)	160	42	0.50	33.6
SEAMAP-GOM Shrimp/Groundfish Trawl Survey (Summer/Fall) (ADCNR)	24	42	0.50	5.04
SEAMAP-GOM Shrimp/Groundfish Trawl Survey (Summer/Fall) (USM/GCRL)	60	42	0.50	12.60
SEAMAP-GOM Shrimp/Groundfish Trawl Survey (Summer/Fall) (LDWF)	50	42	0.50	10.50
IJA Open Bay Shellfish Trawl Survey (TPWD)	1,080	20	0.17	36.00
SEAMAP-GOM Shrimp/Groundfish Trawl Survey (Summer/Fall) (TPWD)	200	20	0.167	6.67
IJA Inshore Finfish Trawl Survey (MDMR)	72	16	0.167	1.92
IJA Biloxi Bay Beam Trawl Survey (MDMR)	132	5	0.333	2.20
Juvenile Sport Fish Monitoring in FL Bay (NMFS)	500	11	0.033	1.83
Saint Andrews Bay Juvenile Reef Fish Survey (NMFS)	312	3	0.008	0.08
SEAMAP-GOM Shrimp/Groundfish Trawl Survey (Summer/Fall) (NMFS)	670	42	0.50	140.70
Small Pelagics Trawl Survey (Fall) (NMFS)	200	90	0.50	90.00
TOTAL For All Projects	3,460	--	--	341.14

Table 5.12 reports the sea turtle captures from 2009-2014, in Gulf of Mexico trawl gear. During that period, 53 total captures occurred in the Gulf of Mexico across 6 of 12 projects operating in the region; none were lethal.

Table 5.12. Gulf of Mexico FIM Trawl Sea Turtle Captures (2009-2014)

Project	Year						Total Captures by Project	Average Capture by Project(s)	Percentage of All Captures by Project(s)
	2009	2010	2011	2012	2013	2014			
SEAMAP-GOM Shrimp/Groundfish Trawl Survey (Summer) (FFWCC)	3	6	3	5	2	6	25	4.2	47.17%
SEAMAP-GOM Shrimp/Groundfish Trawl Survey (Summer/Fall) (NMFS)	3	5	2	4	2	3	19	3.2	35.85%
SEAMAP-GOM Shrimp/Groundfish Trawl Survey (Summer/Fall) (USM/GCRL)	1	1	0	0	3	0	5	0.8	9.43%
Small Pelagics Trawl Survey (Fall) (NMFS)	0	1	0	1	0	0	2	0.3	3.77%
SEAMAP-GOM Shrimp/Groundfish Trawl Survey (Summer/Fall) (ADCNR)	1	0	0	0	0	0	1	0.2	1.89%
IJA Open Bay Shellfish Trawl Survey (TPWD)	1	0	0	0	0	0	1	0.2	1.89%
SEAMAP-GOM Shrimp/Groundfish Trawl Survey (Summer/Fall) (LDWF)	0	0	0	0	0	0	0	0	0.0%
SEAMAP-GOM Summer and Fall Shrimp/Groundfish Trawl Survey (TPWD)	0	0	0	0	0	0	0	0	0.0%
IJA Inshore Finfish Trawl Survey (MDMR)	0	0	0	0	0	0	0	0	0.0%
IJA Biloxi Bay Beam Trawl Survey (MDMR)	0	0	0	0	0	0	0	0	0.0%
Juvenile Sport Fish Monitoring in FL Bay (NMFS)	0	0	0	0	0	0	0	0	0.0%
Saint Andrews Bay Juvenile Reef Fish Survey (NMFS)	0	0	0	0	0	0	0	0	0.0%

Since the SEAMAP-GOM Shrimp/Groundfish Trawl Survey (Summer) (FFWCC), SEAMAP-GOM Shrimp/Groundfish Trawl Survey (Summer/Fall) (NMFS), SEAMAP-GOM Shrimp/Groundfish Trawl Survey (Summer/Fall) (USM/GCRL), and Small Pelagics Trawl Survey (Fall) (NMFS) trawling projects captured the majority (i.e., ~ 96%) of the sea turtles we followed the same approach described previously and calculated future takes for those projects and the 8 other projects, separately. Sea turtle captures by species, project, and the relative species composition are noted in Table 5.13. Based on the average captures in the past, we anticipate 43 future captures by the four projects mentioned previously during future 5-year periods, and 2 sea turtle capture in the other 8 trawl projects during the same period. In Table 5.14, we reported the likely number and species of our anticipated future trawl takes.

Table 5.13. Gulf of Mexico FIM Trawl Sea Turtle Captures by Species, Project, and Year

Year	Project	Species				Total All Species (2009-2014)
		Loggerhead	Kemp's ridley	Green	Leatherback/ Hawksbill	
2009	SEAMAP-GOM Shrimp/ Groundfish Trawl Survey (FFWCC, USM/GCRL & NMFS) and Small Pelagics Trawl Survey (Fall) (NMFS)	5	1	0	1 (Leatherback)	7
2010		11	1	1	0	13
2011		3	2	0	0	5
2012		9	1	0	0	10
2013		4	3	0	0	7
2014		6	3	0	0	9
2009-2014		38	11	1	1	51
Avg. 2009-2014		6.33	1.83	0.17	0.17	8.5
Percent of 6-Year Total		74.5%	21.57%	1.96%	1.96%	--
2009	Remaining 8 Projects	1	0	0	1 (Hawksbill)	2
2010		0	0	0	0	0
2011		0	0	0	0	0
2012		0	0	0	0	0
2013		0	0	0	0	0
2014		0	0	0	0	0
2009-2014		1	0	0	1	2
Avg. 2009-2014		0.17	0	0	0.17	0.33
Percent of 6-Year Total		50%	0	0	50%	--

Table 5.14. Anticipated Future Gulf of Mexico FIM Trawl Sea Turtle Captures by Species[37]

Project	Species					Total All Species
	Loggerhead	Kemp's ridley	Green	Leatherback	Hawksbill	
SEAMAP-GOM Shrimp/ Groundfish Trawl Survey (FFWCC, USM/GCRL & NMFS) and Small Pelagics Trawl Survey (Fall) (NMFS)	32	10	1	1	0	44
Remaining Projects	1	0	0	0	1	2
Total	33	10	1	1	1	46

Mortalities from Future Trawling Takes

We followed the same approach described previously for the South Atlantic FIM trawling projects to estimate the future trawling mortalities in the Gulf of Mexico region. Given there has never been a documented mortality, the tow times are short, and the care taken when handling the animals before release, we believe it is appropriate to assume these animals were "healthy" upon release; we do not anticipate any immediate mortalities. However, we decided to act conservatively and assume a 20% PIM rate for our future anticipated trawl captures. In some cases, the estimated number of takes is so low that when we multiplied that number by 20% and followed conventional rounding techniques, we still ended up with no mortalities. In these cases, we acted conservatively and rounded our lethal take estimates up to the nearest whole number, even though a nonlethal take is possible. This often meant the only anticipated take would be lethal. Table 5.15 reports the number and outcome of each anticipated incidental take. Because of rounding the numbers in Table 5.15 are slightly higher than the ones reported in Table 5.14.

[37] *SEAMAP-GOM Shrimp/Groundfish Trawl Survey (FFWCC, USM/GCRL, & NMFS) and Small Pelagics Trawl Survey (Fall) (NMFS)*: 43 future takes x 74.5% loggerhead captures = 32.04 loggerhead captures; 43 future takes x 21.57% Kemp's ridley captures = 9.27 Kemp's ridley captures; 43 future takes x 1.96% green captures = 0.83 green captures; 43 future takes x 1.96% leatherback captures = 0.83 leatherback captures

Remaining Projects: 2 future takes x 50% loggerhead and 50% hawksbill captures = 1 loggerhead and 1 hawksbills captures.

Table 5.15. Anticipated Gulf of Mexico FIM Trawl Turtle Takes and Mortalities[38]

Project(s)	Take Type	Species				
		Loggerhead	Kemp's ridley	Green	Leatherback	Hawksbill
SEAMAP-GOM Shrimp/Ground-fish Trawl Survey (FFWCC & NMFS)	Lethal	7	2	1	1	0
	Nonlethal	26	8	0	0	
Remaining Projects	Lethal	1	0	0	0	1
	Nonlethal	0				0
Total	Lethal	8	2	1	1	1
	Nonlethal	26	8	0	0	0

5.4.3 Summary of Anticipated Sea Turtle Trawl Captures by Region

The previous 2 sections evaluated the documented past sea turtle captures on FIM trawl gear and estimated the likely number of future FIM trawl sea turtle captures. We summarized those captures by species and region in Table 5.16.

Table 5.16. Future 5-Year Trawl Sea Turtles Captures and Mortalities by Region

Region	Take Type	Species				
		Loggerhead	Kemp's Ridley	Green	Leatherback	Hawksbill
South Atlantic	Lethal	30	16	1	1	0
	Nonlethal	120	62	3	2	
Gulf of Mexico	Lethal	8	2	1	1	1
	Nonlethal	26	8	0	0	0
Total	Lethal	38	18	2	2	1
	Nonlethal	146	70	3	2	0

[38] *SEAMAP-GOM Shrimp/Groundfish Trawl Survey (FFWCC USM/GCRL, & NMFS) and Small Pelagics Trawl Survey (Fall) (NMFS)*: 32 loggerhead takes x 20% mortality rate = 6.4 loggerhead mortalities; 10 Kemp's ridley takes x 20% mortality rate = 2 Kemp's ridley mortalities; 1 green takes x 20% mortality rate = 0.2 green mortalities; 1 leatherback takes x 20% mortality rate = 0.2 leatherback mortalities
Remaining Projects: 1 loggerhead and 1 hawksbill take x 20% mortality rate for each = 0.2 loggerhead and 0.2 hawksbill mortalities
[38] For example, 1 anticipated green sea turtle takes x 20% mortality rate = 0.2 mortalities, rounded down equals 0.

5.4.4 Documented Past and Anticipated Future Smalltooth Takes During FIM Trawl Projects

Only 1 smalltooth sawfish (released alive) has ever been captured during FIM trawl sampling. Because FIM projects effectively have 100% observer coverage, we believe this interaction rate is accurate. While smalltooth sawfish takes in FIM trawling seem very unlikely (i.e., only 1 ever documented), we believe it is prudent to assume that an incidental take could occur in the future. Even in commercial shrimping, the number of smalltooth sawfish takes is low. Since 2007, 10 smalltooth sawfish have been observed taken by commercial shrimp trawlers. Compared to commercial shrimp fisheries, FIM trawl sampling effort is miniscule. For example, the estimated commercial shrimp fishing effort for 2012 in the Gulf of Mexico alone was 2.26 million hours (NMFS 2014h).[39] By comparison, annual FIM trawl sampling in both the South Atlantic and Gulf of Mexico combined is approximately 800 tow hours.

The range of the smalltooth sawfish is peninsular Florida, specifically south Florida and the Florida Keys. Because the primary areas of residence for the smalltooth sawfish straddle both the Gulf of Mexico and South Atlantic regions, we believe a smalltooth sawfish take could occur during FIM trawl sampling in either region. To act conservatively toward the species, we will assume that 1 take could occur in either region every 5 years..

The only documented smalltooth sawfish capture during FIM trawls was released alive. Observer information from the commercial shrimp fishery indicates that of 10 observed captures, 2 were released dead (25%), 4 were released alive (50%) and 2 with uncertain fates (25%). There is some question as to whether smalltooth sawfish mortalities in commercial shrimp trawls are a result of the actual entanglement with the gear, or whether it is because incidentally caught animals die from air exposure while hanging from the net out of the water. There are no studies of the physiological consequences of capture stress in smalltooth sawfish. Regardless, we believe that the likelihood of an animal's dying as a result of air exposure or any sort of handling is extremely low because the tow times during FIM trawling will be short and because researchers will be available to immediately release an incidentally captured animal. Yet, since there are no studies on physiological consequences of capture stress to smalltooth sawfish, we will act conservatively and assume that the take could be lethal or nonlethal.

[39] 94,100 fishing days x 24 hours/fishing day = 2,258,400 fishing hours

5.5 Documented Past and Anticipated Future Sea Turtle Takes During FIM Longline Projects

5.5.1 South Atlantic Longline Sea Turtle Captures

Longline sampling (bottom and pelagic) is the only FIM-related hook-and-line gear that has ever captured sea turtles. No captures of any kind have occurred during Caribbean hook-and-line sampling. For reference, we summarize the maximum amount of annual longline fishing effort in the South Atlantic in Table 5.17.

From 2009-2014, 29 sea turtle captures occurred in the South Atlantic across 8 projects. The SEAMAP-SA Red Drum Bottom Longline Survey (GADNR) accounted for the majority of those captures (93.1%) (Table 5.18).

Table 5.17. Maximum Longline Effort in the South Atlantic by Project

Project	Number of Hooks/Project	Soak Time (Hr)	Total Hook Hr/Project
SEAMAP-SA Red Drum Bottom Longline Survey (NCDENR)	10,000	0.5	5,000
SEAMAP-SA Red Drum Bottom Longline Survey (SCDNR)	14,400	0.5	7,200
SEAMAP-SA Red Drum Bottom Longline Survey (GADNR)	16,500	0.5	8,250
HMS-Chesapeake Bay and Coastal Virginia Bottom Longline Shark Survey (VIMS)	4,800	4.0	19,200
MARMAP/SEAMAP- Reef Fish Survey (Short Bottom Longline) (SCDNR)	4,000	1.5	6,000
MARMAP/SEAMAP- Reef Fish Survey (Long Bottom Longline) (SCDNR)	6,000	1.5	7,500
Shark and Red Snapper Bottom Longline Survey (NMFS)	28,000	1.0	28,000
Pelagic Longline Survey (NMFS)	6,000	3.0	18,000
TOTAL For All Projects	89,700	--	99,150

Table 5.18. South Atlantic FIM Longline Sea Turtle Captures (2009-2014)

Project	Year						Total Captures by Project	Average Capture by Project(s)	Percent of All Captures by Project(s)
	2009	2010	2011	2012	2013	2014			
SEAMAP-SA Red Drum Bottom Longline Survey (GADNR)	3	4	5	4	5	6	27	4.5	93.1%
HMS-Chesapeake Bay and Coastal Virginia Bottom Longline Shark Survey (VIMS)	0	0	1	0	0	0	1	0.17	3.44%
SEAMAP-SA Red Drum Bottom Longline Survey (NCDENR)	0	0	0	1	0	0	1	0.17	3.44%
Shark and Red Snapper Bottom Longline Survey (NMFS)*	0	0	0	0	0	0	0	0	0%
Pelagic Longline Survey (NMFS)*	0	0	0	0	0	0	0	0	0%
SEAMAP-SA Red Drum Bottom Longline Survey (SCDNR)	0	0	0	0	0	0	0	0	0%
MARMAP/SEAMAP- Reef Fish Survey (Short Bottom Longline) (SCDNR)	0	0	0	0	0	0	0	0	0%
MARMAP/SEAMAP- Reef Fish Survey (Long Bottom Longline) (SCDNR)	0	0	0	0	0	0	0	0	0%
* Sampling effort occurs in both Gulf of Mexico and South Atlantic									

Since the SEAMAP-SA Red Drum Bottom Longline Survey (GADNR) project accounted for such a large proportion of the total captures, we estimated future captures for this project specifically, as well as the remaining 7 projects collectively, based on the average captures of those projects from 2009-2014 (Table 5.18). Sea turtle captures by species, project, and the relative species compositions are noted in Table 5.19. Based on the average captures in the past we anticipate 23 future captures by the SEAMAP-SA Red Drum Bottom Longline Survey (GADNR) during consecutive 5-year periods, and 2 sea turtle capture in the other 7 projects during the same period. In Table 5.20, we report the likely number and species of our anticipated future longline takes.

Table 5.19. South Atlantic FIM Longline Sea Turtle Captures by Species and Year

Year	Project(s)	Species			Total All Species (2009-2014)
		Loggerhead	Kemp's ridley	Leatherback	
2009	SEAMAP-SA Red Drum Bottom Longline Survey (GADNR)	0	3	0	3
2010		2	2	0	4
2011		2	3	0	5
2012		1	3	0	4
2013		1	4	0	5
2014		0	6	0	0
2009-2014		6	21	0	27
Avg. 2009-2014		1.0	3.5	0	4.5
Percent of 6-Year Total		22.22%	77.78%	0	--
2009	Remaining 7 Projects	0	0	0	0
2010		0	0	0	0
2011		0	0	1	1
2012		1	0	0	1
2013		0	0	0	0
2014		0	0	0	0
2009-2014		1	0	1	2
Avg. 2009-2014		0.17	0	0.17	0.33
Percent of 6-Year Total		50.00%	0	50.00%	--

Table 5.20. Anticipated Future South Atlantic FIM Longline Sea Turtle Captures [40]

Project	Species			Total for All Species
	Loggerhead	Kemp's Ridley	Leatherback	
SEAMAP-SA Red Drum Bottom Longline Survey (GADNR)	6	18	0	24
Remaining Projects	1	0	1	2
Total	7	18	1	26

Mortalities from Future Longline Takes

From 2009 through 2013, no mortalities were reported during South Atlantic FIM longline fishing. All other incidentally taken sea turtles were reportedly released in good condition, though no post-release mortality tracking was conducted. It is likely sea turtles released alive from bottom longline gear, particularly, will have experienced some form of physiological injury from forced submergence and/or injury from hooking and entanglement, and many may still carry penetrating or entangling gear. Some of these injuries could, in theory, lead to mortality. Based on this information we do not believe any immediate mortalities are likely. However, to be conservative, we chose to estimate some level of post-release mortality.

To anticipate future post-release mortalities we used the revised criteria (NMFS and SEFSC 2012). Since all FIM bottom longline projects use circle hooks, we anticipate any incidentally taken sea turtle would initially suffer from injuries consistent with Injury Categories I and II in Table 5.21. The reasonable and prudent measures of this Biological Opinion will require a suite of sea turtle release gear aboard all vessels conducting FIM hook-and-line projects. This requirement should facilitate the removal of all or most fishing gear. To estimate post-release mortalities, we acted conservatively and chose the most severe injury category anticipated (Category II, Release Condition C bolded in Table 5.21).

The criteria in Table 5.21 indicate 20% of hardshell and 30% of leatherback sea turtles initially falling into injury Category II that are released with some trailing line still remaining, suffer post-release mortality. Table 5.22 provides our revised estimates of future takes, including those likely to result in mortality.[41] Our leatherback future take estimate is so low that even applying this mortality rate yields no mortality when we follow conventional rounding techniques.[42] Here, we acted conservatively and rounded that number up to the nearest whole number.

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[40] *SEAMAP-SA Red Drum Bottom Longline Survey (GADNR)*: 23 future takes x 22.2% loggerhead captures = 5.1 loggerhead captures; 23 future takes x 77.8% Kemp's ridley captures = 17.88 Kemp's ridley captures *Remaining Projects*: 2 future takes x 50% loggerhead and 50% leatherback captures = 1 loggerhead and 1 leatherback capture.

[41] *SEAMAP-SA Red Drum Bottom Longline Survey (GADNR)*: 6 loggerhead takes x 20% mortality rate = 1.2 loggerhead mortalities; 18 Kemp's ridley takes x 20% mortality rate = 3.6 Kemp's ridley mortalities *Remaining Projects*: 1 loggerhead take x 20% mortality rate = 0.2 loggerhead mortalities; 1 leatherback sea turtle takes x 30% mortality rate = 0.3 leatherback mortalities

[42] 1 leatherback sea turtle takes x 30% mortality rate = 0.3 mortalities; rounded down equals 0.

Table 5.21. Criteria for Assessing Post-Release Mortality, With Mortality Rates Shown as Percentages for Hardshell Sea Turtles and Leatherbacks (in Parentheses) (NMFS and SEFSC 2012)

Injury Category		Release Condition[1]			
		(A) Released entangled (line is trailing or not trailing, turtle is entangled)	**(B) Released with hook and with trailing line greater than or equal to half the length of the carapace (line is trailing, turtle is not entangled)**	**(C) Released with hook and with trailing line less than half the length of the carapace (line is trailing, turtle is not entangled)**	**(D) Released with all gear removed**
		Hardshell (Leatherback)	Hardshell (Leatherback)	Hardshell (Leatherback)	Hardshell (Leatherback)
I	Hooked externally with or without entanglement	55 (65)	20 (30)	10 (15)	5 (10)
II	Hooked in upper or lower jaw with or without entanglement. Includes ramphotheca, but not any other jaw/mouth tissue parts (see Category III).	65 (75)	30 (40)	20 (30)	10 (15)
III	Hooked in cervical esophagus, glottis, jaw joint, soft palate, tongue, and/or other jaw/mouth tissue parts not categorized elsewhere, with or without entanglement. Includes all events where the insertion point of the hook is visible when viewed through the mouth.	75 (85)	45 (55)	35 (45)	25 (35)
IV	Hooked in esophagus at or below level of the heart with or without entanglement. Includes all events where the insertion point of the hook is not visible when viewed through the mouth.	85 (95)	60 (70)	50 (60)	75 (85)
V	Entangled only, no hook involved	Released Entangled 50 (60)	n/a		Fully Disentangled 1 (2)
VI	Comatose/resuscitated	n/a		70 (80)	60 (70)

Table 5.22. Future 5-Year South Atlantic Longline Sea Turtles Captures and Mortalities

Project	Take Type	Species		
		Loggerhead	Kemp's ridley	Leatherback
SEAMAP-SA Red Drum Bottom Longline Survey (GADNR)	Lethal	2	4	0
	Nonlethal	4	14	
Remaining Projects	Lethal	1	1	1
	Nonlethal			
Total	Lethal	3	5	1
	Nonlethal	4	14	

5.5.2 Gulf of Mexico Longline Sea Turtle Captures

For reference, we summarize the maximum amount of annual longline fishing effort in the Gulf of Mexico region in Table 5.23. From 2009-2014, 10 sea turtles were captured in the Gulf of Mexico across the 8 projects. All captures during the period occurred on bottom longline gear. The relative contribution of each species to the total number of incidentally captured sea turtles is also noted in Table 5.24.

Table 5.23. Maximum Longline Effort in the Gulf of Mexico by Project

Project	Number of Hooks/Project	Soak Time (Hr)	Total Hook Hr/Project
HMS - GULFSPAN Bottom Longline Survey (UWF)	6,000	1	6,000
HMS - GULFSPAN Bottom Longline Survey (FSU)	7,400	1	7,400
SEAMAP-GOM Bottom Longline Survey (ADCNR)	3,200	1.0	3,200
SEAMAP-GOM Bottom Longline Survey (USM/GCRL)	4,000	1.0	4,000
SEAMAP-GOM Bottom Longline Survey (LDWF)	9,600	1.0	9,600
SEAMAP-GOM Bottom Longline Survey (TPWD)	2,000	1.0	2,000
SEAMAP-Shark and Red Snapper Bottom Longline (NMFS)*	28,000	1.0	28,000
Pelagic Longline Survey (NMFS)*	6,000	3.0	18,000
TOTAL For All Projects	67,000	--	79,000
*Sampling effort occurs in both Gulf of Mexico and South Atlantic			

Table 5.24. Gulf of Mexico FIM Longline Sea Turtle Captures (2009-2014)

Project	Year						Total Captures by Project	Average Capture by Project(s)	Percent of All Captures by Project(s)
	2009	2010	2011	2012	2013	2014			
SEAMAP-GOM BLL Survey (USM/GCRL)	1	1	2	0	0	2	6	1.0	60.0%
Shark and Red Snapper BLL Survey (NMFS)*	1	0	0	0	1	0	2	0.33	20.0%
SEAMAP-GOM BLL Survey (LDWF)	0	0	1	0	0	0	1	0.17	10.0%
SEAMAP-GOM BLL Survey (TPWD)	0	1	0	0	0	0	1	0.17	10.0%
HMS - GULFSPAN BLL Survey (UWF)*	--	--	--	--	0	0	0	0	0.0%
HMS - GULFSPAN BLL Survey (FSU)	0	0	0	0	0	0	0	0	0.0%
SEAMAP-GOM BLL Survey (ADCNR)	0	0	0	0	0	0	0	0	0.0%
PLL Survey (NMFS)**	0	0	0	0	0	0	0	0.0	0.0%

BLL = Bottom Longline; PLL = Pelagic Longline
*Project did not begin until 2013
**Sampling effort occurs in both Gulf of Mexico and South Atlantic

Since the SEAMAP-GOM Bottom Longline Survey (USM/GCRL) and Shark and Red Snapper Bottom Longline Survey (NMFS) SEAMAP-GOM Bottom Longline Survey (LDWF), and SEAMAP-GOM Bottom Longline Survey (TPWD) projects were the only ones that captured sea turtles, we estimated the likely captures for these projects. Sea turtle captures by species, project, and the relative species composition are noted in Table 5.25. Based on the average captures in the past we anticipate 10 future captures by these projects during future 5-year periods.

Table 5.25. Gulf of Mexico FIM Longline Sea Turtle Captures by Species, Project, and Year

Year	Project	Species		Total All Species (2009-2014)
		Loggerhead	Kemp's ridley	
2009	SEAMAP-GOM Bottom Longline Survey (LDWF, TPWD, & USM/GCRL) & Shark and Red Snapper Bottom Longline Survey (NMFS)	2	0	2
2010		2	0	2
2011		1	2	3
2012		0	0	0
2013		1	0	1
2014		2	0	2
2009-2014		8	2	10
Average 2009-2014		1.33	0.33	1.67
Percent of 6-year Total		80%	20%	--

Mortalities from Future Longline Takes

From 2009 through 2014, a single mortality was reported in the Gulf of Mexico. All other incidentally taken sea turtles were reportedly released in good condition, though no post-release mortality tracking was conducted. It is likely sea turtles released alive from bottom longline gear particularly will have experienced some form of physiological injury from forced submergence and/or traumatic injury from hooking and entanglement. Many may still carry penetrating or entangling gear. Some of these injuries could, in theory, lead to mortality. To be conservative, we chose to estimate some level of post-release mortality. We followed the same approach described previously for the South Atlantic to calculate post-release mortalities. Based on that approach, we anticipate 20% of hardshell and 30% of leatherback sea turtles will suffer post-release mortality. Our Kemp's ridley future take estimate is so low that even applying this mortality rate yields zero mortality when we follow conventional rounding techniques. Here, we acted conservatively and rounded that number up to the nearest whole number.

Table 5.26. Future 5-Year Gulf of Mexico Longline Sea Turtles Captures and Mortalities[43]

Take Type	Species	
	Loggerhead	Kemp's ridley
Lethal	2	1
Nonlethal	6	1
Total	8	2

[43] *SEAMAP-GOM Bottom Longline Survey (LDWF, TPWD, & USM/GCRL) & Shark and Red Snapper Bottom Longline Survey (NMFS)*: 8 loggerhead takes x 20% mortality rate = 1.6 loggerhead mortalities; 2 Kemp's ridley takes x 20% mortality rate = 0.4 Kemp's ridley mortalities

5.5.3 Summary of Anticipated Longline Sea Turtle Captures by Region

The previous 2 sections evaluated the documented past sea turtle captures on FIM longline gear and estimated the likely number of future FIM longline sea turtle captures. We summarized those captures by species and region in Table 5.27.

