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

JUL 09 2018

F/SER31:BGR
SER-2018-19302

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

Ref.: SAJ-2018-00631 (NW-SJR), Darek Olszewski, Shoreline Stabilization, Port Charlotte, Charlotte 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 (ESA). The Opinion considers the effects of a proposal by the Jacksonville District of the United States (U.S.) Army Corps of Engineers (USACE) to authorize shoreline stabilization under the authorities of Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act on the following listed species and/or critical habitat: loggerhead sea turtle (Northwest Atlantic [NWA] distinct population segment [DPS]), Kemp's ridley sea turtle, green sea turtle (North Atlantic [NA] and South Atlantic [SA] DPSs), smalltooth sawfish (U.S. DPS), and smalltooth sawfish critical habitat. NMFS concludes that the proposed action may affect, but is not likely to adversely affect, loggerhead sea turtle (NWA DPS), Kemp's ridley sea turtle, green sea turtle (NA and SA DPSs), and smalltooth sawfish (U.S. DPS). NMFS concludes that the proposed action is likely to adversely affect, but will not destroy or adversely modify, smalltooth sawfish critical habitat.

Please direct questions regarding this Opinion to Bette Rubin, Consultation Biologist, by phone at (727) 209-5993, or by email at Bette.Rubin@noaa.gov.

Sincerely,

Roy E. Crabtree, Ph.D.
Regional Administrator

Enclosures:
Biological Opinion

File: 1514-22 F.4

Endangered Species Act - Section 7 Consultation
Biological Opinion

Action Agency:	U.S. Army Corps of Engineers (USACE), Jacksonville District
Applicant:	Darek Olszewski
	Permit Number SAJ-2018-00631 (NW-SJR)
Activity:	Shoreline Stabilization, Port Charlotte, Charlotte County, Florida
Consulting Agency:	National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), Southeast Regional Office, Protected Resources Division, St. Petersburg, Florida
	Consultation Number SER-2018-19302

JUL 09 2018

Approved by: _____

Roy E. Crabtree, Ph.D., Regional Administrator
NMFS, Southeast Regional Office
St. Petersburg, Florida

Date Issued: July 9, 2018

Table of Contents

List of Figures

List of Tables

Acronyms and Abbreviations

CFR	Code of Federal Regulations
CHEU	Charlotte Harbor Estuary Unit of smalltooth sawfish designated critical habitat
CHPSP	Charlotte Harbor Preserve State Park
CO_2	Carbon Dioxide
DPS	Distinct Population Segment
EFH	Essential Fish Habitat
ESA	Endangered Species Act
FWC	Florida Fish and Wildlife Conservation Commission

FWRI	Fish and Wildlife Research Institute
FR	Federal Register
IPCC	Intergovernmental Panel on Climate Change
MIT	Massachusetts Institute of Technology
MHW	Mean High Water
MLLW	Mean Lower Low Water
NA DPS	North Atlantic DPS of green sea turtle
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NWA DPS	Northwest Atlantic DPS of loggerhead sea turtle
Opinion	Biological Opinion
PCTS	Public Consultation Tracking System
PRD	NMFS Southeast Regional Office Protected Resources Division
RM	Red mangrove essential feature of smalltooth sawfish designated critical habitat
SA DPS	South Atlantic DPS of green sea turtle
SAV	Submerged Aquatic Vegetation
TTIEU	Ten Thousand Islands/Everglades Unit of smalltooth sawfish designated critical habitat
U.S.	United States of America
USACE	U.S. Army Corps of Engineers
YOY	Young-of-the-year

Units of Measurement

ac	acre(s)
°C	degrees Celsius
cm	centimeter(s)
°F	degrees Fahrenheit
ft	foot/feet
ft^2	square foot/feet
in	inch(es)
km	kilometer(s)
lin ft	linear foot/feet
m	meter(s)
mi	mile(s)
mi^2	square mile(s)

1 INTRODUCTION

Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. § 1531 et seq.), requires that each federal agency ensure that any action authorized, funded, or carried out by such 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 such species. Section 7(a)(2) requires federal agencies to consult with the appropriate Secretary in carrying out these responsibilities. The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) and the United States (U.S.) Fish and Wildlife Service share responsibilities for administering the ESA.

Consultation is required when a federal action agency determines that a proposed action "may affect" listed species or designated critical habitat. Informal consultation is concluded after NMFS determines that the action is not likely to adversely affect listed species or critical habitat. Formal consultation is concluded after NMFS issues a Biological Opinion ("Opinion") that identifies whether a proposed action is likely to jeopardize the continued existence of a listed species, or destroy or adversely modify critical habitat, in which case reasonable and prudent alternatives to the action as proposed must be identified to avoid these outcomes. The Opinion states the amount or extent of incidental take of the listed species that may occur, develops measures (i.e., reasonable and prudent measures) to reduce the effect of take, and recommends conservation measures to further the recovery of the species.

This document represents NMFS's Opinion based on our review of impacts associated with the proposed action to issue a permit within Charlotte County, Florida. This Opinion analyzes the proposed action's effects on threatened and endangered species and designated critical habitat, in accordance with Section 7 of the ESA. We based our Opinion on project information provided by U.S. Army Corps of Engineers (USACE) and other sources of information, including the published literature cited herein.

