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Chief, Fort Myers Permits Section
Jacksonville District Corps of Engineers
Department of the Army
1520 Royal Palm Square Boulevard, Suite 310
Fort Myers, Florida 33919

Ref: Highpoint Tower Technology, Inc., Bocilla Island Seaport Reconfiguration, SAJ-2004-00460 (SP-MLB), Bokeelia, Lee County, Florida

Dear Sir or Madam:

The enclosed Biological Opinion (Opinion) was prepared by the National Marine Fisheries Service (NMFS), pursuant to Section 7(a)(2) of the Endangered Species Act. The Opinion considers the effects of a proposal by the United States Army Corps of Engineers (USACE) to authorize the reconfiguration of an existing marina and fishing pier. We base this Opinion on project-specific information provided in the consultation package as well as NMFS's review of published literature. This Opinion analyzes the potential for the project to affect the following: green sea turtle (North Atlantic and South Atlantic distinct population segments [DPSs]), Kemp's ridley sea turtle, loggerhead sea turtle (Northwest Atlantic DPS), smalltooth sawfish (United States DPS), giant manta ray, and smalltooth sawfish designated critical habitat.

We look forward to further cooperation with the USACE on other projects to ensure the conservation and recovery of our threatened and endangered marine species. This project has been assigned the tracking number SERO-2020-01970 in our new NMFS Environmental Consultation Organizer (ECO). Please refer to the ECO number in all future inquiries regarding this consultation. Please direct questions regarding this Opinion to Dana M. Bethea, Consultation Biologist, by phone at 727-209-5974, or by email at Dana.Bethea@noaa.gov.

Sincerely,

Andrew J. Strelcheck
Acting Regional Administrator

Enclosure: Biological Opinion
File: 1514-22.f



**Endangered Species Act - Section 7 Consultation
Biological Opinion**

Action Agency: United States Army Corps of Engineers

Applicant: Highpoint Tower Technology, Inc., c/o Hans Wilson & Associates

Activity: Bocilla Island Seaport Reconfiguration
SAJ-2004-00460 (SP-MLB)

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

Tracking Number: SERO-2020-01970
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Approved by: _____
Andrew J. Strelcheck, Acting Regional Administrator
NMFS, Southeast Regional Office
St. Petersburg, Florida

Date Issued: _____

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Acronyms and Abbreviations

ADA	Americans with Disabilities Act
CFR	Code of Federal Regulations
CHEU	Charlotte Harbor Estuary Unit of smalltooth sawfish designated critical habitat
CHPSP	Charlotte Harbor Preserve State Park
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CO ₂	Carbon Dioxide
CPUE	Catch per unit effort
CR	Conservation Recommendations
DDT	Dichlorodiphenyltrichloroethane
DO	Dissolved Oxygen
DPS	Distinct Population Segment
DWH	<i>Deepwater Horizon</i>
DTRU	Dry Tortugas Recovery Unit
EFH	Essential Fish Habitat
ESA	Endangered Species Act
FP	Fibropapillomatosis disease
FR	Federal Register
FWC	Florida Fish and Wildlife Conservation Commission
FWRI	Fish and Wildlife Research Institute
GADNR	Georgia Department of Natural Resources
GCRU	Greater Caribbean Recovery Unit
IPCC	Intergovernmental Panel on Climate Change
ISED	International Sawfish Encounter Database
ITS	Incidental Take Statement
LED	Light Emitting Diode
MHW	Mean High Water
MIT	Massachusetts Institute of Technology

MLW	Mean Low Water
MLLW	Mean Lower Low Water
MMF	Marine Megafauna Foundation
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NA	North Atlantic
NCWRC	North Carolina Wildlife Resources Commission
NGMRU	Northern Gulf of Mexico Recovery Unit
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRU	Northern Recovery Unit
NWA	Northwest Atlantic
Opinion	Biological Opinion
PCB	Polychlorinated Biphenyls
PFC	Perfluorinated Chemicals
PFRU	Peninsular Florida Recovery Unit
PRD	NMFS Protected Resources Division
PRM	Post-release mortality
RPMs	Reasonable and Prudent Measures
SA	South Atlantic
SAV	Submerged Aquatic Vegetation
SCDNR	South Carolina Department of Natural Resources
SCL	Straight Carapace length
SERO	NMFS Southeast Regional Office
SH	Shallow, euryhaline habitat essential feature of smalltooth sawfish designated critical habitat
STSSN	Sea Turtle Stranding and Salvage Network
T&Cs	Terms and Conditions
TED	Turtle Exclusion Device
TEWG	Turtle Expert Working Group
TTIEU	Ten Thousand Islands/Everglades Unit of smalltooth sawfish designated critical habitat
U.S.	United States of America
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
YOY	Young-of-the-year

Units of Measure

ac	Acre(s)
°C	Degrees Celsius
cm	Centimeter(s)
°F	Degrees Fahrenheit
ft	Foot/feet
ft ²	Square foot/feet
g	Gram(s)
in	Inch(es)
kg	Kilogram(s)

km	Kilometer(s)
lb	Pound(s)
lin ft	Linear foot/feet
m	Meter(s)
m ²	Square meter(s)
mm	Millimeter(s)
mi	Mile(s)
oz	Ounce(s)

Introduction

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

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

This document represents NMFS's Opinion based on our review of effects associated with the United States Army Corps of Engineers (USACE) proposed action to permit the reconfiguration of the Bocilla Island Seaport in Lee County, Florida. This Opinion analyzes the proposed actions' effects on threatened and endangered species and designated critical habitat in accordance with Section 7 of the ESA. We based our Opinion on information provided by the USACE, the Sea Turtle Stranding and Salvage Network (STSSN), the International Sawfish Encounter Database (ISED), and the published literature cited herein.

1. CONSULTATION HISTORY

The following is the consultation history for NMFS Environmental Consultation Organizer tracking number SERO-2020-01970 Bocilla Island Seaport Reconfiguration.

On July 15, 2020, NMFS received a request for consultation under Section 7 of the ESA from USACE in a letter dated July 16, 2020.

On July 21, 2020, NMFS requested additional information related to whether or not public, recreational fishing would be allowed at the Charlotte Harbor Fishing Pier. NMFS received response on September 8, 2020.

On September 9, 2020, NMFS sought clarification of the description of the proposed action. NMFS received USACE's complete response on September 22, 2020, and initiated consultation that day.

On November 14, 2020, NMFS requested additional information during our internal review process. NMFS received response on November 19, 2020.

On December 7, 2020, NMFS requested additional information during our internal review process. NMFS received response on December 7, 2020.

2. DESCRIPTION OF THE PROPOSED ACTION

2.1 Proposed Action

The USACE proposes to permit Highpoint Tower Technology, Inc. (the applicant) to remove or remove and reconfigure the following existing structures at the Bocilla Island Seaport (the Seaport):

- Main "L-shaped" dock (875-square foot [ft²] wooden dock with 3 finger piers)
- Finger piers along the existing seawall (19 finger piers of varying lengths)
- Boat ramp staging dock (460-ft² wooden dock with terminal platform)
- Boat ramp dock (290-ft² fixed dock)
- East mooring dock (642-ft² fixed dock)
- Charlotte Harbor Fishing Pier finger pier (138-ft²)

The existing overwater area to be reconfigured is 2,255 ft².

The USACE proposes to permit the applicant to construct the following structures at the Seaport (Figure 1):

- Dock A will be a 6-foot (ft)-wide x 220-ft-long (1,320-ft²) fixed access dock with railing, leading to a 5-ft-wide x 30-ft-long (150-ft²) aluminum ramp connected to an 8-ft-wide x 80-ft-long (640-ft²) floating dock.

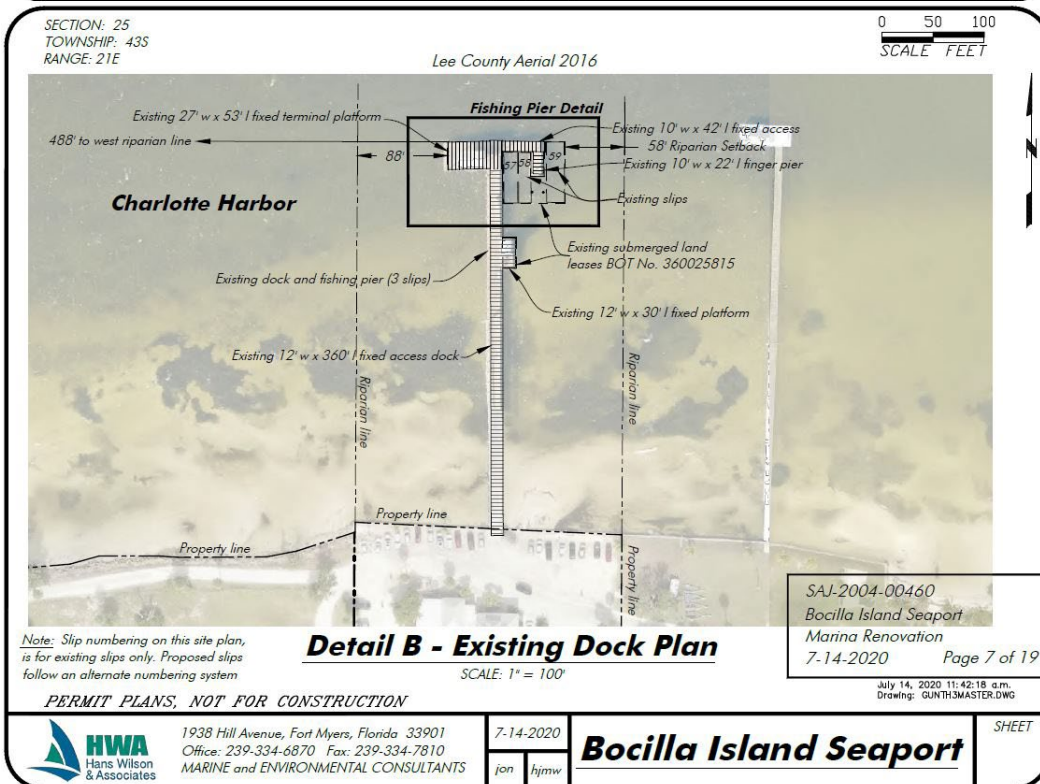
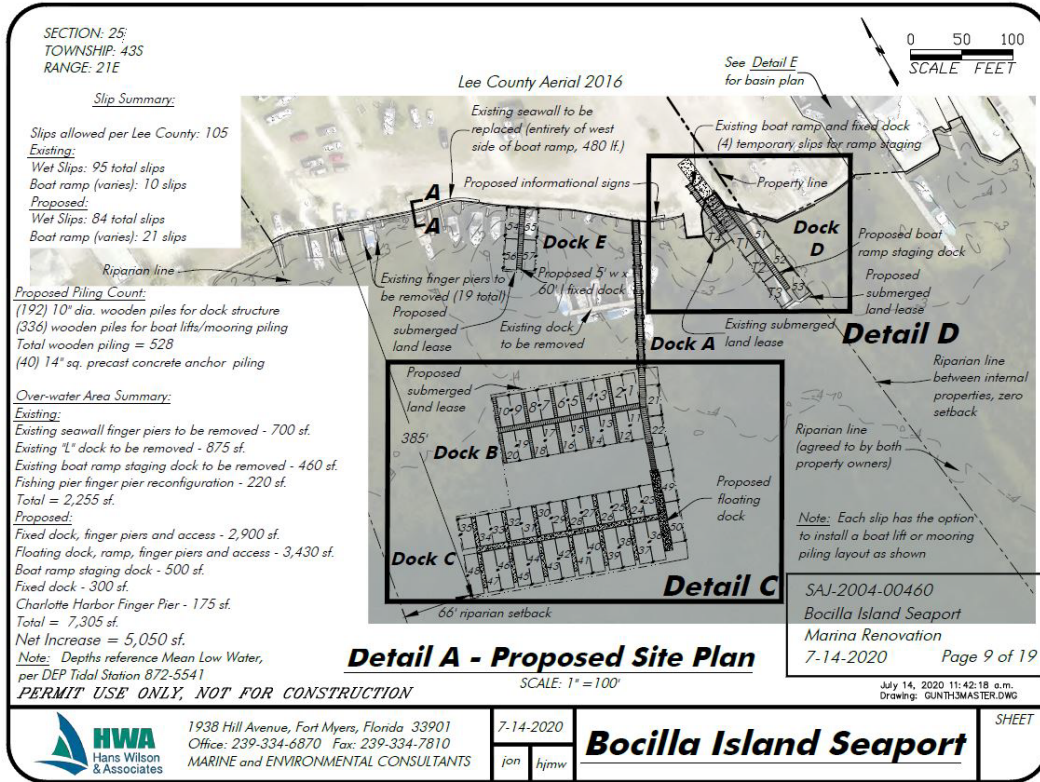


Figure 1. Top: The proposed site plan for the south side of the Bocilla Island Seaport Reconfiguration. Bottom: The proposed site plan for the north side of the Bocilla Island Seaport Reconfiguration. Images supplied by the USACE.

- Dock B will be a fixed wooden dock, 5-ft-wide x 140-ft-long (700-ft²) with 10, 3-ft-wide x 30-ft-long (900-ft²) finger piers.
- Dock C will be a floating dock, 6-ft-wide x 180-ft-long (1,080-ft²) with 6, 4-ft-wide x 30-ft-long (720-ft²) floating finger piers and 6, 4-ft-wide x 35-ft-long (840-ft²) floating finger piers.
- Dock D will be a 5-ft-wide x 100-ft-long (500-ft²) fixed dock adjacent to the existing boat ramp for staging of boat ramp vessels and mooring.
- Dock E will be a 5-ft-wide x 60-ft-long (300-ft²) fixed dock.
- The Charlotte Harbor Fishing Pier finger renovation will be a 5-ft-wide x 35-ft-long (175-ft²) fixed dock.

The proposed overwater area is 7,305 ft². Construction will result in an increase in overwater area of 5,050 ft².

The total overwater area of the project will equal 7,305 ft². The number of boat slips will remain the same (i.e., 105). The number of new piles for the project will total 581 (Table 1). Work may include installation of boatlifts in lieu of mooring piles, which would not increase the total number of piles.

Table 1. Pile Installation and Methodology

Pile types	Number of Piles	Installation Method	Confined Space or Open Water
Wood, 10-in round	541	Jetting, then impact hammer using a cushion block	Open water
Concrete, 14-in square	40	Jetting, then impact hammer using a cushion block	Open water

Additionally, a total of 1,500-linear feet (lin ft) of existing concrete seawall is proposed to be replaced up to 18-inches (in)-waterward of its existing location and raised 1 ft. This includes the entirety of the seawall located to the west of the existing boat ramp. The seawall will be an earth-anchored design with tiebacks/deadmen for support.

It is anticipated that all work will be completed using a crane and excavator both from the uplands and mounted on a barge. All piles will be initially jetted into place for proper alignment and stability then driven via impact hammer the last few feet to gain proper bearing. When an impact hammer will be used, no more than 10 piles will be installed per day. Debris will be taken to the uplands for proper disposal. In-water work will last 90-120 days, during daylight hours only.

The applicant will comply with the NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*.¹ The applicant will also extend these conditions to giant manta ray. Floating

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

turbidity curtains with weighted skirts extending to the bottom will be installed around the work zone to enclose all construction. The turbidity curtains will remain in place until construction is complete and turbidity levels within the action area are compliant with Florida state standards.

To minimize potential impacts to ESA-listed species, USACE will add the following conditions to the permit to be followed during construction (adapted from the JAXBO²):

- The existing parking lot will be used for delivery and storage of the majority of construction material and equipment.
- Prior to the onset of construction activities, the applicant, or designated agent, will conduct a meeting with all construction staff to discuss field identification of sea turtles, marine mammals, and sturgeon, their protected status, what to do if any are observed within the project area, and applicable penalties that may be imposed if State or Federal regulations are violated. All personnel shall be made aware that there are civil and criminal penalties for harming, harassing, or killing ESA-listed species or marine mammals.
- When in-water project construction takes place from floating equipment (e.g., barge), prop or wheel-washing is prohibited.
- All construction personnel must watch for and avoid collision with ESA-listed species. Vessel operators must avoid potential interactions with protected species and operate in accordance with the following protective measures:
 - All vessels associated with the construction project shall operate at “Idle Speed/ No Wake” at all times while operating in water depths where the draft of the vessel provides less than a 4-foot (ft) clearance from the bottom, and in all depths after a protected species has been observed in and has departed the area.
 - All vessels will follow marked channels and routes using the maximum water depth whenever possible.
 - Operation of any mechanical construction equipment, including vessels, shall cease immediately if a listed species is observed within a 50-ft radius of construction equipment and shall not resume until the species has departed the area of its own volition.
 - If the detection of species is not possible during certain weather conditions (e.g., fog, rain, wind), then in-water operations will cease until weather conditions improve and detection is again feasible.
- Any collision(s) with or injury to any ESA-listed species occurring during the construction shall be reported immediately to NMFS’s Protected Resources Division (PRD) at (1-727-824-5312) or by email to takereport.nmfsser@noaa.gov.

² Biological Opinion on the Authorization of Minor In-Water Activities throughout the Geographic Area of Jurisdiction of the U.S. Army Corps of Engineers Jacksonville District, including Florida and the U.S. Caribbean (SER-2015-17616), issued November 20, 2017.

To minimize potential impacts to ESA-listed species upon completion of the project, USACE will add the following best management practices to the permit to be followed by the applicant post-construction:

- The applicant will coordinate an agreement with the Florida STSSN, as needed, for the rehabilitation of recreational hook-and-line sea turtle captures. Contact information for the State Coordinators for the STSSN are found at the following website:
<https://www.fisheries.noaa.gov/state-coordinators-sea-turtle-stranding-and-salvage-network>
- Fishing line recycling receptacles and trash receptacles with lids will be maintained along the fishing pier and docks in order to prevent fishing lines from being disposed of in the ocean or on the beaches. Receptacles will be clearly marked and will be emptied regularly to ensure they do not overflow and that fishing lines are disposed of properly.
- Upon completion of the reconfiguration, updated educational signs must be posted in visible locations on the south and north sides, alerting users of listed species in the area. The applicant will replace the current signs with the “Save Dolphins, Sea Turtles, Sawfish, and Manta Rays” sign and the “Save Sawfish” sign, which are available for download at the following website:
<https://www.fisheries.noaa.gov/southeast/consultations/protected-species-educational-signs>.
- The applicant will conduct in-water cleanup around the fishing pier on an annual basis.

2.2 Proposed Action Area

The Seaport consists of a commercial marina with a public boat ramp and docks on the south side and a public, recreational fishing pier, the Charlotte Harbor Fishing Pier, with boat slips on the north side (Figure 2). It is located at 8491 and 8421 Main Street, Bokeelia, Lee County, Florida (Latitude 26.704500, Longitude -82.164170) within the boundary of smalltooth sawfish critical habitat (Charlotte Harbor Estuary Unit [CHEU]).



Figure 2. The extent of the Bocilla Island Seaport outlined in red (©Google Earth 2020).

The Seaport is owned and maintained by Lee County (the County) and has been in operation since prior to 1944. The south side of the Seaport is located in Back Bay adjacent to Jug Creek, which flows into Pine Island Sound and Charlotte Harbor. The north side of the Seaport extends directly into Charlotte Harbor. The Seaport is approximately 4.0 mi from the Gulf of Mexico and is currently open. Recreational fishing is allowed only at the Charlotte Harbor Fishing Pier on the north side of the Seaport. Both sides are lit at night; lighting is not sea turtle-friendly. The County estimates that 20 anglers, on average, fish from the Charlotte Harbor Fishing Pier each day, which is open to the public 365 days a year from 7 AM to 7 PM. According to the County, there have been no reported takes of ESA-listed species from previous recreational fishing activities at the Charlotte Harbor Fishing Pier. Further, NMFS is not aware of any reported takes of ESA-listed species from previous recreational fishing activities at this pier. Educational signs are currently posted at the fishing pier to inform the public about smalltooth sawfish. The Seaport currently has existing fish cleaning stations at several pre-defined locations on both sides, all which empty into the water.

The action area is defined by regulation as all areas to be affected by the Federal action and not merely the immediate area involved in the action (50 Code of Federal Regulations [CFR] 402.02). Therefore, the action area for includes the existing Seaport's physical footprint, the reconfigured Seaport's footprint, the water surrounding the pier that is accessible to recreational anglers upon completion of the proposed action (i.e., casting distance or approximately 200-ft), and the anticipated 705-ft radius of behavioral noise effect due to the installation of 14-in-square concrete piles by impact hammer (without a cushion block). Therefore, to be conservative, the extent of the action area is a 705-ft radius around the reconfigured Seaport's footprint (Figure 3).



Figure 3. The Bocilla Island Seaport, surrounding area, and a 705-ft radius (in red) denoting the extent of the action area based on behavioral noise effects to ESA-listed fishes (©2020 Google Earth)

Mangroves are present in action area, but not located within water accessible to recreational anglers. No mangroves will be affected due to the proposed action. Bottom substrate within the action area is described as a mix of sand, silt, and muck. The most recent benthic survey in 2007 reported no seagrasses observed within the footprint of the proposed action. Water depth within the action area is 2-6 ft at mean low water (MLW). The action area is not located on or near any known sea turtle nesting beaches.

3. STATUS OF LISTED SPECIES AND CRITICAL HABITAT

Table 2 provides the effect determinations for ESA-listed species the USACE and NMFS believe may be affected by the proposed action.

Table 2. Effects Determinations for ESA-Listed Species that May Be Affected by the Proposed Action

Species	ESA Listing Status ³	Action Agency Effect Determination	NMFS Effect Determination
Sea Turtles			
Green (North Atlantic [NA] distinct population segment [DPS])	T	LAA	LAA
Green (South Atlantic [SA] DPS)	T	LAA	LAA
Hawksbill	E	NE	NE/NP
Kemp's ridley	E	LAA	LAA
Leatherback	E	NE	NE/NP
Loggerhead (Northwest Atlantic [NWA] DPS)	T	LAA	LAA
Fish			
Smalltooth sawfish (U.S. DPS)	E	LAA	LAA
Giant manta ray	T	NLAA	NLAA

The Charlotte Harbor Fishing Pier is located in the inshore, protected waters of Zone 4, a statistical subarea used when reporting commercial fishing data. Zone 4 extends from 26° to 25° North latitude (approximately Manasota Key Beach in Lee County south to Little Marco Island in Collier County) along the west coast of Florida (Gulf of Mexico). To determine which sea turtle species are likely to occur within the action area, we reviewed the available inshore STSSN data for Zone 4 (i.e., reported stranding data in Zone 4 for all areas inside protected waters, 2007-2016; Table 3). Based on the data, we believe only green sea turtle (NA and SA DPSs), Kemp's ridley sea turtle, and loggerhead sea turtle (NWA DPS) may be affected by construction effects as well as recreational fishing that will occur at the pier upon completion of the proposed action. While hawksbill sea turtle is represented in the data, we do not believe this species will be in the action area or caught on or entangled in recreational hook and line gear used at the pier. Only 1 of the 3 STSSN records of hawksbill sea turtles is due to gear entanglement (commercial or recreational); the other 2 are due to cold stun and an unknown source. Further, hawksbill sea turtles typically inhabit inshore reef and hard bottom areas, which are not located within the action area, feeding primarily on encrusting sponges and not baits typically fished from piers. We do not believe leatherback sea turtles will be in the action area or caught on or entangled in recreational hook and line gear used at the pier. Leatherback sea turtles tend to be pelagic feeders, feeding on jellyfish and not baits typically fished from piers.

³ E = endangered; T = threatened; NLAA = may affect, not likely to adversely affect; NE = no effect.; NP = not present

Table 3. Summary of STSSN Inshore Data for Zone 4 (2007-2016)

Species	Number of Known Sea Turtles Stranded or Salvaged (All Activities)	Number of Known Gear Entanglements	Number of Known Recreational Hook-and-line Captures
Green sea turtle	156	12	0
Hawksbill sea turtle	3	1	0
Kemp’s ridley sea turtle	115	7	1
Leatherback sea turtle	0	0	0
Loggerhead sea turtle	153	5	0
Unidentified	11	1	0
Total	438	26	1

Table 4 provides the effects determinations for designated critical habitat occurring within the action area that the USACE and NMFS believe may be affected by the proposed action.

Table 4. Effects Determinations for Designated Critical Habitat that May Be Affected by the Proposed Action

Species	Unit	Action Agency Effect Determination	NMFS Effect Determination
Smalltooth sawfish (U.S. DPS)	CHEU	Likely to adversely affect	Likely to adversely affect, will not destroy or adversely modify

3.1 Potential Routes of Effect Not Likely To Adversely Affect ESA-Listed Species

Green, Kemp’s ridley, and loggerhead sea turtles, smalltooth sawfish, and giant manta ray may be injured if struck by equipment or materials during construction activities. However, we believe that such route of effect is extremely unlikely to occur. These species are expected to exhibit avoidance behavior by moving away from physical disturbances. In addition, the applicant will implement NMFS’s *Sea Turtle and Smalltooth Sawfish Construction Conditions* and extend these conditions to giant manta ray. This will further reduce the risk of injury to these species during construction activities. If at any point, a sea turtle species, smalltooth sawfish, or giant manta ray is observed within 50 ft of the work site, all construction or operation of any mechanical equipment will cease until the animal has departed the project area on its own volition.

Green, Kemp’s ridley, and loggerhead sea turtles, smalltooth sawfish, and giant manta ray may also be injured due to entanglement in improperly discarded fishing gear upon completion of the proposed action. We believe this route of effect is extremely unlikely to occur. The County maintains fishing line recycling receptacles and trash cans to keep debris out of the water when the public fishing structure is open for use by the public, and we expect that anglers will appropriately dispose of fishing gear using these bins in the future. The receptacles are clearly marked and will continue to be emptied regularly to ensure they are not overfilled and that fishing lines are disposed of properly. The County also maintains posted signage that instructs anglers not to dispose of fishing line or debris in the water. Further, to the best of our knowledge,

there has never been a reported entanglement with any of these species at the Charlotte Harbor Fishing Pier.

Giant manta ray are prone to foul-hooking by recreational fishing gear used at fishing structures that are ocean-facing or located in or near inlet/passes. However, we believe the risk of foul-hooking by recreational fishing gear to giant manta ray is extremely unlikely to occur. The Charlotte Harbor Fishing Pier is not directly ocean-facing nor is it located in or near an inlet or pass where giant manta ray are known to congregate. Further, to the best of our knowledge, there are no reported recreational interactions with giant manta ray at the Charlotte Harbor Fishing Pier.

The action area contains habitat that may be used by Green, Kemp's ridley, and loggerhead sea turtles, smalltooth sawfish, and giant manta ray. These species may be affected by their inability to access the action area due to their avoidance of construction activities and physical exclusion from the project area due to blockage by turbidity curtains. We believe the effect of temporary loss of habitat access will be insignificant, given the availability of similar habitat nearby, the abundance of habitat outside of the action area, and the temporary nature of the project (i.e., 90-120 days, during daylight hours only).

The action area contains habitat that serves nursery area functions, including foraging and refuge, for juvenile smalltooth sawfish. Juvenile smalltooth sawfish may be affected by the permanent loss of 2,250 ft² of habitat associated with the proposed action (1,500-lin ft seawall x 1.5-ft-waterward of the existing seawall). We believe the permanent loss of habitat will be insignificant to juvenile smalltooth sawfish given the proposed project's small area of impact relative to the surrounding area. There are unconsolidated shorelines adjacent to the action area, undisturbed habitat available in the surrounding mangrove shorelines outside of the action area, and extensive red mangrove and shallow, euryhaline habitat remaining within the CHEU.

The NMFS educational signs "Save the Dolphins, Sea Turtles, Sawfish, and Manta Ray" and "Save Sawfish" will be installed in a visible locations on the north and south sides upon completion of the reconfiguration of the Seaport. We believe the placement of educational signs is a beneficial effect to Green, Kemp's ridley, and loggerhead sea turtles, smalltooth sawfish, and giant manta ray. The signs will provide information to the public on how to avoid and minimize encounters with these species as well as proper handling techniques. The signs will also encourage anglers to report sightings and interactions, thus providing valuable distribution and abundance data to researchers and resource managers. Accurate distribution and abundance data allows management to evaluate the status of the species and refine conservation and recovery measures.

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

evaluation of effects to listed species as a result of noise created by construction activities is based on the analysis prepared in support of the Opinion for SAJ-82.⁴ The noise analysis in this consultation evaluates effects to ESA-listed fish and sea turtles identified by NMFS as potentially affected in the table above. While we have no information regarding noise effects specific to giant manta rays, we believe that effects to giant manta rays from pile driving noise would be very similar to effects on smalltooth sawfish (which are considered in SAJ-82), because both species are elasmobranchs and lack swim bladders.

Based on our noise calculations, the use of a water jet to create pilot holes or install piles will not result in injurious noise effects or behavioral noise effects.

Based on our noise calculations, the installation of wood piles by impact hammer will not cause single-strike or peak-pressure injury to sea turtles or ESA-listed fish. The cumulative sound exposure level (cSEL) of multiple pile strikes over the course of a day may cause injury to ESA-listed fishes and sea turtles at a radius of up to 30 ft (9 m). Due to the mobility of sea turtles and ESA-listed fish species, and because the project occurs in open water, we expect them to move away from noise disturbances. Because we anticipate the animal will move away, we believe that an animal's suffering physical injury from noise is extremely unlikely to occur. Even in the unlikely event an animal does not vacate the daily cumulative injurious impact zone, the radius of that area is smaller than the 50-ft radius that will be visually monitored for listed species. Construction personnel will cease construction activities if an animal is sighted per NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*, which the applicant will extend to giant manta ray as well. Thus, we believe the likelihood of any injurious cSEL effects is extremely unlikely to occur. An animal's movement away from the injurious impact zone is a behavioral response, with the same effects discussed below.

Based on our noise calculations, installation of concrete piles up to 24-in-diameter by impact hammer will not cause single-strike or peak-pressure injurious noise effects. However, the cumulative sound exposure level of multiple pile strikes over the course of a day may cause injury to ESA-listed fishes and sea turtles up to 72 ft (22 m) away from the pile. Due to the mobility of sea turtles and ESA-listed fish species, and because the project occurs in open water, we expect them to move away from noise disturbances. Because we anticipate the animal will move away, we believe that an animal's suffering physical injury from noise is extremely unlikely to occur and is therefore extremely unlikely to occur. An animal's movement away from the injurious sound radius is a behavioral response, with the same effects discussed below.

The installation of piles (up to 14-in-diameter wood piles and up to 24-in-diameter concrete piles) using an impact hammer could also result in behavioral effects at radii 705 ft (215 m) for ESA-listed fishes and 151 ft (46 m) for sea turtles. Due to the mobility of sea turtles and ESA-listed fish species, we expect them to move away from noise disturbances in this open-water environment. Because there is similar habitat nearby, we believe behavioral effects will be insignificant. If an individual chooses to remain within the behavioral response zone, it could be exposed to behavioral noise impacts during pile installation. Since installation will occur only during the day, these species will be able to resume normal activities during quiet periods

⁴ NMFS. Biological Opinion on Regional General Permit SAJ-82 (SAJ-2007-01590), Florida Keys, Monroe County, Florida. June 10, 2014.

between pile installations and at night. Therefore, we anticipate any behavioral effects will be insignificant.

3.2 Potential Routes of Effect Likely To Adversely Affect ESA-Listed Species

NMFS determined that recreational hook-and-line interactions from the completed pier are likely to adversely affect green sea turtle (NA and SA DPSs), Kemp's ridley sea turtle, loggerhead sea turtle (NWA DPS), and smalltooth sawfish. We provide greater detail on the potential effects of entanglement, hooking, and trailing line to sea turtles and smalltooth sawfish in the Effects of the Action section below (Section 5.1).

3.3 Status of Sea Turtles

Section 3.3.1 addresses the general threats that confront all sea turtle species. Sections 3.3.2 – 3.3.5 address information on the distribution, life history, population structure, abundance, population trends, and unique threats to each species of sea turtle likely to be adversely affected by the proposed action.