Table 5.27. Future 5-Year Longline Sea Turtles Captures and Mortalities by Region

Region	Take Type	Species		
		Loggerhead	Kemp's ridley	Leatherback
South Atlantic	Lethal	3	5	1
	Nonlethal	4	14	
Gulf of Mexico	Lethal	2	1	0
	Nonlethal	6	1	
Total	Lethal	5	6	1
	Nonlethal	10	15	

5.6 Documented Past and Anticipated Future Sea Turtle Takes during FIM Gillnet Projects

5.6.1 Hawksbill and Leatherback Gillnet Captures

No South Atlantic or Gulf of Mexico FIM gillnet projects have ever caught a hawksbill or leatherback sea turtle. Because these projects operate primarily in riverine or estuarine habitats, it is not surprising that no leatherback captures have occurred. Leatherbacks are the most pelagic[44] of the sea turtles, only entering coastal waters on a seasonal basis either to feed in areas where jellyfish are concentrated or to nest. Because FIM gillnet projects do not occur near leatherback nesting beaches or areas where jellyfish are likely to congregate, it is not surprising that no leatherbacks have been captured in the past. From 2007-2013, only 4 combined leatherback sea turtles have been documented in the STSSN stranding data for the Gulf of Mexico and South Atlantic (0.23% of all strandings reported). For these reasons, we believe that FIM gillnetting will not affect leatherback sea turtles.

Similarly, hawksbills usually occur between latitudes 30°N and 30°S and adult foraging habitat is typically coral reefs. The hawksbill's diet is highly specialized and consists primarily of sponges (Meylan 1988a). Other food items, notably corallimorphs and zooanthids, have been documented to be important in some areas of the Caribbean (León and Díez 2000; Mayor et al. 1998a; van Dam and Díez 1997). Additionally, from 2007-2013, only 2 hawksbill sea turtle strandings) has been documented in the STSSN stranding data for areas where FIM gillnetting will occur (0.11% of all strandings. Due to hawksbill sea turtles' preferred habitat and diet, the FIM gillnetting locations at the periphery of their northern range, and the small number of observations of the species in the action area for

[44] Pelagic: relating to or living in the open sea far from shore

the last several years, it is not expected that interactions with FIM gillnets will occur. Therefore, we believe FIM gillnet projects will not affect hawksbill sea turtles.

5.6.2 South Atlantic Gillnet Captures

Table 5.28 summarizes the maximum amount of annual fishing effort for each gillnet project in the South Atlantic. Two gillnet projects operate in the South Atlantic. The ACFCMA American Shad Drift Gillnet Survey (SCDNR) operates in the rivers of South Carolina and did not capture a sea turtle from 2009-2013. Because this project operates primarily in riverine habitats where sea turtles are unlikely to occur, it is not surprising that no captures have occurred. Because no captures have occurred in the past, we have no data upon which to estimate the number of potential future captures. For this reason, we will only estimate future sea turtle captures for the RecFIN Red Drum Trammel Net Survey (SCDNR). Table 5.29 reports the sea turtles captured by year.

Table 5.28. Maximum Annual FIM Gillnet Effort in the South Atlantic by Project

Project	Gear Type	Number of Sets/Season	Total Length (ft)	Mesh Size (in)	Net Depth (ft)	Soak Time (hr)	Max. Annual Fishing Effort (ft^2 hr)
South Atlantic Region							
ACFCMA American Shad Drift Gillnet Survey (SCDNR)	Drift GN	120	450	5.0	22	0.333	395,604
RecFIN Red Drum Trammel Net Survey (SCDNR)	Trammel Net	1,100	600	2.5 & 14.0	7	0.167	771,540

Table 5.29. South Atlantic FIM Gillnet Sea Turtle Captures (2009-2014)

Project	Year						Total Captures	Average Captures
	2009	2010	2011	2012	2013	2014		
RecFIN Red Drum Trammel Net Survey (SCDNR)	33	22	14	29	0	5	103	17.16

From 2009-2014, 105 sea turtles were captured; all the animals were released alive in good condition. Sea turtle captures by species, year, and the relative species compositions are noted in Table 5.30. Based on the average captures in the past, we anticipate 85.8 future captures will occur in South Atlantic FIM gillnet gear during future 5-year periods. In Table 5.31, we report the likely number and species of our anticipated future gillnet takes.

Table 5.30. South Atlantic FIM Gillnet Sea Turtle Captures by Species and Year

Year	Species			Total of All Species (2009-2014)
	Loggerhead	Kemp's ridley	Green	
2009	1	1	31	33
2010	0	2	20	22
2011	0	0	14	14
2012	1	0	28	29
2013	0	0	0	0
2014	0	0	5	5
2009-2014	2	3	98	103
Avg. 2009-2014	0.33	0.5	16.3	17.16
Percentage of 6-year Total	1.94%	2.91%	95.14%	--

Table 5.31. Anticipated Future South Atlantic FIM Gillnet Sea Turtle Captures[45]

Project	Species			Total of All Species
	Loggerhead	Kemp's ridley	Green	
Total	2	3	82	87

Estimating Future Immediate Mortalities
No FIM gillnet projects have ever reported sea turtle mortalities resulting from capture. Because FIM gillnet project have such short soak times (15-20 minutes) and are constantly tended, we anticipate a high survival rate for any sea turtles captured in the future. Thus, we anticipate no immediate mortalities associated with FIM-related gillnet gear.

Estimating Future Post-Interaction Mortalities
Based on NMFS's new draft PIM criteria, we have decided to act conservatively and apply the 20% PIM rate. In some cases, the estimated number of takes is so low that when we multiplied that number by 20% and followed conventional rounding techniques, we still ended up with no mortalities.[46] In these cases, we acted conservatively and rounded our lethal take estimates up to the nearest whole number, even though a nonlethal take is possible. Table 5.32 reports the number and outcome of each anticipated incidental take.

[45] *RecFIN Red Drum Trammel Net Survey (SCDNR):* 85.8 future takes x 1.94% loggerhead captures = 1.66 loggerhead captures; 85.8 future takes x 2.91% Kemp's ridley captures = 2.49 Kemp's ridley captures; 85.8 future takes x 95.14% green captures = 81.63 green captures

[46] For example, 2 loggerhead sea turtle captures x 20% mortality = 0.4 mortalities; conventional rounding rounds down to 0 mortalities.

Table 5.32. Anticipated South Atlantic FIM Gillnet Sea Turtle Takes and Mortalities [47]

Project(s)	Take Type	Species		
		Loggerhead	Kemp's ridley	Green
RecFIN Red Drum Trammel Net Survey (SCDNR)	Lethal	1	1	17
	Nonlethal	1	2	65
	Total	2	3	82

5.6.3 Gulf of Mexico Gillnet Captures

Table 5.33 summarizes the maximum amount of annual fishing effort for each gillnet project in the Gulf of Mexico. There are currently 5 FIM gillnet projects in the Gulf of Mexico considered in this Opinion. At present, only the HMS-GULFSPAN Gillnet Survey (NMFS) has reported sea turtle captures; 3 since 2012, all Kemp's ridleys. Anecdotal evidence, however, has indicated historical encounters where sea turtles occasionally bump into a net and then swim away or instances where the net was lifted to allow a sea turtle to roll out and swim free (D. Grubbs, Florida State University pers. comm. to A. Herndon, NMFS, October, 2012).

Based on the past capture data, we anticipate 5 incidental captures may occur in the future; based on past captures, all would be Kemp's ridleys.[48] However, because we are aware of anecdotal evidence indicating that other sea turtles may have been captured in the past, we are hesitant to assume that only Kemp's ridleys will be captured in the future. Therefore, we will assume 1 of our anticipated future sea turtle captures might be green or loggerhead sea turtle. Aside from Kemp's ridley sea turtles, these are the 2 most common sea turtle species found in the areas where Gulf of Mexico FIM gillnet projects occur. As with the South Atlantic FIM gillnet projects, we have no data indicating that interactions with Gulf of Mexico gillnet gear has resulted in mortalities. Because FIM gillnet project have such short soak times (15-20 minutes) and are constantly tended, we anticipate a high survival rate for any sea turtles captured in the future. Thus, we anticipate no immediate mortalities associated with FIM-related gillnet gear.

We also believe all sea turtles previously caught during Gulf of Mexico FIM gillnet sampling were released healthy. However, based on NMFS's new draft PIM criteria, we have decided to act conservatively and apply the 20% PIM rate. Since we only estimated 1 potential future take of a loggerhead or green sea turtle, when we multiplied that number by 20% and followed conventional rounding techniques, we still ended up with no mortalities. We acted conservatively and rounded our lethal take estimate up to the nearest whole number, even though a nonlethal take is possible.

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[47] *RecFIN Red Drum Trammel Net Survey (SCDNR):* 2 loggerhead takes x 20% mortality rate = 0.4 loggerhead mortalities; 3 Kemp's ridley takes x 20% mortality rate = 0.6 Kemp's ridley mortalities; 82 green takes x 20% mortality rate = 16.4 green mortalities

[48] 3 sea turtle captures ÷ 3 years reporting = 1 sea turtle capture annually; 1 sea turtle capture annually x 5 years = 5 sea turtle captures

Table 5.33. Maximum Annual FIM Gillnet Effort in the Gulf of Mexico by Project

Project	Gear Type	Number of Sets/Season	Total Length (ft)	Mesh Size (in)	Net Depth (ft)	Soak Time (hr)	Maximum Annual Fishing Effort (ft^2 hr)
HMS - GULFSPAN Gillnet Survey (MML)	Anchored GN	40	1,200	4.5	10	1	480,000
		40	600	3.0, 3.5, 4.0, 4.5, 5.0, and 5.5*	10	1	240,000
HMS - GULFSPAN Gillnet Survey (UWF)	Anchored GN	20	600			0.5	60,000
HMS - GULFSPAN Gillnet Survey (FL-Florida State University)	Anchored GN	100	600			1	600,000
HMS - GULFSPAN Gillnet Survey (USM/GCRL)	Anchored GN	24	600			1	144,000
HMS - GULFSPAN Gillnet Survey (NMFS)	Anchored GN	150	600			0.5	450,000
IJA – Coastal Finfish Gillnet Survey (MDMR)	Anchored GN	96	750	2.0, 2.5, 3.0, 3.5, 4.0	6	1	432,000

*Each GULFSPAN project uses the same size gillnet mesh

5.6.4 Summary of Anticipated Sea Turtle Gillnet Captures by Region

The previous 2 sections evaluated the documented past sea turtle captures on FIM gillnet gear and estimated the likely number of future FIM gillnet sea turtle captures. We summarized those captures by species and region in Table 5.34.

Table 5.34. Future 5-Year Gillnet Sea Turtles Captures by Region

Region	Take Type	Species		
		Loggerhead	Green	Kemp's ridley
South Atlantic	Lethal	1	17	1
	Nonlethal	1	65	2
Gulf of Mexico	Lethal	1		1
	Nonlethal	0		3
Total	Lethal	2	18	2
	Nonlethal	3	65	5

5.7 Documented Past and Anticipated Future Atlantic Sturgeon FIM Bottom Trawl Takes

Table 5.6 (see Section 5.4) summarizes the maximum amount of annual fishing effort for each bottom trawl project in the South Atlantic and Table 5.35 summarizes the documented Atlantic sturgeon takes during FIM bottom trawling. Gulf of Mexico projects are not considered here because Atlantic sturgeon only occur in the South Atlantic portion of the action area. From 2001-2014, 206 captures were documented, none were lethal, across the 3 bottom trawl projects. However, for funding or permitting reasons the USFWS Atlantic Striped Bass Cruise only used hook-and-line gear in 2011, 2012, and 2014; the project will continue to use bottom trawl gear in the future. When estimating future bottom trawl takes, we omitted the hook-and-line only years from our estimates. Aside from those omitted years, we chose to use the all data available to estimate future Atlantic sturgeon takes. Unlike sea turtle populations, we do not have evidence that Atlantic sturgeon populations are increasing to an extent that would lead us to believe the more recent data is more indicative of interaction potential than past data.

Table 5.35. FIM Bottom Trawl Atlantic Sturgeon Captures

Year	Project			Total Annual Takes
	SEAMAP-SA Coastal Trawl Survey (SCDNR)	SEAMAP-SA North Carolina Pamlico Sound Trawl Survey (NCDENR)	USFWS Atlantic Striped Bass Cruise	
2001	1	0	4	5
2002	3	0	23	26
2003	1	0	8	9
2004	3	0	1	4
2005	1	0	1	2
2006	0	0	29	29
2007	1	0	13	14
2008	2	0	73	75
2009	0	0	31	31
2010	0	0	1	1
2011*	3	0	--	3
2012*	1	0	--	1
2013	2	0	4	6
2014*	0	0	--	0
Total 2001-2014	18	0	188	206
Average 2001-2014	1.28	0.00	17.09	18.37

* Bottom trawl gear was not used during these years.

The Atlantic Striped Bass Tagging Survey accounted for the vast majority (i.e., 91.3%; 188 of 206 total) of all Atlantic sturgeon captures. Since the Atlantic Striped Bass Tagging Survey accounted for such a large proportion of the total captures, we estimated future captures for this project and the 2 remaining, separately, based on their average captures from 2001-2014 (Table 5.35). Based on the average captures in the past, we anticipate 86

future captures by the Atlantic Striped Bass Tagging Survey during future 5-year periods, and 7 captures in the other 2 trawl projects during the same period (Table 5.36).

Table 5.36. Anticipated Future Atlantic Sturgeon FIM Bottom Trawl Takes[49]

Projects	Anticipated 5-yr Atlantic Sturgeon Takes
Atlantic Striped Bass Tagging Survey	86
Remaining Projects	7
Total	93

Estimated Atlantic Sturgeon Take by Life Stage

In the previous section, we estimated total takes. In general, impacts to adults (i.e., sexually mature animals) are more likely to affect population growth rates than impacts to subadults. The NEFSC conducted an analysis of the Atlantic sturgeon captures observed by the NEFOP, categorizing them by length. The NEFOP data used by the NEFSC represents the best available to determine the percentage of subadults in the Southeast. While other Atlantic sturgeon samples have been collected from other areas (i.e., Bay of Fundy, Long Island Sound, North Carolina) they encompass smaller localized sample areas than the information in the NEFOP. A comparable program to the NEFOP does not exist off the coast of the Southeast (Damon-Randall et al. 2013), though the NEFOP data does include information from North Carolina. Of 726 NEFOP observations that could be categorized in this way, 75% (545) were subadults and 25% (182) were adults. Multiplying this ratio by our take estimate, we estimated the number of adults and subadults taken over 5-year periods and summarized our results in Table 5.36.[50]

Table 5.36. Anticipated Future Adult and Subadult Atlantic Sturgeon (ATS) Takes

Total Takes	Total Subadult ATS Takes	Total Adult ATS Takes
92	69	23

Estimated Atlantic Sturgeon Mortality in Trawl Gear

No FIM bottom trawl projects have ever reported an Atlantic sturgeon mortality. In 2007, the Atlantic States Marine Fisheries Commission (ASMFC) and NMFS sponsored a workshop to provide an updated assessment on the impacts of commercial otter trawl, sink gillnet, and anchored gillnet fishing on Atlantic sturgeon from 2001-2006 (Shepherd et al. 2007) . The ASMFC report also evaluated how a number of specific factors (mesh size, twine material, tie-down use, etc.) can affect mortality rates in different gear types (Shepherd et al. 2007) . The (Shepherd et al. 2007) report indicates a mortality rate in all trawl gears of approximately 6%. Miller and Shepherd (2011) also provided an estimate of Atlantic sturgeon bycatch in sink gillnet and otter trawl fisheries in the mid-Atlantic and Northeast. Miller and Shepherd (2011) reported the average Atlantic sturgeon mortality rate in federal otter trawl fisheries from 2006-2010 was approximately 5%. We used the

[49] *Atlantic Striped Bass Tagging Survey:* 17.09 average Atlantic sturgeon captures per year x 5 years = 85.45 captures. *Remaining Projects:* 1.28 average Atlantic sturgeon captures per year x 5 years = 6.4 captures

[50] 91.9 Atlantic sturgeon takes over 5 years x 75% = 68.93 subadults and 25% = 22.97 adults

mortality estimate from Miller and Shepherd (2011) because it was estimated based on the most recent data.

To estimate the number of potential future mortalities, we multiplied our estimates from Table 5.36 by the 5% mortality rate estimated in Miller and Shepherd (2011).[51,52] Our take estimates by life stage and type are presented in Table 5.37. The table also depicts the number of total takes likely to be lethal and nonlethal takes.

Table 5.37. Anticipated Future Atlantic Sturgeon (ATS) Takes and Mortalities

Take Type	Number of Adult ATS	Number of Subadult ATS
Lethal	2	4
Nonlethal	21	65

Assigning Takes to the 5 Atlantic Sturgeon DPSs

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.

As part of their analysis, GARFO-PRD examined the raw results of the genetic analyses to determine if natural geographic boundaries emerged. Given the relatively small number of samples, boundaries were not obvious from the genetics data alone (Damon-Randall et al. 2013). The results of the MSA for the coastal samples indicated groupings of animals that coincided with 3 "marine ecoregions." These marine ecoregions were defined by The Nature Conservancy and refined in 2007. Within a marine ecoregion, the composition of marine species is relatively homogenous and clearly distinct from adjacent ecoregions. The Nature Conservancy focused on features such as population isolation,[53] upwelling,

[51] 69 estimated subadult Atlantic sturgeon takes annually x 5% mortality rate = 3.45 Atlantic sturgeon mortalities

[52] 23 estimated adult Atlantic sturgeon takes annually x 5% mortality rate = 1.15 Atlantic sturgeon mortalities

[53] Isolation in the marine environment may be caused by "deep water, narrow straits, or rapid changes in shelf conditions" Spalding, M. D., H. E. Fox, G. R. Allen, and N. Davidson. 2007. Marine ecoregions of the world. Pages Companion publication: Spalding, M. D., Fox, H. E., Allen, G. R., Davidson, N., Ferdaña, Z. A.,

nutrient inputs, freshwater influx, temperature regimes, ice regimes, exposure, sediments, currents, and bathymetric or coastal complexity, when defining ecoregions. Along the east coast of the United States, there are 3 marine ecoregions (Figure 5.5). The South Atlantic portion of the proposed action operates to some extent in the Virginian ecoregion but primarily occurs in the Carolinian ecoregion.

Figure 5.5. Three marine ecoregions off the east coast of the United States
Source: (Damon-Randall et al. 2013)

GARFO-PRD refined these marine ecoregions using the boundaries for existing fisheries statistical areas and known Atlantic sturgeon migratory pathways (Damon-Randall et al. 2013). According to Damon-Randall et al. (2013), the Gulf of Maine/Bay of Fundy marine ecoregion falls into Marine Mixing Zone (MMZ) 1, the Virginian marine ecoregion falls into MMZ 2, and the Carolinian marine ecoregion falls into MMZ 3 (Figure 5.6). Marine Mixing Zone 3, which extends from Cape Hatteras to the tip of Florida, corresponds to the portion of the action area where the Atlantic sturgeon are likely to occur in the marine environment. While updates to this analysis were conducted in 2013, Damon-Randall et al. (2013) report no new data for MMZ 3 were available. NMFS determined that the original data from the NEFOP and ASM programs still represent the best available information

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Finlayson, M., Halpern, B. S., Jorge, M. A., Lombana, A., Lourie, S. A., Martin, K. D., McManus, E., Molnar, J., Recchia, C. A., Robertson, J. (2007) Marine Ecoregions of the World: a bioregionalization of coast and shelf areas. BioScience 57: 573-583 *in.* The Nature Conservancy, Arlington, Virginia.

with respect to the DPS composition of animals in MMZ 3. Damon-Randall et al. (2013) reported the composition of Atlantic sturgeon residing in MMZ 3 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 important to note that we estimate a few subadult Atlantic sturgeon takes are likely from the population in St. John, Canada. Since these animals are from a population outside the United States that was not listed under the ESA, we do not consider the take of these animals further in this Biological Opinion. Removing the contributions of those fish means the average composition estimates do not add to 100. Therefore, the take estimates in Table 5.39 may be slightly less than those estimated above.

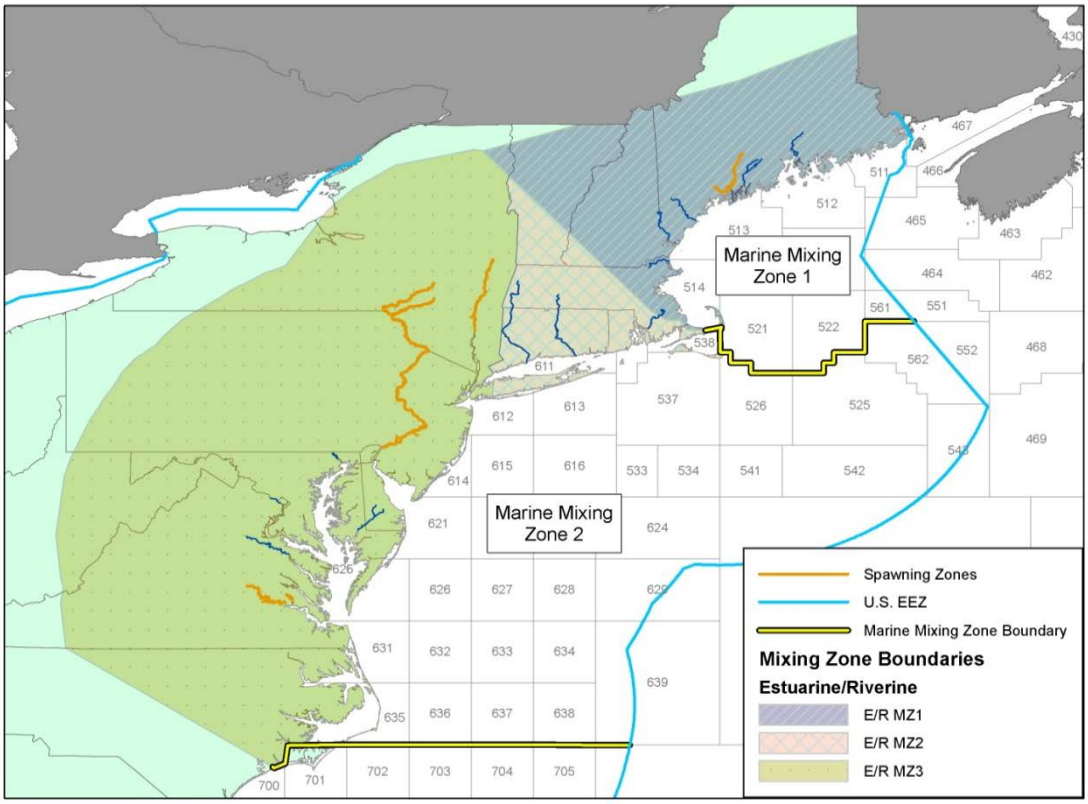

Figure 5.6. Map of Mixing Zones Source: (Damon-Randall et al. 2013)

Table 5.39. Anticipated Future FIM Bottom Trawl Atlantic Sturgeon Takes by Type and DPS

DPS*	Adults			Subadults			Total Takes (Adults + Subadults)
	Number of Nonlethal Takes	Number of Lethal Takes	Total Takes	Number of Nonlethal Takes	Number of Lethal Takes	Total Takes	
GOM	3	1	4	8	1	9	13
NYB	11	1	12	34	2	36	48
CB	3	1	4	9	1	10	14
Carolina	1	0	1	2	0	2	3
SA	5	1	6	15	1	16	22
Total	23	4	27	68	5	73	100

GOM = Gulf of Maine DPS, NYB = New York Bight DPS, CB = Chesapeake Bay DPS, and SA = South Atlantic DPS

*NOTE: Takes estimated for animals from the St. John, Canada, population are not considered here because they were not listed under the ESA. Because these takes are not considered here, our total take numbers presented in this table are slightly less than the total estimated in Table 5.37.

5.8 Documented Past and Anticipated Future Atlantic Sturgeon FIM Gillnet Takes

The maximum amount of annual gillnet effort in the South Atlantic where Atlantic sturgeon live is described in Table 5.28. Since Atlantic sturgeon only occur in the South Atlantic portion of the action area, Gulf of Mexico projects are not considered here. The data on past Atlantic sturgeon captures in FIM gillnets are only available for the period from 2008-2014. Table 5.39 reports the captures of Atlantic sturgeon by project during that period.

Table 5.39. South Atlantic FIM Gillnet Atlantic Sturgeon Captures (2008-2014)

Project	Year							Total Captures	Average Captures
	2008	2009	2010	2011	2012	2013	2014		
RecFIN Red Drum Trammel Net Survey (SCDNR)	0	1	0	0	0	0	0	1	0.14
ACFCMA American Shad Drift Gillnet Survey (SCDNR)	2	0	0	8	30	0	0	40	5.71

As we have done in other situations when 1 project appears to be capturing a far greater proportion of species, we estimated future take numbers separately for the 2 projects. Based on the past capture data, we anticipate the 1 Atlantic sturgeon will be captured during future 5-year periods by the RecFIN Red Drum Trammel Net Survey (SCDNR) and 29 will be captured by the ACFCMA American Shad Drift Gillnet Survey (SCDNR) (Table 5.41).

Table 5.41. Anticipated Future Atlantic Sturgeon FIM Gillnet Takes

Projects	Anticipated 5-yr Atlantic Sturgeon Takes
RecFIN Red Drum Trammel Net Survey (SCDNR)	1
ACFCMA American Shad Drift Gillnet Survey (SCDNR)	29
Total	30

Estimated Atlantic Sturgeon Take by Life Stage

Just as we did in Section 5.7, we also calculated the likely number of future Atlantic sturgeon takes by life stage. We used the same 75% subadults/25% adult estimates and multiplied them by our take estimates. We summarized our estimates of adults and subadults taken annually and over 5 years in Table 5.42.[54] Because FIM gillnet projects have such short times and are constantly tended, Atlantic sturgeon mortality has never been reported. Because of rounding, our estimates in Table 5.42 are slightly higher than Table 5.41.

Table 5.42. Anticipated Future Adult and Subadult Atlantic Sturgeon (ATS) Gillnet Takes

Total Takes	Total Subadult ATS Takes	Total Adult ATS Takes
31	23	8

Estimated Atlantic Sturgeon Mortality in FIM Gillnet Gear

No FIM gillnet projects have ever reported an Atlantic sturgeon mortality resulting from capture. Because the nets are constantly tended and short soak times are used, it is not surprising that no mortalities have ever been reported. The (Shepherd et al. 2007) report and Miller and Shepherd (2011) calculated morality rates in commercial sink gillnet gear by mesh size. Table 5.43 reports those rates by mesh size.

Table 5.43. Gillnet Mesh Size Categories and Associated Mortality Rates

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

Sink gillnets are weighted and anchored, likely increasing the potential for mortality. Because they are likely more lethal, we believe using a mortality based on sink gillnets is conservative. Table 5.28 indicates there are approximately 1.1 million ft^2-hours of FIM gillnet fishing effort in the South Atlantic annually. Based on the information provided on each gillnet project in Section 2.2.3.1, we estimate approximately 55.7% of that total effort is conducted with gillnet mesh sizes of 5 inches or smaller; the "small mesh" category in

[54] 30 Atlantic sturgeon takes over 5 years x 75% = 22.5 subadults and 25% = 7.5 adults

Miller and Shepherd (2011). Conversely, 44.3% of all annual FIM gillnet fishing effort is conducted using mesh sizes of 14 in; the "extra-large mesh" category. Because these 2 categories have very different mortality rates, we applied each mortality rate proportion to the amount of fishing effort. For example, we anticipate 8 adults may be taken every 5 years. Therefore, we multiplied 8 by 55.7% to estimate the number of adults potentially exposed to small-mesh gillnet, and multiplied that number by the 0.2% mortality rate associated with mesh of that size. We followed the same approach to estimate the number of adults potentially taken in 14-in mesh gillnets and then multiplied that number by the 46.6% mortality rate for extra-large mesh gillnets. We combined both estimates to derive our overall adult mortality estimate.[55] We used the same approach to estimate the potential number of future subadult mortalities.[56] Our estimates of likely Atlantic sturgeon takes during South Atlantic FIM gillnet, by life stage, are presented in Table 5.43. The table also depicts the number of total takes likely to be lethal and nonlethal takes.