2 CONSULTATION HISTORY

The following is the consultation history for Public Consultation Tracking System (PCTS) identifier number SER-2018-19302, Olszewski Seawall. On May 7, 2018, NMFS received a request for formal consultation under Section 7 of the ESA from the USACE for construction permit application SAJ-2018-00631 (NW-SJR) in a letter dated that day, May 7, 2018. The USACE determined that the proposed project may affect, but is not likely to adversely affect, green sea turtle, Kemp's ridley sea turtle, loggerhead sea turtle, and smalltooth sawfish. The USACE also determined the project is likely to affect smalltooth sawfish critical habitat. NMFS did not need to request any additional information, so consultation was initiated that same day, May 7, 2018. During the review process, we requested additional information on June 21, 2018, and received a response on June 22, 2018.

3 DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA

3.1 Proposed Action

The USACE is considering an application to construct a new 80-linear foot (lin ft) seawall to be installed at the mean high water (MHW) line. The applicant proposes to remove approximately 70 lin ft (560 square feet [ft^2]) of red mangrove shoreline using mechanical equipment from shore. The seawall will be jetted into place, also using mechanical equipment from shore. In-water construction is expected to take 2 days to complete, with all work occurring during daylight hours only. The applicant will comply with NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions*[1], including the use of turbidity curtains.

3.2 Action Area

The project site is located within the Charlotte Harbor Estuary Unit (CHEU) of designated smalltooth sawfish critical habitat at 18406 Arapahoe Circle, in Port Charlotte, Charlotte County, Florida (26.95361°N, 82.15065°W [North American Datum 1983]). The project site is at an undeveloped, single-family residential lot along Manchester Waterway, a manmade canal, approximately 2.28 miles (mi) from the Peace River, and approximately 2.48 mi from the Myakka River (Figure 1). The project site is adjacent to other residential properties along the canal that have unconsolidated or consolidated shorelines, docks, and vessel storage. The project site is directly across the canal from extensive habitat included in the Charlotte Harbor Preserve State Park (CHPSP) system. The CHPSP system is comprised of 43,000 acres (ac) and protects 80 mi of shoreline habitat along the Charlotte Harbor estuaries in Charlotte and Lee Counties, Florida, providing a buffer between the established Charlotte Harbor Aquatic Preserves and urban development and agriculture (Florida Department of Environmental Protection 2016).

[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 (PRD), 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.

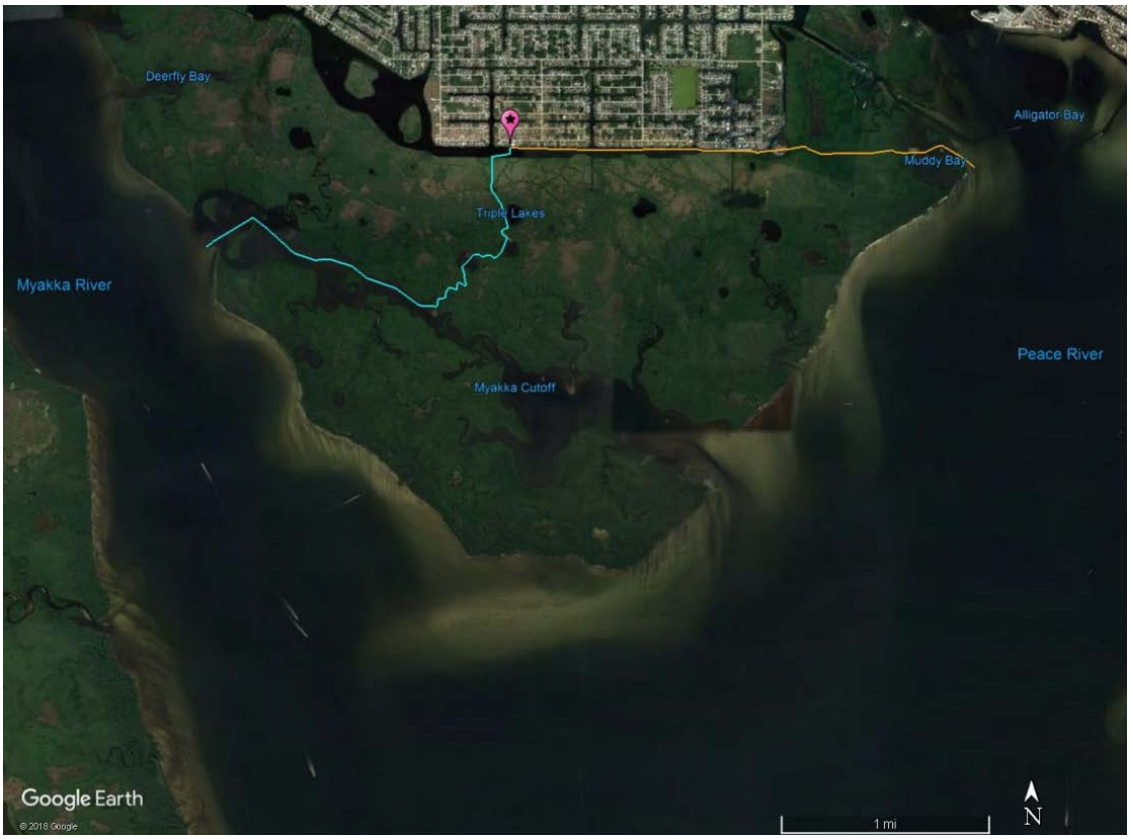


Figure 1. The project site (pink pin) and the shortest navigable paths to the two major waterways: the blue line shows the 2.48-mi path to the Myakka River, and the orange line shows the 2.28-mi path to the Peace River (©2018 Google).