3.3.1 General Threats Faced by All Sea Turtle Species

Sea turtles face numerous natural and man-made threats that shape their status and affect their ability to recover. Many of the threats are either the same or similar in nature for all ESA-listed sea turtle species. The threats 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 of the Species where appropriate.

3.3.1.1 Fisheries

Incidental bycatch in commercial fisheries is identified as a major contributor to past declines, and threat to future recovery, for all of the sea turtle species (NMFS and USFWS 1991a; NMFS and USFWS 1992; NMFS and USFWS 1993; NMFS and USFWS 2008; 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 U.S. 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 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 U.S., and continue to interact with and kill large numbers of sea turtles each year.

In addition to domestic fisheries, sea turtles are subject to direct as well as incidental capture in numerous foreign fisheries, further impeding the ability of sea turtles to survive and recover on a global scale. For example, pelagic stage sea turtles, especially loggerheads and leatherbacks, circumnavigating the Atlantic are susceptible to international longline fisheries including the

Azorean, Spanish, and various other fleets (Aguilar et al. 1994; Bolten et al. 1994). Bottom longlines and gillnet fishing is known to occur in many foreign waters, including (but not limited to) the northwest Atlantic, western Mediterranean, South America, West Africa, Central America, and the Caribbean. Shrimp trawl fisheries are also occurring off the shores of numerous foreign countries and pose a significant threat to sea turtles similar to the impacts seen in U.S. waters. Many unreported takes or incomplete records by foreign fleets make it difficult to characterize the total impact that international fishing pressure is having on listed sea turtles. Nevertheless, international fisheries represent a continuing threat to sea turtle survival and recovery throughout their respective ranges.

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

3.3.1.3 Coastal Development and Erosion Control

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

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

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

3.3.1.5 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. The National Oceanic and Atmospheric Association's (NOAA's) climate information portal provides basic background information on these and other measured or anticipated effects (see <http://www.climate.gov>).

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

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

sites and decrease available nesting habitat (Baker et al. 2006; Daniels et al. 1993; Fish et al. 2005). The loss of habitat as a result of climate change could be accelerated due to a combination of other environmental and oceanographic changes such as an increase in the frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion (Antonelis et al. 2006; Baker et al. 2006).

Other changes in the marine ecosystem caused by global climate change (e.g., ocean acidification, salinity, oceanic currents, dissolved oxygen [DO] 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.

3.3.1.6 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 2008).

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

The green sea turtle was originally listed as threatened under the ESA on July 28, 1978, except for the Florida and Pacific coast of Mexico breeding populations, which were listed as endangered. On April 6, 2016, the original listing was replaced with the listing of 11 DPSs (81 FR 20057 2016) (Figure 4). The Mediterranean, Central West Pacific, and Central South Pacific DPSs were listed as endangered. The NA, SA, Southwest Indian, North Indian, East Indian-West Pacific, Southwest Pacific, Central North Pacific, and East Pacific DPSs were listed as threatened. For the purposes of this consultation, only the SA DPS and NA DPS will be considered, as they are the only two DPSs with individuals occurring in the Atlantic and Gulf of Mexico waters of the United States.

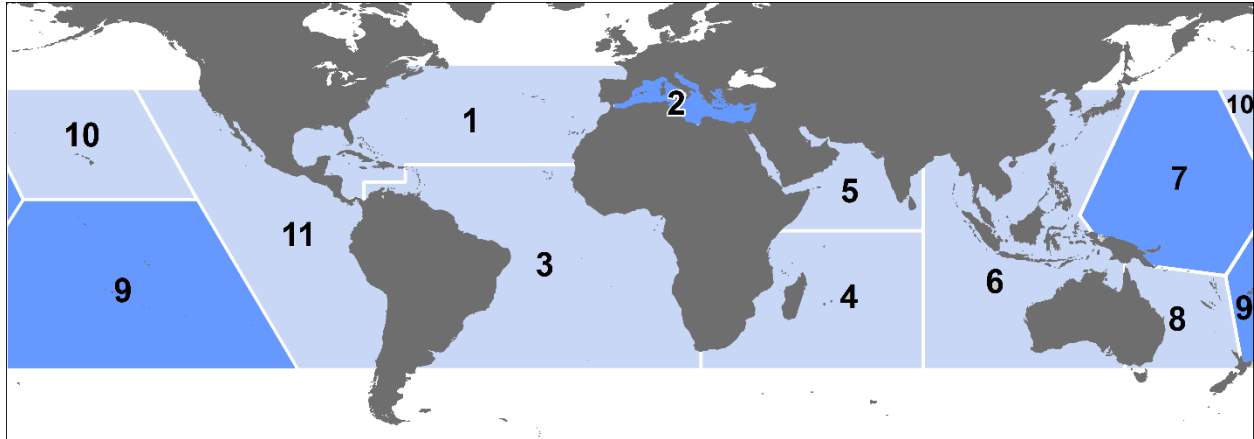


Figure 4. Threatened (light) and endangered (dark) green turtle DPSs: 1. NA, 2. Mediterranean, 3. SA, 4. Southwest Indian, 5. North Indian, 6. East Indian-West Pacific, 7. Central West Pacific, 8. Southwest Pacific, 9. Central South Pacific, 10. Central North Pacific, and 11. East Pacific.

3.3.2.1 Species Description and Distribution

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

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

Differences in mitochondrial DNA properties of green sea turtles from different nesting regions indicate there are genetic subpopulations (Bowen et al. 1992; FitzSimmons et al. 2006). Despite the genetic differences, sea turtles from separate nesting origins are commonly found mixed together on foraging grounds throughout the species' range. Within U.S. waters individuals from both the NA and SA DPSs can be found on foraging grounds. While there are currently no in-depth studies available to determine the percent of NA and SA DPS individuals in any given location, two small-scale studies provide an insight into the degree of mixing on the foraging grounds. An analysis of cold-stunned green turtles in St. Joseph Bay, Florida (northern Gulf of Mexico) found approximately 4% of individuals came from nesting stocks in the SA DPS (specifically Suriname, Aves Island, Brazil, Ascension Island, and Guinea Bissau) (Foley et al. 2007). On the Atlantic coast of Florida, a study on the foraging grounds off Hutchinson Island found that approximately 5% of the turtles sampled came from the Aves Island/Suriname nesting

assemblage, which is part of the SA DPS (Bass and Witzell 2000). All of the individuals in both studies were benthic juveniles. Available information on green turtle migratory behavior indicates that long distance dispersal is only seen for juvenile turtles. This suggests that larger adult-sized turtles return to forage within the region of their natal rookeries, thereby limiting the potential for gene flow across larger scales (Monzón-Argüello et al. 2010). While all of the mainland U.S. nesting individuals are part of the NA DPS, the U.S. Caribbean nesting assemblages are split between the NA and SA DPS. Nesters in Puerto Rico are part of the NA DPS, while those in the U.S. Virgin Islands are part of the SA DPS. We do not currently have information on what percent of individuals on the U.S. Caribbean foraging grounds come from which DPS.

North Atlantic DPS

The NA DPS boundary is illustrated in Figure 2. Four regions support nesting concentrations of particular interest in the NA DPS: Costa Rica (Tortuguero), Mexico (Campeche, Yucatan, and Quintana Roo), U.S. (Florida), and Cuba. By far the most important nesting concentration for green turtles in this DPS is Tortuguero, Costa Rica. Nesting also occurs in the Bahamas, Belize, Cayman Islands, Dominican Republic, Haiti, Honduras, Jamaica, Nicaragua, Panama, Puerto Rico, Turks and Caicos Islands, and North Carolina, South Carolina, Georgia, and Texas, U.S. In the eastern North Atlantic, nesting has been reported in Mauritania (Fretey 2001).

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

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

South Atlantic DPS

The SA DPS boundary is shown in Figure 2, and includes the U.S. Virgin Islands in the Caribbean. The SA DPS nesting sites can be roughly divided into four regions: western Africa,

Ascension Island, Brazil, and the South Atlantic Caribbean (including Colombia, the Guianas, and Aves Island in addition to the numerous small, island nesting sites).

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

3.3.2.2 Life History Information

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

After emerging from the nest, hatchlings swim to offshore areas and go through a post-hatchling pelagic stage where they are believed to live for several years. During this life stage, green sea turtles feed close to the surface on a variety of marine algae and other life associated with drift lines and debris. This early oceanic phase remains one of the most poorly understood aspects of green sea turtle life history (NMFS and USFWS 2007a). Green sea turtles exhibit particularly slow growth rates of about 0.4-2 in (1-5 cm) per year (Green 1993), which may be attributed to their largely herbivorous, low-net energy diet (Bjorndal 1982). At approximately 8-10 in (20-25 cm) carapace length, juveniles leave the pelagic environment and enter nearshore developmental habitats such as protected lagoons and open coastal areas rich in sea grass and marine algae.

Growth studies using skeletochronology indicate that green sea turtles in the western Atlantic shift from the oceanic phase to nearshore developmental habitats after approximately 5-6 years (Bresette et al. 2006; Zug and Glor 1998). Within the developmental habitats, juveniles begin the switch to a more herbivorous diet, and by adulthood feed almost exclusively on seagrasses and algae (Rebel 1974), although some populations are known to also feed heavily on invertebrates (Carballo et al. 2002). Green sea turtles mature slowly, requiring 20-50 years to reach sexual maturity (Chaloupka and Musick 1997; Hirth 1997).

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

3.3.2.3 Status and Population Dynamics

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

North Atlantic DPS

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

Quintana Roo, Mexico, accounts for approximately 11% of nesting for the DPS (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 2007d). By 2012, more than 26,000 nests were counted in Quintana Roo (J. Zurita, CIQROO, unpublished data, 2013, in Seminoff et al. 2015).

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

years or more resulted in an estimate of the Tortuguero, Costa Rica population's growing at 4.9% annually.

In the continental U.S., green sea turtle nesting occurs along the Atlantic coast, primarily along the central and southeast coast of Florida (Meylan et al. 1994; Weishampel et al. 2003). Occasional nesting has also been documented along the Gulf Coast of Florida (Meylan et al. 1995). Green sea turtle nesting is documented annually on beaches of North Carolina, South Carolina, and Georgia, though nesting is found in low quantities (up to tens of nests) (nesting databases maintained on www.seaturtle.org).

Florida accounts for approximately 5% of nesting for this DPS (Seminoff et al. 2015). In Florida, index beaches were established to standardize data collection methods and effort on key nesting beaches. Since establishment of the index beaches in 1989, the pattern of green sea turtle nesting has generally shown biennial peaks in abundance with a positive trend during the 10 years of regular monitoring (Figure 3). According to data collected from Florida's index nesting beach survey from 1989-2019, green sea turtle nest counts across Florida have increased dramatically, from a low of 267 in the early 1990s to a high of 40,911 in 2019. Two consecutive years of nesting declines in 2008 and 2009 caused some concern, but this was followed by increases in 2010 and 2011, and a return to the trend of biennial peaks in abundance thereafter (Figure 5). Modeling by Chaloupka et al. (2008) using data sets of 25 years or more resulted in an estimate of the Florida nesting stock at the Archie Carr National Wildlife Refuge growing at an annual rate of 13.9% at that time. Increases have been even more rapid in recent years.

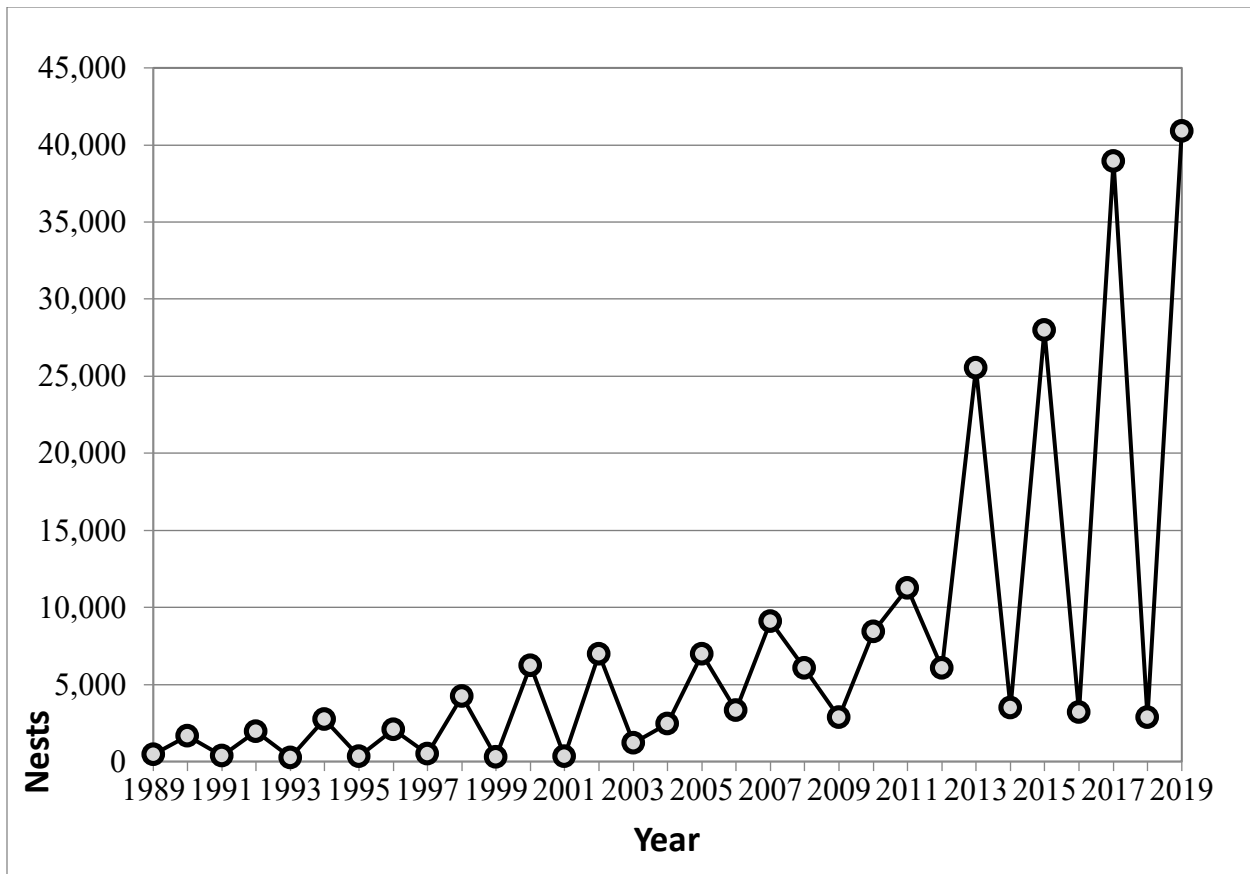


Figure 5. Green sea turtle nesting at Florida index beaches since 1989

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

South Atlantic DPS

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

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

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

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

approximately 340 green sea turtles were found cold-stunned in Mexico, though approximately 300 of those were subsequently rehabilitated and released.

Whereas oil spill impacts are discussed generally for all species in Section 3.3.1, specific impacts of the DWH spill on green sea turtles are considered here. Impacts to green sea turtles occurred to offshore small juveniles only. A total of 154,000 small juvenile greens (36.6% of the total small juvenile sea turtle exposures to oil from the spill) were estimated to have been exposed to oil. A large number of small juveniles were removed from the population, as 57,300 small juveniles greens are estimated to have died as a result of the exposure. A total of 4 nests (580 eggs) were also translocated during response efforts, with 455 hatchlings released (the fate of which is unknown) (DWH Trustees 2015b). Additional unquantified effects may have included inhalation of volatile compounds, disruption of foraging or migratory movements due to surface or subsurface oil, ingestion of prey species contaminated with oil and/or dispersants, and loss of foraging resources, which could lead to compromised growth and/or reproductive potential. There is no information currently available to determine the extent of those impacts, if they occurred.

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

3.3.3 Status of Kemp's Ridley Sea Turtle

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

3.3.3.1 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.

3.3.3.2 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 1989), although the time spent in the oceanic zone may vary from 1-4 years or perhaps more (TEWG 2000). Juvenile Kemp's ridley sea turtles use these nearshore coastal habitats from April through November, but they move towards more suitable overwintering habitat in deeper offshore waters (or more southern waters along the Atlantic coast) as water temperature drops.

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

3.3.3.3 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 6), which indicates the species is recovering.

It is worth noting that when the Bi-National Kemp's Ridley Sea Turtle Population Restoration Project was initiated in 1978, only Rancho Nuevo nests were recorded. In 1988, nesting data from southern beaches at Playa Dos and Barra del Tordo were added. In 1989, data from the northern beaches of Barra Ostionales and Tepehuajes were added, and most recently in 1996, data from La Pesca and Altamira beaches were recorded. Currently, nesting at Rancho Nuevo accounts for just over 81% of all recorded Kemp's ridley nests in Mexico. Following a significant, unexplained 1-year decline in 2010, Kemp's ridley nests in Mexico increased to 21,797 in 2012 (Gladys Porter Zoo 2013). From 2013 through 2014, there was a second significant decline, as only 16,385 and 11,279 nests were recorded, respectively. More recent data, however, indicated an increase in nesting. In 2015 there were 14,006 recorded nests, and in 2016 overall numbers increased to 18,354 recorded nests (Gladys Porter Zoo 2016). There was a record high nesting season in 2017, with 24,570 nests recorded (J. Pena, pers. comm., August 31, 2017), but nesting for 2018 declined to 17,945, with another steep drop to 11,090 nests in 2019 (Gladys Porter Zoo data, 2019). At this time, it is unclear whether the increases and declines in nesting seen over the past decade represents a population oscillating around an equilibrium point or if nesting will decline or increase in the future.

A small nesting population is also emerging in the United States, primarily in Texas, rising from 6 nests in 1996 to 42 in 2004, to a record high of 353 nests in 2017 (National Park Service data). It is worth noting that nesting in Texas has paralleled the trends observed in Mexico, characterized by a significant decline in 2010, followed by a second decline in 2013-2014, but with a rebound in 2015, the record nesting in 2017, and then a drop back down to 190 nests in 2019 (National Park Service data).

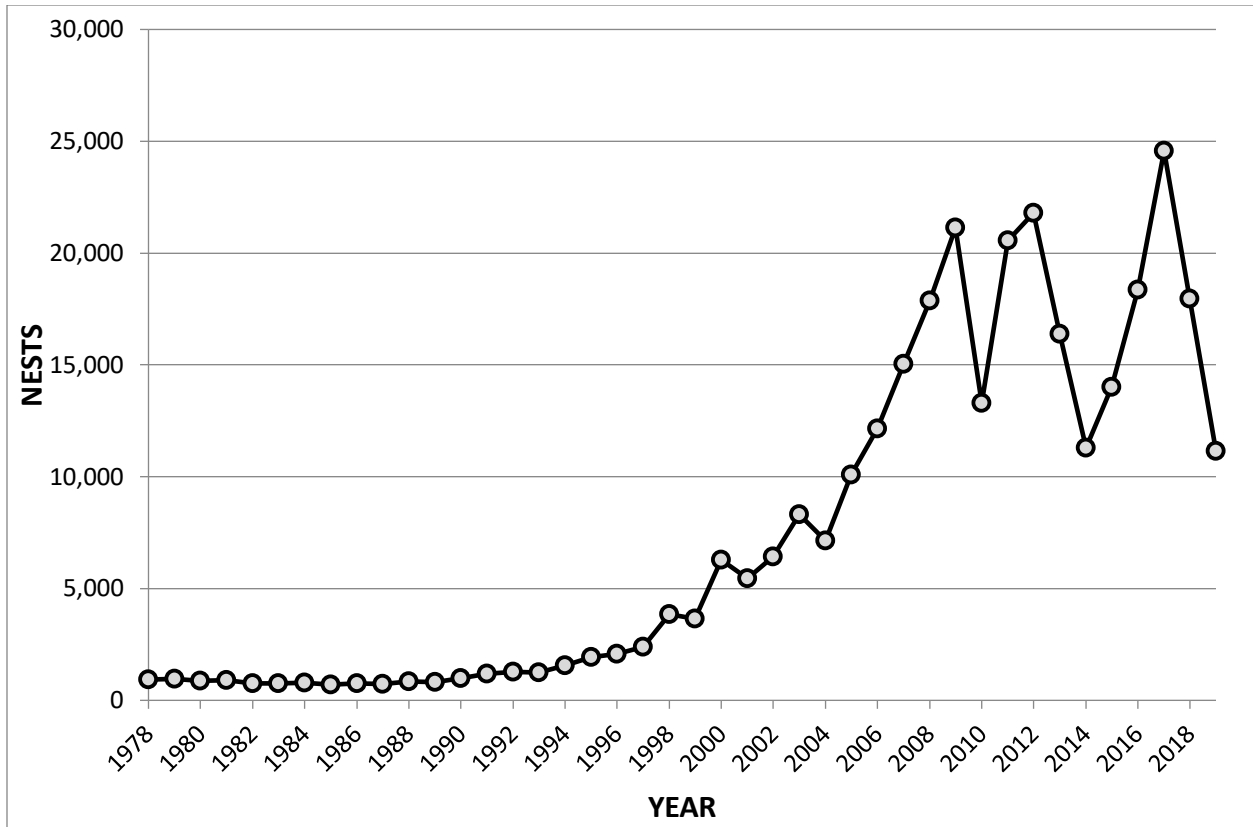


Figure 6. Kemp’s ridley nest totals from Mexican beaches (Gladys Porter Zoo nesting database 2019)

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

3.3.3.4 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*⁵ 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.

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

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

⁵ *Arribada* is the Spanish word for "arrival" and is the term used for massive synchronized nesting within the genus *Lepidochelys*.

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

In response to these strandings, and due to speculation that fishery interactions may be the cause, fishery observer effort was shifted to evaluate the inshore skimmer trawl fisheries beginning in 2012. During May-July of that year, observers reported 24 sea turtle interactions in the skimmer trawl fisheries. All but a single sea turtle were identified as Kemp's ridleys (1 sea turtle was an unidentified hardshell turtle). Encountered sea turtles were all very small juvenile specimens, ranging from 7.6-19.0 in (19.4-48.3 cm) curved carapace length (CCL). Subsequent years of observation noted additional captures in the skimmer trawl fisheries, including some mortalities. The small average size of encountered Kemp's ridleys introduces a potential conservation issue, as over 50% of these reported sea turtles could potentially pass through the maximum 4-in bar spacing of TEDs currently required in the shrimp fisheries. Due to this issue, a proposed 2012 rule to require 4-in bar spacing TEDs in the skimmer trawl fisheries (77 FR 27411) was not implemented. Following additional gear testing, however, we proposed a new rule in 2016 (81 FR 91097) to require TEDs with 3-inch (in) bar spacing for all vessels using skimmer trawls, pusher-head trawls, or wing nets. Ultimately, we published a final rule on December 20, 2019 (84 FR 70048), that requires all skimmer trawl vessels 40 feet and greater in length to use TEDs designed to exclude small sea turtles in their nets effective April 1, 2021. Given the nesting trends and habitat utilization of Kemp's ridley sea turtles, it is likely that fishery interactions in the Northern Gulf of Mexico may continue to be an issue of concern for the species, and one that may potentially slow the rate of recovery for Kemp's ridley sea turtles.

While oil spill impacts are discussed generally for all species in Section 3.3.1, specific impacts of the DWH oil spill event on Kemp's ridley sea turtles are considered here. Kemp's ridleys experienced the greatest negative impact stemming from the DWH oil spill event of any sea turtle species. Impacts to Kemp's ridley sea turtles occurred to offshore small juveniles, as well as large juveniles and adults. Loss of hatchling production resulting from injury to adult turtles was also estimated for this species. Injuries to adult turtles of other species, such as loggerheads, certainly would have resulted in unrealized nests and hatchlings to those species as well. Yet, the calculation of unrealized nests and hatchlings was limited to Kemp's ridleys for several reasons. All Kemp's ridleys in the Gulf belong to the same population (NMFS et al. 2011b), so total population abundance could be calculated based on numbers of hatchlings because all individuals that enter the population could reasonably be expected to inhabit the northern Gulf of Mexico throughout their lives (DWH Trustees 2016).

A total of 217,000 small juvenile Kemp's ridleys (51.5% of the total small juvenile sea turtle exposures to oil from the spill) were estimated to have been exposed to oil. That means approximately half of all small juvenile Kemp's ridleys from the total population estimate of 430,000 oceanic small juveniles were exposed to oil. Furthermore, a large number of small juveniles were removed from the population, as up to 90,300 small juveniles Kemp's ridleys are estimated to have died as a direct result of the exposure. Therefore, as much as 20% of the small oceanic juveniles of this species were killed during that year. Impacts to large juveniles (>3 years old) and adults were also high. An estimated 21,990 such individuals were exposed to oil (about 22% of the total estimated population for those age classes); of those, 3,110 mortalities were estimated (or 3% of the population for those age classes). The loss of near-reproductive and

reproductive-stage females would have contributed to some extent to the decline in total nesting abundance observed between 2011 and 2014. The estimated number of unrealized Kemp's ridley nests is between 1,300 and 2,000, which translates to between approximately 65,000 and 95,000 unrealized hatchlings (DWH Trustees 2016). This is a minimum estimate, however, because the sublethal effects of the DWH oil spill event on turtles, their prey, and their habitats might have delayed or reduced reproduction in subsequent years, which may have contributed substantially to additional nesting deficits observed following the DWH oil spill event. These sublethal effects could have slowed growth and maturation rates, increased remigration intervals, and decreased clutch frequency (number of nests per female per nesting season). The nature of the DWH oil spill event effect on reduced Kemp's ridley nesting abundance and associated hatchling production after 2010 requires further evaluation. It is clear that the DWH oil spill event resulted in large losses to the Kemp's ridley population across various age classes, and likely had an important population-level effect on the species. Still, we do not have a clear understanding of those impacts on the population trajectory for the species into the future.

3.3.4 Status of Loggerhead Sea Turtle – Northwest Atlantic DPS

The loggerhead sea turtle was listed as a threatened species throughout its global range on July 28, 1978. NMFS and USFWS published a Final Rule which designated 9 DPSs for loggerhead sea turtles (76 FR 58868, September 22, 2011, and effective October 24, 2011). This rule listed the following DPSs: (1) NWA (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 NWA DPS is the only one that occurs within the action area, and therefore it is the only one considered in this Opinion.

3.3.4.1 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 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 vertebrales, and a nuchal (precentral) scute that is in contact with the first pair of costal scutes (Dodd Jr. 1988).

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

The majority of loggerhead nesting occurs at the western rims of the Atlantic and Indian Oceans concentrated in the north and south temperate zones and subtropics (NRC 1990). For the NWA DPS, most nesting occurs along the coast of the United States, from southern Virginia to

Alabama. Additional nesting beaches for this DPS are found along the northern and western Gulf of Mexico, eastern Yucatán Peninsula, at Cay Sal Bank in the eastern Bahamas (Addison 1997; Addison and Morford 1996), off the southwestern coast of Cuba (Moncada Gavilan 2001), and along the coasts of Central America, Colombia, Venezuela, and the eastern Caribbean Islands.

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

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

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

3.3.4.2 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 zone⁶), (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 2008). Loggerheads are long-lived animals. They reach sexual maturity between 20-38 years of age, although age of maturity varies widely among populations (Frazer and Ehrhart 1985; NMFS 2001). The annual mating season occurs from late March to early June, and female turtles lay eggs throughout the summer months. Females deposit an average of 4.1 nests within a nesting season (Murphy and Hopkins 1984), but an individual female only nests every 3.7 years on average (Tucker 2010). Each nest contains an average of 100-126 eggs (Dodd Jr. 1988) which incubate for 42-75 days before hatching (NMFS and USFWS 2008). Loggerhead hatchlings are 1.5-2-in-long and weigh about 0.7 oz (20 g).

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

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

⁶ Neritic refers to the nearshore marine environment from the surface to the sea floor where water depths do not exceed 200 meters.

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 [GADNR], unpublished data; South Carolina Department of Natural Resources [SCDNR], 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 U.S., and along the north coast of Cuba (A. Bolten and K. Bjorndal, University of Florida, unpublished data). Moncada et al. (2010) report the recapture of 5 adult female loggerheads in Cuban waters originally flipper-tagged in Quintana Roo, Mexico, which indicates that Cuban shelf waters likely also provide foraging habitat for adult females that nest in Mexico.

3.3.4.3 Status and Population Dynamics

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

Numbers of nests and nesting females can vary widely from year to year. Nesting beach surveys, though, can provide a reliable assessment of trends in the adult female population, due to the strong nest site fidelity of female loggerhead sea turtles, as long as such studies are sufficiently long and survey effort and methods are standardized (e.g., (NMFS and USFWS 2008). NMFS and USFWS (2008) 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 PFRU is the largest loggerhead nesting assemblage in the Northwest Atlantic. A near-complete nest census (all beaches including index nesting beaches) undertaken from 1989 to 2007 showed an average of 64,513 loggerhead nests per year, representing approximately 15,735 nesting females per year (NMFS and USFWS 2008). The statewide estimated total for 2017 was 96,912 nests (FWRI nesting database).

In addition to the total nest count estimates, the Florida Fish and Wildlife Research Institute (FWRI) uses an index nesting beach survey method. The index survey uses standardized data-collection criteria to measure seasonal nesting and allow accurate comparisons between beaches and between years. This provides a better tool for understanding the nesting trends (Figure 7). FWRI performed a detailed analysis of the long-term loggerhead index nesting data (1989-2017; <http://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead-trend/>). Over that time period, 3 distinct trends were identified. From 1989-1998, there was a 24% increase that was followed by a sharp decline over the subsequent 9 years. A large increase in loggerhead nesting has

occurred since, as indicated by the 71% increase in nesting over the 10-year period from 2007 and 2016. Nesting in 2016 also represented a new record for loggerheads on the core index beaches. FWRI examined the trend from the 1998 nesting high through 2016 and found that the decade-long post-1998 decline was replaced with a slight but nonsignificant increasing trend. Looking at the data from 1989 through 2016, FWRI concluded that there was an overall positive change in the nest counts although it was not statistically significant due to the wide variability between 2012-2016 resulting in widening confidence intervals. Nesting at the core index beaches declined in 2017 to 48,033, and rose slightly again to 48,983 in 2018, and then to 53,507 in 2019, which is the 3rd highest total since 2001. However, it is important to note that with the wide confidence intervals and uncertainty around the variability in nesting parameters (changes and variability in nests/female, nesting intervals, etc.) it is unclear whether the nesting trend equates to an increase in the population or nesting females over that time frame (Ceriani, et al. 2019).