Assigning Takes to the 5 Atlantic Sturgeon DPSs

We followed the same approach described in Section 5.7 to assign our estimated Atlantic sturgeon takes by DPS. Since the mean composition estimates do not add to 100, the take estimates in Table 5.44 are less than those estimated in Table 5.42. Because we rounded each of our estimates up to the nearest whole number, the number of takes shown in Table 5.44 is greater than the total reported in 5.42.

[55] 8 adults x 55.7% of effort by small-mesh gillnets = 4.46 adults potentially exposed. 4.46 adults exposed to small-mesh gillnets x 0.2% small-mesh mortality rate = 0.009 small-mesh mortalities. 8 adults x 44.3% of effort by extra-large-mesh gillnets = 3.54 adults potentially exposed. 3.54 adults exposed to extra-large-mesh gillnets x 46.6% extra-large mesh mortality rate = 1.65 extra-large-mesh mortalities. 1.65 extra-large-mesh mortalities + 0.008 small-mesh mortalities = 1.66 total adult mortalities.

[56] 23 subadults x 55.7% of effort by small-mesh gillnets = 12.81 potentially exposed. 12.81 subadult potentially exposed to small-mesh gillnets x 0.2% small-mesh mortality rate = 0.025 small-mesh mortalities. 23 subadults x 44.3% of effort by extra-large-mesh gillnets = 10.19 subadults potentially exposed. 10.19 subadult potentially exposed to extra-large-mesh gillnets x 46.6% extra-large-mesh mortality rate = 4.75 extra-large mesh mortalities. 4.75 extra-large-mesh mortalities + 0.025 small-mesh mortalities = 4.77 total subadult mortalities.

Table 5.44. Anticipated Future FIM Gillnet Takes of Atlantic Sturgeon Takes by Type and DPS

DPS*	Adults			Subadults			Total Takes (Adults + Subadults)
	Number of Nonlethal Takes	Number of Lethal Takes	Total Takes	Number of Nonlethal Takes	Number of Lethal Takes	Total Takes	
GOM	1	1	2	2	1	3	5
NYB	4	1	5	10	3	13	18
CB	1	1	2	3	1	4	6
Carolina	1	0	1	1	1	2	3
SA	1	1	2	4	2	6	8
Total	8	4	12	20	8	28	40

GOM = Gulf of Maine DPS, NYB = New York Bight DPS, CB = Chesapeake Bay DPS, and SA = South Atlantic DPS

*NOTE: Takes estimated for animals from the St. John, Canada, population are not considered here because they were not listed under the ESA. Thus, our total take numbers presented in this table are slightly less than the total estimated in Table 5.41.

5.9 Documented Past and Anticipated Future Shortnose Sturgeon FIM Gillnet Takes

The maximum amount of annual riverine gillnet effort is provided for reference in Table 5.28 (see Section 5.6). Across the 2 gillnet projects operating in the South Atlantic data on the capture of the shortnose sturgeon goes back to 2008. During that period, 5 shortnose sturgeon were captured and all were released alive (Table 5.45). Based on the average captures across both projects in the past, we anticipate 4 future captures will occur in South Atlantic FIM gillnet gear during future 5-year periods.

Table 5.45. South Atlantic FIM Gillnet Shortnose Sturgeon Captures (2008-2014)

Project	Year							Total Captures	Average Captures
	2008	2009	2010	2011	2012	2013	2014		
RecFIN Red Drum Trammel Net Survey (SCDNR)	0	0	1	0	0	0	0	1	0.14
ACFCMA American Shad Drift Gillnet Survey (SCDNR)	0	0	0	1	3	0	0	4	0.57
Total	0	0	1	1	3	0	0	5	0.71

Estimated Shortnose Sturgeon Mortality in FIM Gillnet Gear

There have been no reported shortnose sturgeon mortalities during FIM riverine gillnet sampling. As with other FIM projects we would expect that short soak times, constant tending, and care taken by researchers would minimize the potential mortality. Collins et al. (1996) and Bahn et al. (2012) both provide estimates of shortnose sturgeon mortality in commercial shad sink gillnets. Collins et al. (1996) estimated both shortnose and Atlantic sturgeon bycatch in the shrimp fishery and gillnet fisheries for American shad off South

Carolina and Georgia from 1990-1995. Data were collected during 4 separate studies, 2 looked specifically at sturgeon bycatch in the shad fisheries, the other 2 were not solely focused on documenting sturgeon bycatch, but sturgeon bycatch data were still collected. The authors note 2 types of gillnets were used: drift and sink. Sink gillnets were "anchored in place, usually for days at a time, and generally checked once or twice a day," while the drift nets were not anchored and constantly tended (Collins et al. 1996). The authors reported only Georgia fishers used drift nets. They reported that nets varied in length and to some degree, depth, but in almost all cases, the mesh was 5.5-in-stretched mesh (Collins et al. 1996). Collins et al. (1996) estimated that sturgeons from the South Carolina study suffered a 16% mortality rate in gillnets. All nets reported in the South Carolina study were sink gillnets (Collins et al. 1996). They did not estimate a specific mortality rate for Atlantic and shortnose sturgeon separately. They also did not estimate gillnet mortalities for animals in Georgia rivers.

Bahn et al. (2012) looked specifically at the bycatch of shortnose sturgeon in the American shad fishery in the Altamaha River from 2007-2009. They report that Georgia state regulations require that anchored gillnets use a 4.5-in mesh. They also reported that while both sink and drift gillnets were authorized, sink gillnets were the primary gear type used. Bahn et al. (2012) stated that soak times varied, but nets were generally left in all day and were checked only once or twice a day. The authors provided capture and mortality information by year (2007-2009), month (January-March) and river location (Upper or Lower). The authors reported no shortnose sturgeon mortality in most years. However, 2 years did have documented mortalities. In 2007, on the Lower Altamaha, a mortality rate of 8.6% was observed, and in 2009 on the Upper Altamaha a mortality rate of 2.8% was documented. Over the course of the study, in both river regions, the average morality rate was 2.3% (Bahn et al. 2012).

The morality rates reported in Collins et al. (1996) and Bahn et al. (2012) are for sink gillnets. Sink gillnets are anchored, likely increasing the potential for mortality. Because they are likely more lethal, we believe using a mortality based on sink gillnet gear is conservative. To estimate gillnet mortality for FIM gillnet projects, we chose to use the 8.6% mortality rate reported by Bahn et al. (2012) because it is more recent, specific to shortnose sturgeon, and conservative.

To estimate the number of potential future mortalities we multiplied our estimates from Table 5.45 by the 8.6% mortality rate; Table 5.46 reports those results.[57]

Table 5.46. Anticipated Shortnose Sturgeon Gillnet Takes and Mortalities

Take Period	Take Type	Number of Shortnose Sturgeon
5 years	Lethal	1
	Nonlethal	3
5-YR TOTAL		4

[57] 4 estimated shortnose sturgeon takes over 5 years x 8.6% mortality rate = 0.34 shortnose sturgeon mortalities

5.10 Documented Past and Anticipated Future Scalloped Hammerhead Shark Caribbean Hook-and-Line Captures

ESA-listed scalloped hammerhead sharks only occur in the Caribbean. Only Caribbean FIM-related hook-and-line gear has ever captured scalloped hammerhead sharks. For reference, we summarize the maximum amount of hook-and-line fishing effort in the Caribbean in Table 5.47.

Table 5.47. Maximum Hook-and-Line Effort in the Caribbean by Project

Project	Number Hooks/Project	Soak Time (Hr)	Total Hook Hr/Project
SEAMAP-C Finfish Rod-and-Reel Survey (PR-DENR)	3,240	4.00	12,960
SEAMAP-C Lane Snapper BLL (PR-DENR)	18,000	0.75	13,500
SEAMAP-C Yellowtail Snapper Rod-and-Reel Survey (PR-DENR)	1,620	4.00	6,480
Caribbean Reef Fish Survey (Bandit Gear) (NMFS)	3,000	0.17	510
TOTAL For All Projects	25,860	--	33,450

From 2009-2014, 1 scalloped hammerhead capture occurred in the Caribbean across 4 projects. The capture occurred during the SEAMAP-C Lane Snapper BLL (PR-DENR) sampling project. Since only a single capture has been documented during the last 5 years, we believe it is prudent to assume that 1 may occur again during Caribbean hook-and-line sampling during future 5 year periods.

Mortalities from Future Takes

The scalloped hammerhead shark captured in 2012 was reportedly landed and not released. The susceptibility of sharks in general to immediate or PRM varies by species (Gallagher et al. 2014) and gear type (de Silva et al. 2001; Francis et al. 2001; Moyes et al. 2006). While specific information on the PRM of scalloped hammerhead sharks is not available, Gallagher et al. (2014) does provide PRM information on the closely related great hammerhead. Gallagher et al. (2014) report that of 5 shark species studied, the great hammerhead shark was the most susceptible to adverse physiological effects (e.g., increased whole blood lactate levels and increased partial pressures of carbon dioxide) caused by being hooked. Of 102 sharks captured during the study, the great hammerhead was the only species to die post-release (Gallagher et al. 2014). Additionally, Gallagher et al. (2014) report that great hammerhead PRM may have been as high as 46.4% after 4 weeks. While not specific to scalloped hammerhead sharks, the data on this closely related species suggests PRM of scalloped hammerhead sharks may be likely. Therefore, we anticipate the scalloped hammerhead captures over consecutive 5-year periods could be lethal.

5.11 Summary

Based on what we know about trawl, hook-and-line, and gillnet gear in general, and after evaluating the likely effects of future FIM projects on sea turtles, smalltooth sawfish, Atlantic sturgeon, and shortnose sturgeon, we believe incidental take of all these species may occur in the future. We have summarized the number of takes we anticipate on a 5-year basis in Table 5.48. In some instances we anticipate a future take may be lethal or nonlethal. For the purposes of monitoring incidental take levels and reinitiating consultation, we will not consider our take estimates exceeded if the number of nonlethal take exceeds our estimate, so long as the number of lethal captures and total captures for each species is not exceeded.

Table 5.48. 5-Year Anticipated Future Take by FIM Activities in the Southeast

Species	South Atlantic Region							
	TRAWL		HOOK & LINE		GILLNET		TOTAL	
	N/L	L	N/L	L	N/L	L	N/L	L
Loggerhead sea turtle	120	30	4	3	1	1	125	34
Kemp's ridley sea turtle	62	16	14	5	2	1	78	22
Green sea turtle	3	1	N/A		65	17	68	18
Leatherback sea turtle	2	1	1		N/A		3	1
Smalltooth sawfish	1†		N/A		N/A		1†	
Shortnose sturgeon	N/A		N/A		3	1	3	1
	Gulf of Mexico Region							
	TRAWL		HOOK & LINE		GILLNET		TOTAL	
	N/L	L	N/L	L	N/L	L	N/L	L
Loggerhead sea turtle	26	8	6	2	1††	0	33	10
Kemp's ridley sea turtle	8	2	1	1	3	1	12	4
Green sea turtle	0	1	N/A		1††	0	2	1
Leatherback sea turtle	0	1	N/A		N/A		0	1
Hawksbill sea turtle	0	1	N/A		N/A		0	1
Smalltooth sawfish	1†		N/A		N/A		1†	
	Caribbean Region							
	TRAWL		HOOK & LINE		GILLNET		TOTAL	
	N/L	L	N/L	L	N/L	L	N/L	L
Scalloped hammerhead	N/A		0	1	N/A		0	1

		South Atlantic Region											
		TRAWL				GILLNET				TOTAL			
		Adult		Subadult		Adult		Subadult		Adult		Subadult	
		N/L	L	N/L	L	N/L	L	N/L	L	N/L	L	N/L	L
Atlantic sturgeon	GOM DPS	3	1	8	1	1	1	2	1	4	2	10	2
	NYB DPS	11	1	34	2	4	1	10	3	15	2	44	5
	CB DPS	3	1	9	1	1	1	3	1	4	2	12	2
	Carolina DPS	1	0	2	0	1	0	1	1	2	0	3	1
	SA DPS	5	1	15	1	1	1	4	2	6	2	19	3
	Total	23	4	68	5	8	4	20	8	31	8	88	13

L = Lethal; N/L = Nonlethal; N/A = Not applicable

†This take is either 1 smalltooth sawfish in the GOM or SA in bottom trawl gear, it is not 1 take for each region.

††This take is either 1 loggerhead or 1 green, not 1 take of each species.

6.0 Cumulative Effects

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

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

6.1 State Fisheries

During this consultation, we searched for information on future state, tribal, local, or private actions that were reasonably certain to occur in the action area. The fisheries described as occurring within the action area (see Sections 3 and 4, the Status of the Species, and the Environmental Baseline, respectively) are expected to continue as described into the foreseeable future, concurrent with the proposed action. Numerous fisheries in state waters of the South Atlantic and Gulf of Mexico regions have also been known to adversely affect sea turtles, smalltooth sawfish, and ESA-listed sturgeon. The past and present impacts of these activates have been discussed in the Environmental Baseline section of this opinion. NMFS is not aware of any proposed or anticipated changes in these fisheries that would substantially change the impacts each fishery has on sea turtles, smalltooth sawfish, and ESA-listed sturgeon covered by this opinion.

6.2 Vessel Interactions

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

6.3 Pollution

Human activities in the action area causing pollution are reasonably certain to continue in the future, as are impacts from them on sea turtles, smalltooth sawfish, and ESA-listed sturgeon. However, the level of impacts cannot be projected. Marine debris (e.g.,

discarded fishing line or lines from boats) can entangle sea turtles in the water and drown them. Sea turtles commonly ingest plastic or mistake debris for food. Excessive turbidity due to coastal development and/or construction sites could influence sea turtle foraging behavior. As mentioned previously, sea turtles are not very easily affected by changes in water quality or increased suspended sediments, but if these alterations make habitat less suitable for sea turtles and hinder their capability to forage, eventually they would tend to leave or avoid these areas (Ruben and Morreale 1999).

6.4 Global Climate Change

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

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

6.5 Coastal Development

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

7.0 Jeopardy Analyses

Section 5 outlined how interactions with the FIM fishing gear can affect sea turtles, smalltooth sawfish, Atlantic sturgeon, and shortnose sturgeon, and estimated the number of each species likely to be captured and killed over consecutive 5-year periods. Now we assess each species' response to this impact. The assessment considers the effects on the entire population from these anticipated takes, and whether those effects, in the context of the status of the species (Section 3), the environmental baseline (Section 4), and the cumulative effects (Section 6), will jeopardize the continued existence of any ESA-listed species known to interact with FIM fishing gear.

There were instances where we concluded future anticipated takes could include a combination of species (i.e., one loggerhead or one green sea turtle) or might be lethal or nonlethal. During our jeopardy analysis we will act conservatively and consider each possible outcome. For example, if we anticipated one take of a green sea turtle or one take of a loggerhead sea turtle, and that take might be lethal or nonlethal, our jeopardy analysis would consider 4 potential scenarios: one for a lethal green sea turtle take, one for a nonlethal green sea turtle take, and so on for loggerheads. We believe this approach is conservative toward the species. However, this does not change the number or type of total incidental takes potentially authorized.

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

7.1 Sea Turtles

Some sea turtle species are listed as a single species distributed globally; therefore, a jeopardy determination must find the proposed action will appreciably reduce the likelihood of such species' survival and recovery at the scale of its global range. Nine DPSs for loggerheads and 11 for green sea turtles have been identified. The loggerhead DPS potentially affected by the proposed action is the Northwest Atlantic DPS, listed as threatened. Two green sea turtle DPSs (North Atlantic DPS and South Atlantic DPS) may occur in the action area. Therefore, for loggerhead and green sea turtles, a jeopardy determination must find the proposed action will appreciably reduce the likelihood of survival and recovery of the these DPSs.

7.1.1 Loggerhead Sea Turtles (NWA DPS)

The proposed action may result in 202 loggerhead sea turtle takes (158 nonlethal, 44 lethal) over future consecutive 5 year periods. The potential nonlethal take of 158 loggerhead sea

turtles over 5 years is not expected to have any measurable impact on the reproduction, numbers, or distribution of this species. The individuals suffering nonlethal injuries are expected to fully recover such that no reductions in reproduction or numbers of loggerhead sea turtles are anticipated. The takes may occur anywhere in the action area and the action area encompasses a tiny portion of the overall range/distribution of the NWA DPS of loggerhead sea turtles. Since any incidentally caught animal would be released within the general area where caught, no change in the distribution of loggerhead sea turtles is anticipated.

The 44 lethal interactions during consecutive 5 year periods (8.8 annually) associated with the proposed action represent a reduction in numbers. These lethal takes would also result in a future reduction in reproduction as a result of lost reproductive potential, as some of these individuals would be females who would have survived other threats and reproduced in the future, thus eliminating each female individual's contribution to future generations. For example, an adult female loggerhead sea turtle can lay 3 or 4 clutches of eggs every 2-4 years, with 100-130 eggs per clutch. While we have no reason to believe the proposed action will disproportionately affect females, the potential loss of up to 44 adult female sea turtles over a 5-year period (8.8 annually) could preclude the production of thousands of eggs and hatchlings of which a small percentage would be expected to survive to sexual maturity. A reduction in the distribution of loggerhead sea turtles is not expected from lethal takes attributed to the proposed action. Because all the potential interactions are expected to occur at random throughout the proposed action area, which accounts for a tiny fraction of the species' overall range, the distribution of loggerhead sea turtles is expected to be unaffected.

Whether or not the reductions in loggerhead sea turtle numbers and reproduction attributed to the proposed action would appreciably reduce the likelihood of survival for loggerheads depends on what effect these reductions in numbers and reproduction would have on overall population sizes and trends, i.e., whether the estimated reductions, when viewed within the context of the environmental baseline, status of the species, and cumulative effects are of such an extent that adverse effects on population dynamics are appreciable. In Section 3.3.1, we reviewed the status of the species in terms of nesting and female population trends and several recent assessments based on population modeling (i.e., (Conant et al. 2009; NMFS-SEFSC 2009a). Below, we synthesize what that information means in general terms and in 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. (2009) concluded loggerhead natural growth rates are small, natural survival needs to be high, and even low to moderate mortality can drive the population into decline. Because recruitment to the adult population takes many years, population modeling studies suggest even small increased mortality rates in adults and subadults could substantially impact population numbers and viability (Chaloupka and Musick 1997a; Crouse et al. 1987; Crowder et al. 1994).

SEFSC (2009) estimated the adult female population size for the NW Atlantic DPS is likely between approximately 20,000-40,000 individuals, with a low likelihood of being up to 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. In Review). A much less robust estimate for total benthic females in the western North Atlantic was also obtained, with a likely range of approximately 30,000-300,000 individuals, up to less than 1 million.

NMFS-NEFSC (2011) preliminarily estimated the loggerhead population in the Northwestern Atlantic Ocean along the continental shelf of the Eastern Seaboard during the summer of 2010 at 588,439 individuals (estimate ranged from 381,941 to 817,023) based on positively identified individuals. The NMFS-NEFSC's point estimate increased to approximately 801,000 individuals when including data on unidentified sea turtles that were likely loggerheads. The NMFS-NEFSC (2011) underestimates the total population of loggerheads since it did not include Florida's east coast south of Cape Canaveral or the Gulf of Mexico, which are areas where large numbers of loggerheads are also expected. In other words, it provides an estimate of a subset of the entire population. The proposed action could remove up to 44 individuals over future consecutive 5 year periods (8.8 annually). These takes represent approximately 0.002% annually of the low end of the estimates that reflects a subset of the entire loggerhead population in the western North Atlantic Ocean. For all intents and purposes, the loss of up to 44 individuals over future consecutive 5-year periods is so small in relation to the overall population, that it would be hardly detectable. The amount of loss is likely smaller than the error associated with estimating (through extrapolation) the overall population in the 2011 report.

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 (1989-2015). 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 (74%) from 2008 to 2015. Examining only the period between the high-count nesting season in 1998 and the most recent nesting season (2015), researchers found a slight but nonsignificant increase, indicating a reversal of the post-1998 decline. The overall change in counts from 1989 to 2015 was significantly positive (38%); however, it should be noted that wide confidence intervals are associated with this complex data set (http://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead-trends/).

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

Kemp's ridleys, the NWA DPS is proportionally much less intrinsically linked with the GOM.

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

Abundance estimates accounting for only a subset of the entire loggerhead sea turtle population in the western North Atlantic indicates the population is large (i.e., several hundred thousand individuals). Nesting trends have been significantly increasing over several years. Additionally, our estimate of future take is based on our belief that the same level of take occurred in the past. It is worth noting that this level of take has already occurred in the past, yet we have still seen positive trends in the status of this species. We believe the potential lethal take of 44 loggerhead sea turtles over future consecutive 5 year periods (3.2 annually) attributed to the proposed action will not have any detectable effect on those trend or numbers. Consequently, we expect the western North Atlantic population to remain large (i.e., hundreds of thousands of individuals) and to retain the potential for recovery, and the proposed action to not cause the population to lose genetic heterogeneity, broad demographic representation, or successful reproduction, nor affect loggerheads' ability to meet their lifecycle requirements, including reproduction, sustenance, and shelter.

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. Elements of the proposed action support or implement the specific actions needed to achieve a number of these recovery objectives. Thus, 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

Objective: Minimize bycatch in domestic and international commercial and artisanal fisheries

Objective: Minimize trophic changes from fishery harvest and habitat alteration

The recovery plan anticipates that, with implementation of the plan, the western North Atlantic population will recover within 50-150 years, but notes that reaching recovery in only 50 years would require a rapid reversal of the then-declining trends of the NRU, PFRU, and NGMRU. 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.

Recovery Objective No. 1, "Ensure that the number of nests in each recovery unit is increasing…," is the plan's overarching objective and has associated demographic criteria. Nesting trends have been significantly increasing over several years. As noted previously, we believe the future takes predicted will be similar to the levels of take that has occurred in the past and those past takes did not impede the positive trends we are currently seeing in nesting during that time. We also indicated that the potential lethal take of 44 loggerhead sea turtles over future consecutive 5 year periods (8.8 annually) is so small in relation to the overall population, that it would be hardly detectable. For these reasons, we do not believe the proposed action will impede achieving this recovery objective.

Continuation of the proposed action is not believed to be counter to the recovery plan's Objective No. 10: "minimize bycatch in domestic and international commercial and artisanal fisheries." While bycatch may still occur during fisheries independent monitoring, techniques are used to keep bycatch at levels far below bycatch occurring in commercial and recreational fisheries using similar gears, and to avoid or minimize lethal bycatch. For these reasons, we do not believe the proposed action will impede achieving this recovery objective.

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

7.1.2 Green Sea Turtles (NA and SA DPS)

Mixed-stock analyses of foraging grounds show that green sea turtles from multiple nesting beaches commonly mix at feeding areas across the Caribbean and Gulf of Mexico, with higher contributions from nearby large nesting sites and some contribution estimated from nesting populations outside the DPS (Bass et al. 1998; Bass and Witzell 2000; Bjorndal and Bolten 2008; Bolker et al. 2007). In other words, the proportion of animals on the foraging grounds from a given nesting beach is proportional to the overall importance of that nesting beach to entire DPS. For example, Tortuguero, Costa Rica, is largest nesting beach in the NA DPS and the number of animals from that nesting beach on foraging grounds were higher than from any other nesting beach. More specifically, Lahanas et al. (1998) showed that juvenile green sea turtles in the Bahamas originate mainly from western Caribbean (Tortuguero, Costa Rica) (79.5%) (NA DPS) but that a significant proportion may be coming from the eastern Caribbean (Aves Island/Suriname; 12.9%) (SA DPS).

Flipper tagging studies provide additional information on the co-mingling of turtles from the NA DPS and SA DPS. Flipper tagging studies on foraging grounds and/or nesting beaches have been conducted in Bermuda (Meylan et al. 2011), Costa Rica (Troeng et al. 2005), Cuba (Moncada et al. 2006), Florida (Johnson and Ehrhart 1996a; Kubis et al. 2009), Mexico (Zurita et al. 2003; Zurita et al. 1994), Panama (Meylan et al. 2011), Puerto Rico (Collazo et al. 1992; Patricio et al. 2011), and Texas (Shaver 1994; Shaver 2002). Nesters have been satellite tracked from Florida, Cuba, Cayman Islands, Mexico, and Costa Rica. Troeng et al. (2005) report that while there is some crossover of adult female nesters from NA DPS into the SA DPS, particularly in the equatorial region where the DPS boundaries are in closer proximity to each other, NA DPS nesters primarily use the foraging grounds within the NA DPS.

Taken together, this information suggests that while the vast majority, if not all, of the anticipated captures in the Gulf of Mexico and South Atlantic regions are likely to come from the NA DPS, it is possible that animals from the SA DPS could be captured during the proposed action.

For these reasons, we will act conservatively and conduct 2 jeopardy analyses, 1 for each DPS. The NA DPS analysis will conservatively assume that all the animals captured during the proposed action are from that DPS. Our analysis of the SA DPS will consider a proportion of the animals from the Gulf of Mexico and South Atlantic regions. That proportion will be determined using the best available information regarding the degree of mixing between the 2 DPSs as described above.

NA DPS

The proposed action may result in 89 green sea turtle takes over consecutive 5 year periods. We anticipate up to 86 captures would occur in the South Atlantic region of the action area (68 nonlethal, 18 lethal) and 3 in the Gulf of Mexico (2 nonlethal, 1 lethal).

The potential nonlethal take of 70 green sea turtles over 5 years is not expected to have any measurable impact on the reproduction, numbers, or distribution of these species. The individuals suffering nonlethal injuries are expected to fully recover such that no reductions in reproduction or numbers of green sea turtles are anticipated. The takes may occur anywhere in the action area, which encompasses only a tiny portion of green sea turtles' overall range/distribution within the NA DPS. Because any incidentally caught animal would be released within the general area where caught, no change in the distribution of NA DPS green sea turtles is anticipated.

The potential lethal take of 19 green sea turtles over 5 years (3.8 annually) would reduce the number of green sea turtles, compared to their numbers in the absence of the proposed action, assuming all other variables remained the same. Lethal interactions would also result in a potential reduction in future reproduction, assuming some individuals would be females and would have survived otherwise to reproduce. For example, an adult green sea turtle can lay 1-7 clutches (usually 2-3) of eggs every 2-4 years, with 110-115 eggs/nest, of which a small percentage is expected to survive to sexual maturity. The anticipated lethal interactions are expected to occur anywhere in the action area and sea turtles generally have large ranges in which they disperse; thus, no reduction in the distribution of green sea turtles within the NA DPS is expected from these takes.

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. Seminoff et al. (2015) estimate there are greater than 167,000 nesting females in the NA DPS. The nesting at Tortuguero, Costa Rica, accounts for approximately 79% of that estimate (approximately 131,000 nesters), with Quintana Roo, Mexico, (approximately 18,250 nesters; 11%), and Florida, USA, (approximately 8,400 nesters; 5%) also accounting for a large portion of the overall nesting (Seminoff et al. 2015).

At Tortuguero, Costa Rica, the number of nests laid per year from 1999 to 2003, was approximately 104,411 nests/year, which corresponds to approximately 17,402-37,290 nesting females each year (Troëng and Rankin 2005). That number increased to an estimated 180,310 nests during 2010; corresponding to 30,052-64,396 nesters. This increase has occurred despite substantial human impacts to the population at the nesting beach and at foraging areas (Campell and Lagueux 2005; Troëng 1998; Troëng and Rankin 2005).