The action area is defined by regulation as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 Code of Federal Regulations [CFR] 402.02). For the purposes of this Federal action, the action area includes the 80-lin ft unarmored shoreline and submerged habitat within the immediate vicinity of the project site that will be affected by the proposed action, including the submerged habitat within the boundary of the turbidity curtain (Figure 2). The substrate in the action area is sandy. Depth in the action area is less than 2.4 inches (in) at MHW. The action area is void of corals and submerged aquatic vegetation (SAV). There are 70 lin ft (560 ft^2) of red mangrove shoreline within the action area.

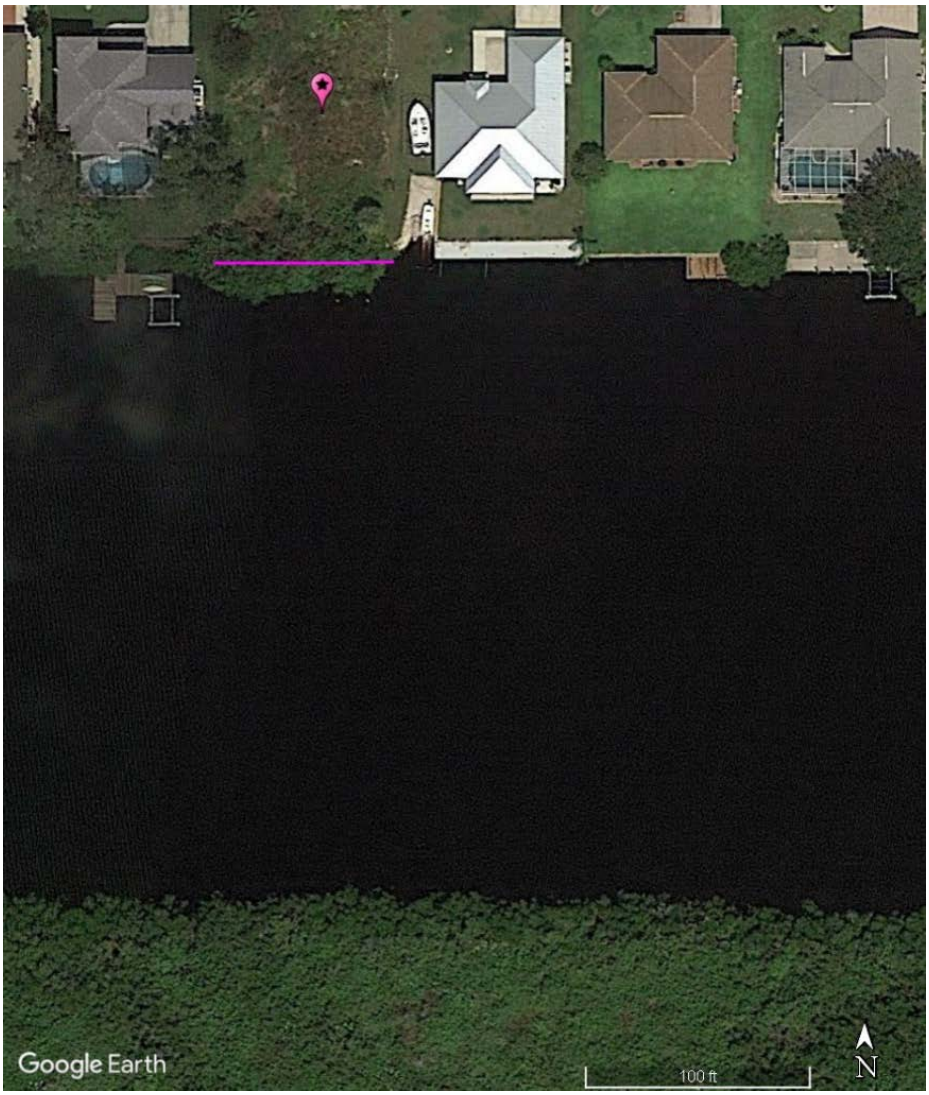


Figure 2. The project site at 18406 Arapahoe Circle, Port Charlotte, Charlotte County, Florida, along the Manchester waterway. The pink line indicates approximately 80 lin ft of unconsolidated shoreline at the project site (©2018 Google).

4 STATUS OF LISTED SPECIES AND CRITICAL HABITAT

Table 1 provides the effect determinations for ESA-listed species the USACE and/or NMFS believe may be affected by the proposed action. In Section 4.1, we discuss why we believe green sea turtle (North Atlantic [NA] and South Atlantic [SA] distinct population segments [DPSs]), Kemp's ridley sea turtle, loggerhead sea turtle (Northwest Atlantic [NWA] DPS), and smalltooth sawfish (U.S. DPS) may be affected, but are not likely to be adversely affected, by the proposed action.

Table 1. Effects Determinations for Species (DPSs) the Action Agency and/or NMFS Believe May Be Affected by the Proposed Action

Species (DPS)	ESA Listing Status	Action Agency Effect Determination	NMFS Effect Determination
Sea Turtles			
Green (NA DPS)	T	NLAA	NLAA
Green (SA DPS)	T	NLAA	NLAA
Kemp's ridley	E	NLAA	NLAA
Loggerhead (NWA DPS)	T	NLAA	NLAA
Fish			
Smalltooth sawfish (U.S. DPS)	E	NLAA	NLAA
E = endangered; T = threatened; NLAA = may affect, not likely to adversely affect			

Table 2 provides the effects determinations for designated critical habitat occurring within the action area that the USACE and/or NMFS believe may be affected by the proposed action. The proposed action area is within the boundary of smalltooth sawfish designated critical habitat (CHEU). 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 feet (ft) (0.9 meters [m]) measured at Mean Lower Low Water (MLLW), and (2) red mangroves.