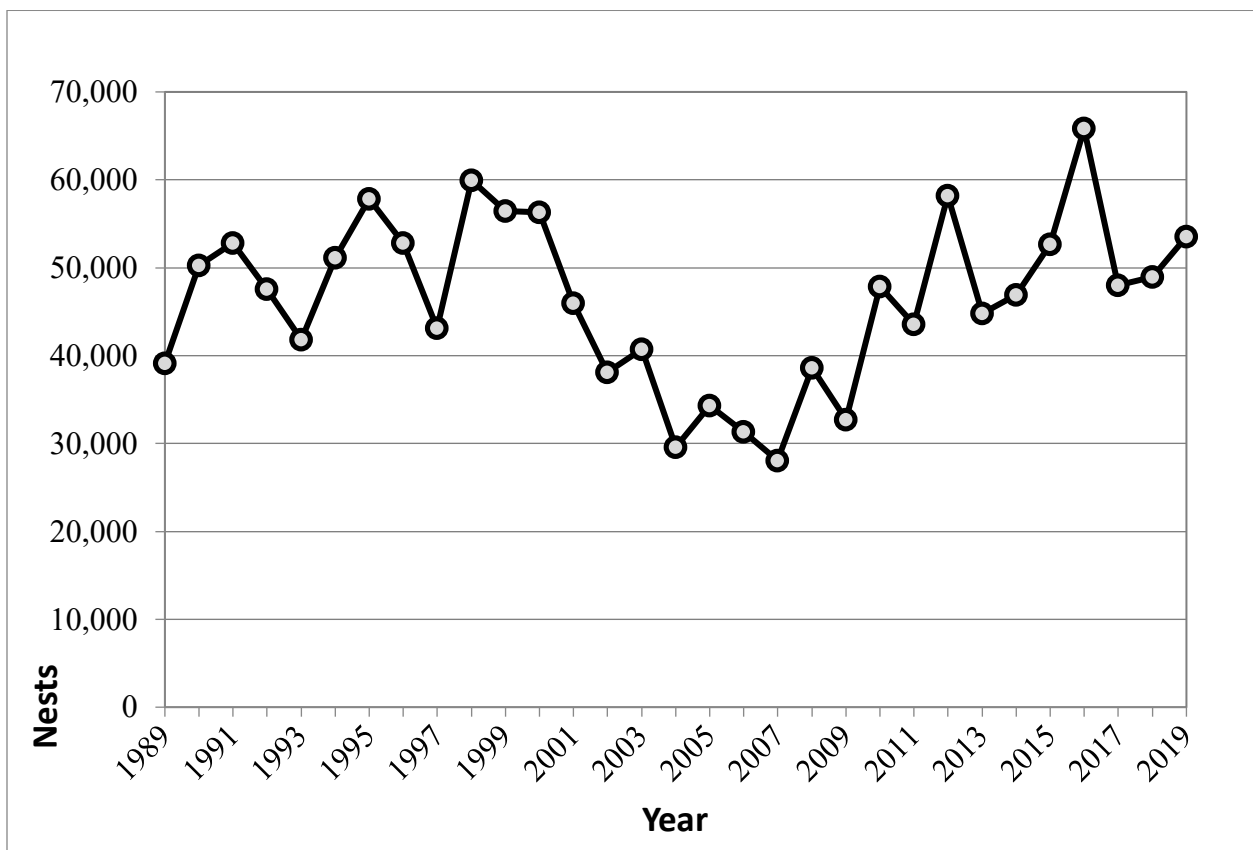


Figure 7. Loggerhead sea turtle nesting at Florida index beaches since 1989

Northern Recovery Unit

Annual nest totals from beaches within the NRU averaged 5,215 nests from 1989-2008, a period of near-complete surveys of NRU nesting beaches (GADNR unpublished data, North Carolina Wildlife Resources Commission [NCWRC] unpublished data, 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 5) are showing improved nesting numbers and a departure from the declining trend. Georgia nesting has rebounded to show the first statistically significant increasing trend since comprehensive nesting surveys began in 1989 (Mark Dodd, GADNR press release, <http://www.georgiawildlife.com/node/3139>). South Carolina and North Carolina nesting have also begun to shift away from the past declining trend. Loggerhead nesting in Georgia, South Carolina, and North Carolina all broke records in 2015 and then topped those records again in 2016. Nesting in 2017 and 2018 declined relative to 2016, back to levels seen in 2013 and 2015, but then bounced back in 2019, breaking records for each of the three states and the overall Recovery Unit.

Table 5. Total Number of NRU Loggerhead Nests (GADNR, SCDNR, and NCWRC nesting datasets compiled at Seaturtle.org)

Year	Georgia	South Carolina	North Carolina	Totals
2008	1,649	4,500	841	6,990
2009	998	2,182	302	3,472
2010	1,760	3,141	856	5,757
2011	1,992	4,015	950	6,957
2012	2,241	4,615	1,074	7,930
2013	2,289	5,193	1,260	8,742
2014	1,196	2,083	542	3,821
2015	2,319	5,104	1,254	8,677
2016	3,265	6,443	1,612	11,320
2017	2,155	5,232	1,195	8,582
2018	1,735	2,762	765	5,262
2019	3,945	8,774	2,291	15,010

South Carolina also conducts an index beach nesting survey similar to the one described for Florida. Although the survey only includes a subset of nesting, the standardized effort and locations allow for a better representation of the nesting trend over time. Increases in nesting were seen for the period from 2009-2013, with a subsequent steep drop in 2014. Nesting then rebounded in 2015 and 2016, setting new highs each of those years. Nesting in 2017 dropped back down from the 2016 high, but was still the second highest on record (Figure 8).

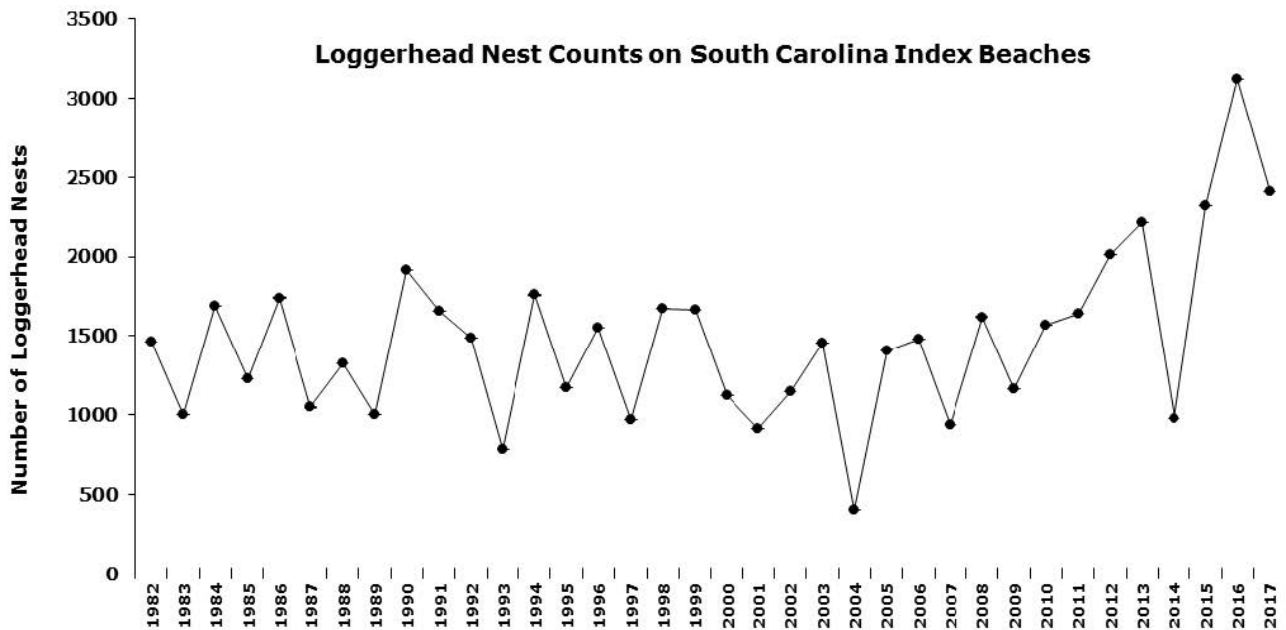


Figure 8. South Carolina index nesting beach counts for loggerhead sea turtles (from the SCDNR website: <http://www.dnr.sc.gov/seaturtle/nest.htm>)

Other Northwest Atlantic DPS Recovery Units

The remaining 3 recovery units—DTRU, NGMRU, and 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 2008). 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 2008). 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 2008).

3.3.4.4 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 (2008), caution about extrapolating localized in-water trends to the broader population and relating localized trends in neritic sites to population trends at nesting beaches. The apparent overall increase in the abundance of neritic loggerheads in the southeastern United States may be due to increased abundance of the largest oceanic/neritic juveniles (historically referred to as small benthic juveniles), which could indicate a relatively large number of individuals around the same age may mature in the near future (TEWG 2009). In-water studies throughout the eastern United States, however, indicate a substantial decrease in the abundance of the smallest oceanic/neritic juvenile loggerheads, a pattern corroborated by stranding data (TEWG 2009).

3.3.4.5 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 2009). The model uses the range of published information for the various parameters including mortality by stage, stage duration (years in a stage), and fecundity parameters such as eggs per nest, nests per nesting female, hatchling emergence success, sex ratio, and remigration interval. Resulting trajectories of model runs for each individual recovery unit, and the western North Atlantic population as a whole, were found to be very similar. The model run estimates from the adult female population size for the western North Atlantic (from the 2004-2008 time frame), suggest the adult female population size is approximately 20,000-40,000 individuals, with a low likelihood of females' numbering up to 70,000 (NMFS-SEFSC 2009). 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 2009). 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).

3.3.4.6 Threats

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. 2008) and metal loads (D'Ilio et al. 2011) in sampled tissues among the sea turtle species. It is thought that dietary preferences were likely to be the main differentiating factor among sea turtle species.

Storelli et al. (2008) analyzed tissues from stranded loggerhead sea turtles and found that mercury accumulates in sea turtle livers while cadmium accumulates in their kidneys, as has been reported for other marine organisms like dolphins, seals, and porpoises (Law et al. 1991).

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

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

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

3.4 Status of Smalltooth Sawfish

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

3.4.1 Species Description and Distribution

The smalltooth sawfish is a tropical marine and estuarine elasmobranch. It is a batoid with a long, narrow, flattened, rostral blade (rostrum) lined with a series of transverse teeth along either edge. In general, smalltooth sawfish inhabit shallow coastal waters of the Atlantic Ocean (Dulvy et al. 2016) and feed on a variety of fish (e.g., mullet, jacks, and ladyfish) (Poulakis et al. 2017; Simpfendorfer 2001).

Although this species is reported throughout the tropical Atlantic, NMFS identified smalltooth sawfish from the Southeast U.S. as a 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 U.S., smalltooth sawfish have historically been captured in estuarine and coastal waters from North Carolina southward through Texas, although peninsular Florida has been the region of the U.S. with the largest number of recorded captures (NMFS 2018). Recent records indicate there is a resident reproducing population of smalltooth sawfish in south and southwest Florida from Charlotte Harbor through the Florida Keys, which is also the last U.S. stronghold for the species (Poulakis and Seitz 2004; Seitz and Poulakis 2002; Simpfendorfer and Wiley 2005). Water temperatures (no lower than 8-12 degrees Celsius) 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 juveniles or adults (over 10 ft) that likely represent seasonal migrants, wanderers, or colonizers from a historical Florida core population to the south, rather than being members of a continuous, even-density population (Bigelow and Schroeder 1953).

3.4.2 Life History Information

Smalltooth sawfish mate in the spring and early summer (Grubbs unpublished data; Poulakis unpublished data). Fertilization is internal and females give birth to live young. Evidence suggests a gestation period of approximately 12 months and females produce litters of 7-14 young (Feldheim et al. 2017)(Gelsleichter unpublished data). Females have a biennial reproductive cycle (Feldheim et al. 2017) and parturition (act of giving birth) occurs nearly year round though peaking in spring and early summer (March – July) (Poulakis et al. 2011a)(Carlson unpublished data). Smalltooth sawfish are approximately 26-31 in (64-80 cm) at birth (Bethea et al. 2012; Poulakis et al. 2011a) and may grow to a maximum length of approximately 16 ft (500 cm) ((Brame et al. 2019). Simpfendorfer et al. (2008a) 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. Uncertainty remains in estimating post-juvenile growth rates and age at maturity;

yet, recent advances indicate maturity at 7-11 years (Carlson and Simpfendorfer 2015) at lengths of approximately 340 cm for males and 350-370 cm for females (Gelsleichter unpublished data).

There are distinct differences in habitat use based on life history stage as the species shifts use through ontogeny. Juvenile smalltooth sawfish less than 220 cm, inhabit the shallow euryhaline waters (i.e., variable salinity) of estuaries and can be found in sheltered bays, dredged canals, along banks and sandbars, and in rivers (NMFS 2000b). These juveniles are often closely associated with muddy or sandy substrates, and shorelines containing red mangroves, *Rhizophora mangle* (Hollensead et al. 2016; Hollensead et al. 2018; Poulakis et al. 2011a; Poulakis et al. 2013; Simpfendorfer 2001; Simpfendorfer 2003a; Simpfendorfer et al. 2010a). (Simpfendorfer et al. 2010a) indicated the smallest juveniles (young-of-the-year juveniles measuring < 100 cm in length) generally used the shallowest water (depths less than 0.5 m [1.64 ft]), had small home ranges (4,264-4,557 square meters), 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 2007b), 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 2006a). As juveniles increase in size, they begin to expand their home ranges (Simpfendorfer et al. 2010a; Simpfendorfer et al. 2011a), eventually moving to more offshore habitats where they likely feed on larger prey as they continue to mature.

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 et al. 2011a; Poulakis 2012b). These high-use 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. Juvenile 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. 2011a). 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. 2011a).

The juvenile “hotspots” may be of further significance following the findings of female philopatry (Feldheim et al. 2017). More specifically, Feldheim et al. (2017) found that female sawfish return to the same parturition (birthing) sites over multiple years (parturition site fidelity). NMFS expects that these parturition sites align closely with the juvenile “hotspots” given the high fidelity shown by the smallest size/age classes of sawfish to specific nursery areas. Therefore, disturbance of these nursery areas could have wide-ranging effects on the sawfish population if it were to disrupt future parturition.

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 (2004) 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 meters [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). Yet, current field studies show adult smalltooth sawfish also use shallow estuarine habitats within Florida Bay and the Everglades (Grubbs unpublished data). Further, NMFS expects that females return to shallow estuaries during parturition (when adult females return to shallow estuaries to give birth).

3.4.3 Status and Population Dynamics

Based on the contraction of the species' geographic range, we expect that the population to be a fraction of its historical size. However, few long-term abundance data exist for the smalltooth sawfish, making it very difficult to estimate the current population size. Despite the lack of scientific data, recent encounters with young-of-the-year, older juveniles, and sexually mature smalltooth sawfish indicate that the U.S. population is currently reproducing (Feldheim et al. 2017; Seitz and Poulakis 2002; Simpfendorfer 2003a). The abundance of juveniles publically encountered by anglers and boaters, including very small individuals, suggests that the population remains viable (Simpfendorfer and Wiley 2004), and data analyzed from Everglades National Park as part of an established fisheries-dependent monitoring program (angler interviews) indicated a slightly increasing trend in juvenile abundance within the park over the past decade (Carlson and Osborne 2012b; Carlson et al. 2007). Similarly, preliminary results of juvenile smalltooth sawfish sampling programs in both Everglades National Park and Charlotte Harbor indicate the juvenile population is at least stable and possibly increasing (Poulakis unpublished data, Carlson unpublished data).

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 rates⁷ of population increase, suggest that the species is particularly vulnerable to excessive mortality and rapid population declines, after which recovery may take decades. Carlson and Simpfendorfer (2015) constructed an age-structured Leslie matrix model for the U.S. population of smalltooth sawfish, using updated life history information, to determine the species' ability to recover under scenarios of variable life history inputs and the effects of bycatch mortality and catastrophes. As expected, population growth was highest ($\lambda=1.237$ year⁻¹) when age-at-maturity was 7 year and decreased to 1.150 year⁻¹ when age-at-maturity was 11 year. Despite a high level of variability throughout the model runs, in the absence of fishing mortality or catastrophic climate effects, the population grew at a relatively rapid rate approaching carrying capacity in 40 years when the initial population was set at 2,250 females or 50 years with an initial population of 600 females. Carlson and Simpfendorfer (2015) concluded that smalltooth sawfish in U.S. waters appear to have the ability to recover within the foreseeable future based on a model relying upon optimistic estimates of population size, lower age-at-maturity and the lower level of fisheries-related mortality. Another analysis was less optimistic based on lower estimates of breeding females in the Caloosahatchee River nursery (Chapman unpublished data). Assuming similar numbers of females among the 5 known nurseries, that

⁷ The rate at which a population increases in size if there are no density-dependent forces regulating the population

study would suggest an initial breeding population of only 140-390 females, essentially half of the initial population considered by Carlson and Simpfendorfer (2015). A smaller initial breeding population would extend the time to reach carrying capacity.

3.4.4 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 2010) 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 2001; 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 2010).

3.4.4.1 Bycatch Mortality

Bycatch mortality is cited as the primary cause for the decline in smalltooth sawfish in the U.S. (NMFS 2010). 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 2009). 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 pounds in 1949 to 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"⁸ (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 anglers. Encounter data (ISED 2014) and past research (Caldwell 1990) document that rostra are sometimes removed from smalltooth sawfish caught by recreational anglers, 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.

⁸ "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.

3.4.4.2 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 U.S. (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 U.S., of which approximately 2,450 ac were intertidal wetlands consisting of mangroves or other estuarine shrubs (Steadman 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 1995a; Reddering 1988a; 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 kinds of habitat losses or alternations, due to their affinity for shallow, estuarine systems. Prohaska et al. (2018) showed that juvenile smalltooth sawfish within the anthropogenically altered Charlotte Harbor estuary have higher metabolic stress compared to those collected from more pristine nurseries in the Everglades. 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.

3.4.4.3 Life History Limitations

The smalltooth sawfish is also limited by its life history characteristics as a relatively slow-growing, 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).

3.4.4.4 Stochastic Events

Although stochastic events such as aperiodic extreme weather and harmful algal blooms are expected to affect smalltooth, we are currently unsure of their impact. A strong and prolonged cold weather event in January 2010 resulted in the mortality of at least 15 juvenile and 1 adult sawfish (Poulakis et al. 2011a; Scharer et al. 2012), and led to far fewer catches in directed research throughout the remainder of the year (Bethea et al. 2011). Another less severe cold front

in 2011 did not result in any known mortality but did alter the typical habitat use patterns of juvenile sawfish within the Caloosahatchee River. Since surveys began, 2 hurricanes have made direct landfall within the core range of US sawfish. While these storms denuded mangroves along the shoreline and created hypoxic water conditions, we are unaware of any direct effects to sawfish. Just prior to the passage of the most recent hurricane (Hurricane Irma), acoustically tagged sawfish moved away from their normal shallow nurseries and then returned within a few days (Poulakis unpublished data; Carlson unpublished data). Harmful algal blooms have occurred within the core range of smalltooth sawfish and affected a variety of fauna including sea turtles, fish, and marine mammals, but to date no sawfish mortalities have been reported.

3.4.4.5 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 2010). 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 (IPCC) has stated that global climate change is unequivocal and its impacts to coastal resources may be significant (IPCC 2007; IPCC 2013). 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. Red mangroves and shallow, euryhaline waters will be directly impacted by climate change through sea level rise, which is expected to increase 0.45 to 0.75 m by 2100 (IPCC 2013). 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.

3.5 Potential Routes of Effect Likely to Adversely Affect Critical Habitat

We believe the proposed action is likely to adversely affect smalltooth sawfish designated critical habitat due to placement of the new seawall waterward of the existing seawall into water between mean high water (MHW) and 3 ft measured at mean lower low water (MLLW). We provide greater detail on the potential effect of this aspect of the proposed action to smalltooth sawfish designated critical habitat in the Effects of the Action section below (Section 5.4).

3.6 Status of Critical Habitat Likely to be Adversely Affected

3.6.1 Smalltooth Sawfish Critical Habitat

The U.S. DPS of smalltooth sawfish was listed as endangered on April 1, 2003; however, at that time, NMFS was unable to determine critical habitat. After funding additional studies necessary for the identification of specific habitats and environmental features important for the conservation of the species, establishing a smalltooth sawfish recovery team, and reviewing the best scientific data available, NMFS issued a Final Rule (74 Federal Register [FR] 45353; see also 50 CFR 226.218) to designate critical habitat for the U.S. DPS of smalltooth sawfish on September 2, 2009. Through the additional studies, researchers identified 2 primary nursery areas in southwest Florida and centered the critical habitat designations around these nurseries. The critical habitat consists of 2 units located along the southwestern coast of Florida: the CHEU, which is comprised of approximately 221,459 ac (346 square miles [mi²]) of coastal habitat, and the Ten Thousand Islands/Everglades Unit (TTIEU), which is comprised of approximately 619,013 ac (967 mi²) of coastal habitat.

3.6.2 Critical Habitat Unit Affected by this Action

This consultation focuses on an activity occurring in the CHEU, which encompasses portions of Charlotte and Lee Counties (Figure 9). The CHEU is comprised of Charlotte Harbor, Gasparilla Sound, Matlacha Pass, Pine Island Sound, San Carlos Bay, and Estero Bay. The unit is fed by the Myakka and Peace Rivers to the north and the Caloosahatchee River to the east. A series of passes between barrier islands connect the CHEU with the Gulf of Mexico. The CHEU is a relatively shallow estuary with large areas of submerged aquatic vegetation (SAV), oyster bars, saltwater marsh, freshwater wetlands, and mangroves. Freshwater flows from the Caloosahatchee River are controlled by the Franklin Lock and Dam, which periodically releases water, which thereby affects downstream salinity regimes. The CHEU boundaries are defined in detail in the Final Rule (74 FR 45353; see also 50 CFR 226.218).

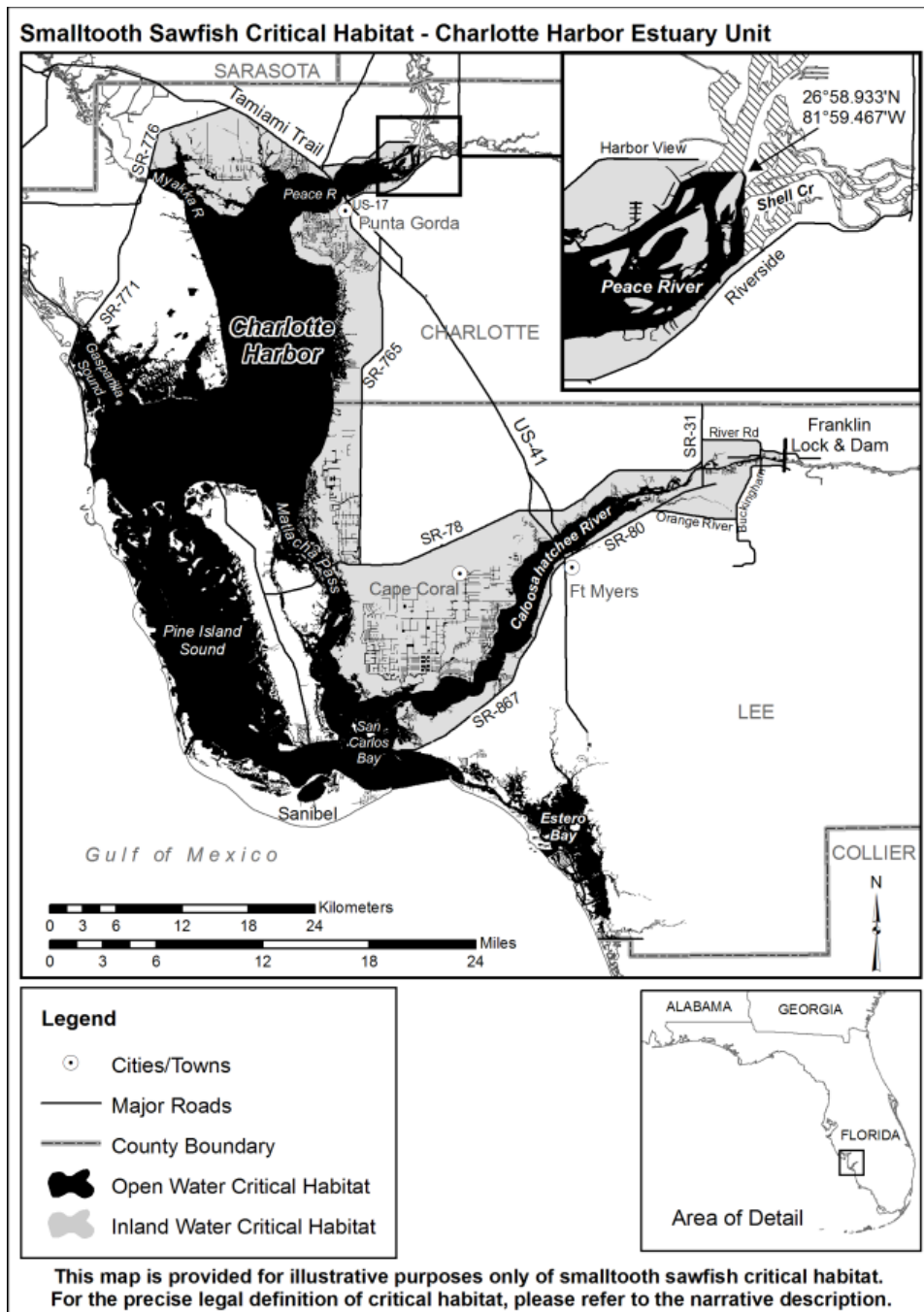


Figure 9. Map of smalltooth sawfish critical habitat – Charlotte Harbor Estuary Unit

3.6.2.1 Essential Features of Critical Habitat

The recovery plan developed for the smalltooth sawfish, which represents NMFS’s best judgment about the objectives and actions necessary for the species’ recovery, identified a need to increase the number of juvenile smalltooth sawfish developing into adulthood by protecting or restoring nursery habitat (NMFS 2009). NMFS determined that without sufficient habitat, the population was unlikely to increase to a level associated with low extinction risk and de-listing. Therefore, within the 2 critical habitat units NMFS identified 2 habitat features essential for the

conservation of this species: (1) red mangroves, and (2) shallow, euryhaline habitats characterized by water depths between MHW and 3 ft (0.9 m) measured at MLLW (Final Rule, 74 FR 45353). These essential features of critical habitat provide juveniles refuge from predation and forage opportunities within their nursery habitat. One or both of these essential features must be present in an action area for it to function as critical habitat for smalltooth sawfish.

3.6.2.2 Habitat Use

Juvenile smalltooth sawfish, identified as those up to 3 years of age or approximately 8 ft (2.4 m) in length (Simpfendorfer et al. 2008b), inhabit the shallow waters of estuaries and can be found in sheltered bays, dredged canals, along banks and sandbars, and in rivers (NMFS 2000a). 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 (Simpfendorfer 2001; 2003b). The structural complexity of red mangrove prop roots creates a unique habitat used by a variety of fish, invertebrates, and birds. Juvenile smalltooth sawfish, particularly young-of-the-year (YOY) (measuring less than 39.4 inches (in) [100 centimeters (cm)] in length), use these areas as both refuge from predators and forage grounds, taking advantage of the large number of fish and invertebrates found there.

Tracking data from the Caloosahatchee River in Florida indicate very shallow depths and specific salinity ranges are important abiotic factors influencing juvenile smalltooth sawfish movement patterns, habitat use, and distribution (Simpfendorfer et al. 2011b). An 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 (Simpfendorfer et al. 2010b). Juvenile smalltooth sawfish spend the majority of their time in waters shallower than 13 ft (4 m) deep (Simpfendorfer et al. 2010b) and are seldom found deeper than 32 ft (10 m) (Poulakis and Seitz 2004). Simpfendorfer et al. (2010b) also indicated the following developmental differences in habitat use: the smallest YOY juveniles generally used water shallower than 1.6 ft (0.5 m), had small home ranges, 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 2007a), they undergo small movements coinciding with changing tidal stages. These movements often involve moving from shallow sandbars at low tide and among red mangrove prop roots at higher tides (Simpfendorfer et al. 2010b), behavior likely to reduce the risk of predation (Simpfendorfer 2006b). As juveniles increase in size, they begin to expand their home ranges (Simpfendorfer et al. 2010b; Simpfendorfer et al. 2011b), 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 capture rates during random sampling events within the estuary (Poulakis 2012a; Poulakis et al. 2011b). The areas, which were termed “hotspots” in Poulakis et al. (2011), correspond with areas where public encounters are most frequently reported. Use of these “hotspots” can be variable within and among years based on the amount and timing of freshwater inflow. Smalltooth sawfish use “hotspots” further upriver during drought (i.e., high salinity) conditions and areas

closer to the mouth of the Caloosahatchee River during times of high freshwater inflow (Poulakis et al. 2011b). At this time, researchers are unsure what specific biotic (e.g., presence or absence of predators and prey) or abiotic factors (e.g., flow rate, water temperature, etc.) influence this habitat selection. Still, they believe a variety of conditions in addition to salinity, such as temperature, dissolved oxygen, water depth, shoreline vegetation, and food availability, may influence smalltooth sawfish habitat selection (Poulakis et al. 2011b).

3.6.2.3 Status and Threats to Critical Habitat

Modification and loss of smalltooth sawfish critical habitat is an ongoing threat contributing to the current status 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 (South Atlantic Fishery Management Council 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; USFWS 1999). Since then, rates of loss have decreased even though habitat loss continues. Between 1998 and 2004, approximately 2,450 ac (3.8 mi²) of intertidal wetlands consisting of mangroves or other estuarine shrubs were lost along the Atlantic and Gulf coasts of the United States (Stedman and Dahl 2008). In another study, Orlando Jr. et al. (1994) analyzed 18 major southeastern estuaries and recorded over 703 mi (1,131 kilometers [km]) of navigation channels and 9,844 mi (15,842 km) of shoreline with modifications. Additionally, changes to the natural freshwater flows into estuarine and marine waters through construction of canals and other water-control devices have altered the temperature, salinity, and nutrient regimes, reduced both wetlands and SAV coverage, and degraded vast areas of coastal habitat utilized by smalltooth sawfish (Gilmore 1995b; Quigley and Flannery 2002; Reddering 1988b; Whitfield and Bruton 1989). Juvenile sawfish and their critical habitat are particularly vulnerable to these kinds of habitat losses or alterations due to the juveniles' affinity for (and developmental need of) 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 in the future.

In Florida, coastal development often involves the removal of mangroves, the armoring of shorelines through seawall construction, and the dredging of canals. This is especially apparent in master plan communities such as Cape Coral and Punta Gorda which are located within the Charlotte Harbor Estuary. These communities were created through dredge-and-fill projects to increase the amount of waterfront property available for development, but in doing so, developers removed the majority of red mangrove habitat from the area. The canals created by these communities require periodic dredging for boat access, further affecting the shallow, euryhaline essential feature of critical habitat. Development continues along the shorelines of Charlotte Harbor in the form of docks, boat ramps, shoreline armoring, utility projects, and navigation channel dredging.

To protect critical habitat, federal agencies must ensure that their activities are not likely to result in the destruction or adverse modification of the physical and biological features that are essential to the conservation of sawfish, or the species' ability to access and use these features (ESA Section 7(a)(2); see also 50 CFR 424.12(b) [discussing essential features]). Therefore, proposed actions that may impact critical habitat require an analysis of potential impacts to each

essential feature. As mentioned previously, there are 2 essential features of smalltooth sawfish critical habitat: (1) red mangroves; and (2) shallow, euryhaline habitats characterized by water depths between the MHW and 3 ft (0.9 m) measured at MLLW. The USACE oversees the permitting process for residential and commercial marine development in the CHEU. The Florida Department of Environmental Protection and their designated authorities also regulate mangrove removal in Florida. All red mangrove removal permit requests within smalltooth sawfish critical habitat necessitate ESA Section 7 consultation. NMFS Protected Resources Division tracks the loss of these essential features of smalltooth sawfish critical habitat.

3.6.2.4 Threats to Critical Habitat

Dock and Boat Ramp Construction

The USACE recommends that applicants construct docks in accordance with the NMFS-USACE *Dock Construction Guidelines in Florida for Docks or Other Minor Structures Constructed in or over Submerged Aquatic Vegetation (SAV), Marsh, or Mangrove Habitat* (“Dock Construction Guidelines”) when possible. The current dock construction guidelines allow for some amount of mangrove removal; however, it is typically restricted to either (1) trimming to facilitate a dock, or (2) complete removal up to the width of the dock extending toward open water, which the guidelines define as a width of 4 ft.

Installation or replacement of boat ramps is often part of larger projects such as marinas, bridge approaches, and causeways where natural and previously created deepwater habitat access channels already exist. Boat ramps can result in the permanent loss of both the red mangrove and the shallow, euryhaline habitat features of critical habitat for smalltooth sawfish.

Marina Construction

Marinas have the potential to adversely affect aquatic habitats. Marinas are typically designed to be deeper than 3 ft MLLW to accommodate vessel traffic; therefore, most existing marinas lacking essential features are unlikely to function as critical habitat for smalltooth sawfish. The expansion of existing marinas and creation of new marinas can result in the permanent loss of large areas of this nursery habitat.