Nesting locations in Mexico along the Yucatan Peninsula also indicate the number of nests laid each year has increased (Seminoff et al. 2015). In the early 1980s, approximately 875 nests/year were deposited, but by 2000 this increased to over 1,500 nests/year (NMFS and

USFWS 2007a). By 2012, more than 26,000 nests were counted in Quintana Roo (J. Zurita, CIQROO, unpubl. data, 2013, in Seminoff et al. 2015)

In Florida, most nesting occurs along the Atlantic coast of eastern central Florida, where a mean of 5,055 nests were deposited each year from 2001 to 2005 (Meylan et al. 2006) and 10,377 each year from 2008 to 2012 (B. Witherington, Florida Fish and Wildlife Conservation Commission, pers. comm., 2013). As described in the Section 3.3.3, nesting has increased substantially over the last 20 years and peaked in 2015 with 27,975 nests statewide in 2015. In-water studies conducted over 24 years in the Indian River Lagoon, Florida, suggest similar increasing trends, with green sea turtle captures up 661% (Ehrhart et al. 2007). Similar in-water work at the St Lucie Power Plant site revealed a significant increase in the annual rate of capture of immature green sea turtles over 26 years (Witherington et al. 2006).

Seminoff et al. (2015) also conducted a population viability analysis (PVA) for the Tortuguero, Costa Rica, and Florida, USA nesting sites (as well as 2 others: Isla Aguada, Mexico and Guanahacabibes, Cuba).[58] The PVAs evaluated the probabilities of nesting populations declining to 2 separate biological thresholds after 100 years: (1) a trend-based reference point where nesting populations decline by 50% and (2) the number of total adult females falls to 300 or fewer at these sites (Seminoff et al. 2015).[59] Seminoff et al. (2015) point out that PVAs do not fully incorporate spatial structure or threats. They also assume all environmental and man-made pressures will remain constant in the forecast period, while also relying solely on nesting data.

The Tortuguero, Costa Rica, PVA indicated a 0.7% probability that this population will fall below the 50% decline threshold at the end of 100 years, and a 0% probability that this population will fall below the absolute abundance reference point of 100 nesting females per year at the end of 100 years (Seminoff et al. 2015). For the Florida, USA, population, the PVA indicated there is a 0.3% probability that this population will fall below the 50% decline threshold at the end of 100 years, and a 0% probability this population falls below the absolute abundance threshold of 100 nesting females per year at the end of 100 years (Seminoff et al. 2015).

Nesting at the primary nesting beaches has been increasing over the course of the decades. Additionally, the PVAs for the Florida and Tortuguero, Costa Rica, nesting beaches indicate no more than a 0.7% probability those populations will reach the 50% decline threshold at the end of 100 years, and a 0% probability these populations will fall below the absolute abundance threshold of 100 nesting females per year at the end of 100 years (Seminoff et al. 2015). We believe these nesting trends are indicative of a species with a

[58] Not enough information was available to conduct a PVA on the Quintana Roo, Mexico, nesting population.

[59] Since green sea turtles are believed to nest every 3 years, the analysis evaluated the likelihood that population would fall to 100 or fewer nesters annually (300 adult females ÷ nesting every 3 years = 100 adult female nesters annually).

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 19 green sea turtles over consecutive 5 year periods into the future (3.8 annually) attributed to the proposed action will not have any measurable effect on that trend. Therefore, we believe the proposed action is not reasonably expected to cause an appreciable reduction in the likelihood of survival of the green sea turtle in the wild.

The NA DPS of green sea turtles will not have a recovery plan in place at the time of listing. However, an Atlantic Recovery Plan for the population of Atlantic green sea turtles (NMFS and USFWS 1991d) 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.*

Green sea turtle nesting in Florida between 2001-2006 was documented as follows: 2001 – 581 nests, 2002 – 9,201 nests, 2003 – 2,622, 2004 – 3,577 nests, 2005 – 9,644 nests, 2006 – 4,970 nests. This averages 5,039 nests annually over those 6 years (2001-2006) (NMFS and USFWS 2007a). Subsequent nesting has shown even higher numbers (i.e., 2007 – 12,751 nests, 2008 – 9,228, 2009 – 4,462, 2010 – 13,225 nests, 2011 – 15,352, 2012 – 9,617, 2013 – 25, 553, 2014 – 3,502; 2015 – 27,975 (http://myfwc.com/research/wildlife/sea-turtles/nesting/2015-nesting-trends/). There are currently no estimates available specifically addressing changes in abundance of individuals on foraging grounds. Given the clear increases in nesting, however, it is likely that numbers on foraging grounds have increased.

The potential lethal take of up to 19 green sea turtles over consecutive 5 year periods (3.8 annually) will result in a reduction in numbers when takes occur, but it is unlikely to have any detectable influence on the recovery objective and trends noted above. Nonlethal takes of sea turtles would not affect the adult female nesting population or number of nests per nesting season. Thus, the proposed action will not impede achieving the recovery objectives above and will not result in an appreciable reduction in the likelihood of green sea turtles' recovery in the wild. Additionally, our estimate of future take is based on our belief that the same level of take occurred in the past. It is worth noting that this level of take has already occurred in the past, yet we have still seen positive trends in the status of this species.

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

SA DPS
The proposed action may result in 89 green sea turtle takes over consecutive 5 year periods. We anticipate up to 86 captures would occur in the South Atlantic region of the action area (68 nonlethal, 18 lethal) and 3 in the Gulf of Mexico (2 nonlethal, 1 lethal). Given the anticipated location of those incidental captures, we believe most of the animals potentially impacted would be from the NA DPS. However, the best available information indicates some animals from the SA DPS may occur within the boundaries of the NA DPS, particularly on the foraging grounds (Bass et al. 2004; Bolker et al. 2007; Lahanas et al. 1998). We do not currently have the ability to determine what proportion of animals incidentally captured by the proposed action would come from the SA DPS versus the NA DPS. However, since we know some degree of overlap is possible, we believe it is prudent to conduct a jeopardy analysis assuming that at least some animals from the SA DPS may be affected. In the absence of specific information on the likely split, we believe the information reported in Lahanas et al. (1998) is instructive. Lahanas et al. (1998) reports 79.5% of green sea turtles in the Bahamas originated from the nesting sites at Tortuguero (NA DPS) and up to 12.9% may have come from nesting beaches at Aves Island/Suriname (SA DPS). Thus, in this study, up to 13% of animals located within the boundary of the NA DPS, may have actually been from the SA DPS.

For our jeopardy analysis, we will conservatively assume that up to 13% of the incidental captures anticipated in the Gulf of Mexico and South Atlantic regions of the action area are animals from the SA DPS. Under these assumptions, we anticipate up to 12 (9 nonlethal, 3 lethal) captures from the South Atlantic and Gulf of Mexico regions of the action area might be individuals from the SA DPS.[60]

The potential nonlethal take of 9 green sea turtles over consecutive 5 year periods is not expected to have any measurable impact on the reproduction, numbers, or distribution of these species. The individuals suffering nonlethal injuries are expected to fully recover such that no reductions in reproduction or numbers of green sea turtles are anticipated. The takes may occur anywhere in the action area and the action area encompasses a tiny portion of green sea turtles' overall range/distribution within the SA DPS. Since any incidentally caught animal would be released within the general area where caught, no change in the distribution of SA DPS green sea turtles is anticipated.

The potential lethal take of 3 green sea turtles over consecutive 5 year periods (0.6 annually) would reduce the number of green sea turtles, compared to their numbers in the absence of the proposed action, assuming all other variables remained the same. Lethal

[60] 70 nonlethal takes (South Atlantic and Gulf of Mexico combined) x 13% = 9.1 nonlethal takes; 19 lethal takes (South Atlantic and Gulf of Mexico combined) x 13% = 2.47.

interactions would also result in a potential reduction in future reproduction, assuming some individuals would be females and would have survived otherwise to reproduce. For example, an adult green sea turtle can lay 1-7 clutches (usually 2-3) of eggs every 2-4 years, with 110-115 eggs/nest, of which a small percentage is expected to survive to sexual maturity. The anticipated lethal interactions are expected to occur anywhere in the action area and sea turtles generally have large ranges in which they disperse; thus, no reduction in the distribution of green sea turtles within the SA DPS is expected from these takes.

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. Seminoff et al. (2015) estimate there are greater than 63,000 nesting females in the SA DPS, though they note the adult female nesting abundance from 37 beaches could not be quantified. The nesting at Poilão, Guinea-Bissau, account for approximately 46% of that estimate (approximately 30,000 nesters), with Ascension Island, United Kingdom, (approximately 13,400 nesters; 21%), and the Galibi Reserve, Surniame (approximately 9,400 nesters; 15%) also accounting for a large portion of the overall nesting (Seminoff et al. 2015).

Unlike the NA DPS, the data available for nesting beaches in the SA DPS are not sufficient to conduct PVAs. Seminoff et al. (2015) report 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) indicate 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) report the nesting concentration at Galibi Reserve and Matapica in Suriname was stable from the 1970s through the 1980s. From 1975–1979, 1,657 females were counted (Schulz 1982), a number that increased to a mean of 1,740 females from 1983–1987 (Ogren 1989b), and to 1,803 females in 1995 (Weijerman et al. 1998). Since 2000, there appears to be a rapid increase in nest numbers (Seminoff et al. 2015).

In the Bijagos Archipelago (Poilão, Guinea-Bissau), Parris and Agardy (1993 as cited in Fretey, 2001) reported approximately 2,000 nesting females per season from 1990 to 1992, and Catry et al. (2002) reported approximately 2,500 females nesting during the 2000 season. Given the typical large annual variability in green sea turtle nesting, Catry et al. (2009) suggested it was premature to consider there to be a positive trend in Poilão nesting, though others have made such a conclusion (Broderick et al. 2006). Despite the seeming increase in nesting, interviews along the coastal areas of Guinea-Bissau generally resulted

in the view that sea turtles overall have decreased noticeably in numbers over the past two decades (Catry et al. 2009). In 2011, a record estimated 50,000 green sea turtle clutches were laid throughout the Bijagos Archipelago (Seminoff et al. 2015).

Nesting at the primary nesting beaches has been increasing over the course of the decades. 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 3 green sea turtles over 5 years (0.6 annually) attributed to the proposed action will not have any measurable effect on that trend. Therefore, we believe the proposed action is not reasonably expected to cause an appreciable reduction in the likelihood of survival of the SA DPS of green sea turtle in the wild.

Like the NA DPS, the SA DPS of green sea turtles will not have a recovery plan in place at the time of listing. However, an Atlantic Recovery Plan for the population of Atlantic green sea turtles (NMFS and USFWS 1991d) 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. 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.*

Green sea turtle nesting in Florida between 2001-2006 was documented as follows: 2001 – 581 nests, 2002 – 9,201 nests, 2003 – 2,622, 2004 – 3,577 nests, 2005 – 9,644 nests, 2006 – 4,970 nests. This averages 5,039 nests annually over those 6 years (2001-2006) (NMFS and USFWS 2007a). Subsequent nesting has shown even higher average numbers (i.e., 2007 – 12,751 nests, 2008 – 9,228, 2009 – 4,462, 2010 – 13,225 nests, 2011 – 15,352, 2012 – 9,617, 2013 – 25, 553, 2014 – 3,502; 2015 – 27,975 (http://myfwc.com/research/wildlife/sea-turtles/nesting/2015-nesting-trends/). There are currently no estimates available specifically addressing changes in abundance of individuals on foraging grounds. Given the clear increases in nesting and in-water abundance, however, it is likely that numbers on foraging grounds have increased.

The potential lethal take of up to 3 green sea turtles over consecutive 5 year periods (0.6 annually) will result in a reduction in numbers when takes occur, but it is unlikely to have any detectable influence on the trends noted above. Nonlethal takes of sea turtles would not affect the adult female nesting population or number of nests per nesting season. Thus, the proposed action is not in opposition to the recovery objectives above and will not result in an appreciable reduction in the likelihood of the SA DPS of green sea turtles' recovery in the wild. Additionally, our estimate of future take is based on our belief that the same

level of take occurred in the past. It is worth noting that this level of take has already occurred in the past, yet we have still seen positive trends in the status of this species.

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

7.1.3 Hawksbill Sea Turtles

The proposed action may result in 1 hawksbill sea turtle takes (lethal or nonlethal) over consecutive future 5 year periods. A nonlethal take is unlikely to have any measurable impact on the reproduction, numbers, or distribution of this species. The individual is expected to fully recover such that no reductions in reproduction or numbers of hawksbill sea turtles are anticipated. The take may occur anywhere in the action area and the action area encompasses a tiny portion of hawksbill sea turtles' overall range/distribution. Since any incidentally caught animal would be released within the general area where caught, no change in the distribution of hawksbill sea turtles is anticipated.

A lethal take would reduce the number of hawksbill sea turtles, compared to the number that would have been present in the absence of the proposed action, assuming all other variables remained the same. The potential lethal interaction could also result in a reduction in future reproduction, assuming the individual would be a female and would have survived to reproduce in the future. For example, an adult hawksbill sea turtle can lay 3-5 clutches of eggs every few years (Meylan and Donnelly 1999; Richardson et al. 1999) with up to 250 eggs/nest (Hirth and Latif 1980). Thus, the loss of a female could preclude the production of thousands of eggs and hatchlings, of which a fraction would otherwise survive to sexual maturity and contribute to future generations. Sea turtles generally have large ranges in which they disperse; thus, no reduction in the distribution of hawksbill sea turtles is expected from this take.

In the absence of any total population estimates for hawksbill sea turtles nesting trends are the best proxy we have for estimating population changes. The 5-year status review estimated between 22,000 and 29,000 adult females existed in the Atlantic basin at the time of its writing in 2007 (NMFS 2013d); this estimate does not include juveniles of either sex or mature males. The potential loss of up to 1 hawksbills over consecutive 5-year periods (0.2 annually) would equal only 0.0045% of the adult female population, which is only a portion of the entire population. Hawksbill nesting trends also indicate an improvement over the last 20 years. A survey of historical nesting trends (i.e., 20-100 years ago) for the 33 nesting sites in the Atlantic Basin found declines at 25 of those sites and data were not available for the remaining 8 sites. However, in the last 20 years, nesting trends have been improving. Of those 33 sites, 10 sites now show an increase in nesting, 10 sites showed a decrease, and data for the remaining 13 are not available (NMFS 2013d).

Our evaluation of the impact of future take is based on our belief that the same level of take occurred in the past. It is worth noting that this level of take has already occurred in the

past, yet we have still seen positive trends in the status of this species. We believe increases in nesting over the last 20 years, relative to the historical trends, indicate improving population numbers. Additionally, even when we conservatively evaluate the potential effects of the proposed action on a portion of the hawksbill population (i.e., adult females) we believe the impacts will be minor relative to the entire population. Thus, we believe the potential loss of up to 1 hawksbill sea turtles over consecutive 5-year periods (0.2 annually) will not have any detectable effect on the population, distribution or reproduction of hawksbills. Therefore, we do not believe the proposed action will cause an appreciable reduction in the likelihood of survival.

The Recovery Plan for the population of the hawksbill sea turtles (NMFS and USFWS 1993b) lists the following relevant recovery objectives over a period of 25 continuous years:

> *Objective: The adult female population is increasing, as evidenced by a statistically significant trend in the annual number of nests on at least 5 index beaches, including Mona Island (Puerto Rico) and Buck Island Reef National Monument (U.S. Virgin Islands).*
>
> *Objective: The numbers of adults, subadults, and juveniles are increasing, as evidenced by a statistically significant trend on at least 5 key foraging areas within Puerto Rico, USVI, and Florida.*

Nesting populations are increasing at the Puerto Rico (Mona Island) and U.S. Virgin Islands (Buck Island Reef National Monument) index beaches. Also in the U.S. Caribbean, additional nesting beaches are now being more systematically monitored to allow for future population trend assessments. Elsewhere in the Caribbean outside U.S. jurisdiction, nesting populations in Antigua/Barbuda and Barbados are increasing; however, other important nesting concentrations in the insular Caribbean are decreasing or their status is unknown, including Antiqua/Barbuda (except Jumby Bay), Bahamas, Cuba (Doce Leguas Cays), Jamaica, and Trinidad and Tobago (NMFS 2013d).

The status of adults, subadults, and juveniles on foraging grounds is being monitored via in-water research. An in-water research project at Mona Island, Puerto Rico, has been ongoing for 15 years. However, abundance indices have not yet been incorporated into a rigorous analysis or a published trends assessment, as of yet. In addition, standardized in-water surveys have been initiated within the wider Caribbean (e.g., Pearl Cays, Nicaragua), but the time series is not long enough to detect a trend. In Florida, 2 in-water projects have been ongoing in Key West and Marquesas Keys conducted by the In-Water Research Group and Palm Beach County (NMFS 2013d).

The proposed action could cause the loss of up to 1 hawksbill sea turtles over consecutive 5-year periods (0.2 annually) and the animal may or may not be an adult and may or may not be a female. Additionally, our evaluation of a potential future mortality is based our belief that the same level of interactions occurred in the past, and with that level we have still seen positive trends in the status of this species. We determined the potential lethal take associated with the proposed action would not have any detectable influence on the

magnitude of those trends. While information on trends for adults, subadults, and juveniles at key foraging areas is not yet available, we also believe it is unlikely the potential removal of 1 hawksbill will have any detectable influence over the numbers of adults, subadults, and juveniles occurring at 5 key foraging areas. Thus, we believe the proposed action is not likely to impede the recovery objectives above and will not result in an appreciable reduction in the likelihood of hawksbill sea turtles' recovery in the wild.

Conclusion

The lethal or nonlethal takes of a hawksbill turtle associated with the proposed action are not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the hawksbill sea turtle in the wild.

7.1.4 Kemp's Ridley Sea Turtles

The proposed action may result in up to 116 Kemp's ridley sea turtle takes (90 nonlethal, 26 lethal) during consecutive 5-year periods. The nonlethal takes of 90 Kemp's ridley sea turtles during consecutive 5-year periods is not expected to have any measurable impact on the reproduction, numbers, or distribution of this species. The individuals are expected to fully recover such that no reductions in reproduction or numbers of Kemp's ridley sea turtles are anticipated. The takes may occur anywhere in the action area and the action area encompasses a tiny portion of Kemp's ridley sea turtles' overall range/distribution. Since any incidentally caught animals would be released within the general area where caught, no change in the distribution of Kemp's ridley sea turtles is anticipated.

The lethal take of up to 26 Kemp's ridley sea turtles during consecutive 5-year periods (5.2 annually) would reduce the species' population compared to the number that would have been present in the absence of the proposed action, assuming all other variables remained the same. The TEWG (1998a) estimates age at maturity from 7-15 years. Females return to their nesting beach about every 2 years (TEWG 1998a). The mean clutch size for Kemp's ridleys is 100 eggs/nest, with an average of 2.5 nests/female/season. Lethal takes could also result in a potential reduction in future reproduction, assuming at least some of these individuals would be female and would have survived to reproduce in the future. While we have no reason to believe the proposed action will disproportionately affect females, the annual loss of up to 2.4 adult female sea turtles, could preclude the production of thousands of eggs and hatchlings, of which a fractional percentage is expected to survive to sexual maturity. Thus, the death of any females would eliminate their contribution to future generations, and result in a reduction in sea turtle reproduction. The anticipated takes are expected to occur anywhere in the action area and sea turtles generally have large ranges; thus, no reduction in the distribution of Kemp's ridley sea turtles is expected from the take of these individuals.

In the absence of any total population estimates for Kemp's ridley sea turtles, nesting trends are the best proxy we have for estimating population changes. Heppell et al. (2005) predicted in a population model that the Kemp's ridley sea turtle population is expected to increase at least 12-16% per year and that the population could attain at least 10,000 females nesting on Mexico beaches by 2015. NMFS et al. (2011d) contains an updated

model which predicts that the population is expected to increase 19% per year and also predicts that the population could 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. In 2009, the population was on track with 21,144 nests, but an unexpected and as yet unexplained drop in nesting occurred in 2010 (loss of 13,302 nests), deviating from the NMFS et al. (2011d) model prediction. A subsequent increase to 20,570 nests occurred in 2011. In 2012, the number had increased again. Researchers documented 21,797 nests in Tamaulipas, Mexico (Burchfield 2013), and 209 nests were reported in Texas as of August 2012. The number of nests documented in Mexico declined to 16,385 again in 2013 and to 11,279 nests in 2014. However, preliminary nesting data from 2015 indicates nesting numbers will be greater than 14,006 nests in Mexico. We will not know if the population is continuing the general trajectory predicted by the model until future nesting data are available. Of course, this updated model assumes that current survival rates within each life stage remain constant. The recent increases in Kemp's ridley sea turtle nesting seen in the last two decades is likely due to a combination of management measures including elimination of direct harvest, nest protection, the use of TEDs, reduced trawling effort in Mexico and the U.S., and possibly other changes in vital rates (TEWG 1998b; TEWG 2000b). While these results are encouraging, the species' limited range as well as low global abundance makes it particularly vulnerable to new sources of mortality as well as demographic and environmental randomness, all of which are often difficult to predict with any certainty.

The nesting trend over the last 2 decades appears to be evidence of an increasing population. Additionally, our evaluation of potential future mortalities is based our belief that the same level of interactions occurred in the past, and with that level we have still seen positive trends in the status of this species. Thus, we believe the potential loss of up to 26 Kemp's ridley sea turtles over consecutive 5-year periods (5.2 annually) will not have any detectable effect on the population, distribution or reproduction of Kemp's ridley sea turtles. Therefore, we do not believe the proposed action will cause an appreciable reduction in the likelihood of survival.

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

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

With respect to this recovery objective, the preliminary nesting numbers for in 2015, indicate there were 10,351 nests in Rancho Nuevo, 890 in Tepehuajes, and 1,535 in Playa Dos, Mexico, for a total of 12,776 nests. This number represents approximately 5,110

nesting females for the season based on 2.5 clutches/female/season. The number of nests reported annually from 2010 to 2014 overall declined; however they rebounded some in 2015. Although there has been a substantial increase in the Kemp's ridley population within the last few decades, the number of nesting females is still below the number of 10,000 nesting females per season required for downlisting (NMFS and USFWS 2015). Since we concluded that the potential loss of up to 26 Kemp's ridley sea turtles over consecutive 5-year periods (5.2 annually) is not likely to have any detectable effect on nesting trends, we do not believe the proposed action will impede the progress toward achieving this recovery objective. Thus, we believe the proposed action will not result in an appreciable reduction in the likelihood of Kemp's ridley sea turtles' recovery in the wild.

Conclusion

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

7.1.5 Leatherback Sea Turtles

The proposed action may result in up to 5 leatherback sea turtle takes (3 nonlethal, 2 lethal) over consecutive 5-year periods. The nonlethal take of 4 leatherback sea turtles over consecutive 5-year periods is not expected to have any measurable impact on the reproduction, numbers, or distribution of this species. The individuals are expected to fully recover such that no reductions in reproduction or numbers of this species are anticipated. Since these takes may occur anywhere in the action area and would be released within the general area where caught, no change in the distribution of leatherback sea turtles is anticipated.

The lethal take of up to 2 leatherback sea turtles over consecutive 5-year periods (0.4 annually) would reduce the population by that number compared to the number that would have been present in the absence of the proposed action, assuming all other variables remained the same. Lethal takes could also result in a potential reduction in future reproduction, assuming one or more of these individuals would be female and would have survived otherwise to reproduce in the future. For example, an adult female leatherback sea turtle can produce up to 700 eggs or more per nesting season (Schultz 1975). Although a significant portion (up to approximately 30%) of the eggs can be infertile, the annual loss of adult female sea turtles, on average, could preclude the production of thousands of eggs and hatchlings of which a small percentage would be expected to survive to sexual maturity. While we have no reason to believe the proposed action will disproportionately affect females, the death of any female leatherbacks that would have survived otherwise to reproduce would eliminate its and its future offspring's contribution to future generations. The anticipated lethal interactions are expected to occur anywhere in the action area. Given these sea turtles generally have large ranges, no reduction in the distribution of leatherback sea turtles is expected from the proposed action.

The Leatherback Turtle Expert Working Group estimates there are between 34,000-95,000 total adults (20,000-56,000 adult females; 10,000-21,000 nesting females) in the North Atlantic. The potential loss of up to 2 leatherback sea turtles over consecutive 5-year periods (0.4 annually) accounts for only 0.0004-0.001% of those population estimates, which are only a subset of the entire population. We do not believe these potential loses will have any detectable impact on these population numbers.

Of the 15 leatherback nesting populations in the North Atlantic, 7 show an increase in nesting (Florida, Puerto Rico [not Culebra], St. Croix-U.S. Virgin Islands, British Virgin Islands, Trinidad, Guyana, and Brazil) and 3 have shown a decline in nesting (Puerto Rico [Culebra], Costa Rica [Tortuguero], and Costa Rica [Gandoca]). The most important nesting populations (French Guiana and Suriname) have remained stable. Suriname and French Guiana may represent over 40% of the world's leatherback population (Spotila et al. 1996), accounting for between 31,000 to 60,000 nests annually (NMFS USFWS 2013).

The main nesting areas in Puerto Tico are at Fajardo on the main island of Puerto Rico and on the island of Culebra. Between 1978 and 2005, nesting increased in Puerto Rico from a minimum of 9 nests recorded in 1978 and to a minimum of 469-882 nests recorded each year between 2000 and 2005 (NMFS USFWS 2013). However since 2004, nesting has steadily declined in Culebra, which appears to reflect a shift in nest site fidelity rather than a decline in the female population (NMFS USFWS 2013).

In the U.S. Virgin Islands, St. Croix (Sandy Point National Wildlife Refuge), leatherback nesting was estimated to increase at 13% per year from 1994 through 2001. However, nesting data from 2001 through 2010 indicate nesting has slowed, possibly due to fewer new recruits and lowered reproductive output (NMFS USFWS 2013). The average annual growth rate was calculated as approximately 1.1 (with an estimated confidence interval between 1.07 and 1.13) using the number of observed females at Sandy Point, St. Croix, from 1986 to 2004 (TEWG 2007).

In Costa Rica, Tortuguero, leatherback nesting has decreased 88.5% overall from 1995 through 2011 (NMFS USFWS 2013). Troëng et al. (2007) estimated a 67.8% overall decline from 1995 through 2006. However, these estimates are based on an extrapolation of track survey data, which has consistently underestimated the number of nests reported during the surveys (NMFS USFWS 2013). Regardless of the method used to derive the estimate, the number of nests observed over the last 17 years has declined. Troeng et al. (2004) found a slight decline in the number of nests at Gandoca, Costa Rica, between 1995 and 2003, but the confidence intervals were large. Data between 1990 and 2004 at Gandoca averaged 582.9 (+ 303.3) nests each year, indicating nest numbers have been lower since 2000 (Chacón-Chaverri and Eckert 2007), and the numbers are not increasing (TEWG 2007).

Aside from the nesting declines in Tortuguero, which are significant, most of the other nesting populations appear to be increasing or are remaining stable, including the most significant populations in French Guiana and Suriname. Since we anticipate a low number of annual mortalities and we have no reason to believe nesting females will be

disproportionately affected, we believe the potential mortalities associated with the proposed action will have no detectable effect on current nesting trends.

Since we do not anticipate the proposed action will have any detectable impact on the population overall, or current nesting trends ,we do not believe the proposed action will cause an appreciable reduction in the likelihood of survival.

The Atlantic recovery plan for the U.S. population of the leatherback sea turtles (NMFS and USFWS 1992a) lists the following relevant recovery objective:

> *Objective*: The adult female population increases over the next 25 years, as evidenced by a statistically significant trend in the number of nests at Culebra, Puerto Rico; St. Croix, U.S. Virgin Islands; and along the east coast of Florida.

We believe the proposed action is not likely to impede the recovery objective above and will not result in an appreciable reduction in the likelihood of leatherback sea turtles' recovery in the wild. As noted previously, the Florida and St. Croix nesting populations are increasing. The nesting population in Culebra, Puerto Rico, had been increasing since the late 1970s but has been declining in recent years; however, it appears these declines may reflect a shift in nest site fidelity rather than a decline in the female population. Since we concluded that the potential loss of up to 2 leatherback sea turtles over consecutive 5-year periods (0.4 annually) is not likely to have any detectable effect on these nesting trends, we do not believe the proposed action is impeding the progress toward achieving this recovery objective. Thus, we believe the proposed action will not result in an appreciable reduction in the likelihood of leatherback sea turtles' recovery in the wild.