Because the proposed action will occur at MHW, there are no potential direct routes of effect to the shallow, euryhaline essential feature of smalltooth sawfish critical habitat. In addition, there are no other potential routes of effect to the shallow, euryhaline essential feature. In Section 4.2, we discuss why we believe the red mangrove essential feature is likely to be adversely affected by the proposed action.

Table 2. Effects Determinations for Designated Critical Habitat the Action Agency and/or NMFS Believe May Be Affected by the Proposed Action

Species	Unit	USACE Effect Determination	NMFS Effect Determination
Smalltooth sawfish	CHEU	LAA	LAA, Will not destroy or adversely modify
LAA = likely to adversely affect			

4.1 Potential Routes of Effect Not Likely to Adversely Affect Listed Species

We have identified the following potential effects to sea turtles and smalltooth sawfish. We believe that these species are not likely to be adversely affected by the proposed in-water construction activities, as described below.

Effects to sea turtles and smalltooth sawfish include the risk of injury from construction equipment or materials during seawall installation, which will be discountable due to the species' ability to move away from the project site if disturbed. The applicant's implementation of

NMFS's *Sea Turtle and Smalltooth Sawfish Construction Conditions* will further reduce the risk by requiring all construction workers to watch for sea turtles and smalltooth sawfish. Operation of any mechanical construction equipment will cease immediately if a sea turtle of smalltooth sawfish is seen within a 50-ft radius of the equipment. Activities will not resume until the protected species has departed the project area of its own volition.

The project site contains habitat that may be used by sea turtles and smalltooth sawfish for foraging and refuge. Sea turtles and smalltooth sawfish 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 habitat displacement effects to sea turtles and smalltooth sawfish will be insignificant, given the availability of unconsolidated habitat nearby along neighboring residential lots, the abundance of unconsolidated habitat outside the action area (e.g., across the canal in the CHPSP system), and the temporary nature of the project (i.e., up to 2 days).

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 the habitat associated with the proposed action (70 lin ft (560 ft^2) of red mangroves). 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 along neighboring residential lots, undisturbed habitat available in the surrounding mangrove islands just outside of the action area (e.g., Alligator Bay and within the CHPSP system), and extensive red mangrove habitat remaining within the CHEU.

Effects to listed species as a result of noise created by construction activities can physically injure animals in the affected areas 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 from 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 (NMFS 2014). Based on our noise calculations, the use of a water jet to install a concrete seawall will not result in injurious noise effects or behavioral noise effects to ESA-listed fish and sea turtles identified by NMFS as potentially affected in Table 1.

4.2 Potential Routes of Effect Likely to Adversely Affect Critical Habitat

4.2.1 Smalltooth Sawfish Critical Habitat

We believe the proposed action is likely to adversely affect smalltooth sawfish designated critical habitat due to the permanent removal of 70 lin ft (560 ft^2) of the red mangrove shoreline essential feature. Typically, USACE reports project effects to red mangroves in both linear feet (denoting the amount of shoreline) and square feet (denoting the magnitude of the area); however, we use linear feet when calculating and tracking losses to the red mangrove essential

feature of critical habitat. Therefore, in the analyses below, losses to red mangroves will be reported in linear feet only (i.e., 70 lin ft). We discuss the effects of the permanent loss of the red mangrove essential feature on critical habitat in the Effects of the Action on Critical Habitat section below.

4.3 Status of Critical Habitat Likely to be Adversely Affected

4.3.1 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 mi^2) of coastal habitat.

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 3). 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 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).

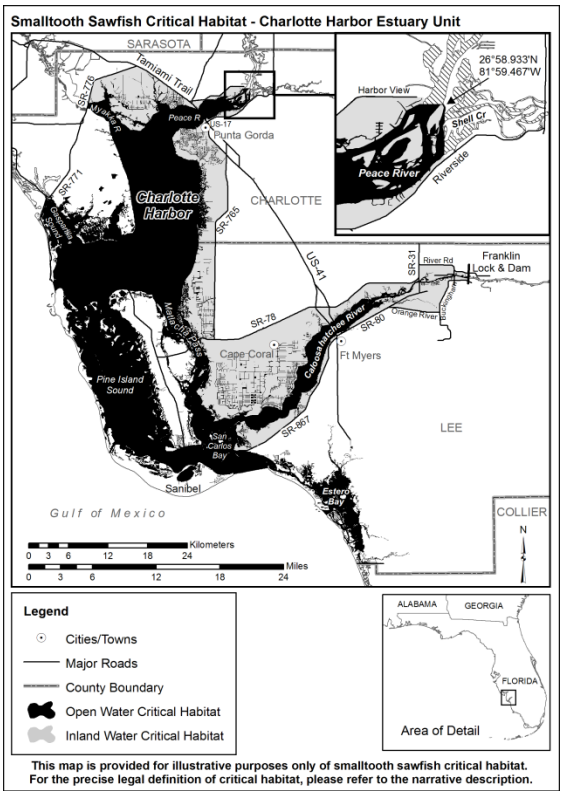


Figure 3. Map of smalltooth sawfish critical habitat – Charlotte Harbor Estuary Unit

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.