Bulkhead and Seawall Construction

Bulkheads and other shoreline stabilization structures are used to protect adjacent shorelines from wave and current action and to enhance water access. These projects may adversely impact critical habitat for smalltooth sawfish by removal of the essential features through direct filling and dredging to construct vertical or riprap seawalls. Generally, vegetation plantings, sloping riprap, or gabions are environmentally-preferred shoreline stabilization methods instead of vertical seawalls because they provide better quality fish and wildlife habitat. Nevertheless, placement of riprap material removes more of the shallow euryhaline essential feature than a vertical seawall. Also, many seawalls built along unconsolidated shorelines require the removal of red mangroves to accommodate the seawalls.

Cable, Pipeline, and Transmission Line Construction

While not as common as other activities, excavation of submerged lands is sometimes required for installing cables, pipelines, and transmission lines. Construction may also require temporary or permanent filling of submerged habitats. Open-cut trenching and installation of aerial transmission line footers are activities that have the ability to temporarily or permanently impact critical habitat for smalltooth sawfish.

Transportation Infrastructure Construction

Potential adverse effects from federal transportation projects in smalltooth sawfish critical habitat (CHEU) include operations of the Federal Highway Administration, USACE, and the Federal Emergency Management Agency. Construction of road improvement projects typically follow the existing alignments and expand to compensate for the increase in public use. Transportation projects may impact critical habitat for smalltooth sawfish through installation of bridge footers, fenders, piles, and abutment armoring, or through removal of existing bridge materials by blasting or mechanical efforts.

Dredging

Riverine, nearshore, and offshore areas are dredged for navigation, construction of infrastructure, and marine mining. An analysis of 18 major southeastern estuaries conducted in 1993-1994 demonstrated that over 7,000 km of navigation channels have already been dredged (Orlando Jr. et al. 1994). Habitat effects of dredging include the loss of submerged habitats by disposal of excavated materials, turbidity and siltation effects, contaminant release, alteration of hydrodynamic regimes, and fragmentation of physical habitats (Gulf of Mexico Fishery Management Council 1998; Gulf of Mexico Fishery Management Council 2005; South Atlantic Fishery Management Council 1998). In the CHEU, dredging to maintain canals and channels constructed prior to the critical habitat designation, limits the amount of available shallow, euryhaline essential feature to the edges of waterways and these dredging activities can disturb juveniles that are using these areas. At the time of critical habitat designation, many previously dredged channels and canals existed within the boundaries of the critical habitat units; however, we are unsure which of those contained the shallow-water essential feature at that time. It is likely that many of these channels and canals were originally dredged deeper than 3 ft MLLW, but they have since shoaled in and now contain the essential feature of shallow, euryhaline habitat. Therefore, maintenance dredging impacts are counted as a loss to this essential feature, even though the areas may or may not have contained the essential feature at time of designation (see Figure 10, Diagrams A and B).

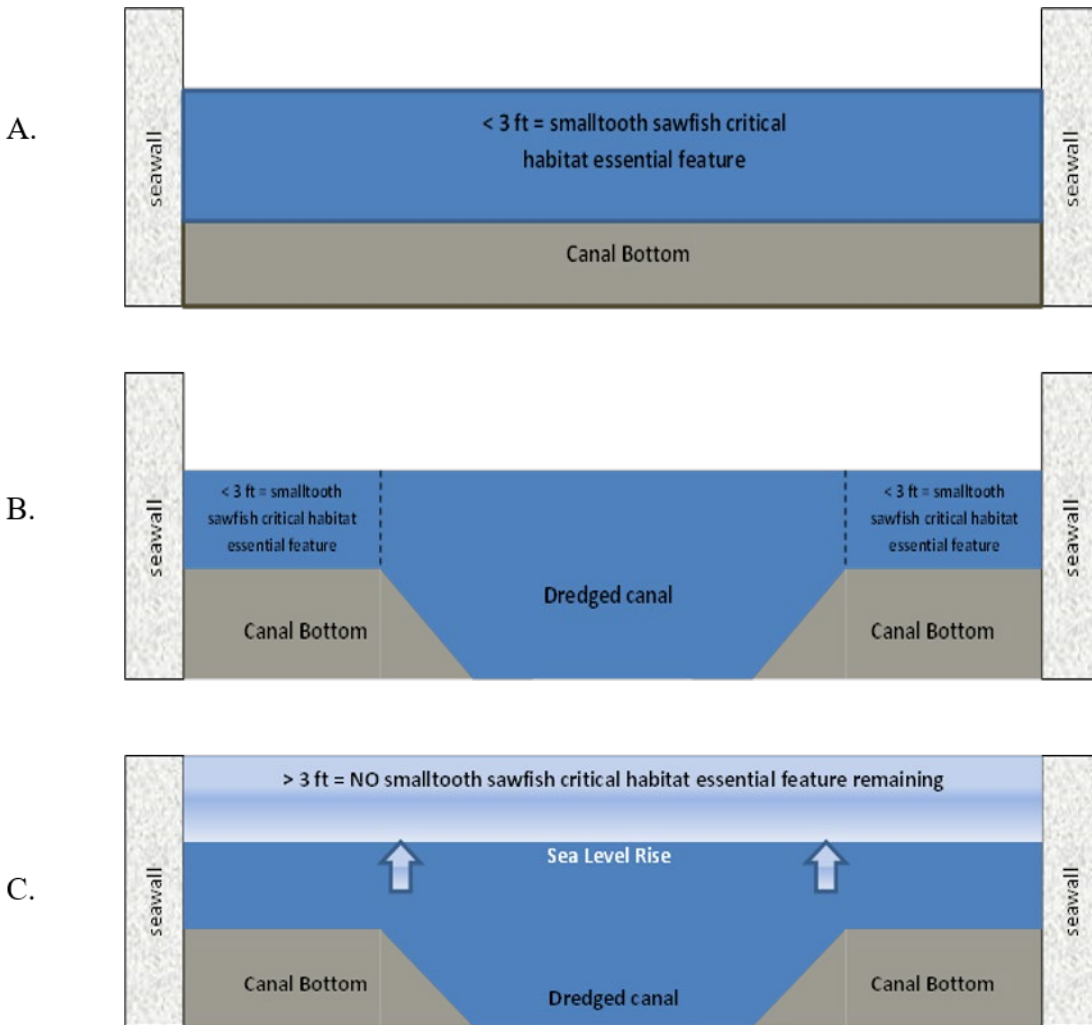


Figure 10. Diagram A depicts a cross section of a historically dredged channel/canal within the boundaries of the critical habitat units that has not been maintained. Diagram B depicts the typical cross section of a maintenance-dredged channel/canal. Diagram C depicts a cross section of a maintained dredged channel/canal after sea level rise of > 1 ft.

Construction, Operations and Maintenance of Impoundments and Other Water Level Controls

Federal agencies such as the USACE have historically been involved in large water control projects in Florida. Agencies sometimes propose impounding rivers and tributaries for such purposes as flood control, salt water intrusion prevention, or creation of industrial, municipal, and agricultural water supplies. Projects to repair or replace water control structures may affect smalltooth sawfish critical habitat by limiting sufficient freshwater discharge, which could alter the salinity of estuaries. The ability of an estuary to function as a nursery depends upon the quantity, timing, and input location of freshwater inflows (Garmestani and Percival 2005; Norton et al. 2012; USEPA 1994). Estuarine ecosystems are vulnerable to the following man-made disturbances: (1) decreases in seasonal inflow caused by the removal of freshwater upstream for agricultural, industrial, and domestic purposes; (2) contamination by industrial and sewage discharges; (3) agricultural runoff carrying pesticides, herbicides, and other toxic pollutants; and

(4) eutrophication (e.g., influx of nutrients such as nitrates and phosphates most often from fertilizer runoff and sewage) caused by excessive nutrient inputs from a variety of nonpoint and point sources. Additionally, rivers and their tributaries are susceptible to natural disturbances, such as floods and droughts, whose effects can be exacerbated by these man-made disturbances.

As stated above, smalltooth sawfish show an affinity for a particular salinity range, moving downriver during wetter months and upriver during drier months to remain within that range (Simpfendorfer et al. 2011b). Therefore, water management decisions that affect salinity regimes may impact the functionality of critical habitat. This may result in smalltooth sawfish following specific salinity gradients into less advantageous habitats (e.g., areas with less shallow-water or red mangrove habitat). Furthermore, large changes in water flow over short durations would likely escalate movement patterns for smalltooth sawfish, thereby increasing predation risk and energy output. Researchers are currently looking into the effects of large-scale freshwater discharges on smalltooth sawfish and their designated critical habitat. The most vulnerable portion of the juvenile sawfish population to water-management outfall projects appears to be smalltooth sawfish in their first year of life. Newborn smalltooth sawfish remain in smaller areas irrespective of salinity, which potentially exposes them to greater osmotic stress (a sudden change in the solute concentration around a cell, causing a rapid change in the movement of water across its cell membrane), and impacts the nursery functions of sawfish critical habitat (Poulakis et al. 2013; Simpfendorfer et al. 2011b).

Climate Change Threats

The Intergovernmental Panel on Climate Change (IPCC) has stated that global climate change is unequivocal and its impacts to coastal resources may be significant (Intergovernmental Panel on Climate Change 2007). There is a large and growing body of literature on past, present, and future impacts of global climate change induced by human activities (i.e., global warming mostly driven by the burning of fossil fuels). The latest report by the Intergovernmental Panel on Climate Change (2013) is more explicit, stating that, “science now shows with 95% certainty that human activity is the dominant cause of observed warming since the mid-twentieth century.” Some of the anticipated outcomes are sea level rise, increased frequency of severe weather events, and changes in air and water temperatures. NOAA’s climate change web portal provides information on the climate-related variability and changes that are exacerbated by human activities (<http://www.climate.gov/#understandingClimate>).

Though the impacts on smalltooth sawfish cannot, for the most part, be predicted with any degree of certainty, we can project some effects to sawfish critical habitat. We know that both essential features (red mangroves and shallow, euryhaline waters less than 3 ft deep at MLLW) will be impacted by climate change. Sea level rise is expected to exceed 3.3 ft (1 m) globally by 2100, according to the most recent publications, exceeding the estimates of the Fourth Assessment of the IPCC (Meehl et al. 2007; Pfeffer et al. 2008; Rahmstorf et al. 2007). Mean sea level rise projections have increased since the Fourth Assessment because of the improved physical understanding of the components of sea level, the improved agreement of process-based models with observations, and the inclusion of ice-sheet dynamical changes (Intergovernmental Panel on Climate Change 2013). A 1-m sea level rise in the state of Florida is within the range of recent estimates by 2080 (Pfeffer et al. 2008; Rahmstorf et al. 2007).

Sea level increases would affect the shallow-water essential feature of smalltooth sawfish critical habitat within the CHEU. A 2010 climate change study by the Massachusetts Institute of Technology (MIT) forecasted sea level rise in a study area with significant overlap with the CHEU (Vargas-Moreno and Flaxman 2010). The study investigated possible trajectories of future transformation in Florida's Greater Everglades landscape relative to 4 main drivers: climate change, shifts in planning approaches and regulations, population change, and variations in financial resources. MIT used (Intergovernmental Panel on Climate Change 2007) sea level modeling data to forecast a range of sea level rise trajectories from low, to moderate, to high predictions (Figure 11). The effects of sea level rise on available shallow-water habitat for smalltooth sawfish would be exacerbated in areas where there is shoreline armoring (e.g., seawalls). This is especially true in canals where the centerlines are maintenance-dredged deeper than 3 ft (0.9 m) for boat accessibility. In these areas, the areas that currently contain the essential feature depth (less than 3 ft at MLLW) will be reduced along the edges of the canals as sea level rises (see previous Figure 10, Diagram C).

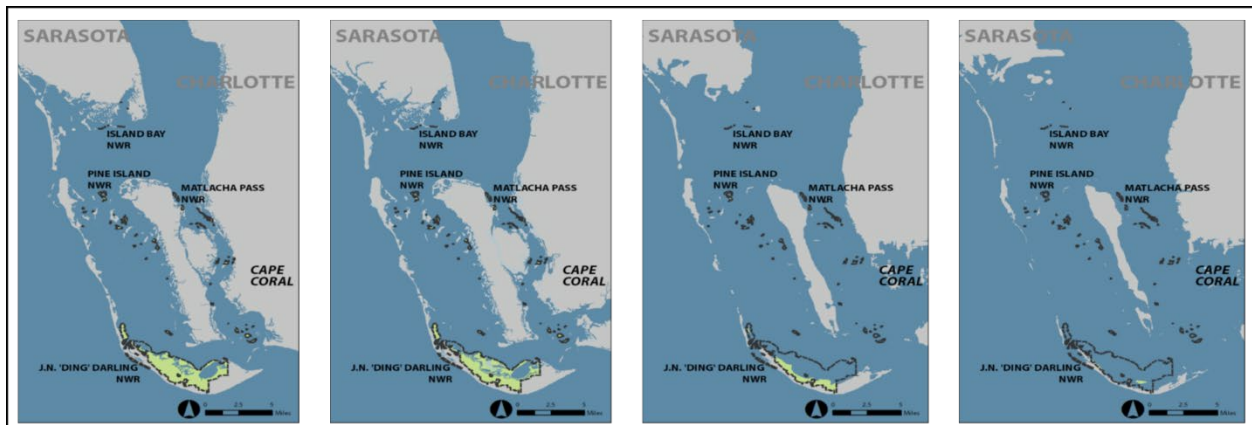


Figure 11. From left to right: current shoreline, + 3.5 in (+ 9 cm); + 18.5 in (+ 47 cm); and + 38.97 in (+ 99 cm) sea level rise by 2060.⁹

Along the Gulf Coast of Florida, and south Florida in particular, rises in sea level will impact mangrove resources. As sea levels rise, mangroves will be forced landward in order to remain at a preferred water inundation level and sediment surface elevation, which is necessary for successful growth. This retreat landward will not keep pace with conservative projected rates of elevation in sea level (Gilman et al. 2008). This forced landward progression poses the greatest threat to mangroves in areas where there is limited or no room for landward or lateral migration (Semeniuk 1994). Such is the case in areas of the CHEU where landward mangrove growth is restricted by shoreline armoring and coastal development. This man-made barrier will prohibit mangroves from moving landward and will result in the loss of the mangrove essential feature.

Other threats to mangroves result from climate change: fluctuations in precipitation amounts and distribution, seawater temperature, carbon dioxide (CO₂) levels, and damage to mangroves from

⁹ Adapted from Vargas-Moreno, J. C., and M. Flaxman. 2010. Addressing the challenges of climate change in the greater everglades landscape. Massachusetts Institute of Technology, Department of Urban Studies and Planning. Project Sheet November, 2010, Cambridge, MA.

increasingly severe storms and hurricanes (McLeod and Salm 2006). A 25% increase in precipitation globally is predicted by 2050 (McLeod and Salm 2006), but the specific geographic distribution will vary, leading to increases and decreases in precipitation at the regional level. Changes in precipitation patterns caused by climate change may adversely affect the growth of mangroves and their distribution (Field 1995; Snedaker 1995). Decreases in precipitation will increase salinity and inhibit mangrove productivity, growth, seedling survival, and spatial coverage (Burchett et al. 1984). Decreases in precipitation may also change mangrove species composition, favoring more salt-tolerant types (Ellison 2010). Increases in precipitation may benefit some species of mangroves, increasing spatial coverage and allowing them to out-compete other salt marsh vegetation (Harty 2004). Even so, potential mangrove expansion requires suitable habitat for mangroves to increase their range, which depends to a great extent on patterns and intensity of coastal development (i.e., bulkhead and seawall construction).

Seawater temperature changes will have potential adverse effects on mangroves as well. Many species of mangroves show an optimal shoot density in sediment temperatures between 59-77 degrees Fahrenheit (°F) (15-25 degrees Celsius [°C]) (Hutchings and Saenger 1987). Yet, at temperatures between 77-95°F (25-35°C), many species begin to show a decline in leaf structure and root and leaf formation rates (Saenger and Moverley 1985). Temperatures above 95°F lead to adverse effects on root structure and survivability of seedlings (UNESCO 1991) and temperatures above 100.4°F (38°C) lead to a cessation of photosynthesis and mangrove mortality (Andrews et al. 1984). Although impossible to forecast precisely, sea surface ocean temperatures are predicted to increase 1.8-3.6°F (1-2°C) by 2060 (Chapter 11 (Intergovernmental Panel on Climate Change 2013)), which will in turn impact underlying sediment temperatures along the coast. If mangroves shift pole-ward in response to temperature increases, they will at some point be limited by temperatures at the lower end of their optimal range and available recruitment area. This is especially true when considering already armored shorelines in residential communities such as those within and surrounding the CHEU of critical habitat for smalltooth sawfish.

As atmospheric CO₂ levels increase, mostly resulting from manmade causes (e.g., burning of fossil fuels), the world's oceans will absorb much of this CO₂, causing potential increases in photosynthesis and mangrove growth rates. This increase in growth rate, however, would be limited by lower salinities expected from CO₂ absorption in the oceans (Ball et al. 1997), and by the availability of undeveloped coastline for mangroves to expand their range. A secondary effect of increased CO₂ concentrations in the oceans is the deleterious effect on coral reefs' ability to absorb calcium carbonate (Hoegh-Guldberg et al. 2007), and subsequent reef erosion. Eroded reefs may not be able to buffer mangrove habitats from waves, especially during storm/hurricane events, causing additional physical effects.

Finally, the anticipated increase in the severity of storms and hurricanes may also impact mangroves. Tropical storms are expected to increase in intensity and/or frequency, which will directly impact existing mangroves that are already adversely impacted by increased seawater temperatures, CO₂, and changes in precipitation (Cahoon et al. 2003; Trenberth 2005). The combination of all of these factors may lead to reduced mangrove height (Ning et al. 2003). Further, intense storms could result in more severe storm surges and lead to potential changes in mangrove community composition, mortality, and recruitment (Gilman et al. 2006). Increased

storm surges and flooding events could also affect mangroves' ability to photosynthesize (Gilman et al. 2006) and the oxygen concentrations in the mangrove lenticels (Ellison 2010).

4. ENVIRONMENTAL BASELINE

By regulation (50 CFR 402.02), environmental baselines for Opinions refer to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to the listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline.

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

Focusing on the current state of critical habitat is important because in some areas critical habitat features will commonly exhibit, or be more susceptible to, adverse responses to stressors than they would be in other areas, or may have been exposed to unique or disproportionate stresses. 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 the Species within the Action Area

Based on STSSN recreational hook-and-line capture and entanglement data, we believe green sea turtle (NA and SA DPSs), Kemp's ridley sea turtle, and loggerhead sea turtle (NWA DPS) may be in the action area and may be adversely affected by recreational hook-and-line fishing that will occur at the pier upon completion of the proposed action. All of these sea turtle species are migratory, traveling to forage grounds or for reproduction purposes. The Gulf of Mexico waters within the action area are likely used by these species of sea turtle for nearshore reproductive, developmental, and foraging habitat. NMFS believes that no individual sea turtle is likely to be a permanent resident of the action area, although some individuals may be present at any given time. These same individuals will migrate into offshore waters of the Gulf of Mexico, Caribbean Sea, and other areas of the North Atlantic Ocean at certain times of the year, and thus may be affected by activities occurring there. Therefore, the status of the sea turtles species in the action area are considered the same as those discussed in Sections 3.3.1-3.3.4. There have been no reported recreational hook-and-line capture of a sea turtle at the Charlotte Harbor Fishing Pier according to STSSN data for the years 2007-2016.

The Charlotte Harbor Fishing Pier currently has sawfish educational signs posted in visible locations; however, no reported sightings or recreational hook-and-line captures of smalltooth sawfish have ever occurred. NMFS believes that no individual smalltooth sawfish is likely to be a permanent resident of the action area. Because the action area is located within the boundary of the CHEU of smalltooth sawfish designated critical habitat and both essential features are present, some individuals may be present at any given time and may be adversely affected by recreational fishing that will occur at the pier upon completion of the reconfiguration. These same individuals will migrate into coastal and offshore waters of the Gulf of Mexico and potentially areas of the North Atlantic Ocean, and thus may be affected by activities occurring there. Therefore, the status of smalltooth sawfish in the action area is considered to be the same as those discussed in Section 3.4.

4.2 Status of the Critical Habitat within the Action Area

The action area is located in Lee County, Florida, within the boundaries of the CHEU of smalltooth sawfish designated critical habitat at an existing commercial marina with a public boat ramp, docks, and a recreational fishing pier. Water depths in the action area are 2-6 ft at MLW. There are red mangroves along the shoreline of the south side of the Seaport; however, the USACE states that no red mangroves will be affected by the proposed action. The project site is located within the Pine Island Sound Aquatic Preserve in the Charlotte Harbor Preserve State Park (CHPSP) system. The CHPSP system is comprised of 43,000 ac and protects 80 mi of shoreline habitat along the Charlotte Harbor estuaries in Charlotte and Lee Counties, Florida, providing a natural buffer between the aquatic preserves and urban development and agriculture (Florida Department of Environmental Protection 2017). Therefore, the status of smalltooth sawfish designated critical habitat in the action area is considered to be the same as those discussed in Section 3.6.

4.3 Factors Affecting the Species and Critical Habitat within the Action Area

4.3.1 Federal Actions

We have consulted on several USACE shoreline stabilization and overwater construction projects in the greater area where the project is located since the effective date of critical habitat designation (i.e., October 2, 2009). However, other than the proposed action, no other federally permitted projects are known to have occurred or have had effects to green sea turtle (NA and SA DPSs), Kemp's ridley sea turtle, loggerhead sea turtle (NWA DPS), smalltooth sawfish, or smalltooth sawfish designated critical habitat within the action area, as per a review of the NMFS Protected Resources Division's completed consultation database by the consulting biologist on September 23, 2020 (data through December 31, 2018).

4.3.2 State or Private Actions

4.3.2.1 Recreational Fishing

Recreational fishing as regulated by the State of Florida can affect green sea turtle (NA and SA DPSs), Kemp's ridley sea turtle, loggerhead sea turtle (NWA DPS), and smalltooth sawfish within the action area. Pressure from recreational fishing in and adjacent to the action area is likely to continue.

Observations of state recreational fisheries have shown that loggerhead sea turtles are known to bite baited hooks and frequently ingest the hooks. Overall, hooked sea turtles have been reported to the STSSN by the public fishing from boats, piers, and beach, banks, and jetties and from commercial anglers fishing for reef fish and for sharks with both single rigs and bottom longlines (NMFS 2001). Additionally, lost fishing gear such as line cut after snagging on rocks, or discarded hooks and line, can also pose an entanglement threat to sea turtles in the area. A detailed summary of the known impacts of hook-and-line incidental captures to Kemp's ridley and loggerhead sea turtles can be found in the Turtle Expert Working Group (TEWG) reports (1998; 2000).

Though anglers are not targeting smalltooth sawfish, but instead capturing them incidentally, recreational fishing is currently a major activity that directly interacts with smalltooth sawfish throughout most of its range, including Tampa Bay. Smalltooth sawfish occur as bycatch in the recreational hook-and-line fishery, mostly by shark, red drum (*Sciaenops ocellatus*), snook (*Centropomus undecimalis*), and tarpon (*Megalops atlanticus*) fishers (Wiley and Simpfendorfer 2010), which may operate within the action area.

Located in Lee County, Florida, the Charlotte Harbor Fishing Pier was constructed prior to 1944. The County estimates that 20 people, on average, fish from the pier each day, which is open to the public 365 days a year from 7 AM to 7 PM. As stated above, there have been no reported captures of smalltooth sawfish at the pier (ISED data 2003-2017). We have no way of knowing how many unreported captures of smalltooth sawfish may have occurred at the pier in the past.

Residential in-water activities that do not require federal permits or otherwise have a federal nexus may adversely affect designated critical habitat for smalltooth sawfish in the action area. The direct and indirect impacts from these activities are difficult to quantify but may include loss or degradation of red mangroves or shallow, euryhaline habitat from unauthorized mangrove trimming, shoreline stabilization, or in-water construction. NMFS does not have any knowledge of state or private actions occurring in the action area that would not also require a federal permit; the likelihood of a project occurring in the action area that does not require a federal permit for in-water construction work is very small. Where possible, conservation actions in ESA Section 10 permits, ESA Section 6 cooperative agreements, and state permitting programs are being implemented or investigated to monitor or study impacts from these sources.

4.3.3 Marine Debris and Acoustic Impacts

A number of activities that may affect green sea turtle (NA and SA DPSs), Kemp's ridley sea turtle, loggerhead sea turtle (NWA DPS), and smalltooth sawfish in the action area include anthropogenic marine debris and acoustic effects. The effects from these activities are difficult to measure. Where possible, conservation actions are being implemented to monitor or study the effects to these species from these sources.

4.3.4 Marine Pollution and Environmental Contamination

Sources of pollutants along the coast that may affect green sea turtle (NA and SA DPSs), Kemp's ridley sea turtle, loggerhead sea turtle (NWA DPS), and smalltooth sawfish include PCB loading, stormwater runoff from coastal towns and cities into rivers and canals emptying into bays and the ocean, and groundwater and other discharges (Vargo et al. 1986). Although pathological effects of oil spills have been documented in laboratory studies of marine mammals and sea turtles (Vargo et al. 1986), the impacts of those and many other anthropogenic toxins have not been investigated in smalltooth sawfish. In addition, marina and dock construction, dredging, aquaculture, oil and gas exploration and extraction, and boat traffic can degrade marine habitats used by sea turtles and smalltooth sawfish, including smalltooth sawfish designated critical habitat. An increase in the number of docks built increases boat and vessel traffic. Fueling facilities at marinas can sometimes discharge oil, gas, and sewage into sensitive estuarine and coastal habitats.

4.3.5 Stochastic Events

Stochastic (i.e., random) events, such as hurricanes or cold snaps, occur in Florida and can affect green sea turtle (NA and SA DPSs), Kemp's ridley sea turtle, loggerhead sea turtle (NWA DPS), smalltooth sawfish, and smalltooth sawfish designated critical habitat. These events are unpredictable and their effect on the recovery of these ESA-listed species is unknown; yet, they have the potential to directly impede recovery if animals die as a result or indirectly if important habitats are damaged. In 2017, Hurricane Irma likely damaged habitat, including mangroves, which are an essential feature of smalltooth sawfish critical habitat, in and around the action area.

4.3.6 Conservation and Recovery Actions Shaping the Environmental Baseline

Federal Essential Fish Habitat (EFH) consultation requirements pursuant to the Magnuson-Stevens Fishery Conservation and Management Act (MSA) can minimize and mitigate for losses of wetland and preserve valuable foraging and developmental habitat that is used by juvenile smalltooth sawfish, including areas that have been designated as smalltooth sawfish critical habitat. NMFS has designated mangrove and estuarine habitats as EFH as recommended by the Gulf of Mexico Fishery Management Council. Both essential features are critical components of areas designated as EFH and receive a basic level of protection under the MSA to the extent that the Act requires minimization of impacts to EFH resources.

5. EFFECTS OF THE ACTION ON ESA-LISTED SPECIES AND CRITICAL HABITAT

Effects of the action are all consequences to ESA-listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time

and may include consequences occurring outside the immediate area involved in the action (50 CFR 402.02).

As discussed above in Section 3, we believe hook-and-line gear commonly used by recreational anglers fishing from the Charlotte Harbor Fishing Pier may adversely affect green sea turtle (NA and SA DPSs), Kemp's ridley sea turtle, loggerhead sea turtle (NWA DPS), and smalltooth sawfish. In Sections 5.1.1-5.1.3, we provide more detail on the potential effects of entanglement, hooking, and trailing line to these species from hook-and-line gear. Section 5.2 addresses how we estimate future captures of sea turtles. Section 5.3 addresses how we estimate future captures of smalltooth sawfish. Section 5.4 provides effects of the action on smalltooth sawfish designated critical habitat.

5.1 Effects of the Action on the Species

5.1.1 Entanglement

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

Due to their toothed rostra, smalltooth sawfish can become entangled in fishing gears such as gill nets, otter trawls, trammel nets, cast nets and seines that are directed at other species (NMFS 2009). Entanglement in recreational fishing line can cause effects to smalltooth sawfish including injury to fins and rostra (Florida Fish and Wildlife Conservation Commission [FWC] unpublished data).

5.1.2 Hooking

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

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

At present, the ISED contains several recreational hook-and-line captures of smalltooth sawfish from fishing structures (A. Brame, NOAA NMFS SERO PRD, to consulting biologist on September 23, 2020). Based on this data, smalltooth sawfish do not appear to be actively attracted to recreational fishing structures or to habituate near recreational fishing structures as a forage source. We believe smalltooth sawfish captures are largely a function of co-occurrence in space and time rather than triggered by the presence of a recreational fishing structure. While hooking interactions within the recreational fishery are numerous, the level of mortality is likely low when smalltooth sawfish are handled and released properly. Further, the threat of mortality associated with recreational fisheries in Florida is expected to be low given that possession of the species in Florida has been prohibited since 1992. Longer fights on recreational hook-and-line gear as opposed to commercial bottom longlines may elevate lactate and HCO_3 levels (Prohaska et al. (2018); however, smalltooth sawfish appear resilient and, when considered in conjunction with information from ongoing tagging and telemetry studies, post-release survival is expected to be high (Brame et al. 2019).

5.1.3 Trailing Line

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

Trailing line (i.e., line left on animal after it has been captured and released) poses a risk to smalltooth sawfish. The effects to smalltooth sawfish from trailing line are the same as those discussed above under Entanglements.

5.2 Sea Turtles

5.2.1 Estimating Captures of Sea Turtles

5.2.1.1 Estimating Reported Captures of Sea Turtles

We believe the best available data to estimate future reported recreational hook-and-line captures of sea turtles at public fishing structures comes from the historic reported captures at similar structures obtained from STSSN data, and any additional information regarding captures at the structure under consultation. The STSSN data contains number and location of sea turtle recreational hook-and-line captures that were reported to the STSSN; it does not provide the total number of potential public fishing structures available in a particular zone, and NMFS does not have that information. Below, we discuss why this is the best available information to estimate the expected annual number of reported recreational hook-and-line captures of sea turtles at the Charlotte Harbor Fishing Pier in the future.

As previously stated, the Charlotte Harbor Fishing Pier is located in the inshore, protected waters of Zone 4. The STSSN dataset contains no reported captures of sea turtles at the Charlotte Harbor Fishing Pier (recreational hook-and-line or otherwise; years 2007-2016) and the applicant also indicated no interactions have been reported. However, there was 1 reported recreational hook-and-line capture of a sea turtle at a similar inshore, public fishing structure in Zone 4 during this period. Because this fishing structure is in a similar habitat and location as the Charlotte Harbor Fishing Pier (i.e., inshore Zone 4), we assume sea turtle behavior, density, and species composition are the same at both locations. Because both fishing structures are of a similar size, they likely have similar angler effort. Further, we assume anglers fishing from both of these structures use similar baits, equipment, and fishing techniques. Therefore, even though the historic reported hook-and-line captures are different between these structures, the potential for interactions with sea turtles is likely the same at both locations.

Whether those interactions with sea turtles are reported varies depending on a number of factors, including whether there are educational signs encouraging reporting and angler behavior; sometimes anglers do not report encounters with ESA-listed species due to concerns over their personal liability or public perception at the time of the capture even if there are posted signs. Given this variability, it is difficult to estimate reporting behavior. However, we assume that similar fishing structures within the same statistical fishing zone (in this case, Zone 4) would have similar reporting rates. Because they are in similar geographic locations, we assume public perception about reporting and angler reporting behavior is likely the same. Therefore, even though the historic reported hook-and-line captures are different between these structures, the potential for reported captures is the same at both locations.

Thus, we believe the best available data to estimate the number of future reported recreational hook-and-line captures of sea turtles at the Charlotte Harbor Fishing Pier can be determined by taking the average of the historic reported recreational hook-and-line captures at the similar fishing structure in the inshore Zone 4 STSSN dataset and the absence of reported captures at the Charlotte Harbor Fishing Pier. Averaging the data in this way helps smooth variability in both the potential for interactions and in reporting behavior among the locations and over time, providing for a more accurate overall estimate of future reported captures at the consultation pier. There is no additional information that can be used to estimate potential reported interactions.