Conclusion

The lethal or nonlethal take of a leatherback 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 leatherback sea turtle in the wild.

7.2 Smalltooth Sawfish

Only the U.S. DPS of smalltooth sawfish is listed; therefore, a jeopardy analysis must determine whether the proposed action is likely to appreciably reduce the likelihood of survival and recovery of the smalltooth sawfish U.S. DPS.

The proposed action may result in up to 1 smalltooth sawfish take (lethal or nonlethal), over consecutive 5-year periods. The nonlethal takes of 1 smalltooth sawfish over consecutive 5-year periods (0.2 annually) is not expected to have any measurable impact on the reproduction, numbers, or distribution of this species. The individuals are expected to fully recover such that no reductions in reproduction or numbers of this species are anticipated. Since this take may occur anywhere within the range of the species and would be released within the general area where caught, no change in the distribution of smalltooth sawfish is anticipated.

The loss of 1 smalltooth sawfish over consecutive 5-year periods (0.2 annually) will reduce the number of smalltooth sawfish as compared to the number of smalltooth sawfish that would have been present in the absence of the proposed action assuming all other variables remained the same. These lethal takes could also result in the loss of reproduction value as compared to the reproductive value in the absence of the proposed action, if a female taken. An adult female smalltooth sawfish may have a litter of approximately 10 pups probably every 2 years. While we have no reason to believe the proposed action will disproportionately affect females, the loss of an adult female smalltooth sawfish over consecutive 5-year periods could preclude the production of up to 25 pups every 5 years, on average. Because smalltooth sawfish produce relatively well-developed young it is likely that some portion of these pups would have survived. Thus, the death of a female eliminates an individual's contribution to future generations, and the proposed action would result in a reduction in future smalltooth sawfish reproduction. Because we anticipate the potential lethal take of smalltooth sawfish could occur anywhere within the species' range, we believe the proposed action will not affect the distribution of the species.

While there is currently no accurate smalltooth sawfish population estimate, a trend analysis of their abundance in the Everglades National Park, considered within the species core range, shows a slightly increasing population abundance trend since 1972 (Carlson et al. 2007). A second analysis that considered data from 1989-2004, indicates smalltooth sawfish relative abundance has increased 5% annually over that 20-year period (Carlson and Osborne 2012; NMFS 2010f). These trends in abundance are in spite of ongoing FIM-related activities during much of that 20 year period.

A separate approach considered demographic variables to estimate intrinsic rates of increase for the smalltooth sawfish population. Using life history data from similar species, Simpfendorfer (2000) estimates the most likely range for the intrinsic rate of increase is 0.08 to 0.13 per year with population doubling times of 5.4 to 8.5 years. Although this rate is very slow, the lethal take of 1 smalltooth sawfish over consecutive 5-year periods (0.2 annually) is not expected to have any measureable impact on this range of population doubling-times. A loss this small would not be observable amongst the assumptions and error associated with the mathematical model.

Even with the ongoing fishing activities associated with the proposed action, the smalltooth sawfish population still remains stable or increasing (Carlson and Osborne 2012). Although the anticipated mortality of 1 smalltooth sawfish over consecutive 5-year periods (0.2 annually) would result in an instantaneous reduction in absolute population number, we do not believe this mortality will have any measurable effect on these trends. Therefore, we believe a lethal or nonlethal take of smalltooth sawfish associated with the proposed action is not reasonably expected to cause, directly or indirectly, an appreciable reduction in the likelihood of survival of the species in the wild.

Although we believe no change in distribution of smalltooth sawfish will occur because of the proposed action, we concluded the lethal take would result in an instantaneous

reduction in absolute population numbers that may also reduce reproduction, but we do not believe the reductions will appreciably reduce the likelihood of survival of the species in the wild. The following analysis considers the effects of that take on the likelihood of recovery in the wild. We consider the recovery objectives in the recovery plan prepared for the species that relate to population numbers or reproduction that may be affected by the predicted reductions in the numbers or reproduction of smalltooth sawfish resulting from the proposed action.

The recovery plan for the smalltooth sawfish (NMFS 2009h) lists 3 main objectives as recovery criteria for the species. The 2 objectives and the associated sub-objectives relevant to the proposed action are:

Objective - Minimize Human Interactions and Associated Injury and Mortality

Sub-objective:

- Develop and seek adoption of guidelines for safe handling and release of smalltooth sawfish to reduce injury and mortality associated with fishing.
- Minimize injury and mortality in all commercial and recreational fisheries.

Objective - Ensure Smalltooth Sawfish Abundance Increases Substantially and the Species Reoccupies Areas from Which It had Previously Been Extirpated

Sub-objective:

- Sufficient numbers of juvenile smalltooth sawfish inhabit several nursery areas across a diverse geographic area to ensure survivorship and growth and to protect against the negative effects of stochastic events within parts of their range.
- Adult smalltooth sawfish (> 340 cm) are distributed throughout the historic core of the species' range (both the Gulf of Mexico and Atlantic coasts of Florida). Numbers of adult smalltooth sawfish in both the Atlantic Ocean and Gulf of Mexico are sufficiently large that there is no significant risk of extirpation (i.e., local extinction) on either coast.
- Historic occurrence and/or seasonal migration of adult smalltooth sawfish are reestablished or maintained both along the Florida peninsula into the South-Atlantic Bight, and west of Florida into the northern and/or western Gulf of Mexico.

With respect to the first recovery objective, NMFS has developed safe-handling guidelines for the species. Nothing about the proposed action would preclude further development or adoption of safe-handling guidelines. Many FIM researchers and participants take precautions to ensure that any incidentally caught smalltooth sawfish and handled quickly and safely. This helps to minimize injuries to incidentally captured smalltooth sawfish, which is in direct support of the first recovery objective. For these reasons, we do not believe the proposed action will impede the progress toward achieving this recovery objective.

As noted previously, since the number of potential mortalities anticipated under the proposed action are so small (i.e., 1 over consecutive 5-year periods) we believe that potential loss will have no measurable effect on the population's abundance trends or growth rate. Since we anticipate this potential loss will have no measurable effect on the population, we also believe the potential loss will have no effect on: (1) the numbers of juveniles inhabiting nursery areas, (2) the geographic area across which juveniles occur, (3) the number of adults in the Gulf of Mexico or Atlantic Ocean, (4) the distribution of adults throughout the species' historic core range, (5) the species' ability to maintain or reestablish seasonal migrations. For these reasons, we do not believe the proposed action will impede the progress toward achieving this recovery objective. Thus, the effects of the proposed action will not result in an appreciable reduction in the likelihood of smalltooth sawfish recovery in the wild.

Conclusion

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

7.3 Shortnose Sturgeon

The proposed action may result in up to 4 shortnose sturgeon takes (3 nonlethal, 1 lethal), over consecutive 5-year periods. The nonlethal takes of up to 3 shortnose sturgeon over consecutive 5-year periods is not expected to have any measurable impact on the reproduction, numbers, or distribution of this species. The individuals are expected to fully recover such that no reductions in reproduction or numbers of this species are anticipated. Since these takes may occur anywhere in the action area and would be released within the general area where caught, no change in the distribution of shortnose sturgeon is anticipated.

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

Southern metapopulation is unknown due to limited survey effort, with capture in some rivers limited to less than 5 specimens.

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

The loss of 1 shortnose sturgeon over consecutive 5-year periods (0.2 annually) will reduce the number of shortnose sturgeon relative to the number that would have been present in the absence of the proposed action, assuming all other variables remained the same. This lethal take could also result in the loss of reproductive value as compared to the reproductive value in the absence of the proposed action, if a females was taken. The status of the shortnose sturgeons in the South Carolina rivers, where we anticipate this capture is likely to occur, is not well known. Abundance estimate are only available for the Cooper River. Regardless, we believe the potential loss of 1 animal over consecutive 5 year periods will likely be undetectable within any riverine population. Since we do not believe the loss of a single individual will be detectable to any given riverine population, we also believe such a loss would not be detectable against the entire southern metapopulation, nor would the loss of a single individual change their distribution. Thus, we believe the proposed action is not likely to jeopardize the continued existence of shortnose sturgeon.

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

Objective - Protect Shortnose Sturgeon Populations and Habitats

Sub-objective:

- Ensure agency compliance with the ESA.
- Reduce bycatch of shortnose sturgeon.
- Minimize the effects of incidental capture of shortnose sturgeon.

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

Nonlethal takes of shortnose sturgeon will not affect the population. The potential lethal take of 1 shortnose sturgeon over consecutive 5-year periods will result in a reduction in

overall population numbers. We have already determined that while this take would result in an reduction in absolute population number, we do not believe that reduction will have any measurably effects on the species. Additionally, we believe the proposed action will not impede the achievement of the relevant recovery objectives or sub-objectives. Thus, the effects of the proposed action will not result in an appreciable reduction in the likelihood of shortnose sturgeon recovery in the wild.

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

7.4 Atlantic Sturgeon

Five DPSs of Atlantic sturgeon have been listed, 4 as endangered and 1 as threatened. Because Atlantic sturgeon mix extensively in the marine range individuals from all 5 DPSs could occur in the action area. Therefore, a jeopardy determination must be made for each Atlantic sturgeon DPS and would be reached if the proposed action would appreciably reduce the likelihood of survival and recovery of any of the DPSs.

7.4.1 Gulf of Maine DPS

The proposed action may result in 18 Atlantic sturgeon takes from the Gulf of Maine (GOM) DPS over consecutive 5-year periods. We estimate those takes would be 6 adults (4 nonlethal, 2 lethal) and 12 subadults (10 nonlethal, 2 lethal takes).

The potential nonlethal take of 18 Atlantic sturgeon over consecutive 5-year periods is not expected to have any measurable impact on the reproduction, numbers, or distribution of animals from the GOM DPS. The individuals are expected to fully recover such that no reductions in reproduction or numbers of Atlantic sturgeon are anticipated.

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

The potential lethal take of 4 Atlantic sturgeon (2 adults, 2 subadults) over consecutive 5-year periods would reduce the population of Atlantic sturgeon in the GOM DPS by that amount. Adult Atlantic sturgeon are generally considered more important to the species because of their ability to breed. For this reason, we believe the best way to evaluate the impacts of the proposed action on Atlantic sturgeon reproduction is to consider not only how it is likely to affect adults, but also how it would affect subadults that may have lived to become adults (“adult equivalents”). GARFO-PRD developed an approach for estimating “adult equivalents.” They calculated the proportion of subadults likely to survive to be adults by first adding up the total number of Atlantic sturgeon subadults (i.e., ages 2-10) in any year. Then they added up all the adults (i.e., ages 11-20). They then

divided these sums to get the ratio of adults per subadult. When using the age-variable natural mortality, they estimated that each subadult equates to 0.48 adults. By multiplying that value by our estimates of subadult takes for each DPS from Sections 5.7 and 5.8 we calculated the likely number of adult equivalents that may be captured during FIM projects. For the GOM DPS, we anticipate 1 adult equivalent may be killed every 5 years during FIM projects. [61] Therefore, we anticipate the proposed action is likely to result in 3 (2 adult, 1 adult equivalent) lethal adult Atlantic sturgeon takes over consecutive 5-year periods from the GOM DPS (0.6 annually). We will conduct this same conversion exercise for each subsequent DPS.

For the population of GOM DPS Atlantic sturgeon to remain stable over generations, a certain amount of spawning must occur across the entire DPS to offset deaths within the population. Two ways to measure spawning potential are spawning stock biomass per recruit (SSB/R) and eggs per recruit (EPR). $EPR_{Max.}$ refers to the maximum number of eggs produced by a female Atlantic sturgeon over the course of its lifetime assuming no fishing mortality. Similarly, $SSB/R_{Max.}$ is the expected contribution a female Atlantic sturgeon would make during its lifetime to the total weight of the fish in a stock that is old enough to spawn, assuming no fishing mortality. In both cases, as fishing mortality increases, the expected lifetime production of a female decreases from the theoretical maximum (i.e., $SSB/R_{Max.}$ or $EPR_{Max.}$) due to an increased probability the animal will be caught and therefore unable to achieve its maximum potential (Boreman 1997). Since the $EPR_{Max.}$ or $SSB/R_{Max.}$ for each individual within a population is the same, it is appropriate to talk about these parameters not only for individuals but for populations as well.

Goodyear (1993) suggests that maintaining a SSB/R of at least 20% of $SSB/R_{Max.}$ would allow a population to remain stable (i.e., retain the capacity for survival). Boreman (1997) indicates that since stock biomass and egg production are typically linearly correlated (i.e., larger individuals generally produce more eggs than smaller individuals) it is appropriate to apply the 20% (Goodyear 1993) threshold directly to EPR estimates.

Boreman (1997) reported adult female Atlantic sturgeon in the Hudson River could have likely sustained a fishing mortality rate of 14% and still retained enough spawners for the population to remain stable (i.e., maintain an EPR of at least 20% of EPR_{max}). We believe evaluating the potential effects of the proposed action against the fishing mortality associated (F = 0.14) with maintaining an EPR of at least 20% of $EPR_{max,}$ is appropriate for evaluating the potential impacts of the proposed action on the likelihood the GOM DPS will survive in the wild.

Other Biological Opinions have also considered the effects from other federal fisheries on Atlantic sturgeon. Likewise, a quantitative estimate of current/future Atlantic sturgeon takes exists for the American shad fishery in Georgia North Carolina's inshore gillnet fishery. Our analysis will include the authorized/calculated takes reported in the federal Biological Opinions as well as the Georgia and North Carolina fisheries since our analysis

[61] 2 lethal GOM subadult takes x 0.48 subadult survival = 0.96 adult equivalents

uses published literature standard (F=0.14= $EPR_{20\%}$) that includes known fishing mortality from all fishing sources (i.e., federal and state fisheries). Specifically, the Biological Opinion on the HMS Atlantic shark and smoothhound fisheries (NMFS 2012h) estimated 2 lethal takes of adult/adult equivalents GOM DPS fish would occur annually. The GARFO batched consultation on 7 FMPs (NMFS 2013b) also determined up to 22 Atlantic sturgeon adult/adult equivalents would be lethally taken annually from the GOM DPS. The incidental take of Atlantic sturgeon in the commercial shrimp fishery of the South Atlantic has also been considered (NMFS 2014 (NMFS 2012i). That Opinion estimated 1 Atlantic sturgeon from the GOM DPS would be killed annually.

The Incidental Take Permit (ITP) (No. 16645) provided to Georgia in response to their Section 10 application provides for up to 3 lethal takes of Atlantic sturgeon from the GOM DPS over the course their 10 year permits (0.3 annually) (NMFS 2013e). The Opinion issuing those takes indicates those takes will be juveniles and subadults (NMFS 2013e). Converting those animals to adult equivalents as done previously yields a number less than 1, but not zero.[62] Therefore, to be conservative for the species, we will assume the 0.3 animal potentially taken annually would have survived to be an adult and will consider it an adult equivalent.

The ITP (No. 18102) provided to North Carolina in response to their Section 10 application provides for up to 7 lethal takes of Atlantic sturgeon annually through 2023. The Opinion issuing those takes indicates those takes will be juveniles and subadults (NMFS 2014e). Following the previously discussed process for estimating the adult equivalents, we will consider 4 of those captures as adult equivalents.[63]

The anticipated 3 adults/adult equivalents may be taken by the proposed action over consecutive 5-year periods or 0.6 annually. Together, the Biological Opinions for the HMS shark/smoothhound fishery, the GARFO batched FMP, Southeast shrimp trawl fishery, the Georgia shad fishery, the North Carolina gillnet fisheries, and the proposed action estimate 26 GOM DPS adult/adult equivalent mortalities annually. The NEAMAP model estimates a minimum ocean population of 7,455 Atlantic sturgeon in the GOM DPS, of which 4,547 are adults/subadults (Table 7.1). Therefore, our anticipated lethal takes represent 0.67% of the adult/adult equivalent population in the GOM DPS.[64] This is below the estimated 14% fishing mortality rate we believe the population could likely withstand and still maintain $EPR_{20\%.}$ Based on this information, we believe the proposed action's removal of up to 3 adults/adult equivalents over consecutive 5-year periods will cause a reduction in numbers and reproduction. However, we do not believe these reductions will appreciably reduce the likelihood that the GOM DPS will survive in the wild.

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[62] 0.3 annual juvenile/subadult Georgia shad gillnet takes x 0.48 subadult survival = 0.15 adult equivalents
[63] 7 annual juvenile/subadult North Carolina gillnet takes x 0.48 subadult survival = 3.36 adult equivalents
[64] (1 Shrimp fishery take + 2 HMS shark/smoothhound fishery takes + 22 GARFO batched fisheries takes + 4 North Carolina gillnet fisheries + 1 Georgia shad fishery + 0.6 estimated takes from the proposed action) ÷ 4,548 estimated adults/adult equivalents in the GOM DPS = 0.65% of the GOM DPS taken

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

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

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

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

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

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

Nothing about the proposed action will affect the habitat or water quality or curtail the range of the species in the GOM DPS. The proposed action has no relationship to the blockage of access to historical habitats by dams or reservoirs. The bycatch of Atlantic sturgeon in fishing gear will occur under the proposed action. However, we anticipate primarily nonlethal incidental captures that will be documented and procedures have been established to minimize the impact of any interactions that do occur.

The proposed action has nothing to do with 4 of 5 threats leading to listing of this DPS. The bycatch of Atlantic sturgeon in fishing gear will occur under the proposed action. However, we anticipate primarily nonlethal incidental captures that will be documented and procedures have been established to minimize the impact of any interactions that do

occur. For these reasons, we believe the proposed action is not likely to appreciably reduce the likelihood that the GOM DPS will recover in the wild.

Conclusion
Based on the information of this section, we believe continued operation of FIM projects under the umbrella action, are not likely to jeopardize the continued existence of the GOM DPS of Atlantic sturgeon.

7.4.2 New York Bight DPS

The proposed action may result in 66 Atlantic sturgeon takes from the New York Bight (NYB) DPS over consecutive 5-year periods. We estimate those takes would be 17 adults (15 nonlethal, 2 lethal) and 49 subadults (44 nonlethal, 5 lethal).

The potential nonlethal takes of 59 Atlantic sturgeon over consecutive 5-year periods (15 adults, 49 subadults) are not expected to have any measurable impact on the reproduction, numbers, or distribution of these animals from the NYB DPS. The individuals are expected to fully recover such that no reductions in reproduction or numbers of Atlantic sturgeon are anticipated.

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

The potential lethal take of 7 Atlantic sturgeon over consecutive 5-year periods (2 adults, 5 subadults) would reduce the population of Atlantic sturgeon in the NYB DPS by that amount. As discussed previously, we believe breeding adults are especially important the overall populations of the Atlantic sturgeon DPSs. For that reason, we followed the same approach described in Section 7.4.1 to estimate adult equivalents for the NYB DPS. Based on those calculations, we estimated the number of adult equivalents for the NYB DPS affected by the proposed action was 3 over consecutive 5-year periods (0.6 annually). [65] Thus, we anticipate the proposed action is likely to result in 5 Atlantic sturgeon (2 adult, 3 adult equivalents) lethal takes over consecutive 5-year periods (1 annually) from the NYB DPS.

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

[65] 5 lethal NYB subadult takes x 0.48 subadult survival = 2.4 adult equivalents

We anticipated 5 adult/adult equivalents may be taken by the proposed action over consecutive 5-year periods (1 annually). Additionally, we anticipate lethal NYB DPS takes in the HMS Atlantic shark and smoothhound fisheries (10 annually) (NMFS 2012h), the Southeastern shrimp fishery (3 annually) (NMFS 2012i), the 7 fisheries analyzed in the GARFO batched consultation (100 annually) (NMFS 2013b).

The Georgia ITP provides for up to 4 lethal takes of Atlantic sturgeon from the NYB DPS over the course their 10 year permits (0.4 annually); indicating those takes will be juveniles and subadults (NMFS 2013e). Converting those animals to adult equivalents as done previously yields a number less than 1, but not zero.[66] To be conservative for the species, we will assume the 0.4 animal potentially taken annually would have survived to be an adult and will consider it an adult equivalent.

The ITP (No. 18102) provided to North Carolina provides for up to 18 lethal takes of Atlantic sturgeon from the NYB DPS annually through 2023. The Opinion issuing those takes indicates those takes will be juveniles and subadults (NMFS 2014e). Following the previously discussed process for estimating the adult equivalents, we will consider 9 of those captures as adult equivalents.[67]

We anticipate that 124 adult/adult equivalent Atlantic sturgeon may be taken annually in these fisheries and by our proposed action. The NEAMAP model estimates a minimum ocean population of 34,556 Atlantic sturgeon in the NYB DPS, of which 21,086 are adults/subadults (Table 7.1). Based on this information, we believe 0.58% of the adult/adult equivalent population in the NYB DPS will be killed annually.[68] This 0.58% is below the estimated 14% total fishing mortality rate we believe the population could likely withstand and still maintain $EPR_{20\%}$. Based on this information, we believe the proposed action's removal of up to 5 adults/adult equivalents over consecutive 5-year periods (1 annually) will cause a reduction in numbers and reproduction. However, we do not believe these reductions are likely to cause an appreciable reduction in the likelihood that the NYB DPS will survive in the wild.

[66] 0.4 annual juvenile/subadult Georgia shad gillnet takes x 0.48 subadult survival = 0.19 adult equivalents
[67] 18 annual juvenile/subadult North Carolina gillnet takes x 0.48 subadult survival = 8.64 adult equivalents
[68] (3 Shrimp fishery takes + 10 HMS shark/smoothhound fishery takes + 100 GARFO batched fisheries takes + 0.5 Georgia shad fishery + 9 North Carolina gillnet fisheries + 1 estimated takes from the proposed action) ÷ 21,086 estimated adults/adult equivalents in the NYB DPS = 0.58% of the NYB DPS taken

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

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

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

The proposed action could introduce threats of vessel strikes and bycatch from fishing gear. None of the projects operate in the riverine portions of the range of NYB DPS Atlantic sturgeon. Therefore, we believe the threats from vessel strikes to the NYB DPS of Atlantic sturgeon are not of concern when considering the potential effect from this threat to the recovery of the NYB DPS.

The bycatch of Atlantic sturgeon in fishing gear will occur under the proposed action. However, we anticipate primarily nonlethal incidental captures that will be documented and procedures have been established to minimize the impact of any interactions that do occur.

The proposed action has nothing to do with the 5 of 6 threats leading to listing of this DPS. The bycatch of Atlantic sturgeon in fishing gear will occur under the proposed action. However, we anticipate primarily nonlethal incidental captures that will be documented and procedures have been established to minimize the impact of any interactions that do occur. For these reasons, we believe the proposed action is not likely to appreciably reduce the likelihood that the NYB DPS will recover in the wild.

Conclusion

Based on the information of this section, we believe the continued operation of FIM projects under the umbrella action are not likely to jeopardize the continued existence of the NYB DPS of Atlantic sturgeon.

7.4.3 Chesapeake Bay DPS

The proposed action may result in 20 Atlantic sturgeon takes from the Chesapeake Bay (CB) DPS over consecutive 5-year periods. We estimate those takes would be 6 adults (4 nonlethal, 2 lethal) and 14 subadults (12 nonlethal, 2 lethal).

The potential nonlethal takes of 16 Atlantic sturgeon annually (4 adults, 12 subadults) are not expected to have any measurable impact on the reproduction, numbers, or distribution of these animals from the CB DPS. The individuals are expected to fully recover such that no reductions in reproduction or numbers of Atlantic sturgeon are anticipated.

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

The potential lethal take of 4 Atlantic sturgeon over consecutive 5-year periods (2 adult, 2 subadults) would reduce the population of Atlantic sturgeon in the CB DPS by that amount. As discussed previously, we believe breeding adults are especially important to the overall populations of the Atlantic sturgeon DPSs. For that reason, we followed the same approach described in Section 7.4.1 to estimate adult equivalents for the CB DPS. Based on those calculations we estimated the number of adult equivalents for the CB DPS affected by the proposed action was 1 over consecutive 5-year periods. [69] Thus, we anticipate the proposed action is likely to result in 3 Atlantic sturgeon (2 adult, 1 adult equivalents) lethal takes over consecutive 5-year periods (0.6 annually) from the CB DPS.

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

We anticipated 3 adult/adult equivalents may be taken by the proposed action over consecutive 5-year periods (0.6 annually). Additionally, we anticipate lethal CB DPS takes in the HMS Atlantic shark and smoothhound fisheries (3 annually) (NMFS 2012h), the Southeastern shrimp fishery (2 annually) (NMFS 2012i), the 7 fisheries analyzed in the GARFO batched consultation (27 annually) (NMFS 2013b).

The Georgia ITP provides for up to 6 lethal takes of Atlantic sturgeon from the CB DPS over the course their 10 year permits (0.6 annually); indicating those takes will be juveniles and subadults (NMFS 2013e). Converting those animals to adult equivalents as done

[69] 2 lethal CB subadult takes x 0.48 subadult survival = 0.96 adult equivalents

previously yields a number less than 1, but not zero.[70] To be conservative for the species, we will assume the 0.6 animal potentially taken annually would have survived to be an adult and will consider it an adult equivalent.

The North Carolina ITP (No. 18102) provides for up to 69 lethal takes of Atlantic sturgeon from the CB DPS annually through 2023. The Opinion issuing those takes indicates those takes will be juveniles and subadults (NMFS 2014e). Following the previously discussed process for estimating the adult equivalents, we will consider 33 of those captures as adult equivalents.[71]

We anticipate that 67 adult Atlantic sturgeon may be taken annually in these fisheries and by our proposed action. The NEAMAP model estimates a minimum ocean population of 8,811 Atlantic sturgeon in the CB DPS, of which 5,375 are adults/subadults (Table 7.1). Based on this information, we believe 1.23% of the adult/adult equivalent population in the CB DPS will be killed annually.[72] This 1.23% is below the estimated 14% total fishing mortality rate we believe the population could likely withstand and still maintain $EPR_{20\%}$. Based on this information, we believe the proposed action's removal of up to 3 adult/adult equivalent over consecutive 5-year periods (0.6 annually) will cause a reduction in numbers and reproduction. However, we do not believe these reductions are likely to cause an appreciable reduction in the likelihood that the CB DPS will survive in the wild.

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

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

Nothing about the proposed action will affect the habitat or water quality or curtail the range of the species, in the CB DPS. The proposed action could introduce threats of vessel strikes and bycatch from fishing gear. None of the projects operate in the riverine portions of the range of CB DPS Atlantic sturgeon. Therefore, we believe the threats from vessel

[70] 0.6 annual juvenile/subadult Georgia shad gillnet takes x 0.48 subadult survival = 0.29 adult equivalents
[71] 69 annual juvenile/subadult North Carolina gillnet takes x 0.48 subadult survival = 33 adult equivalents
[72] (2 Shrimp fishery takes + 3 HMS shark/smoothhound fishery takes + 27 GARFO batched fisheries takes + 0.6 Georgia shad fishery + 33 North Carolina fisheries + 0.6 estimated takes from the proposed action) ÷ 5,375 estimated adults/adult equivalents in the CB DPS = 1.23% of the NYB DPS taken.

strikes to the CB DPS of Atlantic sturgeon are not of concern when considering the potential effect from this threat to the recovery of the CB DPS.

The proposed action has nothing to do with 4 of 5 threats leading to listing of this DPS. The bycatch of Atlantic sturgeon in fishing gear will occur under the proposed action. However, we anticipate primarily nonlethal incidental captures that will be documented and procedures have been established to minimize the impact of any interactions that do occur. For these reasons, we believe the proposed action is not likely to appreciably reduce the likelihood that the CB DPS will recover in the wild.