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. 2008), inhabit the shallow waters of estuaries and can be found in sheltered bays, dredged canals, along banks and sandbars, and in rivers (NMFS 2000). 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; 2003). 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 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. 2011). 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. 2010). Juvenile smalltooth sawfish spend the majority of their time in waters shallower than 13 ft (4 m) deep (Simpfendorfer et al. 2010) and are seldom found deeper than 32 ft (10 m) (Poulakis and Seitz 2004). Simpfendorfer et al. (2010) 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 2007), 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. 2010), behavior likely to reduce the risk of predation (Simpfendorfer 2006). As juveniles increase in size, they begin to expand their home ranges (Simpfendorfer et al. 2010; Simpfendorfer et al. 2011), eventually moving to more offshore habitats where they likely feed on larger prey and eventually reach sexual maturity.

Researchers have identified several areas within the Charlotte Harbor Estuary that are disproportionately more important to juvenile smalltooth sawfish, based on intra- or inter-annual capture rates during random sampling events within the estuary (Poulakis 2012; Poulakis et al. 2011). The areas, which were termed “hotspots,” 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 hotspot areas closer to the mouth of the Caloosahatchee River during times of high freshwater inflow (Poulakis et al. 2011). At this time, researchers are unsure what specific biotic (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. 2011).

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 (SAFMC 1998). Large areas of coastal habitat were modified or lost between the mid-1970s and mid-1980s within the United States (Dahl and Johnson 1991;

USFWS 1999). Since then, rates of loss have decreased even though habitat loss continues. Between 1998 and 2004, approximately 2,450 ac (3.8 mi^2) 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 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 1995; Quigley and Flannery 2002; Reddering 1988; 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 (PRD) tracks the loss of these essential features of smalltooth sawfish critical habitat.

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.

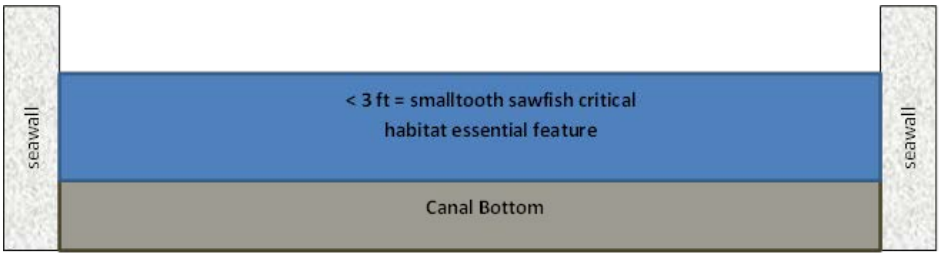
Transportation Infrastructure Construction

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.

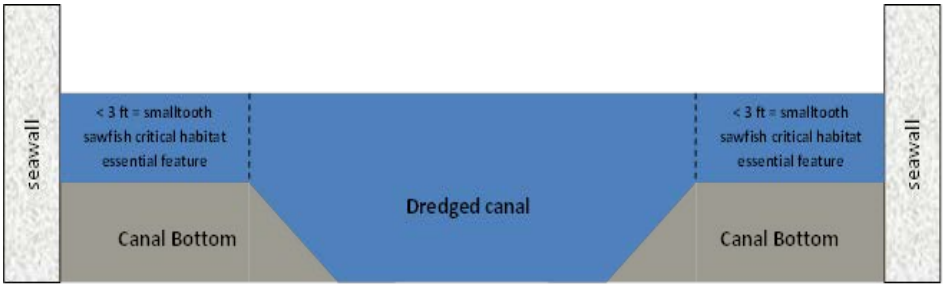
Dredging

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 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 (GMFMC 1998; GMFMC 2005; SAFMC 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 4, Diagrams A and B).

A.



B.



C.

Figure 4. 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. 2011). 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. 2011).

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 (IPCC 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 IPCC (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. 2009). 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 (IPCC 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. 2009).

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 (IPCC 2007) sea level modeling data to forecast a range of sea level rise trajectories from low, to moderate, to high predictions (Figure 5). 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 4, Diagram C).

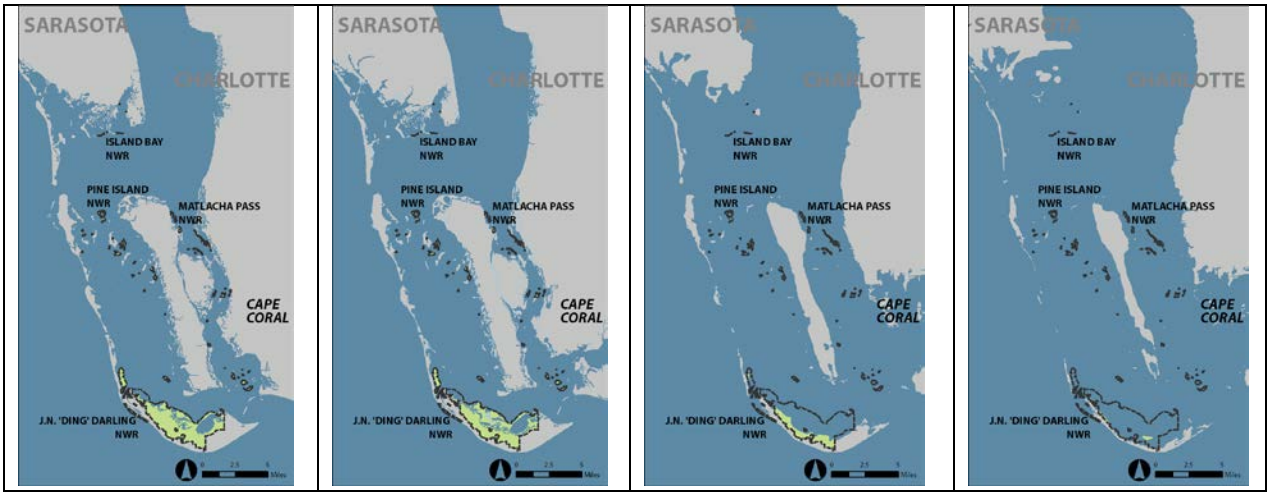


Figure 5. From left to right: current shoreline, + 3.5 in (+ 9 cm); + 18.5 in (+ 47 cm); and + 38.97 in (+ 99 cm) sea level rise by 2060. [2]