To calculate the average number of reported hook-and-line captures at these similar fishing structures in the inshore, protected waters of Zone 4, we use available STSSN data and the following equation:

$$\begin{aligned} & \textit{Average Reported Captures Per Structure in 10 years} \\ & = \textit{Sum of Reported Captures in 10 years} \div 2 \textit{ Locations} \\ & = (1 + 0) \div 2 \\ & = 0.5 \textit{ per structure in 10 years} \end{aligned}$$

To calculate the estimated expected annual number of reported recreational hook-and-line captures of sea turtles at the Charlotte Harbor Fishing Pier, we refer to the information above and use the following equation:

$$\begin{aligned} & \textit{Expected Annual Reported Captures} \\ & = \textit{Average Reported Captures Per Structure in 10 years} \div 10 \textit{ years} \\ & = 0.5 \div 10 \\ & = 0.05 \textit{ per year (Table 6, Line 1)} \end{aligned}$$

5.2.1.2 Estimating Unreported Captures of Sea Turtles

While we believe the best available information for estimating expected reported captures at the Charlotte Harbor Fishing Pier is the average of the historic reported recreational hook-and-line captures at the similar fishing structure in the inshore Zone 4 STSSN dataset and the absence of reported captures at the Charlotte Harbor Fishing Pier, we also recognize the need to account for unreported captures. In the following section, we use the best available data to estimate the number of unreported recreational hook-and-line-captures that may occur. To the best of our knowledge, only 2 fishing pier surveys aimed at collecting data regarding unreported recreational hook-and-line captures of ESA-listed species have been conducted in the Southeast. One is from Charlotte Harbor, Florida, and the other is from Mississippi.

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

NMFS conducted the fishing pier survey in Mississippi that interviewed 382 anglers. This survey indicated that approximately 60% of anglers who incidentally captured a sea turtle on hook-and-line reported it (i.e., 40% of anglers would not have reported a sea turtle capture) (Cook et al. 2014). It is important to note that in 2012 educational signs were installed at all fishing piers in Mississippi, alerting anglers to report accidental hook-and-line captures of sea turtles. After the signs were installed, there was a dramatic increase in the number of reported sea turtle hook-and-line captures. Though this increase in reported captures may not solely be related to outreach

efforts, it does highlight the importance of educational signs on fishing piers. The STSSN in Mississippi indicated that inconsistency in reporting of captures may also be due to anglers' concerns over their personal liability, public perception at the time of the capture, or other consequences from turtle captures (M. Cook, STSSN, pers. comm. to N. Bonine, NMFS SERO PRD, April 17, 2015). Anglers often do not admit the incidental capture for fear of liability.

Below, we will address unreported captures by assuming that the expected annual reported captures of 0.05 sea turtles per year at the Charlotte Harbor Fishing Pier represents 8% of the actual captures and 92% of sea turtle captures will be unreported. We believe it is most conservative to use the unreported rate in the Hill (2013) fishing pier study to estimate the future unreported captures. The study is in a similar location (i.e., Charlotte Harbor), and is a reasonable proxy for reporting behavior at the Charlotte Harbor Fishing Pier. In addition, in the absence of additional information on factors that might affect angler reporting behavior, such as similarity of outreach and education, signage, or culture, we will err on the side of the species and assume fewer interactions were reported, as this will result in a higher total expected interactions. Reinitiation may be required if information reveals changes in reporting behavior.

Therefore, to calculate the expected annual number of unreported recreational hook-and-line captures of sea turtles, we use the equation:

$$\begin{aligned}
 & \textit{Expected Annual Unreported Captures} \\
 & = (\textit{Expected Annual Reported Captures} \div 8\%) \times 92\% \\
 & = (0.05 \div 0.08) \times 0.92 \\
 & = 0.5750 \textit{ per year (Table 6, Line 2)}
 \end{aligned}$$

5.2.1.3 Calculating Total Captures of Sea Turtles

The number of captures in any given year can be influenced by sea temperatures, species abundances, fluctuating salinity levels in estuarine habitats where piers may be located, and other factors that cannot be predicted. For these reasons, we believe basing our future capture estimate on a 1-year estimated capture is largely impractical. Using our experience monitoring other fisheries, a 3-year time period is appropriate for meaningful evaluation of future impacts and monitoring. The triennial takes are set as 3-year running sums (i.e., 2020-2022, 2021-2023, 2022-2024, and so on) and not for static 3-year periods (i.e., 2020-2022, 2023-2025, 2025-2027, and so on). This approach reduces the likelihood of reinitiation of the ESA consultation process because of inherent variability in captures, while still allowing for an accurate assessment of how the proposed action is performing versus our expectations. Table 6 shows the projected total sea turtle captures at the Charlotte Harbor Fishing Pier for any 3-year consecutive period based on the expected annual reported and unreported captures.

Table 6. Summary of Expected Captures of Sea Turtles

Captures	Total
1. Expected Annual Reported	0.0500
2. Expected Annual Unreported	0.5750
Annual Total	0.6250
Triennial (3-year) Total	1.8750

5.2.2 Estimating Post Release Mortality of Sea Turtles

5.2.2.1 Estimating Post Release Mortality for Reported Captures of Sea Turtles

Almost all sea turtles that are captured, landed, and reported to the STSSN are evaluated by a trained veterinarian to determine if they can be immediately released alive or require a rehabilitation facility; exceptions may happen if the sea turtle breaks free before help can arrive. Sea turtles that are captured and reported to the STSSN may die onsite, may be evaluated, released alive, and subsequently suffer post-release mortality (PRM) later, or may be evaluated and taken to a rehabilitation facility. Those taken to a rehabilitation facility may be released alive at later date or kept in rehabilitation indefinitely (i.e., either due to serious injury or death). We consider those that are never returned to the wild population to have suffered PRM because they will never again contribute to the population. The risk of PRM to sea turtles from reported hook-and-line captures will depend on numerous factors, including how deeply the hook is embedded, whether or not the hook was swallowed, whether the sea turtle was released with trailing line, how soon and how effectively the hooked sea turtle was de-hooked or otherwise cut loose and released, and other factors which are discussed in more detail below.

We believe the 10-year STSSN dataset for inshore recreational hook and line captures and entanglements in Zone 4 is the most accurate representation of PRM for sea turtles in the action area because this dataset pertains specifically to Florida where the future reported captures are anticipated to occur. Table 7 provides a breakdown of final disposition of the 27 sea turtles caught or entangled in recreational hook-and-line gear in the STSSN dataset for Zone 4 inshore.

Table 7. Final Disposition of Sea Turtles from Reported Recreational Hook-and-Line Captures and Gear Entanglements in Zone 4, 2007-2016 (n=27)

	Dead or Died Onsite	Released Alive Immediately (Not Evaluated)	Released Alive, Immediately (Evaluated)	Taken to Rehab, Released Alive Later	Taken to Rehab, Kept or Died in Rehab
Number of Records	11	1	2	5	8
Percentage	40.7	3.7	7.4	18.5	29.6

Of the 27 sea turtles reported captured on recreational hook-and-line or entangled in gear in Zone 4 inshore, 70.4% were removed from the wild population either through death or being unable to be released from the rehabilitation facility (i.e., lethal captures, 40.7 + 29.6) and 29.6% were released alive back into the wild population (i.e., non-lethal captures, 3.7 + 7.4 + 18.5).

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

$$\begin{aligned} & \text{Annual Lethal Reported Captures} \\ &= \text{Expected Annual Reported Captures [Table 6, Line 1]} \\ & \quad \times \text{Lethal Captures [calculated from Table 7]} \end{aligned}$$

$$= 0.0500 \times 70.4\%$$

$$= 0.0352 \text{ per year (Table 11, Line 1A)}$$

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

$$\begin{aligned} & \text{Annual Non – lethal Reported Captures} \\ &= \text{Expected Annual Reported Captures at Each Pier [Table 6, Line 1]} \times \text{Non} \\ & \quad \text{– Lethal Captures [calculated from Table 7]} \\ &= 0.0500 \times 29.6\% \\ &= 0.0148 \text{ per year (Table 11, Line 1B)} \end{aligned}$$

5.2.2.2 Estimating Post-Release Mortality for Unreported Captures of Sea Turtles

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

In January 2004, NMFS convened a workshop of experts to develop criteria for estimating PRM of sea turtles caught in the pelagic longline fishery based on the severity of injury. In 2006, those criteria were revised and finalized (Ryder et al. 2006). In February 2012, the Southeast Fisheries Science Center updated the criteria again by adding 3 additional hooking scenarios, bringing the total to 6 categories of injury (NMFS2012a). Table 8 describes injury categories for hardshell sea turtles captured on hook-and-line gear and the associated PRM estimates for sea turtles released with hook and trailing line greater than or equal to half the length of the carapace (i.e., Release Condition B as defined in (NMFS 2012).

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

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

*There is no PRM estimate of Release Condition B for Injury Category V. For Injury Category V, we believe it is prudent to use the PRM for Release Condition A (Released Entangled) because we know the sea turtle was released entangled without a hook, but we do not know how much line was remaining.

**For Injury Category 6, we believe it is prudent to use the PRM Release Condition D (Released with All Gear Removed) because we believe that if a fisher took the time to resuscitate the sea turtle, then it is likely the fisher also took the time to disentangle the animal completely before releasing it back into the wild.

PRM varies based on the initial injury the animal sustained and the amount of gear left on the animal at the time of release. Again, we will rely on the STSSN dataset we used above in Table 7 because this data includes on what part of the body the sea turtle was hooked for all 27 interactions (Table 9).

Table 9. Category of Injury of Sea Turtles from Reported Recreational Hook-and-Line Captures and Gear Entanglements in Zone 4 Inshore, 2007-2016 (n=27)

Injury Category*	I	II	III	IV	V	VI
Number	3	0	2	1	21	0
Percentage	11.1	0	7.4	3.7	77.8	0

*SERO PRD assigned an Injury Category of 0 to all records with unknown hooking and entanglement locations. We exclude Injury Category 0 from the calculation because we are unsure of the location and therefore cannot assign a corresponding PRM. In this case, there are no interactions with an unknown hooking/entanglement location in the dataset.

As above, we assume that 8% of the sea turtles captured at the pier will be reported, and that reported turtles will be sent to rehabilitation if needed. To estimate the fate of the 92% of sea turtles expected to go unreported, and therefore un-evaluated or rehabilitated, we use the estimated PRM for the injury categories in Table 8 along with the percentage of captures in each injury category in Table 9 to calculate the weighted PRM for each injury category. We then sum the weighted PRMs across all injury categories to determine the overall PRM for sea turtles (Table 10). This overall rate helps us account for the varying severity of future injuries and

varying PRM associated with these injuries. Based on the assumptions we have made about the percentage of sea turtles that will be released alive without rehabilitation, the hooking location, and the amount of fishing gear likely to remain on an animal released immediately at the pier, we estimate a total weighted PRM of 46.7% for the 92% of sea turtles captured, unreported, and released immediately at the Charlotte Harbor Fishing Pier.

Table 10. Estimated Weighted and Overall Post Release Mortality for Sea Turtles Released Immediately

Injury Category	PRM (%) [from Table 7]	Percentage [from Table 8]	% Weighted PRM*
I	20	11.1	2.2
II	30	0	0
III	45	7.4	3.3
IV	60	3.7	2.2
V	50	77.8	38.9
VI	60	0	0
		Total % Weighted PRM	46.7

*% Weighted PRM = % PRM × Percentage for each Injury Category

To calculate the estimated annual lethal captures of unreported sea turtles at the Charlotte Harbor Fishing Pier, we use the following equation:

$$\begin{aligned}
 & \text{Annual Unreported Lethal Captures} \\
 &= \text{Annual Unreported Captures [Table 6, Line 2]} \times \text{Total Weighted PRM [Table 10]} \\
 &= 0.5750 \times 46.7\% \\
 &= 0.2683 \text{ per year (Table 11, Line 2A)}
 \end{aligned}$$

If the equation for calculating annual lethal captures of unreported sea turtles multiplies the annual unreported captures by the total weighted PRM of 46.7%, then the equation for calculating annual non-lethal captures of unreported sea turtles would multiply the annual unreported captures by 53.4% (100% – 46.7%). Therefore, to calculate the estimated annual non-lethal captures of unreported sea turtles, we use the following equation:

$$\begin{aligned}
 & \text{Annual Unreported Non – lethal Captures} \\
 &= \text{Annual Unreported Captures [Table 6, Line 2]} \times 53.4\% \\
 &= 0.5750 \times 53.4\% \\
 &= 0.3071 \text{ per year (Table 11, Line 2B)}
 \end{aligned}$$

5.2.2.3 Calculating Total Post Release Mortality of Sea Turtles

As we discussed above, we use a 3-year running total to evaluate future impacts to sea turtles due to PRM. Table 10 shows the total sea turtle captures at the Charlotte Harbor Fishing Pier for any 3-year consecutive period based on the expected annual lethal and non-lethal reported and unreported captures.

Table 11. Summary of Post Release Mortality of Sea Turtles

Captures	A. Lethal	B. Non-lethal
1. Annual Reported Captures	0.0352	0.0148
2. Annual Unreported Captures	0.2683	0.3071
Annual Total	0.3035	0.3219
Triennial (3-year) Total	0.9105	0.9657

5.2.3 Estimating Captures of Sea Turtles by Species

Of the sea turtles in the STSSN inshore stranding data for Zone 4 identifiable to species and which may be adversely affected by gear entanglement or hook-and-line capture at the Charlotte Harbor Fishing Pier (n=25), 48% were green (n=12), 32% were Kemp’s ridley (n=8), and 20% were loggerhead sea turtles (n=5) (Table 2). We will assume the same species composition for future captures at the Charlotte Harbor Fishing Pier because this is the only available data regarding the relative abundance of sea turtle species that may be affected by hook and line gear in the area. Table 12 presents the estimated number of lethal and non-lethal captures by sea turtles species for any consecutive 3-year period based on our calculations from Sections 5.2.1 and 5.3.2. To be conservative to the individual species, numbers of captures are rounded up to the nearest whole number. While this results in an increase in the total number of sea turtles, compared to what is presented in the non-species-specific total estimates in Table 6 and 11, this approach is most conservative to the species, ensures that we are adequately analyzing the effects of the proposed action on whole animals, and that impacts from the proposed action can be more easily tracked. The impacts of future captures to the individual green sea turtle DPSs are discussed in the Jeopardy Analysis (Section 7) and presented in the Incidental Take Statement (Section 9).

Table 12. Estimated Captures of Sea Turtle Species for Any Consecutive 3-Year Period

Species	Lethal Captures	Non-lethal Captures	Total Captures
Green sea turtle (NA or SA DPS)	1 ($0.9105 \times 0.48 = 0.4370$)	1 ($0.9657 \times 0.48 = 0.4635$)	2
Kemp’s ridley sea turtle	1 ($0.9105 \times 0.32 = 0.2914$)	1 ($0.9657 \times 0.32 = 0.3090$)	2
Loggerhead sea turtle (NWA DPS)	1 ($0.9105 \times 0.20 = 0.1821$)	1 ($0.9657 \times 0.20 = 0.1931$)	2

5.3 Smalltooth Sawfish

5.3.1 Estimating Reported Captures of Smalltooth Sawfish

We believe the best available data to estimate future reported recreational hook-and-line captures of smalltooth sawfish at public fishing structures comes from the historic reported captures at similar structures obtained from ISED data, and any additional information regarding captures at

the structure under consultation. The ISED data contains number and location of smalltooth sawfish recreational hook-and-line captures that were reported; it does not provide the total number of potential public fishing structures available in a particular zone, and NMFS does not have that information. Below, we discuss why this is the best available information to estimate the expected annual number of reported recreational hook-and-line captures of smalltooth sawfish at the Charlotte Harbor Fishing Pier in the future.

As previously stated, the Charlotte Harbor Fishing Pier is located in Lee County, Florida. The ISED data for Lee County since the species was listed contains no reported captures of smalltooth sawfish at the Charlotte Harbor Fishing Pier (recreational hook-and-line or otherwise; years 2003-2017), and the applicant also indicated that no interactions have been reported. However, there were 76 reported recreational hook-and-line captures of smalltooth sawfish at 19 similar inshore, public fishing structures in Lee County during this period. Because these fishing structures are in a similar habitat and location as the Charlotte Harbor Fishing Pier (i.e., inshore, coastal Lee County), we assume smalltooth sawfish behavior and density is the same at all locations. Because all of these fishing structures are of a similar size, they likely have similar angler effort. Further, we assume anglers fishing these structures use similar baits, equipment, and fishing techniques. Therefore, even though the historic reported hook-and-line captures are different between these structures, the potential for interactions with smalltooth sawfish is likely the same at all locations.

Whether those interactions with smalltooth sawfish are reported varies depending on a number of factors, including whether there are educational signs encouraging reporting and angler behavior; sometimes anglers do not report encounters with ESA-listed species due to concerns over their personal liability or public perception at the time of the capture even if there are posted signs. Given this variability, it is difficult to estimate reporting behavior. However, we assume that similar fishing structures within the same area (in this case, inshore, coastal Lee County) would have similar reporting rates. Because they are in similar geographic locations, we assume public perception about reporting and angler reporting behavior is likely the same. Therefore, even though the historic reported hook-and-line captures are different between these structures, the potential for reported captures is the same at both locations.

Thus, we believe the best available data to estimate the number of future reported recreational hook-and-line captures of smalltooth sawfish at the Charlotte Harbor Fishing Pier can be determined by taking the average of the historic reported recreational hook-and-line captures at the similar fishing structures in the inshore, coastal Lee County ISED dataset and the absence of reported captures at the Charlotte Harbor Fishing Pier. Averaging the data in this way helps smooth variability in both the potential for interactions and in reporting behavior among the locations and over time, providing for a more accurate overall estimate of future reported captures at the consultation pier. There is no additional information that can be used to estimate potential reported interactions.

To calculate the average number of reported hook-and-line captures at these similar fishing structures in inshore, coastal Lee County, we use available ISED data and the following equation:

$$\begin{aligned}
& \textit{Average Reported Captures Per Structure in 15 years} \\
& = \textit{Sum of Reported Captures in 15 years} \div 20 \textit{ Locations} \\
& = (76 + 0) \div 20 \\
& = 3.8 \textit{ per structure in 15 years}
\end{aligned}$$

To calculate the estimated expected annual number of reported recreational hook-and-line captures of smalltooth sawfish at the Charlotte Harbor Fishing Pier, we refer to the information on the similar structures above and use the following equation:

$$\begin{aligned}
& \textit{Expected Annual Reported Captures} \\
& = \textit{Average Reported Captures Per Structure in 15 years} \div 15 \textit{ years} \\
& = 3.8 \div 15 \\
& = 0.2533 \textit{ per structure per year (Table 13, Line 1)}
\end{aligned}$$

5.3.2 Estimating Unreported Captures of Smalltooth Sawfish

While we believe the best available information for estimating expected reported captures at the Charlotte Harbor Fishing Pier is the average of the historic reported recreational hook-and-line captures at the similar fishing structures in the inshore, coastal Lee County ISED dataset and the absence of reported captures at the Charlotte Harbor Fishing Pier, we also recognize the need to account for unreported captures. As previously discussed, only 2 fishing pier surveys aimed at collecting data regarding unreported recreational hook-and-line captures of ESA-listed species have been conducted in the Southeast. Like above, we will use the unreported rate from Hill (2013). Hill (2013) found that only 12% of anglers would have reported a smalltooth sawfish hook-and-line capture (i.e., 88% of anglers would not have reported a smalltooth sawfish capture).

Below, we will address unreported captures by assuming that the expected annual reported captures of 0.2533 smalltooth sawfish per year represents 12% of the actual captures and 88% of captures will be unreported. We believe it is most conservative to use the unreported rate in the Hill (2013) fishing pier study to estimate the future unreported captures. The study is in a similar location (i.e., Charlotte Harbor), and is a reasonable proxy for reporting behavior at the Charlotte Harbor Fishing Pier. In addition, in the absence of additional information on factors that might affect angler reporting behavior, such as similarity of outreach and education, signage, or culture, we will err on the side of the species and assume fewer interactions were reported, as this will result in a higher total expected interactions. Reinitiation may be required if information reveals changes in reporting behavior.

Therefore, to calculate the expected annual number of unreported recreational hook-and-line captures of smalltooth sawfish, we use the equation:

$$\begin{aligned}
& \textit{Expected Annual Unreported Captures} \\
& = (\textit{Expected Annual Reported Captures} \div 12\%) \times 88\% \\
& = (0.2533 \div 0.12) \times 0.88 \\
& = 1.8575 \textit{ per structure per year (Table 13, Line 2)}
\end{aligned}$$

5.3.3 Calculating Total Captures of Smalltooth Sawfish

As previously discussed, we believe using a 3-year period is appropriate for meaningful monitoring. Table 13 presents the estimated smalltooth sawfish captures at the Charlotte Harbor Fishing Pier for any 3-year consecutive period based on the expected annual reported and unreported captures calculated above.

Table 13. Summary of Expected Captures of Smalltooth Sawfish

Captures	Total
1. Expected Annual Reported	0.2533
2. Expected Annual Unreported	1.8575
Annual Total	2.1108
Triennial (3-year) Total	6.3324

We round 6.3324 up to 7 to account for the capture of whole animals in our Jeopardy analysis. Therefore, we estimate that up to 7 smalltooth sawfish could be caught at the Charlotte Harbor Fishing Pier during any consecutive 3-year period. As previously stated, we believe that all captures of smalltooth sawfish will be non-lethal with no associated PRM.

5.4 Effects of the Action on Critical Habitat

The proposed action area is within the boundary of the CHEU of smalltooth sawfish designated critical habitat. The physical and biological features essential to the conservation of the U.S. DPS of smalltooth sawfish, which provide nursery area functions, are: (1) shallow, euryhaline habitats characterized by water depths between MHW and 3 ft (0.9 m) measured at MLLW, and (2) red mangroves. We believe the proposed action will affect the essential features of smalltooth sawfish designated critical habitat as outlined below.

5.4.1 Effects of the Action on the Shallow Euryhaline Essential Feature of Smalltooth Sawfish Designated Critical Habitat

We believe the proposed action is likely to adversely affect smalltooth sawfish designated critical habitat due to the permanent removal of 2,250 ft² of the shallow, euryhaline habitat essential feature (1,500-lin ft seawall placed 1.5-ft-waterward of the existing seawall into water less than 3 ft measured at MLLW), which provides forage, shelter, or other nursery habitat functions for juvenile smalltooth sawfish. Because we calculate and track losses to the shallow, euryhaline habitat essential feature of critical habitat in acres, we convert the project's effect from square feet to acres and use acres in the analyses below (i.e., 0.051653 ac).¹⁰

NMFS estimated that the total amount of shallow, euryhaline habitat in CHEU at the effective date of species listing (May 1, 2003) was approximately 84,480 ac. While the available shallow, euryhaline essential feature will be diminished, the proposed action is not severing or preventing juvenile smalltooth sawfish access to alternate habitat with this essential feature in the surrounding area. Still, some ecological function provided to juvenile smalltooth sawfish

¹⁰ 1 square foot = 0.0000229568 acres

currently using the area, and conservation benefits to future juvenile sawfish in terms of the shallow, euryhaline essential feature, will be lost; therefore, we believe the project is likely to adversely affect critical habitat in the CHEU.

5.4.2 Effects of the Action on the Red Mangrove Essential Feature of Smalltooth Sawfish Designated Critical Habitat

Because the proposed action will not remove or restrict access to red mangroves, there are no potential routes of adverse effects to the red mangrove essential feature of smalltooth sawfish designated critical habitat. In addition, there are no other potential routes of effect to the red mangrove essential feature.

6. CUMULATIVE EFFECTS

ESA Section 7 regulations require NMFS to consider cumulative effects in formulating its Opinions (50 CFR 402.14). Cumulative effects include the effects of future state, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Opinion (50 CFR 402.02).

At this time, we are not aware of any non-federal actions, beyond those discussed in the Environmental Baseline section, being planned or under development in the action area which would have effects to green sea turtle (NA and SA DPSs), Kemp's ridley sea turtle, loggerhead sea turtle (NWA DPS), smalltooth sawfish, or smalltooth sawfish designated critical habitat. Within the action area, major future changes are not anticipated in these ongoing human activities. The present, major human uses of the action area are expected to continue at the present levels of intensity in the near future.

Many threats to green sea turtle (NA and SA DPSs), Kemp's ridley sea turtle, loggerhead sea turtle (NWA DPS), smalltooth sawfish, and smalltooth sawfish designated critical habitat are expected to be exacerbated by the effects of global climate change. These threats are the same as those previously discussed in Section 3.3, 3.4, and 3.6.

7. JEOPARDY ANALYSIS

The analyses conducted in the previous section of this Opinion serve to provide a basis to determine whether the proposed action is likely to jeopardize the continued existence of smalltooth sawfish (U.S. DPS). In the Effects of the Action, we outlined how the proposed action would affect this species at the individual level and the extent of those effects in terms of the number of associated interactions, captures, and mortalities of each species to the extent possible based on the best available data. Now we assess the species' response to this impact, in terms of overall population effects, and whether those effects of the proposed action, when considered in the context of the Status of the Species, the Environmental Baseline, and the Cumulative Effects, are likely to jeopardize the continued existence of this species in the wild. To "jeopardize the continued existence of" means to "engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and the recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that

species” (50 CFR 402.02). Thus, in making this determination for the species, we must look at whether the proposed action directly or indirectly reduces the reproduction, numbers, or distribution of the species. Then, if there is a reduction in 1 or more of these elements, we evaluate whether it would be expected to cause an appreciable reduction in the likelihood of both the survival and the recovery of the species.

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

The status of the species likely to be adversely affected by the proposed action is reviewed in the Status of the Species. For any species listed globally, a jeopardy determination must find that the proposed action will appreciably reduce the likelihood of survival and recovery at the global species range (i.e., in the wild). For any species listed as DPSs, a jeopardy determination must find that the proposed action will appreciably reduce the likelihood of survival and recovery of that DPS.

7.1 Green Sea Turtle (NA and SA DPSs)

Within U.S. waters, individuals from both the NA and SA DPS of green sea turtle can be found on foraging grounds. While there are currently no in-depth studies available to determine the percent of NA and SA DPS individuals in any given location, an analysis of cold-stunned green turtles in St. Joseph Bay, Florida (northern Gulf of Mexico) found approximately 4% of individuals came from nesting stocks in the SA DPS (specifically Suriname, Aves Island, Brazil, Ascension Island, and Guinea Bissau) (Foley et al. 2007). This information suggests that the vast majority of the anticipated captures in the Gulf of Mexico are likely to come from the NA DPS. However, 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 assume based on Foley et al. (2007) that 96% of animals adversely affected during the proposed action are from that DPS. The SA DPS analysis will assume that 4% of the green sea turtles adversely affected by the proposed action are from that DPS.

Applying the above percentages to our estimated 2 total captures of green sea turtles (1 lethal, 1 non-lethal) during any consecutive 3-year period, we estimate the following:

- Up to 2 green sea turtles will come from the NA DPS ($2 \times 0.96 = 1.92$, rounded up to 2), of which 1 will be lethal and 1 will be non-lethal.
- Up to 1 green sea turtle will come from the SA DPS ($2 \times 0.04 = 0.04$, rounded up to 1), which could be lethal or non-lethal.

We note rounding when splitting the capture into the two DPSs results in a slightly higher combined total than the 3-year total (i.e., 3 instead of 2). While we use the higher numbers for purposes of analyzing the likelihood of jeopardy to the DPSs (Section 7.1.1 and 7.1.2), we do not expect more than 2 green sea turtle captures at the Charlotte Harbor Fishing Pier during any consecutive 3-year period.

7.1.1 NA DPS of Green Sea Turtle

7.1.1.1 Survival

The proposed action is expected to result in capture of up to 2 green sea turtles (1 lethal, 1 non-lethal) from the NA DPS over any consecutive 3-year period. The potential non-lethal capture of a green sea turtle from the NA DPS is not expected to have any measurable impact on the reproduction, numbers, or distribution of the species. The individual suffering non-lethal injuries or stresses is expected to fully recover such that no reductions in reproduction or numbers of green sea turtles are anticipated. The potential non-lethal capture will occur in the action area, which encompass a small portion of the overall range or distribution of green sea turtles within the NA DPS. Any incidentally caught animals would be released within the general area where caught and no change in the distribution of NA DPS green sea turtles would be anticipated. The potential lethal capture of up to 1 green sea turtle from the NA DPS during any consecutive 3-year period would reduce the number of NA DPS green sea turtles, compared to their numbers in the absence of the proposed action, assuming all other variables remained the same. A lethal capture would also result in a potential reduction in future reproduction, assuming the individual was female and would have survived otherwise to reproduce. For example, as discussed in this Opinion, an adult green sea turtle can lay up to 7 clutches (usually 3-4) of eggs every 2-4 years, with a mean clutch size of 110-115 eggs per nest, of which a small percentage is expected to survive to sexual maturity. Potential lethal captures are expected to occur in a discrete action area and green sea turtles in the NA DPS generally have large ranges; thus, no reduction in the distribution is expected from the capture of these individuals.

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

In Section 3.2.2, we summarized the available information on number of green sea turtle nesters and nesting trends at NA DPS beaches; all major nesting populations demonstrate long-term increases in abundance (Seminoﬀ et al. 2015). Therefore, nesting at the primary nesting beaches has been increasing over the course of the decades, against the background of the past and ongoing human and natural factors that have contributed to the Status of the Species. We believe these nesting trends are indicative of a species with a high number of sexually mature individuals. In the absence of any total population estimates, nesting trends are the best proxy for estimating population changes. Since the nesting abundance trend information for the NA DPS of green sea turtle is clearly increasing, we believe the potential lethal capture of up to 1 green sea turtle from the NA DPS during any consecutive 3-year period attributed to the pier will not have any measurable effect on that trend. After analyzing the magnitude of the effects, in combination with the past, present, and future expected impacts to the DPS discussed in this Opinion, we believe that recreational fishing from the consultation pier is not reasonably expected to cause an appreciable reduction in the likelihood of survival of the green sea turtle NA DPS in the wild.

7.1.1.2 Recovery

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

- The level of nesting in Florida has increased to an average of 5,000 nests per year for at least 6 years.
- A reduction in stage class mortality is reflected in higher counts of individuals on foraging grounds.

According to data collected from Florida’s index nesting beach survey from 1989-2019, green sea turtle nest counts across Florida index beaches have increased substantially from a low of approximately 267 in the early 1990s to a high of almost 41,000 in 2019 (See Figure 3), and indicate that the first listed recovery objective is being met. There are currently no estimates available specifically addressing changes in abundance of individuals on foraging grounds. Given the clear increases in nesting, however, it is likely that numbers on foraging grounds have increased, which is consistent with the criteria of the second listed recovery objective.

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

above and will not result in an appreciable reduction in the likelihood of NA DPS green sea turtles' recovery in the wild.

7.1.1.3 Conclusion

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

7.1.2 SA DPS of Green Sea Turtle

7.1.2.1 Survival

The proposed action is expected to result in the capture of up to 1 green sea turtle, which could be lethal or non-lethal, from the SA DPS over any consecutive 3-year period. The potential non-lethal capture of a green sea turtle from the SA DPS is not expected to have any measurable impact on the reproduction, numbers, or distribution of the species. The individuals suffering non-lethal injuries or stresses are expected to fully recover such that no reductions in reproduction or numbers of green sea turtles are anticipated. The captures will occur in the action area, which encompass a small portion of the overall range or distribution of green sea turtles within the SA DPS. Any incidentally caught animal would be released within the general area where caught and no change in the distribution of SA DPS green sea turtles would be anticipated. The potential lethal capture of a SA DPS green sea turtle during any consecutive 3-year period would reduce the number of green sea turtles, compared to their numbers in the absence of the proposed action, assuming all other variables remained the same. A lethal capture would also result in a potential reduction in future reproduction, assuming the individual would be female and would have survived otherwise to reproduce. Like above, the anticipated lethal capture is expected to occur in a small, discrete action area and green sea turtles in the SA DPS generally have large ranges; thus, no reduction in the distribution is expected from the capture of these individuals.