Conclusion
Based on the information of this section, we believe continued operation of FIM projects under the umbrella action are not expected to jeopardize the continued existence of the CB DPS of Atlantic sturgeon.

7.4.4 South Atlantic DPS

The proposed action may result in 30 Atlantic sturgeon takes from the South Atlantic (SA) DPS over consecutive 5-year periods. We estimate those takes would be 8 adults (6 nonlethal, 2 lethal) and 22 subadults (19 nonlethal, 3 lethal).

The potential nonlethal takes of 25 Atlantic sturgeon over consecutive 5-year periods (6 adults, 19 subadults) are not expected to have any measurable impact on the reproduction, numbers, or distribution of these animals from the SA DPS. The individuals are expected to fully recover such that no reductions in reproduction or numbers of Atlantic sturgeon are anticipated.

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

The potential lethal take of 5 Atlantic sturgeon over consecutive 5-year periods (2 adult, 3 subadults) would reduce the population of Atlantic sturgeon in the SA DPS by that amount. As discussed previously, we believe breeding adults are especially important to the overall populations of the Atlantic sturgeon DPSs. For that reason, we followed the same approach described in Section 7.4.1 to estimate adult equivalents for the SA DPS. Based on those calculations we estimated the number of adult equivalents for the SA DPS affected by the proposed action was 4 over consecutive 5-year periods. [73] Thus, we anticipate the proposed action is likely to result in 4 Atlantic sturgeon (2 adult, 2 adult equivalents) lethal takes over consecutive 5-year periods (0.8 annually) from the SA DPS.

[73] 3 lethal SA subadult takes x 0.48 subadult survival = 1.44 adult equivalents

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

We anticipated 4 adult/adult equivalents may be taken by the proposed action over consecutive 5-year periods (0.8 annually). Additionally, we anticipate lethal SA DPS takes in the HMS Atlantic shark and smoothhound fisheries (4 annually) (NMFS 2012h), the Southeastern shrimp fishery (7 annually) (NMFS 2012i), the 7 fisheries analyzed in the GARFO batched consultation (43 annually) (NMFS 2013b).
The Georgia ITP provides for up to 27 lethal takes of Atlantic sturgeon from the SA DPS over the course their 10 year permits (2.7 annually); indicating those takes will be juveniles and subadults (NMFS 2013e). Following the previously discussed process for estimating the adult equivalents, we will consider 2 of those captures as adult equivalents.[74]

The North Carolina ITP (No. 18102) provides for up to 69 lethal takes of Atlantic sturgeon from the SA DPS annually through 2023. The Opinion issuing those takes indicates those takes will be juveniles and subadults (NMFS 2014e). Following the previously discussed process for estimating the adult equivalents, we will consider 33 of those captures as adult equivalents.[75]

We anticipate that 90 adult Atlantic sturgeon may be taken annually in these fisheries and by our proposed action. The NEAMAP model estimates a minimum ocean population of 14,911 Atlantic sturgeon in the SA DPS, of which 9,096 are adults/subadults (Table 7.1). Based on this information, we believe 0.98% of the adult/adult equivalent population in the SA DPS will be killed annually. This 0.98% is below the estimated 14% total fishing mortality rate we believe the population could likely withstand and still maintain EPR20%. Based on this information, we believe the proposed action's removal of up to 4 adult/adult equivalent over consecutive 5-year periods (0.8 annually) will cause a reduction in numbers and reproduction. However, we do not believe these reductions are likely to cause an appreciable reduction in the likelihood that the SA DPS will survive in the wild.

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

1) Dredging that can displace sturgeon while it is occurring and affect the quality of the habitat afterwards by changing the depth, sediment characteristics, and prey availability.
2) Degraded water quality in areas as a result of withdrawals for public use, runoff from agriculture, industrial discharges, and the alteration of river systems by dams and reservoirs.

[74] 2.7 annual juvenile/subadult Georgia shad gillnet takes x 0.48 subadult survival = 1.3 adult equivalents
[75] 69 annual juvenile/subadult North Carolina gillnet takes x 0.48 subadult survival = 33 adult equivalents

3) Impeded access to historical habitat by dams and reservoirs.
4) Bycatch of Atlantic sturgeon in commercial fisheries.
5) Inadequacy of regulatory mechanisms to control bycatch and the modification and curtailment of Atlantic sturgeon habitat.

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

The proposed action has nothing to do with 4 of 5 threats leading to listing of this DPS. The bycatch of Atlantic sturgeon in fishing gear will occur under the proposed action. However, we anticipate primarily nonlethal incidental captures that will be documented and procedures have been established to minimize the impact of any interactions that do occur. For these reasons, we believe the proposed action is not likely to appreciably reduce the likelihood that the SA DPS will recover in the wild.

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

7.4.5 Carolina DPS

The proposed action may result in 6 Atlantic sturgeon takes from the Carolina DPS over consecutive 5-year periods. We estimate those takes would be 2 adults (2 nonlethal, 0 lethal) and 4 subadults (3 nonlethal, 1 lethal).

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

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

The potential lethal take of 1 Atlantic sturgeon over consecutive 5-year periods (1 subadult) would reduce the population of Atlantic sturgeon in the Carolina DPS by that amount. As discussed previously, we believe breeding adults are especially important to the overall populations of the Atlantic sturgeon DPSs. For that reason, we followed the same approach described in Section 7.4.1 to estimate adult equivalents for the Carolina

DPS.[76] Based on those calculations we estimated the number of adult equivalents for the Carolina DPS affected by the proposed action was 1 over consecutive 5-year periods. Thus, we anticipate the proposed action is likely to result in 1 Atlantic sturgeon (1 adult equivalent) lethal takes over consecutive 5-year periods (0.2 annually) from the Carolina DPS. We believe the lethal take could occur anywhere within the range of the animals from the DPS. Because these takes are likely to occur at random we do not anticipate any change in the distribution of Atlantic sturgeon in the DPS.

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

We anticipated lethal take by the proposed action over consecutive 5-year periods (0.2 annually). Additionally, we anticipate lethal Carolina DPS takes in the HMS Atlantic shark and smoothhound fisheries (2 annually) (NMFS 2012h), the Southeastern shrimp fishery (3 annually) (NMFS 2012i), the 7 fisheries analyzed in the GARFO batched consultation (5 annually) (NMFS 2013b).

The Georgia ITP provides for up to 5 lethal takes of Atlantic sturgeon from the Carolina DPS over the course their 10 year permits (0.5 annually); indicating those takes will be juveniles and subadults (NMFS 2013e). Converting those animals to adult equivalents as done previously yields a number less than 1, but not zero.[77] To be conservative for the species, we will assume the 0.5 animal potentially taken annually would have survived to be an adult and will consider it an adult equivalent.

The ITP (No. 18102) provided to North Carolina provides for up to 127 lethal takes of Atlantic sturgeon from the Carolina DPS annually through 2023. The Opinion issuing those takes indicates those takes will be juveniles and subadults (NMFS 2014e). Following the previously discussed process for estimating the adult equivalents, we will consider 61 of those captures as adult equivalents.[78]

We anticipate that 72 adult Atlantic sturgeon may be taken annually in these fisheries and by our proposed action. The NEAMAP model estimates a minimum ocean population of 1,356 Atlantic sturgeon in the Carolina DPS, of which 827 are adults/subadults (Table 7.1). Based on this information, we believe 8.6% of the adult/adult equivalent population in the

[76] 1 lethal Carolina subadult takes x 0.48 subadult survival = 0.48 adult equivalents
[77] 0.5 annual juvenile/subadult Georgia shad gillnet takes x 0.48 subadult survival = 0.24 adult equivalents
[78] 127 annual juvenile/subadult North Carolina gillnet takes x 0.48 subadult survival = 61 adult equivalents

Carolina DPS will be killed annually.[79] This 8.6% is below the estimated 14% total fishing mortality rate we believe the population could likely withstand and still maintain $EPR_{20\%}$. Based on this information, we believe the proposed action's removal of up to 1 adult/adult equivalent over consecutive 5-year periods will cause a reduction in numbers and reproduction. However, we do not believe these reductions are likely to cause an appreciable reduction in the likelihood that the Carolina DPS will survive in the wild.

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

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

Nothing about the proposed action will affect the habitat or water quality or curtail the range of the species in the Carolina DPS. The proposed action has no relationship to the blockage of access to historical habitats by dams or reservoirs. The bycatch of Atlantic sturgeon in fishing gear will occur under the proposed action. However, we anticipate primarily nonlethal incidental captures that will be documented and procedures have been established to minimize the impact of any interactions that do occur.

The proposed action has nothing to do with the 4 of 5 threats leading to listing of this DPS. The bycatch of Atlantic sturgeon in fishing gear will occur under the proposed action. However, we anticipate primarily nonlethal incidental captures that will be documented and procedures have been established to minimize the impact of any interactions that do occur. For these reasons, we believe the proposed action is not likely to appreciably reduce the likelihood that the Carolina DPS will recover in the wild.

Conclusion

Based on the information of this section, we believe continued operation of FIM projects under the umbrella action are not expected to jeopardize the continued existence of the Carolina DPS of Atlantic sturgeon.

[79] (3 Shrimp fishery takes + 2 HMS shark/smoothhound fishery takes + 5 GARFO batched fisheries takes + 0.5 Georgia shad fishery + 61 North Carolina gillnet fisheries + 0.2 estimated takes from the proposed action) ÷ 827 estimated adults/adult equivalents in the Carolina DPS = 8.6% of the Carolina DPS taken

7.5 Scalloped Hammerhead Shark

Only the Central and Southwest Atlantic DPS of scalloped hammerhead shark occurs within the action area; therefore, a jeopardy analysis must determine whether the proposed action will appreciably reduce the likelihood of survival and recovery of this DPS.

The proposed action may result in up to 1 lethal scalloped hammerhead take over consecutive 5-year periods (0.2 annually). The loss of 1 scalloped hammerhead over consecutive 5-year periods will reduce the number of scalloped hammerhead as compared to the number of scalloped hammerhead that would have been present in the absence of the proposed action assuming all other variables remained the same. This lethal take could also result in the loss of reproduction value as compared to the reproductive value in the absence of the proposed action, if a female is taken. Within the Central and Southwest Atlantic DPS, female scalloped hammerhead sharks have litters with between 2 and 21 pups, with an average of 14.3 (Hazin et al. 2001), probably every 2 years. While we have no reason to believe the proposed action will disproportionately affect females, the loss of an adult female scalloped hammerhead over consecutive 5-year periods could preclude the production of a maximum of 21 pups every 5 years. Because scalloped hammerhead produce relatively well-developed young, it is likely that some portion of these pups would have survived. Thus, the death of a female eliminates an individual's contribution to future generations, and the proposed action would result in a reduction in future scalloped hammerhead reproduction. While scalloped hammerhead sharks are less migratory than other sharks, they are still wide-ranging. We believe the potential loss of 1 animal during consecutive 5-year periods would not affect the distribution of the species.

There is currently no accurate population estimate for the Central and Southwest Atlantic DPS of scalloped hammerhead sharks. However, Miller et al. (2014) concluded that abundance numbers for this DPS are likely similar to, and probably worse than, those found in the Northwest Atlantic and Gulf of Mexico DPS. The virgin population estimates for the Northwest Atlantic and Gulf of Mexico DPS ranged from 142,000 and 169,000 individuals (range 116,000-260,000) (Hayes et al. 2009). The population estimates for the most recent time period (2005) estimate a much smaller population: 24,850-27,900 individuals (Hayes et al. 2009). Since Miller et al. (2014) concluded that abundance numbers for this DPS are likely similar to, and probably worse than, those found in the Northwest Atlantic and Gulf of Mexico DPS, we will conservatively base our analysis on the 24,850 population number.

The lethal take of 1 scalloped hammerhead over consecutive 5-year periods (0.2 annually) will reduce the number of scalloped hammerheads relative to the number that would have been present in the absence of the proposed action, assuming all other variables remained the same. This lethal take could also result in the loss of reproduction value as compared to the reproductive value in the absence of the proposed action, if females were taken. However, we believe the loss of a scalloped hammerhead over consecutive 5-year periods will not significantly decrease the populations within the Central and Southwest Atlantic DPS nor will it change their distribution. Thus, we believe the proposed action is not likely to jeopardize the continued existence of Central and Southwest Atlantic DPS of scalloped hammerhead sharks.

The following analysis considers the effects of that take on the likelihood of recovery in the wild. Since scalloped hammerhead sharks have just recently been listed, a recovery plan for them is not yet available. However, the first step in recovering a species is to reduce identified threats; only by alleviating threats can lasting recovery be achieved. The Final Listing Rule (79 FR 38213, July 3, 2014) noted the following potential threats to the Central and Southwest Atlantic DPS of scalloped hammerhead sharks:

1) Overutilization in artisanal fisheries, north of Brazil, that operate in nearshore and inshore environments that are likely nursery areas, and overutilization artisanal and commercial fishery within Brazil that target scalloped hammerhead sharks.
2) Operation of domestic artisanal fisheries and foreign commercial fisheries in areas without adequate fisheries regulations and operation of domestic and foreign fisheries in areas without capacity to enforce existing fisheries.
3) Scalloped hammerhead sharks' physiology makes them very susceptible to mortality in fishing gear. They often suffer very high at-vessel fishing mortality (e.g., Morgan and Burgess, 2007; Macbeth et al., 2009), and their schooling behavior increases their likelihood of being caught in large numbers.

None of the proposed FIM projects directly target scalloped hammerhead sharks and none of the projects operate as artisanal or commercial fisheries. The proposed action includes fishery research that may capture a scalloped hammerhead shark. However, the vessels conducting that research are subject to American laws pertaining to fisheries and the protection of federally listed species. We have no reason to believe the researchers conducting research in areas where the listed scalloped hammerheads may occur will disobey any relevant regulations protecting the species.

Recovery is the process by which the ecosystems of the Central and Southwest Atlantic DPS of scalloped hammerhead sharks are restored and the threats to the species are removed. These recovery actions support self-populating and self-regulating populations so they can become persistent members of the native biological communities (USFWS and NMFS 1998). As discussed previously, the proposed action is not likely to impede the Central and Southwest Atlantic DPS of scalloped hammerhead sharks from continuing to survive. The proposed action will not impede the process of restoring the ecosystems that affect the Central and Southwest Atlantic DPS of scalloped hammerhead sharks and will not impede progress toward removing the other threats. Thus, we believe the proposed action is not likely to impede the recovery of, and will not result in an appreciable reduction in, the likelihood of the Central and Southwest Atlantic DPS of scalloped hammerhead shark's recovery in the wild.

Conclusion

Based on the information of this section, we believe the effects from proposed action are not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of Central and Southwest Atlantic DPS of scalloped hammerhead sharks.

8.0 Conclusion

After reviewing the current status of each species, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our Biological Opinion that the action, as proposed, is not likely to jeopardize the continued existence of any ESA-listed species. Below is a more specific discussion of our conclusion for each species.

Sea Turtles
The proposed action is not expected to appreciably reduce the likelihood of survival and recovery of these species. Therefore, it is our opinion that the continued operation of FIM projects under the umbrella action is also not likely to jeopardize the continued existence of loggerhead (the NWA DPS), green (NA and SA DPS), and Kemp's ridley sea turtles. Our analyses for hawksbill and leatherback sea turtles focused on the impacts and their population responses in the action area. Nevertheless, the impact of the effects of the proposed action on the populations in the Atlantic basin must be directly linked to the global populations of the species, and the final jeopardy analysis is for the global populations as listed in the ESA. Because the proposed action will not reduce the likelihood of survival and recovery of the Atlantic population of hawksbill and leatherback sea turtles, it is our opinion that the proposed action is not likely to jeopardize the continued existence of hawksbill and leatherback sea turtles worldwide.

Smalltooth Sawfish
The proposed action is not expected to appreciably reduce the likelihood of survival and recovery of this species. Therefore, it is our opinion that the continued operation of FIM projects under the umbrella action is also not likely to jeopardize the continued existence of the United States DPS of smalltooth sawfish.

Atlantic Sturgeon
The proposed action is not expected to appreciably reduce the likelihood of survival and recovery of the 5 DPSs of this species. Therefore, it is our opinion that the continued operation of FIM projects under the umbrella action is also not likely to jeopardize the continued existence of the Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs of Atlantic sturgeon.

Shortnose Sturgeon
The proposed action is not expected to appreciably reduce the likelihood of survival and recovery of these species. Therefore, it is our opinion that the continued operation of FIM projects under the umbrella action is also not likely to jeopardize the continued existence of the shortnose sturgeon.

Central and Southwest Atlantic DPS of Scalloped Hammerhead Shark
The proposed action is not expected to appreciably reduce the likelihood of survival and recovery of this species. Therefore, it is our opinion that the continued operation of FIM projects under the umbrella action is also not likely to jeopardize the continued existence of the Central and Southwest Atlantic DPS of scalloped hammerhead shark.

9.0 Incidental Take Statement (ITS)

Section 9 of the ESA and federal regulations issued 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 would otherwise be considered prohibited, but which is incidental to and not intended as part of the agency action evaluated in a Biological Opinion, is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the RPMs and terms and conditions of the ITS of that Opinion. The take of scalloped hammerhead by the proposed action is not prohibited, as no Section 4(d) Rule for the species has been promulgated. However, a recent circuit court case held that non-prohibited incidental take must be included in the ITS.[80] Providing an exemption from Section 9 liability is not the only important purpose of specifying take in an incidental take statement. Specifying incidental take ensures we have a metric against which we can measure whether or not reinitiation of consultation is required. It also ensures that we identify reasonable and prudent measures we believe are necessary or appropriate to minimize the impact of such incidental take.

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

9.1 Anticipated Amount of Incidental Take

NMFS anticipates the following incidental takes may occur in the future as a result of the continued operation of NMFS's integrated FIM activities in the Southeast region. We anticipate these takes will occur over consecutive 5-calendar-year periods (Table 9.1) (2015-2019, 2020-2024, etc.). In some places, we have acted conservatively and assumed that some takes may be lethal, even though a nonlethal take is possible. For the purposes of authorizing incidental take, we will not consider our take estimates exceeded if the number of nonlethal take exceeds our estimate, so long as the number of lethal captures and total captures for each species is not exceeded. Take exceedance will be evaluated for each gear type, in each region.

[80] *CBD v. Salazar*, 695 F.3d 893 (9th Cir. 2012). Though the *Salazar* case is not a binding precedent for this action outside of the 9th Circuit, SERO finds the reasoning persuasive and is following the case out of an abundance of caution and anticipation the ruling will be more broadly followed in future cases.

Table 9.1. 5-Year Anticipated Future Take by FIM Activities in the Southeast

Species	South Atlantic Region							
	TRAWL		HOOK & LINE		GILLNET		TOTAL	
	N/L	L	N/L	L	N/L	L	N/L	L
Loggerhead sea turtle	120	30	4	3	1	1	125	34
Kemp's ridley sea turtle	62	16	14	5	2	1	78	22
Green sea turtle	3	1	N/A		65	17	68	18
Leatherback sea turtle	2	1	1		N/A		3	1
Smalltooth sawfish	1†		N/A		N/A		1†	
Shortnose sturgeon	N/A		N/A		3	1	3	1
	Gulf of Mexico Region							
	TRAWL		HOOK & LINE		GILLNET		TOTAL	
	N/L	L	N/L	L	N/L	L	N/L	L
Loggerhead sea turtle	26	8	6	2	1††	0	33	10
Kemp's ridley sea turtle	8	2	1	1	3	1	12	4
Green sea turtle	0	1	N/A		1††	0	2	1
Leatherback sea turtle	0	1	N/A		N/A		1	
Hawksbill sea turtle	0	1	N/A		N/A		1	
Smalltooth sawfish	1†		N/A		N/A		1†	
	Caribbean Region							
	TRAWL		HOOK & LINE		GILLNET		TOTAL	
	N/L	L	N/L	L	N/L	L	N/L	L
Scalloped hammerhead	N/A		0	1	N/A		0	1

		South Atlantic Region											
		TRAWL				GILLNET				TOTAL			
		Adult		Subadult		Adult		Subadult		Adult		Subadult	
		N/L	L	N/L	L	N/L	L	N/L	L	N/L	L	N/L	L
Atlantic sturgeon	GOM DPS	3	1	8	1	1	1	2	1	4	2	10	2
	NYB DPS	11	1	34	2	4	1	10	3	15	2	44	5
	CB DPS	3	1	9	1	1	1	3	1	4	2	12	2
	Carolina DPS	1	0	2	0	1	0	1	1	2	0	3	1
	SA DPS	5	1	15	1	1	1	4	2	6	2	19	3
	Total	23	4	68	5	8	4	20	8	31	8	88	13

L = Lethal; N/L = Nonlethal; N/A = Not applicable

†This take is either 1 smalltooth sawfish in the GOM or SA in bottom trawl gear, it is not 1 take for each region.

††This take is either 1 loggerhead or 1 green, not 1 take of each species.

This Opinion also serves as the permitting authority for taking associated with handling, identifying, measuring, weighing, photographing, tagging (flipper tagging, passive integrated transponder [PIT] tagging, etc.) skin biopsying, and releasing incidentally taken sea turtles, and retaining carcasses (without the need for an ESA Section 10 permit). The measures authorized in this Opinion provide data necessary to monitor our anticipated incidental take. The data collected helps ensure the action is not disproportionately affecting a portion of the population while also supporting recovery objectives.

9.2 Effect of the Take

NMFS has determined the level of anticipated take specified in Section 9.1 is not likely to jeopardize the continued existence of green, hawksbill, Kemp's ridley, leatherback, or loggerhead sea turtles, smalltooth sawfish, the Central and Southwest Atlantic DPS of scalloped hammerhead shark, shortnose sturgeon, or any DPS of Atlantic sturgeon.

9.3 Reasonable and Prudent Measures (RPMs)

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

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

We have determined that the following RPMs are necessary or appropriate to minimize the impacts of future sea turtle, smalltooth sawfish, scalloped hammerhead, shortnose sturgeon, and Atlantic sturgeon takes or to limit adverse effects to these species to predictable levels, and to monitor levels of incidental take.

1. Sea Turtle, Smalltooth Sawfish, Sturgeon, and Scalloped Hammerhead Requirements:

Most, if not all, sea turtles, smalltooth sawfish, scalloped hammerhead sharks, shortnose sturgeon, and Atlantic sturgeon released after interactions with fisheries independent monitoring gear experience some degree of physiological injury (hooking trauma, lacerations/abrasions, etc.). The ultimate severity of these events depends not only upon actual interaction, but also on the amount of gear remaining on the animal at the time of release. The handling of an animal also greatly affects its chance of recovery. Therefore, the experience, ability, and willingness of FIM participants to remove gear are crucial to the survival of sea turtles, smalltooth sawfish, and listed sturgeon following release. NMFS shall require that captured sea turtles, scalloped hammerhead sharks, smalltooth sawfish, shortnose sturgeon, and Atlantic sturgeon are handled in a way that minimizes adverse effects from incidental take and reduces mortality.

2. Limiting Bottom Trawl Tow Times:

Tow times are a significant factor in trawl related mortalities of sea turtles (NRC 1990b). Henwood and Stuntz (1987) concluded that trawls less than 60 minutes had very low mortality rates, less than 1%. Epperly et al. (2002) updated and re-analyzed the data set used by Henwood and Stuntz (1987) and concluded that, in general, tows of short duration caused mortality in no more than 5% of animals. The lack of turtle excluder devices during FIM bottom trawl activities necessitates shortened tow times (30 minute maximum) to minimize the potential for trawl related moralities

3. Monitoring the Frequency and Magnitude of Incidental Take:

The jeopardy analyses for sea turtles, scalloped hammerhead sharks, smalltooth sawfish, shortnose sturgeon, and Atlantic sturgeon are based on the assumption that the frequency and magnitude of adverse effects that occurred in the past will continue into the future. If those prove to be underestimates, we risk having misjudged the potential adverse effects to these species. Thus, it is imperative that we monitor and track the level of take occurring during FIM activities. Therefore, NMFS must ensure that monitoring and reporting of sea turtle, scalloped hammerhead shark, smalltooth sawfish, shortnose sturgeon, and Atlantic sturgeon takes (1) detect captures and mortalities resulting from FIM activities; (2) assess the actual level of incidental take in comparison with the anticipated incidental take documented in this Opinion; and (3) detect when the level of anticipated take is exceeded.

9.4 Terms and Conditions

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

The following terms and conditions implement RPM No. 1.

1. F/SER1 and SEFSC must require that any vessel conducting hook-and-line-related FIM has and uses at least 1 set of sea turtle release gear onboard, along with the latest copy of the document titled “Careful Release Protocols for Sea Turtle Release with Minimal Injury” (available at: http://www.sefsc.noaa.gov/turtles/TM_NMFS_SEFSC_580.pdf).

NOTE: A single set of the required gear may be shared across several vessels, but each vessel actively fishing with hook-and-line gear under a project subject to this Opinion must have a set of the required gear.

a) For Vessels Where the Distance from the Waterline to the top of the Rail (or Gunnel if no Rail) is Less Than 4 ft, the Following Gears and Requirements Apply

Required Item
Dipnet (Handle length must be 6 ft or 150% of freeboard height)
Cushioned Support Device
Short-Handled Dehooker for Ingested Hooks
Short-Handled Dehooker for External Hooks
Long-nose or Needle-nose Pliers
Bolt Cutter
Monofilament Line Cutter
At least Two (2) Types of the Following Mouth Openers and Mouth Gags
Block of Hard Wood
Set of (3) Canine Mouth Gags
Set of (2) Sturdy Dog Chew Bones
Set of (2) Rope Loops Covered with Hose
Hank of Rope
Set of (4) PVC Splice Couplings
Large Avian Oral Speculum

This equipment must meet the specifications described in 50 CFR 635.21(c)(5)(i)(E) through (L), with the following modifications: the dipnet handle can be of variable length, only 1 NMFS-approved short-handled dehooker is required (i.e., §635.21(c)(5)(i)(G) or (H)), if the dehooker selected is desgined to remove ingested hooks.

b) For Vessels Where the Distance from the Waterline to the top of the Rail (or Gunnel if no Rail) is 4 ft or Greater, the Following Gears and Requirements Apply

Required Item
Long-handled line cutter (6 ft or 150% of freeboard height)
Long-handled[81] (6 ft or 150% of freeboard height) dehooker for ingested hooks[82]
Long-handled (6 ft or 150% of freeboard height) dehooker for external hooks
Long-handled device to pull an ''inverted V'' (6 ft or 150% of freeboard height)
Dipnet (handle length must be 6 ft or 150% of freeboard height)
Cushioned Support Device
Short-Handled Dehooker for Ingested Hooks
Short-Handled Dehooker for External Hooks
Long-nose or Needle-nose Pliers
Bolt Cutter
Monofilament Line Cutter
At Least Two (2) Types of the Following Mouth Openers and Mouth Gags
Block of Hard Wood
Set of (3) Canine Mouth Gags
Set of (2) Sturdy Dog Chew Bones
Set of (2) Rope Loops Covered with Hose
Hank of Rope
Set of (4) PVC Splice Couplings
Large Avian Oral Speculum

This equipment must meet the specifications described in 50 CFR 635.21(c)(5)(i)(A) through (L), with the following modifications: the dipnet handle can be of variable length, only 1 NMFS-approved long-handled dehooker is required (i.e., §635.21(c)(5)(i)(B) or (C)) and only 1 NMFS-approved short-handled dehooker is required (i.e., §635.21(c)(5)(i)(G) or (H)), if the dehooker selected is desgined to remove ingested hooks.

2. F/SER1 (via grant requirements for grant-funded projects) and SEFSC (for SEFSC-controlled projects), must ensure that a working, multi-mode PIT tag reader, capable of reading multiple frequencies, is taken on each hook-and-line, gillnet, trammel net, and bottom trawl sampling trip. NOTE: A single PIT tag reader may be shared across several vessels/projects, but each vessel/project actively engaged in hook-and-line, gillnet, trammel net, and bottom trawl sampling must have 1 on board.