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 (CO_2) levels, and damage to mangroves from 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

[2] 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, Cambridge, Massachusetts.

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 1992) 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 (IPCC 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 CO_2 levels increase, mostly resulting from man-made causes (e.g., burning of fossil fuels), the world's oceans will absorb much of this CO_2, causing potential increases in photosynthesis and mangrove growth rates. This increase in growth rate, however, would be limited by lower salinities expected from CO_2 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 CO_2 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, CO_2, 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).

5 ENVIRONMENTAL BASELINE

This section describes the effects of past and ongoing human and natural factors contributing to the current status of the affected smalltooth sawfish critical habitat in the action area. The environmental baseline describes the critical habitat's health based on information available at the time of this consultation.

By regulation, environmental baselines for Opinions include the past and present impacts of all state, federal, or private actions and other human activities in, or having effects in, the action area. We identify the anticipated impacts of all proposed federal projects in the specific action area of the consultation at issue that have already undergone formal or early Section 7 consultation (as defined in 50 CFR 402.11), as well as the impact of state or private actions, or the impacts of natural phenomena, which are concurrent with the consultation in process (50 CFR 402.02).

Focusing on the 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.

5.1 Status of Designated Critical Habitat within the Action Area

5.1.1 Smalltooth Sawfish Critical Habitat

The project site is a vacant, residential lot within Manchester Waterway in the southwestern portion of the residential, manmade canal system in Port Charlotte, Charlotte County, Florida, just north of the confluence of the Myakka and Peace rivers. Water depth in action area is less than 2.4 in at MHW. The shoreline within the action area is vegetated and contains approximately 70 lin ft of red mangroves. The action area is void of corals or SAV. The project site is approximately 2.48 mi inland from the Myakka River, approximately 2.28 mi inland from the Peace River, and adjacent to the CHPSP system. As mentioned previously, 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 (Florida Department of Environmental Protection 2016). There have been no sightings of smalltooth sawfish within the action area; however, there have been 2 sightings of juvenile smalltooth sawfish (birth to 200 cm total length) within the nearby canals and several sighting of juvenile smalltooth sawfish in the CHPSP system to the south (ISED, unpublished data last updated May 2014).

5.2 Factors Affecting Critical Habitat within the Action Area

5.2.1 Smalltooth Sawfish Critical Habitat

Federal Actions

We have consulted on several USACE shoreline stabilization and dock construction projects in the greater residential canal system 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 within the action area, as per a review of the NMFS PRD's completed consultation database by the consulting biologist on June 11, 2018.

State or Private Actions

Examples of nonfederal activities that may adversely affect designated critical habitat for smalltooth sawfish in the action area include residential in-water activities that do not require federal permits or otherwise have a federal nexus. 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.

Other Potential Sources of Impacts to the Environmental Baseline

Stochastic events, such as hurricanes, are common throughout the range of smalltooth sawfish, especially in the current core of its range (i.e., south and southwest Florida). These events are by nature unpredictable and their effect on the survival and recovery of the species and on critical habitat are unknown; however, they have the potential to impede the survival and recovery directly if animals die as a result of them, or indirectly if habitat, especially critical habitat, is damaged as a result of these disturbances. In 2017, Hurricane Irma likely damaged habitat, including mangroves, in and around the action area.

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 (Magnuson-Stevens Act) 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

Magnuson-Stevens Act to the extent that the Act requires minimization of impacts to EFH resources.

6 EFFECTS OF THE ACTION ON CRITICAL HABITAT

6.1 Smalltooth Sawfish Critical Habitat

The proposed action is located within the boundary of the CHEU of smalltooth sawfish designated critical habitat. We believe the proposed action is likely to adversely affect the essential features of designated critical habitat as described below.

6.1.1 Shallow, Euryhaline Essential Feature Impacts

For the reasons discussed above, we believe the proposed action will have no effect on the shallow, euryhaline essential feature of smalltooth sawfish critical habitat.

6.1.2 Red Mangrove Essential Feature Impacts

The proposed action will result in a permanent loss of approximately 70 lin ft of the red mangrove essential feature that provides forage, shelter, or other nursery habitat functions for juvenile smalltooth sawfish. Using remote sensing data acquired from the Florida Fish and Wildlife Conservation Commission (FWC) Fish and Wildlife Research Institute (FWRI), we were able to compile information relating to the total area of this essential feature within smalltooth sawfish critical habitat. Based on that information, we estimated that the total amount of red mangrove shoreline in CHEU at the effective date of species listing (May 1, 2003) was approximately 5,512,320 lin ft. While the available red mangrove essential feature in the CHEU 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 in terms of the red mangrove essential feature will be lost; therefore, we believe the project is likely to adversely affect critical habitat in the CHEU.