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

In Section 3.3.2, we summarized available information on number of green sea turtle nesters and nesting trends at SA DPS beaches; some of the largest nesting beaches such as Ascension Island, Aves Island (Venezuela), and Galibi (Suriname) appear to be increasing. Therefore, it is likely that nesting at the primary nesting beaches has been increasing over the course of the decades, against the background of the past and ongoing human and natural factors that have contributed

to the status of the species. We believe these nesting trends are indicative of a species with a high number of sexually mature individuals. Since the nesting abundance trend information for green sea turtles appears to be increasing, we believe the potential lethal capture of up to 1 green sea turtles from the SA DPS during any consecutive 3-year period attributed to recreational fishing at the pier will not have any measurable effect on that trend. After analyzing the magnitude of the effects, in combination with the past, present, and future expected impacts to the DPS discussed in this Opinion, we believe that recreational fishing from the consultation pier 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.

7.1.2.2 Recovery

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

- The level of nesting in Florida has increased to an average of 5,000 nests per year for at least 6 years.
- A reduction in stage class mortality is reflected in higher counts of individuals on foraging grounds.

Because the first objective listed above is specific to nesting in Florida, it is specific to the NA DPS, but demonstrates the importance of increases in nesting to recovery. As previously stated, nesting at the primary SA DPS nesting beaches appears to have been increasing over the course of the decades. There are currently no estimates available specifically addressing changes in abundance of individuals on foraging grounds. Given the likely increases in nesting, and likely correlation between increased nesting and increased overall population, it is likely that numbers on foraging grounds also have increased.

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

7.1.2.3 Conclusion

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

7.2 Kemp's Ridley Sea Turtle

7.2.1 Survival

The proposed action is expected to result in the capture of up to 2 Kemp's ridley sea turtles (1 lethal, 1 non-lethal) during any consecutive 3-year period. The potential non-lethal capture of a Kemp's ridley sea turtle is not expected to have any measurable impact on the reproduction, numbers, or distribution of the species. The individual suffering non-lethal injuries or stresses are expected to fully recover such that no reductions in reproduction or numbers of Kemp's ridley sea turtles are anticipated. The captures will occur in the action area, which encompasses a small portion of this species overall range/distribution. Any incidentally caught animal would be released within the general area where caught and no change in the distribution of Kemp's ridley sea turtles would be anticipated. The potential lethal capture of up to 1 Kemp's ridley sea turtle during any consecutive 3-year period would reduce the species' population compared to the number that would have been present in the absence of the proposed actions, assuming all other variables remained the same. The Turtle Expert Working Group (TEWG 1998b) estimates age at maturity from 7-15 years for this species. Females return to their nesting beach about every 2 years (TEWG 1998b). The mean clutch size for Kemp's ridley sea turtle is 100 eggs per nest, with an average of 2.5 nests per female per season. A lethal capture could also result in a potential reduction in future reproduction, assuming at least one of these individuals would be female and would have survived to reproduce in the future. The loss of 1 Kemp's ridley sea turtle could preclude the production of thousands of eggs and hatchlings, of which a fractional percentage would be expected to survive to sexual maturity. Thus, the death of any females would eliminate their contribution to future generations, and result in a reduction in sea turtle reproduction. However, the anticipated lethal capture is expected to occur in a small, discrete action area and Kemp's ridley sea turtle generally have large ranges; thus, no reduction in the distribution is expected from the capture of these individuals.

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

In the absence of any total population estimates, nesting trends are the best proxy for estimating population changes. It is important to remember that with significant inter-annual variation in nesting data, sea turtle population trends necessarily are measured over decades and the long-

term trend line better reflects the population trend. In Section 3.3.3, we summarized available information on number of Kemp's ridley sea turtle nesters and nesting trends. At this time, it is unclear whether the increases and declines in Kemp's ridley nesting seen over the past decade at nesting beaches in Mexico, or the similar trend with the emerging Texas population, represents a population oscillating around an equilibrium point or if nesting will decline or increase in the future. With the recent period of increases in nesting (2015-17) bookended by recent periods of declining numbers of nests (2013-14 and 2018-19), it is too early to tell whether the long-term trend line is affected; however, there may be cause for concern. Nonetheless, the full data set from 1990 to present continues to support the conclusion that Kemp's ridley sea turtles are increasing in population size. We believe these nesting trends are indicative of a species with a high number of sexually mature individuals. Since the nesting trend information is increasing, we believe the potential lethal capture of 1 Kemp's ridley sea turtle during any consecutive 3-year period attributed to the proposed action will not have any measurable effect on that trend. After analyzing the magnitude of the effects, in combination with the past, present, and future expected impacts to the DPS discussed in this Opinion, we believe that recreational fishing from the proposed pier is not reasonably expected to cause an appreciable reduction in the likelihood of survival of Kemp's ridley sea turtle in the wild.

7.2.2 Recovery

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

The recovery plan states the average number of nests per female is 2.5; it sets a recovery goal of 10,000 nesting females associated with 25,000 nests. The 2012 nesting season recorded approximately 22,000 nests in Mexico. Yet, in 2013 through 2014, there was a significant decline, with only 16,385 and 11,279 nests recorded, respectively, which would equate to 6,554 nesting females in 2013 ($16,385 / 2.5$) and 4,512 in 2014 ($11,279 / 2.5$). Nest counts increased 2015-2017, they did not reach 25,000 by 2017, and they decreased 2018-2019; however, it is clear that the population has increased over the last 2 decades. The increase in Kemp's ridley sea turtle nesting is likely due to a combination of management measures including elimination of direct harvest, nest protection, the use of TEDs, reduced trawling effort in Mexico and the U.S., and possibly other changes in vital rates (TEWG 1998a; TEWG 2000).

The potential lethal capture of up to 1 Kemp's ridley sea turtle during any consecutive 3-year period by recreational fishing at the pier will result in a reduction in numbers and reproduction; however, it is unlikely to have any detectable influence on the nesting trends noted above. Given annual nesting numbers are in the thousands, the projected loss is not expected to have any discernable impact to the species. The potential non-lethal capture of up to 1 Kemp's ridley sea turtle would not affect the adult female nesting population. Thus, recreational fishing at the pier

will not impede achieving the recovery objectives above and will not result in an appreciable reduction in the likelihood of the Kemp's ridley sea turtles' recovery in the wild.

7.2.3 Conclusion

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

7.3 Loggerhead Sea Turtle (NWA DPS)

7.3.1 Survival

The proposed action is expected to result in the capture of up to 2 loggerhead sea turtles (1 lethal, 1 non-lethal) from the NWA DPS during any consecutive 3-year period. The potential non-lethal capture of a loggerhead sea turtle from the NWA DPS is not expected to have any measurable impact on the reproduction, numbers, or distribution of the species. The individuals suffering non-lethal injuries or stresses are expected to fully recover such that no reductions in reproduction or numbers of loggerhead sea turtles are anticipated. The capture will occur in the action area, which encompasses a small portion of the overall range or distribution of loggerhead sea turtles within the NWA DPS. Any incidentally caught animal would be released within the general area where caught and no change in the distribution of NWA DPS of loggerhead sea turtle would be anticipated. The potential lethal capture of up to 1 loggerhead sea turtle during any consecutive 3-year period represents a reduction in numbers. A lethal capture could also result in a potential reduction in future reproduction, assuming the individual would be female and would have survived to reproduce in the future. For example, an adult female loggerhead sea turtle can lay approximately 4 clutches of eggs every 3-4 years, with 100-126 eggs per clutch. Thus, the loss of adult females could preclude the production of thousands of eggs and hatchlings of which a small percentage would be expected to survive to sexual maturity. However, a reduction in the distribution of loggerhead sea turtles is not expected from lethal capture attributed to the pier. The anticipated lethal capture is expected to occur in a small, discrete action area and loggerhead sea turtles in the NWA DPS generally have large ranges; thus, no reduction in the distribution is expected from a lethal capture.

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

In the absence of any total population estimates, nesting trends are the best proxy for estimating population changes. Abundance estimates in the western North Atlantic indicate the population

is large (i.e., several hundred thousand individuals). In Section 3.3.4, we summarized available information on number of loggerhead sea turtle nesters and nesting trends. Nesting trends across all of the recovery units have been steady or increasing over several years against the background of the past and ongoing human and natural factors that have contributed to the current status of the species. Additionally, in-water research suggests the abundance of neritic juvenile loggerheads is steady or increasing.

While the potential lethal capture of up to 1 loggerhead sea turtle during any consecutive 3-year period will affect the population, in the context of the overall population's size and current trend, we do not expect this loss to result in a detectable change to the population numbers or increasing trend. After analyzing the magnitude of the effects, in combination with the past, present, and future expected impacts to the DPS discussed in this Opinion, we believe the pier is not reasonably expected to cause an appreciable reduction in the likelihood of survival of the NWA DPS of loggerhead sea turtle in the wild.

7.3.2 Recovery

The recovery plan for the for the Northwest Atlantic population of loggerhead sea turtles (NMFS and USFWS 2009) was written prior to the loggerhead sea turtle DPS listings. However, this plan deals with the populations that comprise the current NWA DPS and is therefore, the best information on recovery criteria and goals for the DPS. It lists the following recovery objectives that are relevant to the effects of the proposed actions:

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

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

Nesting trends have been significantly increasing over several years. The potential lethal capture of up to 1 loggerhead sea turtle during any consecutive 3-year period is so small in relation to the overall population, that it would be hardly detectable, even when considered in the context of the Status of the Species, the Environmental Baseline, and Cumulative Effects discussed in this Opinion. We believe this is true for both nesting and juvenile in-water populations. The potential non-lethal capture of up to 1 loggerhead sea turtle from the NWA DPS would not affect the adult female nesting population, number of nests per nesting season, or juvenile in-water populations. Thus, recreational fishing at the proposed pier will not impede achieving the recovery objectives above and will not result in an appreciable reduction in the likelihood of NWA DPS of loggerhead sea turtles' recovery in the wild.

7.3.3 Conclusion

The combined potential lethal and non-lethal capture of loggerhead sea turtles associated with the proposed action is 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.

7.4 U.S. DPS of Smalltooth Sawfish

Recreational fishing from the Charlotte Harbor Fishing Pier is expected to result in the capture of up to 7 smalltooth sawfish over any consecutive 3-year period. We expect all captures to be non-lethal with no associated PRM.

7.4.1 Survival

The potential non-lethal capture of smalltooth sawfish over any consecutive 3-year period is not expected to have any measurable impact on the reproduction, numbers, or distribution of this species. The individuals captured are expected to fully recover such that no reductions in reproduction or numbers of this species are anticipated. Since these captures may occur in the small, discrete action area and would be released within the general area where caught, no change in the distribution of smalltooth sawfish is anticipated. Thus, after analyzing the magnitude of the effects, in combination with the past, present, and future expected impacts to the smalltooth sawfish DPS discussed in this Opinion, we believe that recreational fishing from the Charlotte Harbor Fishing Pier is not reasonably expected to cause an appreciable reduction in the likelihood of survival of the smalltooth sawfish U.S DPS in the wild.

7.4.2 Recovery

The following analysis considers the effects of non-lethal capture on the likelihood of recovery in the wild. The recovery plan for the smalltooth sawfish (NMFS 2009) lists 3 main objectives as recovery criteria for the species. The 2 objectives and the associated sub-objectives relevant to the proposed action are:

Recovery Objective #1- Minimize Human Interactions and Associated Injury and Mortality

Sub-objectives:

- Minimize human interactions and resulting injury and mortality of smalltooth sawfish through public education and outreach targeted at groups that are most likely to interact with sawfish (e.g., fishermen, divers, boaters).
- 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.

Recovery Objective #3 - Ensure Smalltooth Sawfish Abundance Increases Substantially and the Species Reoccupies Areas from which it had Previously Been Extirpated

Sub-objectives:

- 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.

NMFS is currently funding several actions identified in the Recovery Plan for smalltooth sawfish: adult satellite tagging studies, the ISED, and monitoring take in commercial fisheries to name a few. Additionally, NMFS has developed safe-handling guidelines for the species. Despite the ongoing threats from recreational fishing, we have seen a stable or slightly increasing trend in the population of this species. Thus, the proposed action is not likely to impede the recovery objectives above and will not result in an appreciable reduction in the likelihood of the U.S. DPS of smalltooth sawfish's recovery in the wild. NMFS must continue to monitor the status of the population to ensure the species continues to recover.

The potential non-lethal capture of smalltooth sawfish is not expected to have any measurable impact on the reproduction, numbers, or distribution of this species. Because the proposed action will not affect the population of reproductive adult females, we do not expect it to affect Recovery Objective #3, above, which focuses on ensuring abundance increases. The proposed action also will not interfere with Recovery Objective #1. Mortalities are not expected, and the proposed action furthers outreach efforts by ensuring signs are maintained at the pier to educate anglers about safe handling and reporting interactions with the species. Thus, the recreational fishing effects from the Charlotte Harbor Fishing Pier will not result in an appreciable reduction in the likelihood of smalltooth sawfish U.S. DPS recovery in the wild.

7.4.3 Conclusion

The potential non-lethal capture of smalltooth sawfish over any consecutive 3-year period associated with the Charlotte Harbor Fishing Pier is not expected to cause an appreciable reduction in the likelihood of either the survival or recovery of the U.S. DPS of smalltooth sawfish in the wild.

8. DESTRUCTION AND ADVERSE MODIFICATION ANALYSIS

NMFS's regulations define *Destruction or adverse modification* to mean "a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR 402.02). Alterations that may destroy or adversely modify critical habitat may include impacts to the area itself, such as those that would impede access to or use of the essential features. NMFS will generally conclude that a Federal action is likely to "destroy or adversely modify" designated critical habitat if the action results in an alteration of the quantity

or quality of the essential physical or biological features of designated critical habitat and if the effect of the alteration is to appreciably diminish the value of critical habitat as a whole for the conservation of the species.

This analysis takes into account the geographic and temporal scope of the proposed action, recognizing that “functionality” of critical habitat necessarily means that it must now and must continue in the future to support the conservation of the species and progress toward recovery. The analysis takes into account any changes in amount, distribution, or characteristics of the critical habitat that will be required over time to support the successful recovery of the species. Destruction or adverse modification does not depend strictly on the size or proportion of the area adversely affected, but rather on the role the action area and the affected critical habitat serves with regard to the function of the overall critical habitat designation, and how that role is affected by the action.

As stated above, the smalltooth sawfish recovery plan identifies 3 recovery objectives to help facilitate recruitment of juveniles into the recovering adult population (NMFS 2009). Recovery Objective #1 is to minimize human interactions and associated injury and mortality; this objective is not relevant to critical habitat. Recovery Objective #2 is to protect and/or restore smalltooth sawfish habitats. Recovery Objective #3 is to ensure smalltooth sawfish abundance increases substantially and the species reoccupies areas from which it had previously been extirpated. Our analysis evaluates whether the anticipated impacts to critical habitat associated with the proposed action would interfere with Recovery Objectives #2 and #3, and ultimately, the conservation objective behind the designated critical habitat—that is, facilitation of juvenile recruitment into a recovering adult population.

8.1 Protect and Restore Smalltooth Sawfish Habitat (Recovery Objective #2)

In establishing Recovery Objective #2, we recognized that recovery and conservation of smalltooth sawfish depends on the availability and quality of nursery habitats. Historically, juvenile sawfish were documented in mangrove and non-mangrove habitat in the southeastern United States. Due to the protections provided by the Ten Thousand Islands National Wildlife Refuge, Everglades National Park, and the Florida Keys National Marine Sanctuary, much of the historic juvenile smalltooth sawfish habitat in southwest Florida has remained high-quality juvenile habitat. Recovery Regions G, H, and I in southwest Florida extend from the Manatee River on the west coast of Florida, south through Everglades National Park and the Florida Keys to Caesar Creek on the southeast coast of Florida. The CHEU is in Recovery Region G. While much of the CHEU is protected by the CHPSP system and the Estero Bay Aquatic Preserve, it is also highly anthropomorphically influenced.

The recovery plan states that for the 3 recovery regions with remaining high-quality habitats (i.e., Recovery Regions G, H, and I), juvenile habitats “must be maintained over the long term at or above 95% of the acreage available at the time of listing” (NMFS, 2009). To ensure that a proposed action will not impede Recovery Objective #2, we determine whether the critical habitat unit will be able to maintain 95% of the areas containing each essential feature after taking into account project impacts in the context of the status of the critical habitat, the environmental baseline, and cumulative effects. While the CHEU is only a part of the larger

Recovery Region G, and the 95% protection threshold applies across not just Recovery Region G, but also Recovery Regions H and I, the threshold is still useful for evaluating the impacts at the individual recovery region level and for sub-units of the recovery regions. The CHEU contains the only known nursery areas within Recovery Region G; thus, we believe it is appropriate to evaluate impacts at the level of the unit. In addition, functioning critical habitat contains either one or both of the essential features, and the essential features were selected based on their role in facilitating recruitment of juvenile animals into the adult population, which the recovery plan likewise seeks to conserve and protect. Consequently, we also believe it is appropriate to consider whether 95% of each of the essential features of critical habitat in the CHEU is maintained. Therefore, below we estimate the percent impact the proposed action will have on the shallow, euryhaline habitat essential feature of critical habitat within the CHEU. The proposed action will not affect the red mangrove essential feature of smalltooth sawfish critical habitat.

8.1.1 Shallow, Euryhaline Essential Feature Impacts

NMFS estimated that 84,480 ac of shallow, euryhaline habitat (abbreviated SH throughout this section) was available within the CHEU at the effective date of species listing (i.e., May 1, 2003) (Table 14, Line 1). As discussed above, we must determine whether a proposed action's impact will interfere with long-term maintenance of this essential feature at or above 95% of the acreage available at the time of listing; however, loss of critical habitat was not formally monitored until the effective date of critical habitat designation (i.e., October 2, 2009). Therefore, we must estimate habitat loss that occurred during the period between the effective date of species listing and the effective date of critical habitat designation (i.e., May 1, 2003 – October 2, 2009). To do this, we use an 84-month dataset of our completed Section 7 consultations (October 3, 2009 – September 30, 2016), including yearly losses due to programmatic consultations, to generate a rate of loss that can then be used to back-calculate the loss of SH between the effective date of species listing and the effective date of critical habitat designation. We rely on this dataset because using approximately 7 years of information helps avoid over- or under-estimating the rate of habitat loss due to any potential inter-annual variability associated with economic growth and contraction that may have occurred in that time. NMFS consultations completed during this time indicate that 17.60 ac of SH in the CHEU was lost due to federal agency actions.

Based on these losses, we estimate a monthly loss rate of SH in the CHEU using the following equation:

$$\begin{aligned} & \textit{Monthly loss rate of SH (CHEU)} \\ & = \textit{SH lost through federal agency actions} \div 84 \textit{ months} \\ & = 17.60 \textit{ ac} \div 84 \textit{ months} \\ & = 0.21 \textit{ ac per month} \end{aligned}$$

Assuming the same monthly loss rate, we back-calculate the loss of SH in the 77 months between the effective date of species listing and the effective date of critical habitat designation (i.e., May 1, 2003 – October 2, 2009) in the CHEU using the following equation:

$$\begin{aligned}
& \text{SH lost prior to critical habitat designation (CHEU)} \\
& = 0.21 \text{ ac per month} \times 77 \text{ months} \\
& = 16.17 \text{ ac (Table 14, Line 2)}
\end{aligned}$$

Next, we determine the loss of SH since the effective date of critical habitat designation. From the effective date of critical habitat designation through June 30, 2020, 26.37 ac of SH in the CHEU has been lost due to federal agency actions (Table 14, Line 3).¹¹ While this amount of loss only takes into account projects with a federal nexus requiring ESA Section 7 consultation, there are very few projects without a federal nexus that could affect shallow, euryhaline habitat in the CHEU as most in-water construction projects require federal authorization.

Using this information, we calculate the SH currently available in CHEU using the following equation:

$$\begin{aligned}
& \text{SH currently available (CHEU)} \\
& = \text{SH at time of species listing} - (\text{SH lost prior to critical habitat designation} \\
& \quad + \text{SH lost since critical habitat designation}) \\
& = 84,480 \text{ ac} - (16.17 \text{ ac} + 26.37 \text{ ac}) \\
& = 84,437.46 \text{ ac (Table 14, Line 4)}
\end{aligned}$$

We calculate the amount of SH that must be maintained in the CHEU per Recovery Objective #2 using the following equation:

$$\begin{aligned}
& \text{SH that must be maintained (CHEU)} \\
& = \text{SH at time of species listing} \times 95\% \\
& = 84,480 \text{ ac} \times 0.95 \\
& = 80,256 \text{ ac (Table 14, Line 5)}
\end{aligned}$$

The proposed action would result in the permanent loss of 0.051653 ac of SH (Table 14, Line 6). Using the above results, we estimate the total amount of SH lost in the CHEU since species listing, including losses from the proposed action using the following equation:

$$\begin{aligned}
& \% \text{ SH lost since species listing (CHEU)} \\
& = [(\text{SH lost due to this project} + \text{SH lost prior to critical habitat designation} \\
& \quad + \text{SH lost since critical habitat designation}) \\
& \quad \div \text{Total SH at time of species listing}] \times 100 \\
& = [(0.051653 \text{ ac} + 16.17 \text{ ac} + 26.37 \text{ ac}) \div 84,480 \text{ ac}] \times 100 \\
& = (42.591653 \text{ ac} \div 84,480 \text{ ac}) \times 100 \\
& = 0.050416\% \text{ (Table 14, Line 7)}
\end{aligned}$$

Thus, we estimate the percent of SH remaining within the CHEU as:

¹¹ Due to the high frequency of relatively small projects affecting smalltooth sawfish critical habitat, NMFS updates shallow, euryhaline habitat losses every 6 months on the U.S. federal fiscal year (December 31 and June 30).

% *SH remaining (CHEU)*
 = 100% – % *SH lost since species listing (CHEU)*
 = 100% – 0.050416%
 = 99.949584% (*Table 14, Line 8*)

Table 14. Summary of Impacts to the Shallow, Euryhaline Habitat Essential Feature

Shallow, Euryhaline Habitat in the CHEU	Acres
1. Available at the time of species listing	84,480
2. Losses prior to critical habitat designation	16.17
3. Losses since critical habitat designation	26.37
4. Available as of July 1, 2020	84,437.46
5. Area that must be maintained per Recovery Plan	80,256 (95% of 84,480)
6. Affected by the proposed action	0.051653
7. Affected since species listing (including the proposed action)	42.591653 (0.050416% of 84,480)
8. Remaining	84,437.408347 (99.949584% of 84,480)

8.1.2 Summary of Impacts to the Essential Features

Very small percentages of the essential features of smalltooth sawfish designated critical habitat have been affected by federal agency actions since the effective date of species listing. Including losses from the proposed action, 99.949584% of the SH essential feature (*Table 14, Line 8*) available at the time of species listing remain in the CHEU. Thus, the loss of essential feature associated with the proposed action, in combination with losses since we listed the species, does not provide any impediment to effectively protecting 95% of juvenile habitat in the CHEU available at the effective date of species listing, and therefore will not be an impediment to Recovery Objective #2.

8.2 Ensure Smalltooth Sawfish Abundance Increases (Recovery Objective #3)

In establishing Recovery Objective #3, we recognized that it was important that sufficient numbers of juvenile 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. To meet this objective, Recovery Region G (i.e., CHEU) must support sufficiently large numbers of juvenile sawfish to ensure that the species is viable in the long-term and can maintain genetic diversity. Recovery Objective #3 requires that the relative abundance of small juvenile sawfish (< 200 cm) either increases at an average annual rate of at least 5% over a 27-year period, or juvenile abundance is at greater than 80% of the carrying capacity of the recovery region.

Assessing the effect of the proposed action on small juvenile abundance is made difficult by the state of available data. Since the designation of critical habitat and the release of the recovery

plan in 2009, ongoing studies have been in place to monitor the U.S. DPS of smalltooth sawfish. The FWC Fish and Wildlife Research Institute is conducting a study in the CHEU that is supported primarily with funding provided by NMFS through the ESA Section 6 Species Recovery Grants Program, while Florida State University and the NOAA NMFS Southeast Fisheries Science Center Panama City Laboratory have focused studies in the TTIEU. The intent of these studies is to determine the abundance, distribution, habitat use, and movement of smalltooth sawfish. Early indications are that juvenile sawfish are at least stable and likely increasing in the CHEU, due in large part to ESA-listing of the species and designation of critical habitat. While it may be too early to state definitively that juveniles within CHEU are surviving to adulthood, researchers consistently capture newborn smalltooth sawfish, particularly within “hotspots,” indicating adult smalltooth sawfish are pupping within Recovery Region G. Available data from the adjacent Recovery Region H (i.e., TTIEU) indicate that adult smalltooth sawfish are also reproducing within this recovery region and that the juvenile population trend is at least stable and possibly increasing—though variability is high (Carlson and Osborne 2012a; Carlson et al. 2007). With no other data to consider, the abundance trend in the TTIEU represents the best data available for assessing the population trends in the CHEU. Therefore, we do not believe the loss of habitat associated with the proposed action, in combination with the losses to date, will impede the 5% annual growth objective for the juvenile population within Recovery Region G.

9. CONCLUSION

After reviewing the Status of the Species, the Environmental Baseline, the Effects of the Action, and the Cumulative Effects using the best available data, it is NMFS’s Opinion that recreational fishing due to the proposed action is not likely to jeopardize the continued existence of the NA or SA DPS of green sea turtle, Kemp’s ridley sea turtle, the NWA DPS of loggerhead sea turtle, and U.S. DPS of smalltooth sawfish. In addition, it is also our opinion that the loss of 0.051653 ac (2,250 ft²) of shallow, euryhaline essential feature due to the proposed action will not interfere with achieving the relevant habitat-based recovery objectives for smalltooth sawfish. Therefore, we conclude the proposed action will not impede the critical habitat’s ability to support the smalltooth sawfish’s conservation, despite permanent adverse effects. Given the nature of the proposed action and the information provided above, we conclude that the action, as proposed, is likely to adversely affect, but is not likely to destroy or adversely modify, smalltooth sawfish critical habitat.

10. INCIDENTAL TAKE STATEMENT

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

Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. *Incidental take* is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of Section 7(b)(4) and Section 7(o)(2), taking that would otherwise be considered prohibited under Section 9 or Section 4(d), but which is incidental to and not intended as part of the agency action is not

considered to be prohibited taking under the ESA, provided that such taking is in compliance with the Reasonable and Prudent Measures (RPMs) and the Terms and Conditions (T&Cs) of the Incidental Take Statement (ITS) of the Opinion.

10.1 Anticipated Amount or Extent of Incidental Take

The take limits prescribed in this Opinion that will trigger the requirement to reinstate consultation are based on the amount of take that we expect *to be reported* as it is not possible to directly monitor the incidents that go unreported. The best available information for estimating the amount of future take of sea turtles and smalltooth sawfish that will be reported at the Charlotte Harbor Fishing Pier is described in Section 5. Based on the data collected from the Hill (2013) fishing pier study, we anticipate 92% of sea turtle take and 88% of smalltooth sawfish take will go unreported. The anticipated, unreported takes are not directly monitored but can be estimated from reported takes using the process described in Section 5.2.1.2 (sea turtles) and Section 5.3.2 (smalltooth sawfish).

The take limits shown in Table 15 are our best estimates of the amount of sea turtle and smalltooth sawfish take expected to be reported over any consecutive 3-year period. In Section 5.2, we developed an estimate of the total number of sea turtle captures expected to be reported annually (0.05; Table 6, Line 1). We take that number and multiply by 3 to get the 3-year total estimate of reported sea turtle captures ($0.05 \times 3 = 0.15$). We then apply that number to the species breakdown reported in the STSSN inshore data for recreational hook-and-line captures and gear entanglement in Zone 4 (described in Section 5.3.2) to obtain the 3-year total estimate of reported take of each species of sea turtle. For those estimates that come out to be less than 1, we round up to 1 to reach a whole number that can be used as the take limit. In Section 5.3, we developed an estimate of the total number of smalltooth sawfish captures expected to be reported annually (0.2533; Table 13, Line 1). We take that number and multiply by 3 to get the 3-year total estimate of reported smalltooth sawfish captures ($0.2533 \times 3 = 0.7599$). We round 0.7599 to 1 to reach a whole number that can be used as the take limit.

Table 15. Incidental Take Limits by Species for Any Consecutive 3-Year Period

Species	Total Estimated Reported Captures	Incidental Take Limits that will Trigger Reinitiation
Green sea turtle (NA or SA DPS)	$0.15 \times 0.48 = 0.0720$, rounded up to 1	No more than 1 reported capture*
Kemp’s ridley sea turtle	$0.15 \times 0.32 = 0.0480$, rounded up to 1	No more than 1 reported capture per year
Loggerhead sea turtle (NWA DPS)	$0.15 \times 0.20 = 0.0300$, rounded up to 1	No more than 1 reported capture
Smalltooth sawfish (U.S. DPS)	$0.2533 \times 3 = 0.7599$, rounded up to 1	No more than 1 reported capture

*We do not expect, and do not authorize, more than 1 green sea turtle take during any consecutive 3-year time period, which may come from either the NA or the SA DPS.

It is important to note that the mortality rates estimated in Section 5.2.2 for sea turtles are not likely to be detected in the initial reporting of captures, as most sea turtles are expected to live for some period following capture. Some of these individuals may be sent to rehabilitation facilities and later die in those facilities, or may be released and die in the wild from undetected injuries, as discussed in our PRM analysis. While it is also possible that some sea turtles may die immediately from severe injuries related to hook and line capture or entanglement (which will be included in the annual reports discussed below [Terms & Conditions (T&Cs)], we do not expect that result. At the time of the interaction, we expect sea turtle take in the above ITS to be non-lethal. As previously discussed in Section 5.2.2.1, up to 70.4% of the reported interactions could result in a mortality, and reports of such PRM are consistent with the analysis in this Opinion and this ITS. Likewise, we expect PRM of the unreported sea turtle interactions, as described in Section 5.2.2.2. Again, we expect all interactions with smalltooth sawfish (reported and unreported) to be non-lethal with no associated PRM.

10.2 Effect of Take

NMFS has determined that the anticipated incidental take, including the anticipated reported and unreported take, is not likely to jeopardize the continued existence of the green sea turtle (NA or SA DPS), Kemp's ridley sea turtle, loggerhead sea turtle (NWA DPS), or smalltooth sawfish (U.S. DPS).

10.3 Reasonable and Prudent Measures

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

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

NMFS has determined that the following RPMs and associated T&Cs are necessary and appropriate to minimize impacts of the incidental take of ESA-listed species related to the proposed action:

1. The federal action agency must ensure that the applicant provides take reports regarding all interactions with ESA-listed species at the fishing structure.

2. The federal action agency must ensure that the applicant minimizes the likelihood of injury or mortality to ESA-listed species resulting from hook-and-line capture or entanglement by activities at the fishing structure.
3. The federal action agency must ensure that the applicant reduces the impacts to incidentally captured ESA-listed species at the fishing structure.
4. The federal action agency must ensure that the applicant coordinates periodic fishing line removal (i.e., cleanup) events with non-governmental or other local organizations.