[81] A short-handled dehooker with an appropriate length handle extender will also fulfill this requirement.
[82] Until you have received training on the proper use of internal dehookers and internal dehooking techniques, an external dehooker is recommended, and internal hook removal should not be attempted. For those with proper training, an internal and external dehooker or one that does both, is recommended.

3. F/SER1 and SEFSC, must inform FIM project leads they must take the actions described in Appendix C to safely handle and release incidentally caught ESA-listed sea turtles, smalltooth sawfish, and sturgeon.

The following terms and conditions implement RPM No. 2:

4. F/SER1 and SEFSC must ensure that all FIM bottom trawl tow times do not exceed 30 minutes if a turtle excluder device is not used.

The following terms and conditions implement RPM No. 3:

5. *Sea Turtles*: F/SER1 must include a grant requirement indicating that grant-funded projects averaging 1 or more sea turtles captures per year, based on a 5-year period (2010-2014, 2015-2019, 2016-2020, 2017-2021, etc.), have at least 1 scientist on each FIM cruise (or scientific watch) with training, competency in the SEFSC's standard sampling protocols, and the proper equipment, to safely tag and/or collect samples from incidentally taken sea turtles.

   SEFSC must ensure, via staff training, that SEFSC-controlled projects averaging 1 or more sea turtles captures per year, based on a 5-year period (2015-2019, 2016-2020, 2017-2021, etc.), have at least 1 scientist on each FIM cruise (or scientific watch) with training, competency in the SEFSC's standard sampling protocols, and the proper equipment, to safely tag and/or collect samples from incidentally taken sea turtles.

   a) *Sea Turtle Reporting Requirements*: For incidentally taken sea turtles, researchers or FIM participants must record the information as specified on the Protected Species Incidental Take Form (Appendix D).[83] These forms should be submitted in accordance with Term and Condition No. 11, below.

   b) *Sea Turtle Tagging Requirements:* Researchers or FIM participants must scan incidentally taken sea turtles for PIT tags and visually look for flipper tags. Researchers or FIM participants that have taken the Southeast Fishery Science Center Sea Turtle Training class and are competent in the standard collection protocols described in the "Southeast Fisheries Science Center Sea Turtle Research Techniques Manual" (TM-579) (available at: http://www.sefsc.noaa.gov/turtles/TM_579_SEFSC_STRTM.pdf) must tag untagged turtles and collect tissue samples for genetic analysis. Samples must be collected in accordance with the methods described in NOAA TM-579. If the capture of sea turtles during a sampling project is probable, researchers or FIM participants must contact the Southwest Fisheries Science Center for instruction on preserving and submitting genetic samples. A copy of the Protected Species Incidental Take Form should accompany the sample.

[83] Appendix D provides a static version of the document; an interactive PDF that can be filled out will be supplied.

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For dead animals, collect tissue samples following the protocols above. The remaining specimen(s) or body parts of dead sea turtles must be preserved (preferably iced or refrigerated or frozen if necessary) until sampling and disposal procedures are discussed with the NMFS contact identified below. If it is not possible to retain the carcass, please scan the carcass for PIT tags and flipper tags, collect a tissue sample, and photograph the animal. Mark the carcass, if possible, and dispose of carcass near original site of capture.

Dr. Brian Stacy
NOAA/NMFS and University of Florida
2187 Mowry Road, Building 471
Gainesville, Florida 32611
Brian.Stacy@noaa.gov
PH: 352-283-3370

c) *Collaborative Research Authority and Requirements*: In addition to the activities necessary to monitor incidental take, this Opinion also authorizes researchers or FIM participants to retain incidentally captured hardshell sea turtles to assist in collaborative research. Leatherback sea turtles cannot be retained and should be returned to the water as soon as possible. In instances of hardshell sea turtle capture, researchers or FIM participants may retain incidentally captured animals for species research projects if the person(s) conducting the research, is on board or nearby, and holds a valid federal research permit (and any required state permits) authorizing the activities, either as the permit holder, or as designated agent of the permit holder. All additional procedures performed on retained animals must be authorized through the research permit(s). Collaborative research activities must begin within 1 hour of capture and the animal should be returned to the water within 5 hours (of time of capture). If required, animals may be held on board for up 12 hours provided that conditions during holding meet all research permit requirements and safe handling practices are followed. If research does not commence within 1 hour, the animal must be returned to the water. The intent of this provision is to minimize impacts to sea turtles by allowing, where appropriate, these animals to be used as research subjects. This reduces the need for additional animals to undergo the stress of capture associated with permitted scientific research. Instances where collaborative research is conducted should be reported in the on the Protected Species Incidental Take Form (Appendix D) in the "Additional Comments" section. The report should the procedure(s) done, the additional handling that was required, and the amount of time the procedure(s) took.

6. *Smalltooth Sawfish*: F/SER1 must include a grant requirement indicating that grant-funded projects averaging 1 or more smalltooth sawfish captures per year, based on a 5-year period (2015-2019, 2016-2020, 2017-2021, etc.), have at least 1 scientist on each FIM cruise (or scientific watch) with training, and the proper equipment, to safely tag and/or collect samples from incidentally taken smalltooth sawfish.

   SEFSC must ensure, via staff training, that SEFSC-controlled projects averaging 1 or more smalltooth sawfish captures per year, based on a 5-year period (2010-2014, 2015-2019, 2016-2020, 2017-2021, etc.), have at least 1 scientist on each FIM cruise (or scientific watch) with training, and the proper equipment, to safely tag and/or collect samples from incidentally taken smalltooth sawfish.

   a) *Smalltooth Sawfish Reporting Requirements*: For incidentally taken smalltooth sawfish, researchers or FIM participants must record the information as specified on the Protected Species Incidental Take Form (Appendix D). These forms should be submitted in accordance with Term and Condition No. 11, below.

   b) *Smalltooth Sawfish Tagging Requirements:* Researchers and FIM participants should scan for PIT tags if the animal appears likely to survive the procedure. Researchers or FIM participants that have been trained by a principal investigator or a co-principal investigator holding an ESA Section 10(a)(1)(A) permit for smalltooth sawfish should collect biological samples and tag captured animals. Tissue samples in the form of fin clips (approximately 1 gram of tissue) should be collected in from the trailing edge of the second dorsal fin. Samples should be preserved in ethanol if available; otherwise, the samples should be frozen. For dead animals, all researchers or FIM participants must place smalltooth sawfish carcasses on ice and contact appropriate researcher listed below. If it is not possible to retain the carcass, please scan the carcass for PIT tags or other tags, collect a tissue sample, and photograph the animal. Mark the carcass, if possible, and dispose of carcass near the original site of capture. A copy of the Protected Species Incidental Take Form should accompany the tissue sample.

      Researchers or FIM participants from FFWCC should request instruction from the following staff member on submitting the dead carcasses/parts/samples:

      Gregg R. Poulakis, Ph.D.
      Florida Fish and Wildlife Conservation Commission
      Fish and Wildlife Research Institute
      Charlotte Harbor Field Laboratory
      585 Prineville Street
      Port Charlotte, Florida 33954-1006
      Gregg.poulakis@fwc.state.fl.us
      PH: 941-613-0948

      All other researchers or FIM participants must request instructions from the following NMFS staff member on submitting the dead carcasses/parts/samples:

      Dr. John Carlson
      NOAA/NMFS
      Panama City Laboratory

3500 Delwood Beach Road
Panama City, Florida 32408
John.carlson@noaa.gov
PH: 850-234-6541

c) *Collaborative Research Authority and Requirements*: In addition to the activities necessary to monitor incidental take, this Opinion also authorizes researchers or FIM participants to retain incidentally captured smalltooth sawfish to assist in collaborative research. Researchers or FIM participants may retain incidentally captured animals for species research projects if the person(s) conducting the research is on-site and holds a valid federal research permit (and any required state permits) authorizing the activities, either as the permit holder, or as designated agent of the permit holder. All additional procedures performed on retained animals must be authorized through the research permit(s). The intent of this provision is to minimize impacts to smalltooth sawfish by allowing, where appropriate, these animals to be used as research subjects. This reduces the need for additional animals to undergo the stress of capture associated with permitted scientific research. Instances where collaborative research is conducted should be reported in the on the Protected Species Incidental Take Form (Appendix D) in the "Additional Comments" section. The report should the procedure(s) done, the additional handling that was required, and the amount of time the procedure(s) took.

7. *Atlantic Sturgeon*: F/SER1 must include a grant requirement indicating that grant-funded projects averaging 1 or more Atlantic sturgeon captures per year, based on a 5-year period (2010-2014, 2015-2019, 2016-2020, 2017-2021, etc.), have at least 1 scientist on each FIM cruise (or scientific watch) with training, and the proper equipment, to safely tag and/or collect samples from incidentally taken Atlantic sturgeon.

   SEFSC must ensure, via staff training, that SEFSC-controlled projects averaging 1 or more Atlantic sturgeon captures per year, based on a 5-year period (2015-2019, 2016-2020, 2017-2021, etc.), have at least 1 scientist on each FIM cruise (or scientific watch) with training, and the proper equipment, to safely tag and/or collect samples from incidentally taken Atlantic sturgeon.

   a) *Atlantic Sturgeon Reporting Requirements*: For incidentally taken Atlantic sturgeon, researchers or FIM participants must record the information as specified on the Protected Species Incidental Take Form (Appendix D). These forms should be submitted in accordance with Term and Condition No. 11, below.

   b) *Atlantic Sturgeon Tagging Requirement:* Researchers or FIM participants must also scan incidentally taken Atlantic sturgeon for PIT tags if the animal appears likely to survive the procedure. PIT tags must be applied (as described in Appendix E) to previously untagged fish, if tags are available. Researchers or FIM participants must also collect a tissue sample from any Atlantic sturgeon handled onboard if the animal appears healthy. Appendix E outlines specific requirements for the handling and collection of biological and genetic data on incidentally taken sturgeon. Researchers or FIM participants must coordinate with a qualified lab to process the

genetic samples to determine the DPS. The DPS of origin must be reported to NMFS once the sample has been processed, in accordance with Term and Condition No. 11, below.

For instruction on where to send Atlantic sturgeon tissue samples contact:

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

c) For dead animals, once the tissue samples noted above have been collected, please report the incident via the sturgeon reporting hotline at 1-844-STURG-911 (1-844-788-7491) or via email at nmfs.ser.sturgeonnetwork@noaa.gov.

d) *Collaborative Research Authority and Requirements*: In addition to the activities necessary to monitor incidental take, this Opinion also authorizes researchers or FIM participants to retain incidentally captured ESA-listed sturgeon to assist in collaborative research, if the protocols outlined in NMFS's *A Protocol for Use of Shortnose, Atlantic, Gulf, and Green Sturgeons* (available at: http://www.nmfs.noaa.gov/pr/pdfs/species/kahn_mohead_2010.pdf) are followed. Researchers or FIM participants may retain incidentally captured animals for species research projects if the person(s) conducting the research is on-site and holds a valid federal research permit (and any required state permits) authorizing the activities, either as the permit holder, or as designated agent of the permit holder. All additional procedures performed on retained animals must be authorized through the research permit(s). The intent of this provision is to minimize impacts to ESA-listed sturgeon by allowing, where appropriate, these animals to be used as research subjects. This reduces the need for additional animals to undergo the stress of capture associated with permitted scientific research. Instances where collaborative research is conducted should be reported in the on the Protected Species Incidental Take Form (Appendix D) in the "Additional Comments" section. The report should the procedure(s) done, the additional handling that was required, and the amount of time the procedure(s) took.

8. *Shortnose Sturgeon*: F/SER1 must include a grant requirement indicating that grant-funded projects averaging 1 or more shortnose sturgeon captures per year, based on a 5-year period (2010-2014, 2015-2019, 2016-2020, 2017-2021, etc.), have at least 1 scientist on each FIM cruise (or scientific watch) with training, and the proper equipment, to safely tag and/or collect samples from incidentally taken shortnose sturgeon.

   a) SEFSC must ensure, via staff training, that SEFSC-controlled projects averaging 1 or more shortnose sturgeon captures per year, based on a 5-year period (2015-2019, 2016-2020, 2017-2021, etc.), have at least 1 scientist on each FIM cruise (or

scientific watch) with training, and the proper equipment, to safely tag and/or collect samples from incidentally taken shortnose sturgeon.

a) *Shortnose Sturgeon Reporting Requirements:* For incidentally taken shortnose sturgeon, researchers or FIM participants must record the information as specified on the Protected Species Incidental Take Form (Appendix D). These forms should be submitted in accordance with Term and Condition No. 11, below.

b) *Shortnose Sturgeon Tagging Requirement*: Researchers or FIM participants must also scan them for PIT tags if the animal appears likely to survive the procedure. PIT tags must be applied (as described in Appendix E) to previously untagged fish if tags are available. Researchers or FIM participants must also collect a tissue sample from any shortnose sturgeon handled onboard if the animal appears healthy. Appendix E outlines specific requirements for the handling and collection of biological and genetic data on incidentally taken sturgeon. For instruction on where to send shortnose sturgeon tissue samples contact:

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

For dead animals, once the tissue samples noted above have been collected, please report the incident via the sturgeon reporting hotline at 1-844-STURG-911 (1-844-788-7491) or via email at nmfs.ser.sturgeonnetwork@noaa.gov.

c) *Collaborative Research Authority and Requirements*: In addition to the activities necessary to monitor incidental take, this Opinion also authorizes researchers or FIM participants to retain incidentally captured ESA-listed sturgeon to assist in collaborative research, if the protocols outlined in NMFS's *A Protocol for Use of Shortnose, Atlantic, Gulf, and Green Sturgeons* (available at: http://www.nmfs.noaa.gov/pr/pdfs/species/kahn_mohead_2010.pdf) are followed. Researchers or FIM participants may retain incidentally captured animals for species research projects if the person(s) conducting the research, is on board or nearby, and holds a valid federal research permit (and any required state permits) authorizing the activities, either as the permit holder, or as designated agent of the permit holder. All additional procedures performed on retained animals must be authorized through the research permit(s). The intent of this provision is to minimize impacts to ESA-listed sturgeon by allowing, where appropriate, these animals to be used as research subjects. This reduces the need for additional animals to undergo the stress of capture associated with permitted scientific research. Instances where collaborative research is conducted should be reported in the on the Protected Species Incidental Take Form (Appendix D) in the "Additional Comments" section. The report should the procedure(s) done, the additional handling that was required, and the amount of time the procedure(s) took.

9. *Scalloped Hammerhead Shark*: F/SER1 must include a grant requirement indicating that grant-funded projects occurring in the U.S. Caribbean, averaging 1 or more scalloped hammerhead captures per year, based on a 5-year period (2015-2019, 2016-2020, 2017-2021, etc.), have at least 1 scientist on each FIM cruise (or scientific watch) with training, and the proper equipment, to safely tag and/or collect samples from incidentally taken scalloped hammerheads.

   SEFSC must ensure, via staff training, that SEFSC-controlled projects occurring in the U.S. Caribbean, averaging 1 or more scalloped hammerhead captures per year, based on a 5-year period (2010-2014, 2015-2019, 2016-2020, 2017-2021, etc.), have at least 1 scientist on each FIM cruise (or scientific watch) with training, and the proper equipment, to safely tag and/or collect samples from incidentally taken scalloped hammerhead.

   a) *Scalloped Hammerhead Reporting Requirements*: For incidentally taken scalloped hammerheads, researchers or FIM participants must record the information as specified on the Protected Species Incidental Take Form (Appendix D). These forms should be submitted in accordance with Term and Condition No. 11, below.

   b) *Scalloped Hammerhead Tagging Requirements:* Researchers and FIM participants should scan for PIT tags if the animal appears likely to survive the procedure. Researchers and FIM participants feeling comfortable with the procedure should apply a tag to animals without one. For dead animals, all researchers or FIM participants should scan the carcass for PIT tags or other tags, and photograph the animal. Mark the carcass, if possible, and dispose of carcass near the original site of capture.

   c) *Collaborative Research Authority and Requirements*: In addition to the activities necessary to monitor incidental take, this Opinion also authorizes researchers or FIM participants to retain incidentally captured scalloped hammerhead sharks to assist in collaborative research. Researchers or FIM participants may retain incidentally captured animals for species research projects if the person(s) conducting the research is on-site and holds a valid federal research permit (and any required state permits) authorizing the activities, either as the permit holder, or as designated agent of the permit holder. All additional procedures performed on retained animals must be authorized through the research permit(s). The intent of this provision is to minimize impacts to scalloped hammerhead sharks by allowing, where appropriate, these animals to be used as research subjects. This reduces the need for additional animals to undergo the stress of capture associated with permitted scientific research. Instances where collaborative research is conducted should be reported in the on the Protected Species Incidental Take Form (Appendix D) in the "Additional Comments" section. The report should the procedure(s) done, the additional handling that was required, and the amount of time the procedure(s) took.

10. F/SER1 and SEFSC must ensure FIM researchers or participants use the Protected Species Incidental Take Form (Appendix D) to notify F/SER3 and NMFS's Assistant Regional Administrator for Protected Resources, Southeast Regional Office, within 24

hours or a soon as reasonably possible at the email address nmfs.ser.EA_LOA.Takereport@noaa.gov. Submitted take reporting forms should reference the following information: Fisheries Independent Monitoring Protected Species Take (BiOp SER-2009-7541), in the subject line and include the project name and species in the text of the email.

11. In addition to the requirement to report incidental takes within 24 hours, F/SER1 and SEFSC must ensure a report detailing the amount of effort (i.e., number of sets, number of trawls, numbers of hooks used/set, trawl times, type of gear used, number of stations/season, number of sets/stations, soak time) and the number of protected species incidentally taken is submitted annually. In cases where genetic samples of Atlantic sturgeon and shortnose sturgeon were submitted for analysis, annual reports must also include information on the finding of those analyses. If reporting for a project is already required (i.e., as required under a grant funding award), protected species interactions reports may be submitted with those reports. However, a minimum of 1 annual report on protected species interactions must be submitted regardless of other reporting stipulations. If no annual reporting is currently required, a report providing the information described above must be submitted no later than January 31 of the following year. Submit protected species interaction reports to the following address, and refer to this Biological Opinion's take reporting requirements.

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

10.0 Conservation Recommendations

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

The following additional measures are recommended. For F/SER3 to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, F/SER3 requests notification of the implementation of any conservation recommendations.

Sea Turtles:

1. NMFS should support in-water abundance estimates of sea turtles to achieve more accurate status assessments for these species and to better assess the impacts of incidental take during FIM activities.

Smalltooth Sawfish:

2. NMFS should conduct or fund specific research or alternative methods (e.g., surveys) on the distribution, abundance, and migratory behavior of smalltooth sawfish of to better understand their occurrence in federal and state waters.
3. NMFS should conduct or fund reproductive behavioral studies to ensure that any incidental capture of smalltooth sawfish during fisheries independent monitoring activities is not disrupting any such activities.
4. NMFS should conduct or fund surveys or other alternative methods for determining smalltooth sawfish abundance in federal fishing areas off southwest Florida, adjacent to areas where smalltooth sawfish are known to occur in the greatest concentration (e.g., off the Florida Keys).

Sturgeons:

5. NMFS should fund or conduct future research to identify migration patterns of ESA-listed sturgeon. A telemetry studies to track fish and ascertain the use of spawning and foraging habitat would improve knowledge of life history. Data describing the upstream sturgeon spawning areas to characterize habitat and assess availability would assist in determining spawning habitat preference and availability.
6. NMFS should fund or conduct future research that evaluates the relationship between flow, water temperature, and sturgeon migration. Additional information on this relationship would provide a better indicator of conditions that cue and successfully initiate sturgeon spawning movement.
7. NMFS should collect data describing Atlantic sturgeon location and movement in the Atlantic Ocean, by depth and substrate to assist in future assessments of

interactions between fishing gear (i.e., commercial, recreational, or research) sturgeon migratory and feeding behavior.

8. NMFS should collect information on incidental catch rates and condition of sturgeon captured in fisheries independent research gear to assist in future assessments of gear impacts to sturgeon.

Scalloped Hammerhead Sharks:

9. NMFS should support research investigating the location of scalloped hammerhead nursery areas for both listed and non-listed DPSs.
10. NMFS should support research which investigates ways to reduce and minimize at-vessel mortality of hammerhead sharks in commercial fisheries.

11.0 Reinitiation of Consultation

This concludes formal consultation. As provided in 50 CFR 402.16, reinitiation of formal consultation is required if discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if (1) the amount or extent of the taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat (when designated) in a manner or to an extent not previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in the Biological Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the identified action. In instances where the amount or extent of incidental take is exceeded, F/SF1 must immediately request reinitiation of formal consultation.

12.0 References

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

Table A.1. Anticipated Incidental Takes of Sea Turtles

Fishery	ITS Authorization Period	Sea Turtle Species				
		Loggerhead	Leatherback	Kemp's ridley	Green	Hawksbill
Atlantic Herring [NER]	1 Year	6-No more than 3 lethal	1-Lethal or nonlethal	1-Lethal or nonlethal	1-Lethal or nonlethal	None
American Lobster [NER]	1 Year	1-Lethal or nonlethal	5-Lethal or nonlethal	None	None	None
Batched Consultation* (gillnet) [NER]	1 Year	269-No more than 167 lethal (Takes based on a 5-yr average)	4-No more than 3 lethal	4-No more than 3 lethal	4-No more than 3 lethal	None
Batched Consultation* (bottom trawl) [NER]	1 Year	213-No more than 71 lethal (Takes based on a 4-yr average)	4-No more than 2 lethal	3-No more than 2 lethal	3-No more than 2 lethal	None
Batched Consultation* (trap/pot) [NER]	1 Year	1-Lethal or nonlethal	4-Lethal or nonlethal	None	None	None
Caribbean Reef Fish [SER]	3 Years	None	18-All lethal	None	75-All lethal	51-No more than 3 lethal
Coastal Migratory Pelagics [SER]	3 Years	33-All lethal	2 lethal takes for Leatherbacks, Hawksbill, and Kemp's ridley-both lethal take		14-All Lethal	See leatherback entry
Dolphin-Wahoo [SER]	1 Year	12-No more than 2 lethal	12-No more than 1 lethal	3 for all species in combination-no more than 1 lethal take		
Gulf of Mexico Reef Fish [SER]	3 Years	1,044-No more than 572 lethal	11-All lethal	108-No more than 41 lethal	116-No more than 75 lethal	9-No more than 8 lethal

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

Table A.1. Anticipated Incidental Takes of Sea Turtles, continued

Fishery	ITS Authorization Period	Sea Turtle Species				
		Loggerhead	Leatherback	Kemp's ridley	Green	Hawksbill
HMS-Pelagic Longline [SER]	3 Years	1,905-No more than 339 lethal	1,764-No more than 252 lethal	105-No more than 18 lethal for these species in combination		
HMS-Shark Fisheries [SER]	3 Years	126-No more than 78 lethal	18-No more than 9 lethal	36-No more than 21 lethal	57-No more than 33 lethal	18-No more than 9 lethal
Red Crab [NER]	1 Year	1-Lethal or nonlethal	1-Lethal or nonlethal	None	None	None
Gulf of Mexico/South Atlantic Spiny Lobster Fishery [SER]	3 Years	3-Lethal or Nonlethal Take	1 –Lethal or Nonlethal take for Leatherbacks, Hawksbill, and Kemp's ridley		3-Lethal or Nonlethal Take	1 –Lethal or Nonlethal take for Leatherbacks, Hawksbill, and Kemp's ridley
Tilefish [NER]	1 Year	6-No more than 3 lethal	1-Lethal or nonlethal take	None	None	None
South Atlantic Snapper-Grouper [SER]	3 Years	202-No more than 67 lethal	25-No more than 15 lethal	19-No more than 8 lethal	39-No more than 14 lethal	4-No more than 1 lethal
Southeastern U.S. Shrimp [SER]	1 Year	Anticipated shrimp trawl effort (i.e., 132,900 days fished in the Gulf of Mexico and 14,560 trips in the south Atlantic) and fleet TED compliance (i.e., compliance resulting in overall average sea turtle catch rates in the shrimp otter trawl fleet at or below 12%) are used as surrogates for numerical sea turtle take levels.				
Atlantic Sea Scallop – Dredge [NER]	1 Year	161 – No more than 46 lethal	2 –Lethal Takes (gears combined)	3 – No more than 2 Lethal (gears combined)	2 - Lethal takes (gears combined)	None
Atlantic Sea Scallop – Trawl [NER]	1 Year	140 – No more than 66 lethal				None

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

Table A.2. Anticipated Incidental Take of Smalltooth Sawfish

Fishery	3-Year Incidental Take of Smalltooth Sawfish
ATLANTIC HMS-SHARK FISHERIES	32– No more than 7 lethal takes
COASTAL MIGRATORY PELAGICS	2 Nonlethal takes
GULF OF MEXICO/SOUTH ATLANTIC SPINY LOBSTER FISHERY	2 Nonlethal takes
GULF OF MEXICO REEF FISH	8 Nonlethal takes
SOUTH ATLANTIC SNAPPER-GROUPER	8 Nonlethal takes
SOUTHEASTERN U.S. SHRIMP	288– No more than 105 lethal takes

Table A.3. Anticipated Incidental Take of Atlantic Sturgeon by DPS

Fishery	ITS Authorization Period	Atlantic Sturgeon DPS				
		Gulf of Maine	New York Bight	Chesapeake Bay	Carolina	South Atlantic
Southeastern U.S. Shrimp [SER]	3 years	Up to 162 interactions - including 27 captures, no more than 3 lethal	Up to 465 interactions – including 66 captures, no more than 9 lethal	Up to 312 interactions – including 54, no more than 6 lethal	Up to 519 interactions – including 87 captures, no more than 9 lethal	Up to 1,404 interactions – including 228 captures, no more than 21 lethal
HMS Shark and Smoothhound [SER]	3 years	36-No more than 7 lethal	159-No more than 30 lethal	45-No more than 9 lethal	63-No more than 12 lethal	18-No more than 6 lethal
Batched Consultation* (gillnet) [NER]	1 year (Takes based on a 5-yr average)	137-No more than 17 lethal A.E.s	632-No more than 79 lethal A.E.s	162-No more than 21 lethal A.E.s	25-No more than 4 lethal A.E.s	273-No more than 34 lethal A.E.s
Batched Consultation* (bottom trawl) [NER]	1 year (Takes based on a 5-yr average)	148-No more than 5 lethal A.E.s	685-No more than 21 lethal A.E.s	175-No more than 6 lethal A.E.s	27-No more than 1 lethal A.E.s	296-No more than 6 lethal A.E.s
Atlantic Sea Scallop Dredge [NER]	20 years	1 – Lethal (any DPS)				

A.E. = Adult equivalents

Appendix B - Anticipated Incidental Take of Sea Turtles at Fishing Piers

Since the active hurricane seasons of 2004 and 2005, a number of fishing piers have either been built or rebuilt along the Gulf Coast, particularly in Florida and Mississippi. The USACE permits the building on these structures and in some cases, FEMA provides the funding for these projects to occur. For each pier listed in Tables 4.2 and 4.3, we determined that the activities associated with their demolition/reconstruction/repair was not likely to adversely affect any ESA-listed species. However, we did conclude that the fishing likely to occur following the completion of each pier project was likely to adversely affect certain species of sea turtles, but it was not likely to jeopardize their continued existence. Table 4.2 and 4.3 lists each fishing pier with a Biological Opinion, the action agency, the authorized number of sea turtle takes, and date of issuance in Florida and Mississippi/Texas, respectively.