7 CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, or local private actions that are reasonably certain to occur in the action area considered in this Opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the ESA (50 CFR 402.02).

Many threats to smalltooth sawfish critical habitat are expected to be exacerbated by the effects of global climate change. Potential increases in sea level may impact the availability of nursery habitat, particularly shallow, euryhaline habitat and red mangrove lined, low-lying coastal shorelines (IPCC 2014; Wanless et al. 2005). For example, nursery habitat could be negatively affected by increased temperatures, salinities, and acidification of coastal waters (Snedaker 1995), Wanless et al. 2005, (Scavia et al. 2002), as well as increased runoff and erosion due to the expected increase in extreme storm events (IPCC 2014; Wanless et al. 2005). These

alterations of the marine environment due to global climate change could affect the distribution of shallow, euryhaline habitat, which would ultimately affect the distribution, physiology, and growth rates of red mangroves. These alterations could potentially eliminate red mangroves from particular areas. The magnitude of the effects of global climate change on smalltooth sawfish critical habitat are difficult to predict, yet, when combined with the cyclical loss of habitat from extreme storm events, a decrease in the red mangrove essential feature of smalltooth sawfish critical habitat is likely (Norton et al. 2012; Scavia et al. 2002). However, the proposed action is of such a small scale, scope, and limited time frame that is not very likely to contribute to, or be affected cumulatively by climate change.

Smalltooth sawfish habitat, in general, and designated critical habitat, specifically, have been degraded or modified throughout the southeastern U.S. from agriculture, urban development, commercial activities, channel dredging, boating activities, and the diversion of freshwater runoff. No future actions with effects beyond those already described, and no other future state, tribal, or local private actions, are reasonably certain to occur in the action area. The manmade canals within the CHEU will likely continue to experience the same types of actions described in the Status of the Critical Habitat section. These threats include shoreline armoring, canal dredging, and dock construction.

8 INTEGRATION AND SYNTHESIS

NMFS's regulations define *Destruction or adverse modification* to mean "a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features" (50 CFR 402.02). Other 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. We intend the phrase "significantly delay" in development of essential features to encompass a delay that interrupts the likely natural trajectory of the development of physical and biological features in the designated critical habitat to support the species' recovery. 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, or that precludes or significantly delays the capacity of that habitat to develop those features over time, and if the effect of the alteration is to appreciably diminish the value of critical habitat 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.

8.1 Destruction or Adverse Modification Analysis for Smalltooth Sawfish Critical Habitat

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.

8.1.2 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 U.S. 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, 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 red mangrove essential feature of critical habitat within the CHEU.

Red Mangrove Essential Feature Impacts

Remote sensing data from FWC FWRI indicated that approximately 5,512,320 lin ft of red mangrove shoreline (abbreviated RM throughout this section) was available in the CHEU at the effective date of species listing (i.e., May 1, 2003) (Table 3, Line 1). As described above, we must determine whether project impacts will interfere with long-term maintenance of this essential feature at or above 95% of the linear feet of habitat 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 RM 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 9,142.50 lin ft of RM in CHEU was lost due to federal agency actions.

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

$$\begin{aligned} &Monthly\ loss\ rate\ of\ RM\ (CHEU) \\ &\quad = RM\ lost\ through\ federal\ agency\ actions \div 84\ months \\ &Monthly\ loss\ rate\ of\ RM\ (CHEU) = 9{,}142.50\ lin\ ft \div 84\ months \\ &Monthly\ loss\ rate\ of\ RM\ (CHEU) = 108.84\ lin\ ft\ per\ month \end{aligned}$$

Assuming the same monthly loss rates, we back-calculate the loss of RM 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:

$$\begin{aligned} &RM\ loss\ prior\ to\ critical\ habitat\ designation\ (CHEU) \\ &\quad = 108.84\ lin\ ft\ per\ month \times 77\ months \\ &RM\ loss\ prior\ to\ critical\ habitat\ designation\ (CHEU) = 8{,}380.68\ lin\ ft\ (Table\ 3, Line\ 2) \end{aligned}$$

Next, we determine the loss of RM since the effective date of critical habitat designation. From the effective date of critical habitat designation through June 30, 2018, 16,105.92 lin ft of RM in the CHEU has been lost due to federal agency actions (Table 3, Line 3).[3] 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 red mangrove shoreline in the CHEU as most in-water construction projects require federal authorization.

[3] Due to the high frequency of relatively small projects smalltooth sawfish critical habitat, NMFS updates red mangrove shoreline losses quarterly based on the U.S. federal fiscal year (December 31, March 31, June 30, September 30).

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

$$RM\ currently\ available\ (CHEU) = RM\ at\ time\ of\ species\ listing - (RM\ loss\ prior\ to\ critical\ habitat\ designation + RM\ loss\ since\ critical\ habitat\ designation)$$
$$RM\ currently\ available\ (CHEU) = 5{,}512{,}320\ lin\ ft - (8{,}380.68\ lin\ ft + 16{,}105.92\ lin\ ft)$$
$$RM\ currently\ available\ (CHEU) = 5{,}487{,}833.40\ lin\ ft\ (Table\ 3, Line\ 4)$$

We calculate the amount of RM that must be maintained in the CHEU using the following equation:

$$RM\ that\ must\ be\ maintained\ (CHEU) = RM\ at\ time\ of\ species\ listing \times 95\%$$
$$RM\ that\ must\ be\ maintained\ (CHEU) = 5{,}512{,}320\ lin\ ft \times 0.95$$
$$RM\ that\ must\ be\ maintained\ (CHEU) = 5{,}236{,}704\ lin\ ft\ (Table\ 3, Line\ 5)$$