10.4 Terms and Conditions

The following T&Cs implement the above RPMs:

1. To implement RPM 1, the federal action agency must ensure that the applicant reports all known angler-reported hook-and-line captures of ESA-listed species and any other takes of ESA-listed species to the NMFS SERO PRD.
 - a. When the applicant become aware of any reported capture, entanglement, stranding, or other take, the applicant must notify NMFS SERO PRD by email: takereport.nmfs@noaa.gov.
 - i. Emails must reference this Opinion by the NMFS tracking number (SERO-2020-01970 Bocilla Island Seaport Reconfiguration) and date of issuance.
 - ii. The email must state the species, date and time of the incident, general location and activity resulting in capture (e.g., fishing from the boardwalk by hook-and-line), condition of the species (i.e., alive, dead, sent to rehabilitation), size of the individual, behavior, identifying features (i.e., presence of tags, scars, or distinguishing marks), and any photos that may have been taken.
 - b. Every year, the applicant must submit a summary report of capture, entanglement, stranding, or other take of ESA-listed species to NMFS SERO PRD by email: takereport.nmfs@noaa.gov.
 - i. Emails and reports must reference this Opinion by the NMFS tracking number (SERO-2020-01970 Bocilla Island Seaport Reconfiguration) and date of issuance.
 - ii. The report will contain the following information: the total number of ESA-listed species captures, entanglements, strandings, or other take that was reported at or adjacent to the structure included in this Opinion.
 - iii. The report will also contain all information if any sea turtles is unexpectedly captured and taken to a rehabilitation facility holding an appropriate USFWS Native Endangered and Threatened Species Recovery permit. This information can be obtained from the appropriate State Coordinator for the STSSN (<https://www.fisheries.noaa.gov/state-coordinators-sea-turtle-stranding-and-salvage-network>)
 - iv. The first report will be submitted by January 31, 2022, and will cover the time period from project completion until December 31, 2021. The second report will be submitted by January 31, 2023, and will cover calendar year 2022 and include the information in the first report. The third report will

be submitted by January 31, 2024, and will cover the prior two calendar years (calendar years 2023 and 2022) and include the information from the first report. The next report will be submitted by January 31, 2025 and will cover the prior three calendar years (calendar years 2024, 2023, and 2022). Thereafter, reports will be prepared every year, covering the prior rolling three-year time period, and emailed no later than January 31 of any year.

- v. Reports will include current photographs of signs and bins required in T&C 2, below, and records of the clean-ups required in T&C 3 below.
2. To implement RPMs 2 and 3, the federal action agency must make it a condition of its funding that the applicant must:
- a. Install and maintain the following NMFS Protected Species Educational Signs: “Save Dolphins, Sea Turtles, Sawfish, and Manta Rays” sign and the “Save Sawfish” sign.
 - i. Signs will be posted on both sides of the Seaport, at least at the entrance to the boat ramps and fishing pier.
 - ii. Signs will be posted upon completion of the proposed action.
 - iii. Photographs of the installed signs will be emailed to NMFS’s Southeast Regional Office (takereport.nmfsser@noaa.gov) with the NMFS tracking number (SERO-2020-01970 Bocilla Island Seaport Reconfiguration) and date of issuance.
 - iv. Sign designs and installation methods are provided at the following website: <https://www.fisheries.noaa.gov/southeast/consultations/protected-species-educational-signs>.
 - v. Current photographs of the signs will be included in each report required by T&C 1, above.
 - b. Install and maintain fishing line recycling bins and trash receptacles with lids at the structure to reduce the probability of trash and debris entering the water.
 - i. Fishing line recycling bins and trash receptacles will be installed upon completion of the proposed action.
 - ii. Photographs of the installed bins and trash receptacles will be emailed to NMFS’s Southeast Regional Office by email (takereport.nmfsser@noaa.gov) with the NMFS tracking number for this Opinion (SERO-2020-01970 Bocilla Island Seaport Reconfiguration) and date of issuance.
 - iii. The applicant must regularly empty the bins and trash receptacles and make sure they are functional and upright.
 - iv. Additionally, current photographs of the bins will be included in each report required by T&C 1, above.
3. To implement RPMs 2, 3, and 4, the federal action agency must make it a condition of its funding that the applicant must:
- a. Perform at least 1 annual underwater cleanup to remove derelict fishing line and associated gear from around the structure.
 - b. Submit a record of each cleaning event in the report required by T&C 1 above.

11. CONSERVATION RECOMMENDATIONS

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

NMFS believes the following CRs further the conservation of the listed species that will be affected by the proposed action. NMFS strongly recommends that these measures be considered and implemented by the federal action agency:

Sea Turtles

- Conduct or fund research that investigates ways to reduce and minimize mortality of sea turtles in the recreational hook-and-line fishery.
- Conduct or fund outreach designed to increase the public's knowledge and awareness of ESA-listed sea turtle species.

Smalltooth sawfish

- Conduct or fund outreach designed to increase the public's knowledge and awareness of smalltooth sawfish in an effort to minimize interactions, injury, and mortality.
- Provide funding to conduct directed research on smalltooth sawfish that will help further our understanding about the species (e.g., implement a relative abundance monitoring program which will help define how spatial and temporal variability in the physical and biological environment influence smalltooth sawfish) in an effort to predict long-term changes in smalltooth sawfish distribution, abundance, extent, and timing of movements.

NMFS believes the following CRs further the conservation of the designated critical habitat that will be adversely affected by the proposed action. NMFS strongly recommends that these measures be considered and implemented by the federal action agency:

Smalltooth sawfish designated critical habitat

- Fund surveys of detailed bathymetry and mangrove coverage within smalltooth sawfish critical habitat. Lee County and the USACE recently funded such surveys within the Cape Coral municipality. Data is needed from other municipalities within the CHEU to establish a more accurate baseline assessment of both critical habitat features (red mangroves and shallow-water areas).
- Fund and support restoration efforts that rehabilitate and create shallow, euryhaline and mangrove fringe habitats within the range of smalltooth sawfish.

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

12. REINITIATION OF CONSULTATION

As provided in 50 CFR Section 402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law) and if (1) the amount or extent of take specified in the ITS is exceeded, (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered, (3) the identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in the Opinion, or (4) a new species is listed or critical habitat designated that may be affected by the identified action.

13. LITERATURE CITED

- 81 FR 20057. 2016. Endangered and Threatened Wildlife and Plants; Final Rule To List Eleven Distinct Population Segments of the Green Sea Turtle (*Chelonia mydas*) as Endangered or Threatened and Revision of Current Listings Under the Endangered Species Act. Final Rule. Federal Register 81(66):20057 -20090.
- Ackerman, R. A. 1997. The nest environment and the embryonic development of sea turtles. Pages 83-106 in P. L. Lutz, and J. A. Musick, editors. The Biology of Sea Turtles. CRC Press, Boca Raton, Florida.
- Addison, D. 1997. Sea turtle nesting on Cay Sal, Bahamas, recorded June 2-4, 1996. Bahamas Journal of Science 5(1):34-35.
- Addison, D., and B. Morford. 1996. Sea turtle nesting activity on the Cay Sal Bank, Bahamas. Bahamas Journal of Science 3(3):31-36.
- Aguilar, R., J. Mas, and X. Pastor. 1994. Impact of Spanish swordfish longline fisheries on the loggerhead sea turtle *Caretta caretta* population in the western Mediterranean. Pages 91-96 in J. I. Richardson, and T. H. Richardson, editors. Proceedings of the 12th Annual Workshop on Sea Turtle Biology and Conservation. U.S. Department of Commerce, Jekyll Island, Georgia.
- Aguilar, R., J. Mas, and X. Pastor. 1995. Impact of Spanish swordfish longline fisheries on the loggerhead sea turtle, *Caretta caretta*, population in the western Mediterranean. Pages 1 in 12th Annual Workshop on Sea Turtle Biology and Conservation, Jekyll Island, Georgia.
- Aguirre, A., G. Balazs, T. Spraker, S. K. K. Murakawa, and B. Zimmerman. 2002. Pathology of oropharyngeal fibropapillomatosis in green turtles *Chelonia mydas*. Journal of Aquatic Animal Health 14:298-304.
- Andrews, T. J., B. F. Clough, and G. J. Muller. 1984. Photosynthetic gas exchange properties and carbon isotope ratios of some mangroves in North Queensland. Pages 15-23 in H. J. Teas, editor. Physiology and Management of Mangroves. Tasks for Vegetation Science, volume 9. Springer, Dordrecht, Netherlands.
- Antonelis, G. A., J. D. Baker, T. C. Johanos, R. C. Braun, and A. L. Harting. 2006. Hawaiian monk seal (*Monachus schauinslandi*): Status and conservation issues. Atoll Research Bulletin 543:75-101.
- Arendt, M., and coauthors. 2009. Examination of local movement and migratory behavior of sea turtles during spring and summer along the Atlantic coast off the southeastern United States. South Carolina Department of Natural Resources, Marine Resources Division.

- Baker, J., C. Littnan, and D. Johnston. 2006. Potential effects of sea-level rise on terrestrial habitat and biota of the northwestern Hawaiian Islands. Pages 3 *in* Twentieth Annual Meeting Society for Conservation Biology Conference, San Jose, California.
- Balazs, G. H. 1982. Growth rates of immature green turtles in the Hawaiian Archipelago. Pages 117-125 *in* K. A. Bjorndal, editor. *Biology and Conservation of Sea Turtles*. Smithsonian Institution Press, Washington D.C.
- Balazs, G. H. 1983. Recovery records of adult green turtles observed or originally tagged at French Frigate Shoals, Northwestern Hawaiian Islands. National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, NOAA-TM-NMFS-SWFC-36.
- Balazs, G. H. 1985. Impact of ocean debris on marine turtles: entanglement and ingestion. R. S. Shomura, and H. O. Yoshida, editors. *Proceedings of the workshop on the fate and impact of marine debris*. NOAA-NMFS, Honolulu, HI.
- Balazs, G. H., S. G. Pooley, and S. K. Murakawa. 1995. Guidelines for handling marine turtles hooked or entangled in the Hawaii longline fishery: Results of an expert workshop held in Honolulu, Hawaii March 15-17, 1995. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southwest Fisheries Science Center, Honolulu.
- Ball, M. C., M. J. Cochrane, and H. M. Rawson. 1997. Growth and water use of the mangroves *Rhizophora apiculata* and *R. stylosa* in response to salinity and humidity under ambient and elevated concentrations of atmospheric CO₂. *Plant, Cell & Environment* 20(9):1158-1166.
- Bass, A. L., and W. N. Witzell. 2000. Demographic composition of immature green turtles (*Chelonia mydas*) from the east central Florida coast: Evidence from mtDNA markers. *Herpetologica* 56(3):357-367.
- Baughman, J. L. 1943. Notes on sawfish, *Pristis perotteti* Müller and Henle, not previously reported from the waters of the United States. *Copeia* 1943(1):43-48.
- Bethea, D. M., K. L. Smith, and J. K. Carlson. 2012. Relative abundance and essential fish habitat studies for smalltooth sawfish, *Prists pectinata*, in southwest Florida, USA. NOAA Fisheries Southeast Fisheries Science Center, Panama City, FL.
- Bethea, D. M., K. L. Smith, L. D. Hollensead, and J. K. Carlson. 2011. Relative abundance and essential fish habitat studies for smalltooth sawfish, *Pristis pectinata*, in southwest Florida, USA. NOAA Fisheries, Southeast Fisheries Science Center, Panama City, FL.
- Bigelow, S. F., and W. C. Schroeder. 1953. Sharks, sawfishes, guitarfishes, skates, rays, and chimaeroids. Pages 1-514 *in* J. Tee-Van, C. M. Breder, F. F. Hildebrand, A. E. Parr, and W. E. Schroeder, editors. *Fishes of the Western North Atlantic, Part 2*. Sears Foundation of Marine Research, Yale University, New Haven, CT.
- Bjorndal, K. A. 1982. The consequences of herbivory for life history pattern of the Caribbean green turtle, *Chelonia mydas*. Pages 111-116 *in* *Biology and Conservation of Sea Turtles*. Smithsonian Institution, Washington, D. C.
- Bjorndal, K. A., A. B. Bolten, and M. Y. Chaloupka. 2005. Evaluating trends in abundance of immature green turtles, *Chelonia mydas*, in the greater Caribbean. *Ecological Applications* 15(1):304-314.
- Bjorndal, K. A., A. B. Bolten, T. Dellinger, C. Delgado, and H. R. Martins. 2003. Compensatory growth in oceanic loggerhead sea turtles: Response to a stochastic environment. *Ecology* 84(5):1237-1249.

- Bjorndal, K. A., J. A. Wetherall, A. B. Bolten, and J. A. Mortimer. 1999. Twenty-six years of green turtle nesting at Tortuguero, Costa-Rica: An encouraging trend. *Conservation Biology* 13(1):126-134.
- Bolten, A., and B. Witherington. 2003. *Loggerhead Sea Turtles*. Smithsonian Books, Washington, D. C.
- Bolten, A. B., K. A. Bjorndal, and H. R. Martins. 1994. Life history model for the loggerhead sea turtle (*Caretta caretta*) populations in the Atlantic: Potential impacts of a longline fishery. Pages 48-55 in G. J. Balazs, and S. G. Pooley, editors. *Research Plan to Assess Marine Turtle Hooking Mortality*, volume Technical Memorandum NMFS-SEFSC-201. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center.
- Bolten, A. B., and coauthors. 1998. Transatlantic developmental migrations of loggerhead sea turtles demonstrated by mtDNA sequence analysis. *Ecological Applications* 8(1):1-7.
- Bouchard, S., and coauthors. 1998. Effects of exposed pilings on sea turtle nesting activity at Melbourne Beach, Florida. *Journal of Coastal Research* 14(4):1343-1347.
- Bowen, B. W., and coauthors. 1992. Global population structure and natural history of the green turtle (*Chelonia mydas*) in terms of matriarchal phylogeny. *Evolution* 46(4):865-881.
- Brame, A. B., and coauthors. 2019. Biology, ecology, and status of the smalltooth sawfish *Pristis pectinata* in the USA. *Endangered Species Research* 39:9-23.
- Bresette, M., R. A. Scarpino, D. A. Singewald, and E. P. de Maye. 2006. Recruitment of post-pelagic green turtles (*Chelonia mydas*) to nearshore reefs on Florida's southeast coast. Pages 288 in M. Frick, A. Panagopoulou, A. F. Rees, and K. Williams, editors. *Twenty-Sixth Annual Symposium on Sea Turtle Biology and Conservation*. International Sea Turtle Society, Athens, Greece.
- Burchett, M. D., S. Meredith, A. Pulkownik, and S. Pulkownik. 1984. Short term influences affecting growth and distribution of mangrove communities in the Sydney region. *Wetlands Australia* 4(2):63-72.
- Cahoon, D. R., and coauthors. 2003. Mass tree mortality leads to mangrove peat collapse at Bay Islands, Honduras after Hurricane Mitch. *Journal of Ecology* 91(6):1093-1105.
- Caldwell, D. K., and A. Carr. 1957. Status of the sea turtle fishery in Florida. Pages 457-463 in J. B. Trefethen, editor *Twenty-Second North American Wildlife Conference*. Wildlife Management Institute, Statler Hotel, Washington, D. C.
- Caldwell, S. 1990. Texas sawfish: Which way did they go? *Tide* Jan-Feb:16-19.
- Campell, C. L., and C. J. Lagueux. 2005. Survival probability estimates for large juvenile and adult green turtles (*Chelonia mydas*) exposed to an artisanal marine turtle fishery in the western Caribbean. *Herpetologica* 61(2):91-103.
- Carballo, J. L., C. Olabarria, and T. G. Osuna. 2002. Analysis of four macroalgal assemblages along the Pacific Mexican coast during and after the 1997-98 El Niño. *Ecosystems* 5(8):749-760.
- Carlson, J. K., and J. Osborne. 2012a. Relative abundance of smalltooth sawfish (*Pristis pectinata*) based on the Everglades National Park Creel Survey. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, NOAA Technical Memorandum NMFS-SEFSC-626, Panama City, FL.

- Carlson, J. K., and J. Osborne. 2012b. Relative abundance of smalltooth sawfish (*Pristis pectinata*) based on the Everglades National Park Creel Survey. NOAA National Marine Fisheries Service, NMFS-SEFSC-626, Panama City, FL.
- Carlson, J. K., J. Osborne, and T. W. Schmidt. 2007. Monitoring the recovery of smalltooth sawfish, *Pristis pectinata*, using standardized relative indices of abundance. *Biological Conservation* 136(2):195-202.
- Carlson, J. K., and C. A. Simpfendorfer. 2015. Recovery potential of smalltooth sawfish, *Pristis pectinata*, in the United States determined using population viability models. *Aquatic Conservation: Marine and Freshwater Ecosystems* 25(2):187-200.
- Carr, A. F. 1986. New perspectives on the pelagic stage of sea turtle development. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center.
- Carr, T., and N. Carr. 1991. Surveys of the sea turtles of Angola. *Biological Conservation* 58(1):19-29.
- Chaloupka, M., and C. Limpus. 2005. Estimates of sex- and age-class-specific survival probabilities for a southern Great Barrier Reef green sea turtle population. *Marine Biology* 146(6):1251-1261.
- Chaloupka, M., T. M. Work, G. H. Balazs, S. K. K. Murakawa, and R. Morris. 2008. Cause-specific temporal and spatial trends in green sea turtle strandings in the Hawaiian Archipelago (1982-2003). *Marine Biology* 154(5):887-898.
- Chaloupka, M. Y., and J. A. Musick. 1997. Age growth and population dynamics. Pages 233-276 in P. L. Lutz, and J. A. Musick, editors. *The Biology of Sea Turtles*. CRC Press, Boca Raton, Florida.
- Conant, T. A., and coauthors. 2009. Loggerhead sea turtle (*Caretta caretta*) 2009 status review under the U.S. Endangered Species Act. National Oceanic and Atmospheric Administration, National Marine Fisheries Service.
- Cook, M. C., and coauthors. 2014. Hooked on Kemp's - Preliminary Results of Mississippi's Angler Survey. International Sea Turtle Symposium-2014, New Orleans, LA.
- D'Ilio, S., D. Mattei, M. F. Blasi, A. Alimonti, and S. Bogialli. 2011. The occurrence of chemical elements and POPs in loggerhead turtles (*Caretta caretta*): An overview. *Marine Pollution Bulletin* 62(8):1606-1615.
- Dahl, T. E., and C. E. Johnson. 1991. Status and trends of wetlands in the conterminous United States, mid-1970s to mid-1980s. U.S. Fish and Wildlife Service, Washington, D.C.
- Daniels, R. C., T. W. White, and K. K. Chapman. 1993. Sea-level rise - destruction of threatened and endangered species habitat in South Carolina. *Environmental Management* 17(3):373-385.
- Dodd Jr., C. K. 1988. Synopsis of the biological data on the loggerhead sea turtle *Caretta caretta* (Linnaeus 1758). U.S. Fish and Wildlife Service, 88(14).
- Doughty, R. W. 1984. Sea turtles in Texas: A forgotten commerce. *Southwestern Historical Quarterly* 88:43-70.
- Dow, W., K. Eckert, M. Palmer, and P. Kramer. 2007. An atlas of sea turtle nesting habitat for the wider Caribbean region. The Wider Caribbean Sea Turtle Conservation Network and The Nature Conservancy, Beaufort, North Carolina.
- Dulvy, N. K., and coauthors. 2016. Ghosts of the coast: global extinction risk and conservation of sawfishes. *Aquatic Conservation: Marine and Freshwater Ecosystems* 26(1):134-153.

- DWH Trustees. 2015a. Deepwater Horizon Oil Spill: Draft Programmatic Damage Assessment and Restoration Plan and Draft Programmatic Environmental Impact Statement. Retrieved from <http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan/>.
- DWH Trustees. 2015b. DWH Trustees (Deepwater Horizon Natural Resource Damage Assessment Trustees). 2015. Deepwater Horizon Oil Spill: Draft Programmatic Damage Assessment and Restoration Plan and Draft Programmatic Environmental Impact Statement. Retrieved from <http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan/>.
- Ehrhart, L. M. 1983. Marine turtles of the Indian River Lagoon System. *Florida Scientist* 46(3/4):337-346.
- Ehrhart, L. M., W. E. Redfoot, and D. A. Bagley. 2007. Marine turtles of the central region of the Indian River Lagoon System, Florida. *Florida Scientist* 70(4):415-434.
- Ehrhart, L. M., and R. G. Yoder. 1978. Marine turtles of Merritt Island National Wildlife Refuge, Kennedy Space Centre, Florida. *Florida Marine Research Publications* 33:25-30.
- Ellison, J. C. 2010. Vulnerability of Fiji's mangroves and associated coral reefs to climate change. A review. WWF South Pacific Programme, Suva, Fiji.
- EPA. 2012. Climate Change. www.epa.gov/climatechange/index.html.
- Epperly, S. P., J. Braun-McNeill, and P. M. Richards. 2007. Trends in catch rates of sea turtles in North Carolina, USA. *Endangered Species Research* 3(3):283-293.
- Evermann, B. W., and B. A. Bean. 1897. Report on the Fisheries of Indian River, Florida. United States Commission of Fish and Fisheries, Washington D.C.
- Feldheim, K. A., A. T. Fields, D. D. Chapman, R. M. Scharer, and G. R. Poulakis. 2017. Insights into reproduction and behavior of the smalltooth sawfish *Pristis pectinata*. *Endangered Species Research* 34:463-471.
- Field, C. 1995. Impact of expected climate change on mangroves. *Hydrobiologia* 295:75-81.
- Fish, M. R., and coauthors. 2005. Predicting the Impact of Sea-Level Rise on Caribbean Sea Turtle Nesting Habitat. *Conservation Biology* 19(2):482-491.
- FitzSimmons, N. N., L. W. Farrington, M. J. McCann, C. J. Limpus, and C. Moritz. 2006. Green turtle populations in the Indo-Pacific: A (genetic) view from microsatellites. Pages 111 *in* N. Pilcher, editor Twenty-Third Annual Symposium on Sea Turtle Biology and Conservation.
- Florida Department of Environmental Protection. 2017. Charlotte Harbor Aquatic Preserves management plan. Florida Department of Environmental Protection, Florida Coastal Office, NOAA Award Nos. NA11NOS4190073 (CM227) and NA14NOS4190053 (CM504), Tallahassee, FL.
- Foley, A. M., B. A. Schroeder, and S. L. MacPherson. 2008. Post-nesting migrations and resident areas of Florida loggerheads (*Caretta caretta*). Pages 75-76 *in* H. J. Kalb, A. S. Rhode, K. Gayheart, and K. Shanker, editors. Twenty-Fifth Annual Symposium on Sea Turtle Biology and Conservation. U.S. Department of Commerce, Savannah, Georgia.
- Foley, A. M., B. A. Schroeder, A. E. Redlow, K. J. Fick-Child, and W. G. Teas. 2005. Fibropapillomatosis in stranded green turtles (*Chelonia mydas*) from the eastern United States (1980-98): Trends and associations with environmental factors. *Journal of Wildlife Diseases* 41(1):29-41.
- Foley, A. M., and coauthors. 2007. Characteristics of a green turtle (*Chelonia mydas*) assemblage in northwestern Florida determined during a hypothermic stunning event. *Gulf of Mexico Science* 25(2):131-143.

- Formia, A. 1999. Les tortues marines de la Baie de Corisco. *Canopee* 14: i-ii.
- Frazer, N. B., and L. M. Ehrhart. 1985. Preliminary growth models for green, (*Chelonia mydas*) and loggerhead, (*Caretta caretta*), turtles in the wild. *Copeia* 1985(1):73-79.
- Fretey, J. 2001. Biogeography and conservation of marine turtles of the Atlantic Coast of Africa, UNEbraskaP/CMississippi Secretariat.
- Garmestani, A. S., and H. F. Percival. 2005. Raccoon removal reduces sea turtle nest depredation in the Ten Thousand Islands of Florida. *Southeastern Naturalist* 4(3):469-472.
- Garrett, C. 2004. Priority Substances of Interest in the Georgia Basin - Profiles and background information on current toxics issues. Canadian Toxics Work Group Puget Sound, Georgia Basin International Task Force, GBAP Publication No. EC/GB/04/79.
- Geraci, J. R. 1990. Physiologic and toxic effects on cetaceans. Pages 167-197 in J. R. Geraci, and D. J. S. Aubin, editors. *Sea Mammals and Oil: Confronting the Risks*. Academic Press, San Diego.
- Gilman, E. L., J. Ellison, N. C. Duke, and C. Field. 2008. Threats to mangroves from climate change and adaptation options: A review. *Aquatic Botany* 89(2):237-250.
- Gilman, E. L., and coauthors. 2006. Adapting to Pacific Island mangrove responses to sea level rise and other climate change effects. *Climate Research* 32:161-176.
- Gilmore, G. R. 1995a. Environmental and Biogeographic Factors Influencing Ichthyofaunal Diversity: Indian River Lagoon. *Bulletin of Marine Science* 57(1):153-170.
- Gilmore, R. G. 1995b. Environmental and biogeographic factors influencing ichthyofaunal diversity: Indian River Lagoon. *Bulletin of Marine Science* 57(1):153-170.
- Girard, C., A. D. Tucker, and B. Calmettes. 2009. Post-nesting migrations of loggerhead sea turtles in the Gulf of Mexico: Dispersal in highly dynamic conditions. *Marine Biology* 156(9):1827-1839.
- Gladys Porter Zoo. 2013. Gladys Porter Zoo's Preliminary Annual Report on the Mexico/United States of America Population Restoration Project for the Kemp's Ridley Sea Turtle, *Lepidochelys kempii*, on the Coasts of Tamaulipas, Mexico 2013.
- Gonzalez Carman, V., and coauthors. 2011. Argentinian coastal waters: A temperate habitat for three species of threatened sea turtles. *Marine Biology Research* 7:500-508.
- Grant, S. C. H., and P. S. Ross. 2002. Southern Resident killer whales at risk: Toxic chemicals in the British Columbia and Washington environment. Department of Fisheries and Oceans Canada, Sidney, B.C.
- Green, D. 1993. Growth rates of wild immature green turtles in the Galápagos Islands, Ecuador. *Journal of Herpetology* 27(3):338-341.
- Groombridge, B. 1982. Kemp's ridley or Atlantic ridley, *Lepidochelys kempii* (Garman 1980). The IUCN Amphibia, Reptilia Red Data Book:201-208.
- Gulf of Mexico Fishery Management Council. 1998. Generic amendment for addressing essential fish habitat requirements in the following fishery management plans of the Gulf of Mexico: shrimp, red drum fishery, reef fish, coastal migratory pelagic resources (mackerels) in the Gulf of Mexico and south Atlantic, stone crab, spiny lobster, coral and coral reefs. Gulf of Mexico Fishery Management Council, NOAA Award No. NA87FC0003, Tampa, FL.
- Gulf of Mexico Fishery Management Council. 2005. Generic amendment number 3 for addressing essential fish habitat requirements, habitat areas of particular concern, and adverse effects of fishing in the following fishery management plans of the Gulf of Mexico: shrimp, red drum, reef fish, coastal migratory pelagic resources (mackerels) in

- the Gulf of Mexico and south Atlantic, stone crab, spiny lobster, and coral and coral reefs. Gulf of Mexico Fishery Management Council, NOAA Award No. NA03NMF4410028, Tampa, FL.
- Guseman, J. L., and L. M. Ehrhart. 1992. Ecological geography of western Atlantic loggerheads and green turtles: Evidence from remote tag recoveries. Pages 50 *in* M. Salmon, and J. Wyneken, editors. Eleventh Annual Workshop on Sea Turtle Biology and Conservation. U.S. Department of Commerce, Jekyll Island, Georgia.
- Hart, K. M., M. M. Lamont, I. Fujisaki, A. D. Tucker, and R. R. Carthy. 2012. Common coastal foraging areas for loggerheads in the Gulf of Mexico: Opportunities for marine conservation. *Biological Conservation* 145:185-194.
- Hartwell, S. I. 2004. Distribution of DDT in sediments off the central California coast. *Marine Pollution Bulletin* 49(4):299-305.
- Harty, C. 2004. Planning strategies for mangrove and saltmarsh changes in southeast Australia. *Coastal Management* 32:405-415.
- Hawkes, L. A., A. C. Broderick, M. H. Godfrey, and B. J. Godley. 2007. Investigating the potential impacts of climate change on a marine turtle population. *Global Change Biology* 13:1-10.
- Hays, G. C., and coauthors. 2001. The diving behavior of green turtles undertaking oceanic migration to and from Ascension Island: Dive durations, dive profiles, and depth distribution. *Journal of Experimental Biology* 204:4093-4098.
- Hays, G. C., and coauthors. 2002. Water temperature and internesting intervals for loggerhead (*Caretta caretta*) and green (*Chelonia mydas*) sea turtles. *Journal of Thermal Biology* 27(5):429-432.
- Heppell, S. S., and coauthors. 2005. A population model to estimate recovery time, population size, and management impacts on Kemp's ridley sea turtles. *Chelonian Conservation and Biology* 4(4):767-773.
- Heppell, S. S., L. B. Crowder, D. T. Crouse, S. P. Epperly, and N. B. Frazer. 2003. Population models for Atlantic loggerheads: Past, present, and future. Pages 255-273 *in* A. Bolten, and B. Witherington, editors. *Loggerhead Sea Turtles*. Smithsonian Books, Washington, D. C.
- Herbst, L. H. 1994. Fibropapillomatosis of marine turtles. *Annual Review of Fish Diseases* 4:389-425.
- Herbst, L. H., and coauthors. 1995. An infectious etiology for green turtle fibropapillomatosis. *Proceedings of the American Association for Cancer Research Annual Meeting* 36:117.
- Hildebrand, H. H. 1963. Hallazgo del area de anidacion de la tortuga marina "lora", *Lepidochelys kempfi* (Garman), en la costa occidental del Golfo de Mexico (Rept., Chel.). *Ciencia, Mexico* 22:105-112.
- Hildebrand, H. H. 1982. A historical review of the status of sea turtle populations in the western Gulf of Mexico. Pages 447-453 *in* K. A. Bjorndal, editor. *Biology and Conservation of Sea Turtles*. Smithsonian Institution Press, Washington, D. C.
- Hill, A. 2013. Rough Draft of Fishing Piers and Protected Species: An Assessment of the Presence and Effectiveness of Conservation Measures in Charlotte and Lee County, Florida. Pages 50 *in*. University of Miami, Rosenstiel School of Marine and Atmospheric Science.
- Hirth, H. F. 1971. Synopsis of biological data on the green turtle *Chelonia mydas* (Linnaeus) 1758. Food and Agriculture Organization.

- Hirth, H. F. 1997. Synopsis of the biological data on the green turtle *Chelonia mydas* (Linnaeus 1758). Biological Report 91(1):120.
- Hoegh-Guldberg, O., and coauthors. 2007. Coral reefs under rapid climate change and ocean acidification. *Science* 318(5857):1737-1742.
- Hollensead, L. D., R. D. Grubbs, J. K. Carlson, and D. M. Bethea. 2016. Analysis of fine-scale daily movement patterns of juvenile *Pristis pectinata* within a nursery habitat. *Aquatic Conservation: Marine and Freshwater Ecosystems* 26(3):492-505.
- Hollensead, L. D., R. D. Grubbs, J. K. Carlson, and D. M. Bethea. 2018. Assessing residency time and habitat use of juvenile smalltooth sawfish using acoustic monitoring in a nursery habitat. *Endangered Species Research* 37:119-131.
- Hutchings, P., and P. Saenger. 1987. *Ecology of Mangroves*. University of Queensland Press, Queensland, Australia.
- Intergovernmental Panel on Climate Change. 2007. *Climate Change 2007: Synthesis report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Intergovernmental Panel on Climate Change, Geneva, Switzerland.
- Intergovernmental Panel on Climate Change. 2013. *Climate Change 2013: The physical science basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Intergovernmental Panel on Climate Change, Cambridge, United Kingdom and New York, NY.
- IPCC. 2007. Summary for Policymakers. Pages 18 *in* S. Solomon, and coeditors, editors. *Climate Change 2007: the physical science basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, UK and New York, NY.
- IPCC. 2013. Summary for Policymakers. Pages SPM-1 - 36 *in* T. F. Stocker, and coeditors, editors. *Climate Change 2013: the physical science basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom; New York, NY, USA.
- ISED. 2014. International Sawfish Encounter Database. Florida Museum of Natural History, Gainesville, Florida. <http://www.flmnh.ufl.edu/fish/sharks/sawfish/sawfishdatabase.html>.
- Iwata, H., S. Tanabe, N. Sakai, and R. Tatsukawa. 1993. Distribution of persistent organochlorines in the oceanic air and surface seawater and the role of ocean on their global transport and fate. *Environmental Science and Technology* 27(6):1080-1098.
- Jacobson, E. R. 1990. An update on green turtle fibropapilloma. *Marine Turtle Newsletter* 49:7-8.
- Jacobson, E. R., and coauthors. 1989. Cutaneous fibropapillomas of green turtles (*Chelonia mydas*). *Journal Comparative Pathology* 101:39-52.
- Jacobson, E. R., S. B. Simpson Jr., and J. P. Sundberg. 1991. Fibropapillomas in green turtles. Pages 99-100 *in* G. H. Balazs, and S. G. Pooley, editors. *Research Plan for Marine Turtle Fibropapilloma*, volume NOAA-TM-NMFS-SWFSC-156.
- Johnson, S. A., and L. M. Ehrhart. 1994. Nest-site fidelity of the Florida green turtle. Pages 83 *in* B. A. Schroeder, and B. E. Witherington, editors. *Thirteenth Annual Symposium on Sea Turtle Biology and Conservation*.
- Johnson, S. A., and L. M. Ehrhart. 1996. Reproductive ecology of the Florida green turtle: Clutch frequency. *Journal of Herpetology* 30(3):407-410.