Jacksonville Fishing Pier, Duval County, Florida
NMFS issued a Biological Opinion to the USACE on May 9, 2003, for this project (NMFS 2003a). The applicant proposed construction of a 1,300-ft fishing pier in the Atlantic Ocean, in Jacksonville Beach, Duval County, Florida. We concluded that the proposed project was likely to adversely affect, but not jeopardize, the continued existence of green, Kemp's ridley, and loggerhead sea turtles. The Biological Opinion authorized the take of 12 loggerhead sea turtles, 3 green sea turtles, and 2 Kemp's ridley sea turtles each year. Two of those takes may be lethal and could be 2 loggerheads, or 1 loggerhead and either 1 Kemp's ridley or 1 green sea turtle per year.

Lantana Fishing Pier, Palm Beach County, Florida
NMFS issued a Biological Opinion on June 8, 2012, to the Palm Beach County Board of County Commissioner's Engineering and Public Works Department to construct a new 3,092-square-foot concrete fishing pier (NMFS 2011c). The project is located within the Lake Worth Lagoon portion of the Intracoastal Waterway in Lantana, Palm Beach County, Florida. While it is our opinion that this project is likely to adversely affect green, hawksbill, Kemp's ridley, and loggerhead sea turtles, we do not believe the proposed action is likely to jeopardize their continued existence. The Opinion authorized nonlethal take of 7 sea turtles that includes 5 green, and either 2 loggerheads or 1 loggerhead and 1 of either hawksbill or Kemp's ridley sea turtles, and 1 lethal take of either a green or loggerhead sea turtle annually.

Flagler Beach Pier, Flagler County, Florida
NMFS issued a Biological Opinion on June 26, 2012, to the City of Flagler Beach (NMFS 2012b) to repair and operate the Flagler Beach Pier using FEMA funds. The Opinion concluded that the proposed action is likely to adversely affect green, loggerhead, and Kemp's ridley sea turtles, but is not likely to jeopardize their continued existence. The nonlethal take of 2 green sea turtles, and either 2 loggerheads or 1 loggerhead and 1 Kemp's ridley sea turtle take per year was authorized. A single green or loggerhead mortality was also authorized.

Navarre Beach Fishing Pier, Santa Rosa County, Florida
NMFS issued a Biological Opinion to the USACE on November 17, 2008 (NMFS 2008b), for the subject project. The purpose of this project was to build a replacement fishing pier at Navarre Beach, Santa Rosa County, Florida that could withstand the erosion, scour, and loads

accompanying a 20-year storm event. This included the construction of a 24.2-ft-wide by 1,495-ft-long concrete fishing pier with an octagonal terminus and the removal of the existing pier that was severely damaged by Hurricanes Ivan and Dennis. Our Opinion concluded that the proposed action was likely to adversely affect, but not jeopardize, the continued existence of loggerhead and Kemp's ridley sea turtles. The Opinion authorized 6 sea turtle takes per year (4 loggerheads and 2 Kemp's ridleys), 1 of which could result in mortality.

City of Mexico Beach Fishing Pier, Bay County, Florida
NMFS issued a Biological Opinion to the USACE on March 23, 2009, for the subject project (NMFS 2009d). The purpose of the City of Mexico Beach's project was to construct a 14- by 225.4-ft extension, with a 14- by 60-ft "T" terminus, on the end of the existing fishing pier at Mexico Beach, Bay County, Florida. The existing pier measured 14- by 550 ft and received an estimated 15,000 visitors annually. The Opinion concluded that the proposed action was likely to adversely affect loggerhead and Kemp's ridley sea turtles, but it was not likely to jeopardize their continued existence. The Opinion authorized 6 sea turtle takes per year (4 loggerheads and 2 Kemp's ridleys), 1 of which could result in mortality.

M.B. Miller Fishing Pier, Bay County, Florida
NMFS issued a Biological Opinion to the USACE on May 1, 2009, for the subject project (NMFS 2009g). The applicant, the Bay County Board of County Commissioners, proposed to replace the existing 30 M.B. Miller Fishing Pier at Panama City Beach, Bay County, Florida. The existing 554-ft wooden pier was damaged by hurricanes in 2004 and 2005 and was completely removed by mechanical means. A new 17- by 1,500-ft pier was constructed at the project site, which at the time of construction, consisted of unvegetated sandy substrate. The Opinion concluded that the proposed action was likely to adversely affect loggerhead and Kemp's ridley sea turtles, but was not likely to jeopardize their continued existence. The Opinion authorized 6 sea turtle takes per year (4 loggerheads and 2 Kemp's ridleys), 1 of which could result in mortality.

Newport Fishing Pier, City of Sunny Isles Beach, Miami-Dade County, Florida
NMFS issued a Biological Opinion to the USACE on August 15, 2011, for the subject project (NMFS 2011e). The City of Sunny Isles proposed to build a public fishing pier and restaurant to be used for fishing and recreational activities in conjunction with an upland public beachfront park. The project required demolition of the existing Newport Fishing Pier and restaurant that have been closed since June 2007 due to general deterioration and damage from Hurricane Wilma in 2005. The new pier was to be built in the approximate footprint of the current pier and measure approximately 750 ft long. The Opinion authorized 8 sea turtle takes per year: 5 green and either 2 loggerhead or 1 loggerhead and 1 of either hawksbill or Kemp's ridley sea turtles will be nonlethally taken. An additional take of a either a green or loggerhead may result in mortality.

South Pointe Park Fishing Pier, City of Miami Beach, Miami-Dade County, Florida
NMFS issued a Biological Opinion to the USACE on September 4, 2012, for the subject project (NMFS 2012d). The City of Miami Beach proposed to demolish an existing 10,083-ft^2 public fishing pier at South Pointe Park, including removal of 82 existing concrete piles, and installation of a new 10,095-ft^2 fishing pier with 61 reinforced concrete piles. The Opinion concluded that

the proposed action was likely to adversely affect loggerhead and Kemp's ridley sea turtles, but was not likely to jeopardize their continued existence. The Opinion authorized 10 sea turtle takes per year, 6 green and either 2 loggerhead or 1 loggerhead and 1 of either hawksbill or Kemp's ridley sea turtles will be nonlethally taken; an additional 2 green sea turtle mortalities were also authorized.

Melody Lane Fishing Pier, City of Fort Pierce, St. Lucie County, Florida
NMFS issued a Biological Opinion to the USACE on June 28, 2013, for the subject project (NMFS 2013a). The City of Fort Pierce proposed to reconstruct a fishing pier; the pier would be 10 ft wide and extend 200 ft with a terminal platform measuring 16 ft by 26 ft. The Opinion concluded that the fishing likely to occur following the reconstruction of the pier was likely to adversely affect loggerhead and green sea turtles, but was not likely to jeopardize their continued existence. The Opinion authorized 4 sea turtle takes per year; 3 green sea turtles and 1 loggerhead. Of those 4 anticipate takes, 1 was anticipated to result in mortality of either species.

Englewood Marine Center Fishing Pier, Sarasota County, Florida
NMFS issued a Biological Opinion to the USACE on September 11, 2013, for the subject project (NMFS 2013a). The Englewood Marine Center proposed to replace existing residential dock with a fishing pier. The fishing pier measured 972 ft^2 with a 5.8-ft-wide and 128-ft-long walkway, 8-ft-wide turnaround halfway down the walkway to accommodate wheelchairs, and a terminal platform measuring 20 ft wide. This pier required the installation of 50 new 10-in wood piles. The Opinion concluded that the fishing likely to occur following the construction of the pier was likely to adversely affect loggerhead, green sea turtles, or Kemp's ridley sea turtles, but it was not likely to jeopardize their continued existence. The Opinion authorized 1 sea turtle take per year. The take of a loggerhead, green, or Kemp's ridley was authorized. That take may result in mortality once every 6 years.

Smyrna Dunes and Riverside Park Fishing Piers, Volusia County, Florida
NMFS issued a Biological Opinion to the USACE on April 16, 2014, for the subject projects (NMFS 2014c). The County of Volusia proposed to build and operate a fishing pier at the end of an existing boardwalk at the Smyrna Dunes Park. The new fishing pier would include a 4,014-ft^2 L-shaped dock consisting of an 84-ft-long by 6-ft-wide walkway and a 351-ft-long by 10-ft-wide terminal platform. Similarly, the City of Holly Hill proposed to build and operate a fishing pier at Riverside Park, located along the western shoreline of the Halifax River. The 3,302-ft^2 pier will consist of a 228-ft-long by 9-ft-wide walkway with 2 new 25-ft by 25-ft covered platforms. The Opinion concluded that the fishing likely to occur following the construction of the pier was likely to adversely affect loggerhead and green sea turtles, but it was not likely to jeopardize their continued existence. The Opinion authorized 39 sea turtle takes during consecutive 3-year periods across both piers. The take of 11 loggerheads and 28 green sea turtles was authorized. Up to 5 mortalities over consecutive 3-year periods were anticipated.

Clermont Harbor Fishing Pier, Hancock County, Mississippi
NMFS issued a Biological Opinion to the USACE on January 4, 2010, for the subject project (NMFS 2010c). The Hancock County Board of Supervisors proposed to extend an existing 8-ft-wide by 305-ft-long lighted pier with 5 covered gazebos, with a lighted pier extension measuring 8-ft wide by 104-ft long, with 2 covered gazebos measuring 8 ft wide by 24 ft long. Concrete

pile installation was also required to build the extension. The Opinion concluded that the fishing likely to occur following the extension of the pier was likely to adversely affect loggerhead and Kemp's ridley sea turtles, but it was not likely to jeopardize their continued existence. The Opinion authorized 2 sea turtle takes per year, either loggerhead or Kemp's ridleys. One of those takes may result in mortality.

Washington Street Fishing Pier, Hancock County, Mississippi
NMFS issued a Biological Opinion to the USACE on June 30, 2010, for the subject project (NMFS 2010d). The Hancock County Board of Supervisors proposed to extend the existing Washington Street fishing pier an additional 150 ft with a terminal deck measuring 20-ft by 50-ft and repair an existing jetty 130 ft. The pier extension mimicked the existing pier, which consisted of wooden piles, decking, and railings. The Opinion concluded that the fishing likely to occur following the extension of the pier was likely to adversely affect loggerhead and Kemp's ridley sea turtles, but was not likely to jeopardize their continued existence. The Opinion authorized 2 sea turtle takes per year which were expected to be either loggerhead or Kemp's ridleys. One of those takes may result in mortality.

Coliseum Pier, City of Biloxi, Harrison County, Mississippi
NMFS issued a Biological Opinion to the USACE on May 28, 2009, for the subject project (NMFS 2009a). The City of Biloxi proposed to reconstruct Biloxi Coliseum Pier Fishing Pier within the same footprint as the original structure, which measured 10 ft wide by 920 ft long. The Opinion concluded that the fishing likely to occur following the extension of the pier was likely to adversely affect loggerhead and Kemp's ridley sea turtles, but was not likely to jeopardize their continued existence. The Opinion authorized 2 sea turtle takes per year which were expected to be either loggerhead or Kemp's ridleys. One of those takes may result in mortality.

Rutherford Fishing Pier, City of Bay St. Louis, Hancock County, Mississippi
NMFS issued a Biological Opinion to the USACE on January 18, 2011, for the subject project (NMFS 2010b). The City of Bay St. Louis proposed to build a harbor for recreational boaters and reconstruct the Rutherford Fishing Pier in Hancock County, Mississippi. The pier reconstruction included 3 new 40-ft by 10-ft fishing piers, 3 new 15-ft by 15-ft pavilions, 1 new 30-ft by 20-ft pavilion and 3 new 30-ft by 10-ft T-Head piers, and a 1,200-lin-ft vinyl sheet pile breakwater along the northern margin of the harbor. The Opinion concluded that the fishing likely to occur following the reconstruction of the pier was likely to adversely affect loggerhead and Kemp's ridley sea turtles, but was not likely to jeopardize their continued existence. The Opinion authorized 4 sea turtle takes per year; 3 (Kemp's ridley or loggerhead) were likely to be nonlethal and 1 will result in mortality (Kemp's ridley or loggerhead).

Old Highway 90 Fishing Pier, City of Biloxi Harrison County, Mississippi
NMFS issued a Biological Opinion to the USACE on January 11, 2012, for the subject project (NMFS 2012g). The City of Biloxi proposed to reconstruct the Old Highway 90 Fishing Pier to the same general footprint of the previous fishing pier; the pier would measure 4,643 ft long by 34 ft wide. The project required the removal of existing piles and the installation of new piles. The Opinion concluded that the fishing likely to occur following the reconstruction of the pier was likely to adversely affect loggerhead, green, and Kemp's ridley sea turtles, but was not likely

to jeopardize their continued existence. The Opinion authorized 8 sea turtle takes per year; either 7 Kemp's ridley sea turtles, or 6 Kemp's ridley and either 1 green or loggerhead sea turtle, will be nonlethally taken, and 1 capture of a Kemp's ridley sea turtle will result in mortality.

West Side Fishing Pier, Ken Combs Fishing Pier, Moses Fishing Pier, and Urie Fishing Piers 1 and 2, City of Gulfport, Hancock County, Mississippi

NMFS issued a Biological Opinion to FEMA on March 7, 2014, evaluating the effects for construction and/or repair of 4 fishing piers (West Side Fishing Pier, Ken Combs Fishing Pier, Moses Fishing Pier, and Urie Fishing Piers 1 and 2) (NMFS 2014a). Each pier required some level of reconstruction to repair hurricane damage. Each pier was rebuilt to its existing footprint. The Opinion concluded that the fishing likely to occur following the reconstruction of the piers was likely to adversely affect loggerhead, green, and Kemp's ridley sea turtles, but it was not likely to jeopardize their continued existence. The Opinion concluded that over a 3-year period, at all 4 piers, up to 40 Kemp's ridley sea turtles may be captured. Of those 40 incidental captures, up to 21 may result in mortality and 19 will not. During that same 3-year period the Opinion concluded that up to 3 loggerhead and/or green sea turtles may also be captured at all 4 piers subject to consultation. Of those 3 captures, 1 may result in mortality.

Small Craft Harbor Fishing Pier, City of Pass Christian and Garfield Ladner Memorial Fishing Pier, City of Waveland, Hancock County, Mississippi

NMFS issued a batched Biological Opinion to FEMA on September 17, 2014, evaluating the effects for construction and/or repair of 2 fishing piers in Pass Christian (Small Craft Harbor Fishing Pier) and Waveland (Garfield Ladner Memorial Fishing Pier) Mississippi (NMFS 2014b). Each pier required some level of reconstruction to repair hurricane damage. Each pier was rebuilt to its existing footprint. The Opinion concluded that the fishing likely to occur following the reconstruction of the piers was likely to adversely affect loggerhead, green, and Kemp's ridley sea turtles, but it was not likely to jeopardize their continued existence. The Opinion concluded that over a 3-year period at the Small Craft Harbor Fishing Pier up to 121 Kemp's ridley sea turtles may be captured. Of those 121 incidental captures, up to 45 may result in mortality and 76 will not. During that same 3-year period the Opinion concluded that 1 loggerhead may also be captured, which may be lethal or nonlethal. Up to 8 green sea turtles are also anticipated to be captured over that 3-year period; 3 lethal and 5 nonlethal. At the Garfield Ladner Memorial Fishing Pier, the Opinion concluded that over a 3-year period up to 152 Kemp's ridley sea turtles may be captured. Of those 152 incidental captures, up to 52 may result in mortality and 100 will not. During that same 3-year period the Opinion concluded that up to 1 loggerhead or green sea turtles may also be captured; that capture may be lethal or nonlethal.

Clayton' s Beach Bar and Grill Fishing Pier, South Padre Island, Cameron County, Texas

NMFS issued a Biological Opinion to the USACE on December 3, 2014, for the subject project (NMFS 2014g). The applicant proposed to reconstruct an observation and fishing pier that would measure 1,000 ft long by 15 ft wide. The project required the installation of new piles. The Opinion concluded that the fishing likely to occur following the construction of the pier was likely to adversely affect loggerhead and green sea turtles, but was not likely to jeopardize their continued existence. The Opinion authorized 3 sea turtle takes during consecutive 3-year periods. The Opinion anticipated up to 1 loggerhead might be captured and 2 green sea turtles might be captured during that period; 1 of those captures (of either species) might be lethal.

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

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

For Live Entanglements/Hookings/Trawl Captures:

Sea Turtles:

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

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

Smalltooth Sawfish:

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

Sturgeon (Atlantic, Gulf, and Shortnose):

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

For Comatose/Inactive or Otherwise Unresponsive Sea Turtles:

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

Appendix D - Protected Species Incidental Take Form

NOAA Fisheries

Southeast Region Protected Species Incidental Take Reporting Form

version 1.3 10/2014

REPORTER INFORMATION

Reporting Agency: _____ Project/Survey Name: _____

VESSEL/TRIP INFORMATION

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

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

GEAR CHARACTERISTICS

Trawl Type _____

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

Footrope length (ft) _____

Trawl Body	Cod End	Ground Gear
material type _____	material type _____	length (ft) _____
mesh size (in) (stretched) _____	mesh size (in) (stretched) _____	size (in) _____

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

net sampling location (water column) _____ net sampling depth (m) _____

Other Net Types _____

Seine/Gillnet/Trammel:

Floatline length (ft) _____ diameter (in) _____

Leadline length (ft) _____ diameter (in) _____

Fyke:

Leader length (ft) _____

All Net Types:

mesh material type _____ twine size (in) _____

Gillnet:

net sampling location (water column) _____ mode of fishing _____

Panels/bags in net

# of panels _____ mesh size (in): (stretched) panel 1 _____ panel 4 _____

length (ft) _____ panel 2 _____ panel 5 _____

height (ft) _____ panel 3 _____ panel 6 _____

spacing (ft) _____

Longline/Hook and Line Type _____

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

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

Backbone length (m) (vertical line/bandit reel only) _____ test (lb) _____ line type _____

bait type _____

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

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

- ☐ 4/0 ☐ 11/0
- ☐ 6/0 ☐ 12/0
- ☐ 7/0 ☐ 13/0
- ☐ 8/0 ☐ 15/0
- ☐ 9/0 ☐ 18/0

hook type _____ hooks/line (rod and reel only) _____

gangions _____

Manufacturer _____

Style No. _____ offset _____

All Other Gear *(describe)*: _____

CAPTURE INFORMATION

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

Standard Soak Time (min) _____

Soak Time (calculated) 0

Water Depth (m) _____

Surface Water Temp (°C) _____

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CAPTURE INFORMATION (Cont.)

Latitude: (DD.DDDD) ____ Longitude: (DD.DDDD) ____

Date ____ Time (24hr) ____ Zone ____

Marine Jurisdiction ____ Animal Boarded? ____

Condition of animal at time of capture ____

If comatose/unresponsive, attempted resuscitation? ____

IDENTIFICATION

Species ____ Confidence in species ID ____

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

GEAR INTERACTION

ALL NET GEAR:

Capture Location in Gear (check all that applies)	Entanglement Location on Animal (check all that applies)	Gear left on Animal?	How Much?
☐ cod end	☐ beak/neck/head/saw/rostrum	☐	____ ☐
☐ lazy line	☐ rear flipper/groin/peduncle	☐	____ ☐
☐ wing extension	☐ front flipper/shoulder/armpit	☐	____ ☐
☐ in the body mesh size(in) (stretched) ____	☐ carapace/plastron/body	☐	____ ☐
☐ near lead line	☐ pectoral flipper	☐	____ ☐
☐ near float line	☐ dorsal fin	☐	____ ☐
☐ other (describe): ____	☐ tail/fluke	☐	____ ☐
	☐ other (describe): ____	☐	____ ☐

ALL LONGLINE/HOOK AND LINE GEAR:

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

If Hooked, Hook Location on Animal

Internal: (check all that applies)

☐ beak/mouth jaw location: ☐ upper ☐ lower ☐ side (mouth only)

mouth location: ☐ tongue ☐ jaw joint ☐ glottis/throat ☐ roof of mouth

☐ swallowed/esophagus (hook visible)

☐ swallowed/esophagus (hook not visible)

☐ unknown

☐ other (describe): ____

External: (check all that applies)

☐ beak/neck/head/saw/rostrum

☐ rear flipper/groin/peduncle

☐ front flipper/shoulder/armpit

☐ carapace/plastron/body

☐ pectoral flipper

☐ dorsal fin

☐ tail/fluke

☐ other (describe): ____

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BIOLOGICAL INFORMATION

Measurements

Finfish

total length _____ ☐ estimated

fork length _____ ☐ estimated

Marine Mammals

total length _____ ☐ estimated

Sea Turtles

curved carapace length (cm) _____

curved carapace width (cm) _____

straight carapace length (cm) _____ ☐ estimated

straight carapace width (cm) _____

All Incidentally Captured Animals

Weight _____ ☐ estimated

Sex _____

Tag/ID #

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

Other tag (describe) _____ PIT scan? ☐

Samples

Samples Taken	Type	Sample Number	*Final Disposition* Person	Affiliation
	blood			
	fin clip			
	tissue			
	carcass			
	other (describe): _____			

RELEASE INFORMATION

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

Date _____ Time (24hr) _____ Zone _____

Time taken to release animal 0 _____ (calculated)

Final Disposition:

- ☐ discarded dead/comatose/unresponsive carcass (marked?) ☐
- ☐ salvaged carcass/parts (list all): _____
- ☐ released alive
- ☐ taken to holding facility (location): _____
- ☐ unknown (explain): _____

Behavior upon release:

- ☐ swam away vigorously ☐ dove quickly
- ☐ swam away slowly ☐ dove slowly
- ☐ remained at surface ☐ sank
- ☐ surfaced to breathe
- ☐ other (describe): _____

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

Data Recorder _____ Tagger _____

Mitigation Measures in place at time of capture:

Additional Comments:

Please submit completed PSIT Form and photographs within 24 hours to nmfs.ser.ea_loa.takereport@noaa.gov. Please enter Fisheries Independent Monitoring Protected Species Take (BiOp SER-2009-7541) in the subject line and include the project name and species in the text of the email.

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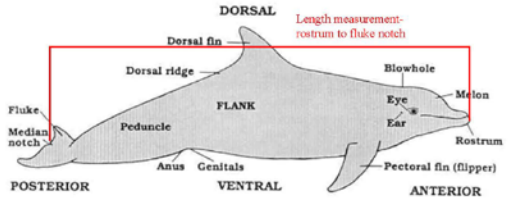
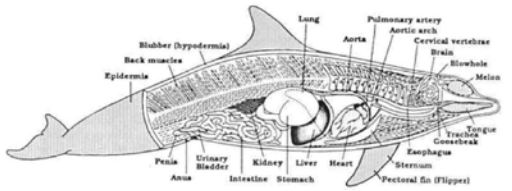
Appendix D - Protected Species Incidental Take Form (cont'd)

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

Marine Mammals



Basic External Anatomy

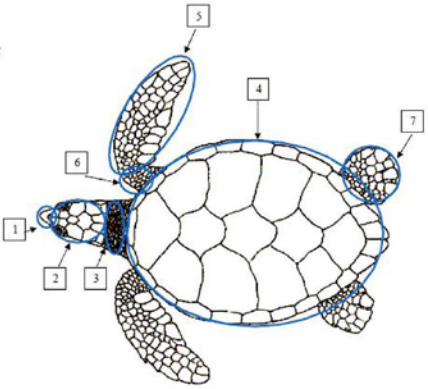


Basic Internal Anatomy

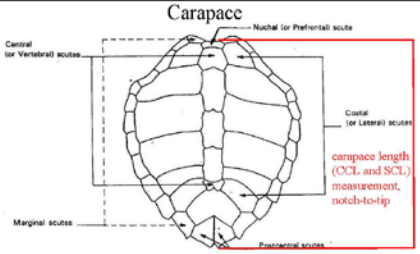
Sea Turtles

External hardshell:

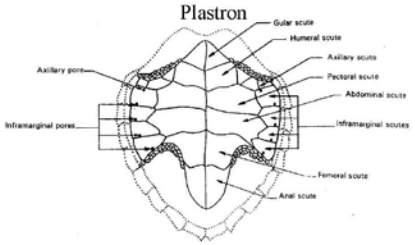
1) Beak
2) Head
3) Neck
4) Carapace
5) Front Flipper
6) Shoulder
7) Rear Flipper



Carapace

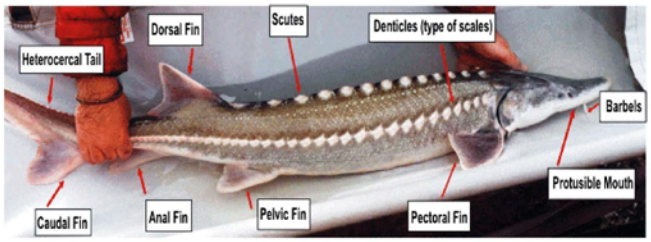


Plastron

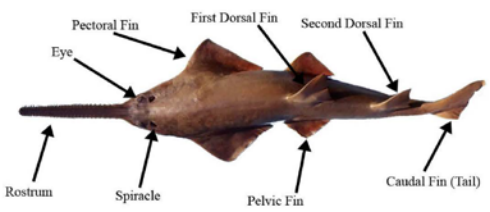


Finfish

Sturgeon



Sawfish



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

General Handling and Holding of Sturgeon

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

PIT Tagging

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

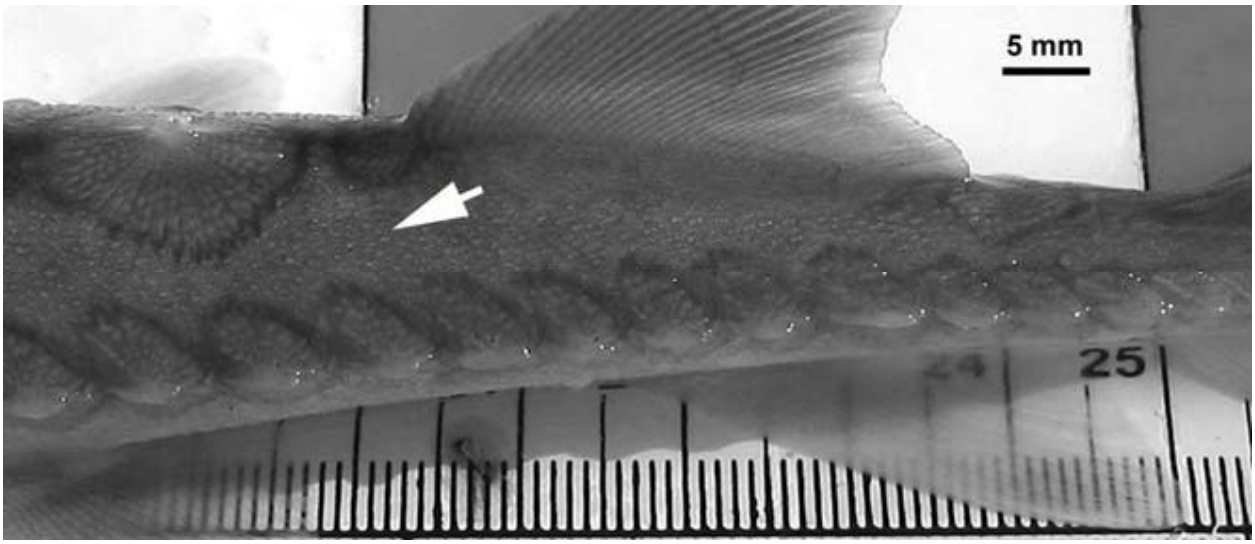

Figure E1. Standardized Location for PIT Tagging all Gulf, Atlantic, and shortnose sturgeon
(Photo Credit: J. Henne, USFWS)

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

11. NMFS recommends only sturgeon over 300 mm should receive PIT tags.

Genetic Tissue Sampling

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

13. NMFS strongly recommends genetic tissue samples be taken from every sturgeon captured unless, due to marks or tags, the researcher knows a genetic sample has already been obtained.

Transport of Samples

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

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