- Lagueux, C. J. 2001. Status and distribution of the green turtle, *Chelonia mydas*, in the wider Caribbean region. Pages 32-35 in K. L. Eckert, and F. A. Abreu Grobois, editors. Marine Turtle Conservation in the Wider Caribbean Region - A Dialogue for Effective Regional Management, Santo Domingo, Dominican Republic.
- Laurent, L., and coauthors. 1998. Molecular resolution of marine turtle stock composition in fishery by-catch: A case study in the Mediterranean. *Molecular Ecology* 7:1529-1542.
- Law, R. J., and coauthors. 1991. Concentrations of trace metals in the livers of marine mammals (seals, porpoises and dolphins) from waters around the British Isles. *Marine Pollution Bulletin* 22(4):183-191.
- Lezama, C. 2009. impacto de la pesquería artesanal sobre la tortoga verde (*Chelonia mydas*) en las costas del Rio de la Plata exterior. Universidad de la República.
- Lima, E. H. S. M., M. T. D. Melo, and P. C. R. Barata. 2010. Incidental capture of sea turtles by the lobster fishery off the Ceará Coast, Brazil. *Marine Turtle Newsletter* 128:16-19.
- López-Barrera, E. A., G. O. Longo, and E. L. A. Monteiro-Filho. 2012. Incidental capture of green turtle (*Chelonia mydas*) in gillnets of small-scale fisheries in the Paranaguá Bay, Southern Brazil. *Ocean and Coastal Management* 60:11-18.
- López-Mendilaharsu, M., A. Estrades, M. A. C. Caraccio, V., M. Hernández, and V. Quirici. 2006. Biología, ecología y etología de las tortugas marinas en la zona costera uruguay, Montevideo, Uruguay: Vida Silvestre, Uruguay.
- Lutcavage, M., P. Plotkin, B. Witherington, and P. Lutz. 1997. Human impacts on sea turtle survival. Pages 387-409 in P. Lutz, and J. A. Musick, editors. *The Biology of Sea Turtles*, volume 1. CRC Press, Boca Raton, Florida.
- Marcovaldi, N., B. B. Gifforni, H. Becker, F. N. Fiedler, and G. Sales. 2009. Sea Turtle Interactions in Coastal Net Fisheries in Brazil. U.S. National Marine Fisheries Service, Southeast Fisheries Science Center: Honolulu, Gland, Switze, Honolulu, Hawaii, USA.
- Márquez M., R. 1990. Sea turtles of the world. An annotated and illustrated catalogue of sea turtle species known to date, Rome.
- Márquez M., R. 1994. Synopsis of biological data on the Kemp's ridley sea turtle, *Lepidochelys kempii* (Garman, 1880). National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Center.
- Matkin, C. O., and E. Saulitis. 1997. Restoration notebook: Killer whale (*Orcinus orca*). Exxon Valdez Oil Spill Trustee Council, Anchorage, Alaska.
- McLeod, E., and R. V. Salm. 2006. Managing mangroves for resilience to climate change. The World Conservation Union (IUCN), IUCN Resilience Science Group Working Paper Series - No 2, Gland, Switzerland.
- McMichael, E., R. R. Carthy, and J. A. Seminoff. 2003. Evidence of homing behavior in juvenile green turtles in the northeastern Gulf of Mexico. Pages 223-224 in J. A. Seminoff, editor *Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation*.
- Meehl, G. A., and coauthors. 2007. Global climate projections. Pages 747-846 in S. Solomon, and coeditors, editors. *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, U.K.
- Meylan, A., B. Schroeder, and A. Mosier. 1994. Marine turtle nesting activity in the State of Florida, 1979-1992. Pages 83 in K. A. Bjorndal, A. B. Bolten, D. A. Johnson, and P. J. Eliazar, editors. *Fourteenth Annual Symposium on Sea Turtle Biology and Conservation*.

- Meylan, A. B., B. A. Schroeder, and A. Mosier. 1995. Sea turtle nesting activity in the State of Florida 1979-1992. Florida Department of Environmental Protection (52):63.
- Milton, S. L., and P. L. Lutz. 2003. Physiological and genetic responses to environmental stress. Pages 163-197 in P. L. Lutz, J. A. Musick, and J. Wyneken, editors. The Biology of Sea Turtles, volume II. CRC Press, Boca Raton, Florida.
- Mo, C. L. 1988. Effect of bacterial and fungal infection on hatching success of Olive Ridley sea turtle eggs. World Wildlife Fund-U.S.
- Moncada, F., and coauthors. 2010. Movement patterns of loggerhead turtles *Caretta caretta* in Cuban waters inferred from flipper tag recaptures. Endangered Species Research 11(1):61-68.
- Moncada Gavilan, F. 2001. Status and distribution of the loggerhead turtle, *Caretta caretta*, in the wider Caribbean region. Pages 36-40 in K. L. Eckert, and F. A. Abreu Grobois, editors. Marine Turtle Conservation in the Wider Caribbean Region - A Dialogue for Effective Regional Management, Santo Domingo, Dominican Republic.
- Monzón-Argüello, C., and coauthors. 2010. Evidence from genetic and Lagrangian drifter data for transatlantic transport of small juvenile green turtles. Journal of Biogeography 37(9):1752-1766.
- Murphy, T. M., and S. R. Hopkins. 1984. Aerial and ground surveys of marine turtle nesting beaches in the southeast region. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Center.
- Musick, J. A. 1999. Ecology and conservation of long-lived marine animals. American Fisheries Society Symposium 23:1-10.
- Musick, J. A., and C. J. Limpus. 1997. Habitat utilization and migration in juvenile sea turtles. Pages 137-163 in P. L. Lutz, and J. A. Musick, editors. The Biology of Sea Turtles. CRC Press, New York, New York.
- Naro-Maciel, E., J. H. Becker, E. H. S. M. Lima, M. A. Marcovaldi, and R. DeSalle. 2007. Testing dispersal hypotheses in foraging green sea turtles (*Chelonia mydas*) of Brazil. Journal of Heredity 98(1):29-39.
- Naro-Maciel, E., and coauthors. 2012. The interplay of homing and dispersal in green turtles: A focus on the southwestern atlantic. Journal of Heredity 103(6):792-805.
- Ning, Z. H., R. E. Turner, T. K. Doyle, and K. Abdollahi. 2003. Integrated assessment of the climate change impacts on the Gulf Coast region: Findings of the Gulf Coast Regional Assessment. Gulf Coast Regional Conservation Committee (GCRCC) and LSU Graphic Services, 1-930129-01-7, Baton Rouge, LA.
- NMFS-NEFSC. 2011. Preliminary summer 2010 regional abundance estimate of loggerhead turtles (*Caretta caretta*) in northwestern Atlantic Ocean continental shelf waters. U.S. Department of Commerce, Northeast Fisheries Science Center, Reference Document 11-03.
- NMFS-SEFSC. 2009. An assessment of loggerhead sea turtles to estimate impacts of mortality on population dynamics. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, PRD-08/09-14.
- NMFS. 1997. Endangered Species Act Section 7 Consultation - Biological Opinion on Navy activities off the southeastern United States along the Atlantic coast, National Marine Fisheries Service, Office of Protected Resources and the Southeast Regional Office.

- NMFS. 2000a. Status review of smalltooth sawfish (*Pristis pectinata*). U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, Saint Petersburg, FL.
- NMFS. 2000b. Status review of smalltooth sawfish, *Pristis pectinata*. NOAA Fisheries, Southeast Regional Office, St. Petersburg, FL.
- NMFS. 2001. Stock assessments of loggerhead and leatherback sea turtles and an assessment of the impact of the pelagic longline fishery on the loggerhead and leatherback sea turtles of the western North Atlantic. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center.
- NMFS. 2006. Sea Turtle and Smalltooth Sawfish Construction Conditions revised March 23, 2006. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, Protected Resources Division, Saint Petersburg, Florida.
http://sero.nmfs.noaa.gov/protected_resources/section_7/guidance_docs/documents/sea_turtle_and_smalltooth_sawfish_construction_conditions_3-23-06.pdf, accessed June 2, 2017.
- NMFS. 2009. Smalltooth sawfish recovery plan (*Pristis pectinata*). NOAA Fisheries, Silver Spring, MD.
- NMFS. 2010. Smalltooth sawfish 5-year review: summary and evaluation. NOAA Fisheries, Southeast Regional Office, St. Petersburg, FL.
- NMFS. 2012. Protocols for Categorizing Sea Turtles for Post-release Mortality Estimates. August 2001, revised February 2012. PRD Contribution: #PRD-2011-07. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, Florida.
- NMFS. 2018. Smalltooth sawfish 5-year review: summary and evaluation. NOAA Fisheries, Southeast Regional Office
 St. Petersburg, FL.
- NMFS, and USFWS. 1991a. Recovery plan for U.S. population of the Atlantic green turtle (*Chelonia mydas*). National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, Washington, D. C.
- NMFS, and USFWS. 1992. Recovery plan for leatherback turtles *Dermochelys coriacea* in the U. S. Caribbean, Atlantic and Gulf of Mexico. National Marine Fisheries Service and U.S. Fish and Wildlife Service, Silver Spring, Maryland.
- NMFS, and USFWS. 1993. Recovery plan for the hawksbill turtle *Eretmochelys imbricata* in the U.S. Caribbean, Atlantic and Gulf of Mexico. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, St. Petersburg, Florida.
- NMFS, and USFWS. 2007a. Green Sea Turtle (*Chelonia mydas*) 5-year review: Summary and Evaluation. National Marine Fisheries Service, Silver Spring, Maryland.
- NMFS, and USFWS. 2007b. Kemp's ridley sea turtle (*Lepidochelys kempii*) 5-year review: Summary and evaluation. National Marine Fisheries Service and U.S. Fish and Wildlife Service, Silver Spring, Maryland.
- NMFS, and USFWS. 2007c. Loggerhead sea turtle (*Caretta caretta*) 5-year review: Summary and evaluation. National Marine Fisheries Service and U.S. Fish and Wildlife Service, Silver Spring, Maryland.
- NMFS, and USFWS. 2008. Recovery plan for the northwest Atlantic population of the loggerhead sea turtle (*Caretta caretta*), second revision. National Oceanic and

- Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, Silver Spring, Maryland.
- NMFS, USFWS, and SEMARNAT. 2011a. Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*), Second Revision. National Marine Fisheries Service, Silver Spring, Maryland.
- NMFS, USFWS, and SEMARNAT. 2011b. Bi-National Recovery Plan for the Kemp's Ridley Sea Turtle (*Lepidochelys kempii*), Second Revision. Pages 156 *in*. National Marine Fisheries Service, Silver Spring, Maryland.
- NMFS and USFWS. 1991b. Recovery plan for U.S. Population of Atlantic Green Turtle (*Chelonia mydas*). U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources, Silver Spring, Maryland.
- NMFS and USFWS. 2007d. Green Sea Turtle (*Chelonia mydas*) 5-year review: Summary and Evaluation. National Marine Fisheries Service, Silver Spring, Maryland.
- NMFS and USFWS. 2009. Recovery plan for the northwest Atlantic population of the loggerhead sea turtle (*Caretta caretta*). National Marine Fisheries Service and U.S. Fish and Wildlife Service, Silver Spring, Maryland.
- NOAA. 2012. Understanding Climate. <http://www.climate.gov/#understandingClimate>.
- Norton, S. L., and coauthors. 2012. Designating critical habitat for juvenile endangered smalltooth sawfish in the United States. *Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science* 4(1):473-480.
- NRC. 1990. Decline of the sea turtles: Causes and prevention. National Research Council, Washington, D. C.
- Ogren, L. H. 1989. Distribution of juvenile and subadult Kemp's ridley sea turtles: Preliminary results from 1984-1987 surveys. Pages 116-123 *in* C. W. Caillouet Jr., and A. M. Landry Jr., editors. First International Symposium on Kemp's Ridley Sea Turtle Biology, Conservation and Management. Texas A&M University, Sea Grant College, Galveston, Texas.
- Orlando Jr., S. P., and coauthors. 1994. Salinity characteristics of South Atlantic estuaries. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service, Office of Ocean Resources Conservation and Assessment, Strategic Environmental Assessments Division, Silver Spring, MD.
- Orlando, S. P., Jr. , and coauthors. 1994. Salinity Characteristics of South Atlantic Estuaries. NOAA, Office of Ocean Resources Conservation and Assessment, Silver Spring, MD.
- Pfeffer, W. T., J. Harper, and S. O'Neel. 2008. Kinematic constraints on glacier contributions to 21st-century sea-level rise. *Science* 321:1340-1343.
- Pike, D. A., R. L. Antworth, and J. C. Stiner. 2006. Earlier nesting contributes to shorter nesting seasons for the loggerhead seaturtle, *Caretta caretta*. *Journal of Herpetology* 40(1):91-94.
- Poulakis, G., P. Stevens, A. A. Timmers, T. R. Wiley, and C. Simpfendorfer. 2011a. Abiotic affinities and spatiotemporal distribution of the endangered smalltooth sawfish, *Pristis pectinata*, in a south-western Florida nursery. *Marine and Freshwater Research* 62:1165-1177.
- Poulakis, G. R. 2012a. Distribution, habitat use, and movements of juvenile smalltooth sawfish, *Pristis pectinata*, in the Charlotte Harbor Estuarine System, Florida. Dissertation. Florida Institute of Technology, Melbourne, FL.

- Poulakis, G. R. 2012b. Distribution, habitat use, and movements of juvenile smalltooth sawfish, *Pristis pectinata*, in the Charlotte Harbor estuarine system, Florida. Dissertation. Florida Institute of Technology, Melbourne, FL.
- Poulakis, G. R., and J. C. Seitz. 2004. Recent occurrence of the smalltooth sawfish, *Pristis pectinata* (Elasmobranchiomorpha: Pristidae), in Florida Bay and the Florida Keys, with comments on sawfish ecology. *Florida Scientist* 67(1):27-35.
- Poulakis, G. R., P. W. Stevens, A. A. Timmers, C. J. Stafford, and C. A. Simpfendorfer. 2013. Movements of juvenile endangered smalltooth sawfish, *Pristis pectinata*, in an estuarine river system: use of non-main-stem river habitats and lagged responses to freshwater inflow-related changes. *Environmental Biology of Fishes* 96(6):763-778.
- Poulakis, G. R., P. W. Stevens, A. A. Timmers, T. R. Wiley, and C. A. Simpfendorfer. 2011b. Abiotic affinities and spatiotemporal distribution of the endangered smalltooth sawfish, *Pristis pectinata*, in a south-western Florida nursery. *Marine and Freshwater Research* 62(10):1165-1177.
- Poulakis, G. R., and coauthors. 2017. Sympatric elasmobranchs and fecal samples provide insight into the trophic ecology of the smalltooth sawfish. *Endangered Species Research* 32:491-506.
- Pritchard, P. C. H. 1969. The survival status of ridley sea-turtles in America. *Biological Conservation* 2(1):13-17.
- Prohaska, B. K., and coauthors. 2018. Physiological stress in the smalltooth sawfish: effects of ontogeny, capture method, and habitat quality. *Endangered Species Research* 36:121-135.
- Prosdocimi, L., V. González Carman, D. A. Albareda, and M. I. Remis. 2012. Genetic composition of green turtle feeding grounds in coastal waters of Argentina based on mitochondrial DNA. *Journal of Experimental Marine Biology and Ecology* 412:37-45.
- Quigley, D. T. G., and K. Flannery. 2002. Leucoptic harbour porpoise *Phocoena phocoena* (L.). *Irish Naturalists' Journal* 27(4):164-172.
- Rahmstorf, S., and coauthors. 2007. Recent climate observations compared to projections. *Science* 316(5825):709.
- Rebel, T. P. 1974. Sea Turtles and the Turtle Industry of the West Indies, Florida and the Gulf of Mexico. University of Miami Press, Coral Gables, Florida.
- Reddering, J. S. V. 1988a. Prediction of the effects of reduced river discharge on estuaries of the south-eastern Cape Province, South Africa. *South African Journal of Science* 84:726-730.
- Reddering, J. S. V. 1988b. Prediction of the effects of reduced river discharge on estuaries of the south-eastern Cape Province, South Africa. *South African Journal of Science* 84(9):726-730.
- Rivas-Zinno, F. 2012. Captura incidental de tortugas marinas en Bajos del Solis, Uruguay. Universidad de la Republica Uruguay, Departamento de Ecología y Evolución.
- Ryder, C. E., T. A. Conant, and B. A. Schroeder. 2006. Report of the Workshop on Marine Turtle Longline Post-Interaction Mortality. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources.
- Saenger, P., and J. Moverley. 1985. Vegetative phenology of mangroves along the Queensland coastline. *Proceedings of the Ecological Society of Australia* 13:257-265.
- SAFMC. 1998. Final habitat plan for the South Atlantic region: Essential fish habitat requirements for fishery management plans of the South Atlantic Fishery Management Council. South Atlantic Fishery Management Council, Charleston, South Carolina.

- Scharer, R. M., W. F. Patterson III, J. K. Carlson, and G. R. Poulakis. 2012. Age and growth of endangered smalltooth sawfish (*Pristis pectinata*) verified with LA-ICP-MS analysis of vertebrae. *PloS one* 7:e47850.
- Schmid, J. R., and J. A. Barichivich. 2006. *Lepidochelys kempii*—Kemp’s ridley. Pages 128-141 in P. A. Meylan, editor. *Biology and conservation of Florida turtles*. Chelonian Research Monographs, volume 3.
- Schmid, J. R., and A. Woodhead. 2000. Von Bertalanffy growth models for wild Kemp’s ridley turtles: analysis of the NMFS Miami Laboratory tagging database. U. S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, Florida.
- Schroeder, B. A., and A. M. Foley. 1995. Population studies of marine turtles in Florida Bay. J. I. Richardson, and T. H. Richardson, editors. *Twelfth Annual Workshop on Sea Turtle Biology and Conservation*.
- Seitz, J. C., and G. R. Poulakis. 2002. Recent occurrence of sawfishes (Elasmobranchiomorphi: Pristidae) along the southwest coast of Florida (USA). *Florida Scientist* 65(4):256-266.
- Semeniuk, V. 1994. Predicting the effect of sea-level rise on mangroves in northwestern Australia. *Journal of Coastal Research* 10(4):1050-1076.
- Seminoff, J. A., and coauthors. 2015. Status review of the green turtle (*Chelonia Mydas*) under the endangered species act. NOAA Technical Memorandum, NMFS-SWFSC-539.
- Shaver, D. J. 1994. Relative abundance, temporal patterns, and growth of sea turtles at the Mansfield Channel, Texas. *Journal of Herpetology* 28(4):491-497.
- Simpfendorfer, C., G. Poulakis, P. M. O’Donnell, and T. R. Wiley. 2008a. Growth rates of juvenile smalltooth sawfish *Pristis pectinata* Latham in the Western Atlantic. *Journal of Fish Biology* 72:711-723.
- Simpfendorfer, C. A. 2000. Predicting population recovery rates for endangered western Atlantic sawfishes using demographic analysis. *Environmental Biology of Fishes* 58(4):371-377.
- Simpfendorfer, C. A. 2001. Essential habitat of the smalltooth sawfish, *Pristis pectinata*. Mote Marine Laboratory, Technical Report 786, Sarasota, FL.
- Simpfendorfer, C. A. 2002. Smalltooth sawfish: The USA's first endangered elasmobranch? *Endangered Species Update* 19(3):53-57.
- Simpfendorfer, C. A. 2003a. Abundance, movement and habitat use of the smalltooth sawfish. Final Report. Mote Marine Laboratory Mote Technical Report No. 929, Sarasota, FL.
- Simpfendorfer, C. A. 2003b. Abundance, movement and habitat use of the smalltooth sawfish: Final report. Mote Marine Laboratory, Center for Shark Research, Technical Report No. 929 and NMFS contract number: WC133F-02-SE-0247, Sarasota, FL.
- Simpfendorfer, C. A. 2006a. Movement and habitat use of smalltooth sawfish. Final Report. Mote Marine Laboratory, Mote Marine Laboratory Technical Report 1070, Sarasota, FL.
- Simpfendorfer, C. A. 2006b. Movement and habitat use of smalltooth sawfish: Final report. Mote Marine Laboratory, Center for Shark Research, Technical Report 1070 and NOAA P.O. No. WC133F-04-SE-1543, Sarasota, FL.
- Simpfendorfer, C. A., G. R. Poulakis, P. M. O’Donnell, and T. R. Wiley. 2008b. Growth rates of juvenile smalltooth sawfish *Pristis pectinata* Latham in the Western Atlantic. *Journal of Fish Biology* 72(3):711-723.
- Simpfendorfer, C. A., and T. R. Wiley. 2004. Determination of the distribution of Florida’s remnant sawfish population, and identification of areas critical to their conservation. Mote Marine Laboratory, Sarasota, Florida.

- Simpfendorfer, C. A., and T. R. Wiley. 2005. Identification of priority areas for smalltooth sawfish conservation. Final report to the National Fish and Wildlife Foundation for Grant # 2003-0041-000. Mote Marine Laboratory.
- Simpfendorfer, C. A., T. R. Wiley, and B. G. Yeiser. 2010a. Improving conservation planning for an endangered sawfish using data from acoustic telemetry. *Biological Conservation* 143(6):1460-1469.
- Simpfendorfer, C. A., T. R. Wiley, and B. G. Yeiser III. 2010b. Improving conservation planning for an endangered sawfish using data from acoustic telemetry. *Biological Conservation* 143(6):1460-1469.
- Simpfendorfer, C. A., and coauthors. 2011a. Environmental influences on the spatial ecology of juvenile smalltooth sawfish (*Pristis pectinata*): results from acoustic monitoring. *PLoS one* 6(2):e16918.
- Simpfendorfer, C. A., and coauthors. 2011b. Environmental influences on the spatial ecology of juvenile smalltooth sawfish (*Pristis pectinata*): results from acoustic monitoring. *PLOS ONE* 6(2):e16918.
- Snedaker, S. C. 1995. Mangroves and climate change in the Florida and Caribbean region: Scenarios and hypotheses. *Hydrobiologia* 295(1-3):43-49.
- Snelson, F., and S. Williams. 1981. Notes on the occurrence, distribution, and biology of *elasmobranch* fishes in the Indian River lagoon system, Florida. *Estuaries and Coasts* 4(2):110-120.
- Snover, M. L. 2002. Growth and ontogeny of sea turtles using skeletochronology: Methods, validation and application to conservation. Duke University.
- South Atlantic Fishery Management Council. 1998. Final plan for the South Atlantic Region: Essential fish habitat requirements for the fishery management plan of the South Atlantic Fishery Management Council. South Atlantic Fishery Management Council, Charleston, SC.
- Steadman, S., and T. E. Dahl. 2008. Status and trends of wetlands in the coastal watersheds of the Eastern United States 1998 to 2004. Pages 32 in N. M. F. S. a. U. S. D. o. t. National Oceanic and Atmospheric Administration, and F. a. W. S. Interior, editors.
- Stedman, S.-M., and T. E. Dahl. 2008. Status and trends of wetlands in the coastal watersheds of the Eastern United States 1998-2004. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service and U.S. Department of the Interior, Fish and Wildlife Service.
- Storelli, M. M., G. Barone, A. Storelli, and G. O. Marcotrigiano. 2008. Total and subcellular distribution of trace elements (Cd, Cu and Zn) in the liver and kidney of green turtles (*Chelonia mydas*) from the Mediterranean Sea. *Chemosphere* 70(5):908-913.
- TEWG. 1998a. An assessment of the Kemp's ridley (*Lepidochelys kempii*) and loggerhead (*Caretta caretta*) sea turtle populations in the Western North Atlantic. Department of Commerce, Turtle Expert Working Group.
- TEWG. 1998b. An assessment of the Kemp's ridley (*Lepidochelys kempii*) and loggerhead (*Caretta caretta*) sea turtle populations in the western North Atlantic. U. S. Dept. Commerce.
- TEWG. 2000. Assessment update for the Kemp's ridley and loggerhead sea turtle populations in the western North Atlantic. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, Turtle Expert Working Group.

- TEWG. 2009. An assessment of the loggerhead turtle population in the western North Atlantic ocean. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Turtle Expert Working Group, NMFS-SEFSC-575.
- Trenberth, K. 2005. Uncertainty in hurricanes and global warming. *Science* 308(5729):1753-1754.
- Troëng, S., and E. Rankin. 2005. Long-term conservation efforts contribute to positive green turtle *Chelonia mydas* nesting trend at Tortuguero, Costa Rica. *Biological Conservation* 121:111-116.
- Tucker, A. D. 2010. Nest site fidelity and clutch frequency of loggerhead turtles are better elucidated by satellite telemetry than by nocturnal tagging efforts: Implications for stock estimation. *Journal of Experimental Marine Biology and Ecology* 383(1):48-55.
- UNESCO. 1991. Coastal systems studies and sustainable development: Abstracts. United Nations Educational, Scientific, and Cultural Organization (UNESCO), MARINF/85, COMAR Interregional Scientific Conference, Paris, 1991.
- USEPA. 1994. Freshwater inflow action agenda for the Gulf of Mexico; First generation-Management Committee report. U.S. Environmental Protection Agency, Office of Water, Gulf of Mexico Program, EPA 800-B-94-006, Stennis Space Center, MS.
- USFWS. 1999. South Florida multi-species recovery plan. U.S. Department of the Interior, Fish and Wildlife Service, Southeast Region, Atlanta, GA.
- USFWS and NMFS. 1998. Endangered Species Act consultation handbook. Procedures for Conducting Section 7 Consultations and Conferences. U.S. Fish and Wildlife, National Marine Fisheries Service.
- Vargas-Moreno, J. C., and M. Flaxman. 2010. Addressing the challenges of climate change in the greater everglades landscape. Massachusetts Institute of Technology, Department of Urban Studies and Planning. Project Sheet November, 2010, Cambridge, MA.
- Vargo, S., P. Lutz, D. Odell, E. V. Vleet, and G. Bossart. 1986. Study of the effects of oil on marine turtles. U.S. Department of the Interior, Minerals Management Service, Vienna, Virginia.
- Watson, J. W., S. P. Epperly, A. K. Shah, and D. G. Foster. 2005. Fishing methods to reduce sea turtle mortality associated with pelagic longlines. *Canadian Journal of Fisheries and Aquatic Sciences* 62(5):965-981.
- Weishampel, J. F., D. A. Bagley, and L. M. Ehrhart. 2004. Earlier nesting by loggerhead sea turtles following sea surface warming. *Global Change Biology* 10:1424-1427.
- Weishampel, J. F., D. A. Bagley, L. M. Ehrhart, and B. L. Rodenbeck. 2003. Spatiotemporal patterns of annual sea turtle nesting behaviors along an East Central Florida beach. *Biological Conservation* 110(2):295-303.
- Wershoven, J. L., and R. W. Wershoven. 1992. Juvenile green turtles in their nearshore habitat of Broward County, Florida: A five year review. Pages 121-123 *in* M. Salmon, and J. Wyneken, editors. Eleventh Annual Workshop on Sea Turtle Biology and Conservation.
- White, F. N. 1994. Swallowing dynamics of sea turtles. Pages 89-95 *in* G. H. Balazs, and S. G. Pooley, editors. Research Plan to Assess Marine Turtle Hooking Mortality. National Oceanic and Atmospheric Administration, Honolulu, Hawaii.
- Whitfield, A. K., and M. N. Bruton. 1989. Some biological implications of reduced freshwater inflow into eastern Cape estuaries: a preliminary assessment. *South African Journal of Science* 85:691-694.

- Wiley, T. R., and C. A. Simpfendorfer. 2007a. The ecology of elasmobranchs occurring in the Everglades National Park, Florida: Implications for conservation and management. *Bulletin of Marine Science* 80(1):171-189.
- Wiley, T. R., and C. A. Simpfendorfer. 2007b. Site fidelity/residency patterns/habitat modeling. Final Report to the National Marine Fisheries Service, Grant number WC133F-06-SE-2976. Mote Marine Laboratory.
- Wiley, T. R., and C. A. Simpfendorfer. 2010. Using public encounter data to direct recovery efforts for the endangered smalltooth sawfish, *Pristis pectinata*. *Endangered Species Research* 12:179-191.
- Witherington, B., M. Bresette, and R. Herren. 2006. *Chelonia mydas* - Green turtle. *Chelonian Research Monographs* 3:90-104.
- Witherington, B., S. Hirama, and A. Moiser. 2003. Effects of beach armoring structures on marine turtle nesting. U.S. Fish and Wildlife Service.
- Witherington, B., S. Hirama, and A. Moiser. 2007. Changes to armoring and other barriers to sea turtle nesting following severe hurricanes striking Florida beaches. U.S. Fish and Wildlife Service.
- Witherington, B. E. 1992. Behavioral responses of nesting sea turtles to artificial lighting. *Herpetologica* 48(1):31-39.
- Witherington, B. E. 2002. Ecology of neonate loggerhead turtles inhabiting lines of downwelling near a Gulf Stream front. *Marine Biology* 140(4):843-853.
- Witherington, B. E., and K. A. Bjorndal. 1991. Influences of artificial lighting on the seaward orientation of hatchling loggerhead turtles *Caretta caretta*. *Biological Conservation* 55(2):139-149.
- Witherington, B. E., and L. M. Ehrhart. 1989a. Hypothermic stunning and mortality of marine turtles in the Indian River Lagoon System, Florida. *Copeia* 1989(3):696-703.
- Witherington, B. E., and L. M. Ehrhart. 1989b. Status, and reproductive characteristics of green turtles (*Chelonia mydas*) nesting in Florida. Pages 351-352 in L. Ogren, and coeditors, editors. Second Western Atlantic Turtle Symposium. .
- Witzell, W. N. 2002. Immature Atlantic loggerhead turtles (*Caretta caretta*): Suggested changes to the life history model. *Herpetological Review* 33(4):266-269.
- Work, T. M. 2000. Synopsis of necropsy findings of sea turtles caught by the Hawaii-based pelagic longline fishery.
- Zug, G. R., and R. E. Glor. 1998. Estimates of age and growth in a population of green sea turtles (*Chelonia mydas*) from the Indian River lagoon system, Florida: A skeletochronological analysis. *Canadian Journal of Zoology* 76(8):1497-1506.
- Zurita, J. C., and coauthors. 2003. Nesting loggerhead and green sea turtles in Quintana Roo, Mexico. Pages 25-127 in J. A. Seminoff, editor Twenty-Second Annual Symposium on Sea Turtle Biology and Conservation, Miami, Florida.
- Zwinnenberg, A. J. 1977. Kemp's ridley, *Lepidochelys kempii* (Garman, 1880), undoubtedly the most endangered marine turtle today (with notes on the current status of *Lepidochelys olivacea*). *Bulletin Maryland Herpetological Society* 13(3):170-192.