The proposed action would result in the loss of 70 lin ft of RM (Table 3, Line 6). Using the above results, we estimate the total amount of RM lost in the CHEU since species listing, including losses from the proposed action using the following equation:

$$\%\ RM\ lost\ in\ CHEU\ since\ species\ listing = [(RM\ loss\ due\ to\ this\ project + RM\ lost\ prior\ to\ critical\ habitat\ designation + RM\ lost\ since\ critical\ habitat\ designation) \div Total\ RM\ in\ CHEU\ at\ time\ of\ species\ listing] \times 100$$
$$\%\ RM\ lost\ in\ CHEU\ since\ species\ listing = [(70\ lin\ ft + 8{,}380.68\ lin\ ft + 16{,}105.92\ lin\ ft) \div 5{,}512{,}320\ lin\ ft] \times 100$$
$$\%\ RM\ lost\ in\ CHEU\ since\ species\ listing = (24{,}556.60\ lin\ ft \div 5{,}512{,}320\ lin\ ft) \times 100$$
$$\%\ RM\ lost\ in\ CHEU\ since\ species\ listing = 0.445486\%\ (\text{Table 3, Line 7})$$

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

$$\%\ RM\ remaining\ (CHEU) = 100\% - \%\ RM\ lost\ since\ species\ listing\ (CHEU)$$
$$\%\ RM\ remaining\ (CHEU) = 100\% - 0.445486\%$$
$$\%\ RM\ remaining\ (CHEU) = 99.554514\%\ (Table\ 3, Line\ 8)$$

Table 3. Summary of Impacts to the Red Mangrove Essential Feature

Red Mangrove Shoreline in the CHEU		**Linear Feet**
1.	Available at the time of species listing	5,512,320
2.	Losses prior to critical habitat designation	8,380.68
3.	Losses since critical habitat designation	16,105.92
4.	Available as of July 1, 2018	5,487,833.40
5.	Linear feet that must be maintained per Recovery Plan	5,236,704 (95% of 5,512,320)
6.	Affected by the proposed action	70
7.	Affected since species listing (including the proposed action)	24,556.60 (0.445486% of 5,512,320)
8.	Remaining	5,487,763.40 (99.554514% of 5,512,320)

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 this project, 99.554514% of the RM essential feature (Table 3, Line 8) available at the time of species listing remain in the CHEU. Thus, the loss of essential features 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.

8.1.3 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. FWC FWRI 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, also funded by NMFS through ESA Section 6, 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 juvenile sawfish. Given the limited duration of the study in the CHEU (September 2009-current), there is not yet enough data to discern the trend in juvenile abundance within that Unit. 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 "hot spots," 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 2012; 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 current status of smalltooth sawfish critical habitat, the environmental baseline, and the cumulative effects, it is our opinion that the loss of 70 lin ft (560 ft^2) of red mangrove essential feature from the proposed seawall installation 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

NMFS does not anticipate that the proposed action will incidentally take any species and no take is authorized. Nonetheless, any take of smalltooth sawfish or sea turtles shall be immediately reported to takereport.nmfsser@noaa.gov. Refer to the present Biological Opinion by title, Olszewski Seawall, issuance date, NMFS PCTS identifier number, SER-2018-19302, and USACE permit number, SAJ-2018-00631 (NW-SJR). At that time, consultation must be reinitiated.

11 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize their authority to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations identified in Biological Opinions can assist action agencies in implementing their responsibilities under Section 7(a)(1). Conservation recommendations are discretionary activities designed to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The following conservation recommendations are discretionary measures

that NMFS believes are consistent with this obligation and therefore should be carried out by the federal action agency:

1. Continue public outreach and education on smalltooth sawfish and smalltooth sawfish critical habitat in an effort to minimize interactions, injury, and mortality.

2. 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.

3. 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).

4. Fund and support restoration efforts that rehabilitate and create shallow, euryhaline and mangrove fringe habitats within the range of smalltooth sawfish.

To stay abreast of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, we request notification of the implementation of any conservation recommendations.

12 REINITIATION OF CONSULTATION

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

13 LITERATURE CITED

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 volume 9. Dr. W. Junk Publishers.

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 CO_2. Plant, Cell & Environment 20(9):1158-1166.

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):10.

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.

Carlson, J. K., and J. Osborne. 2012. Relative abundance of smalltooth sawfish (*Pristis pectinata*) based on the Everglades National Park Creel Survey. NOAA Technical Memorandum NMFS-SEFSC-626. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Center, Panama City Laboratory, NOAA Technical Memorandum NMFS-SEFSC-626, Panama City, Florida.

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.

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.

Ellison, J. 2010. Vulnerability of Fiji's mangroves and associated coral reefs to climate change. A review., Suva, Fiji, WWF South Pacific Office.

Field, C. D. 1995. Impact of expected climate change on mangroves. Hydrobiologia 295(1-3):75-81.

Florida Department of Environmental Protection, F. C. O. 2016. Charlotte Harbor Aquatic Preserves Management Plan. Florida Department of Environmental Protection, Florida Coastal Office, Tallahassee, Florida.

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.

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 climate change. Climate Research 32:161-176.

Gilmore, G. R. 1995. Environmental and Biogeographic Factors Influencing Ichthyofaunal Diversity: Indian River Lagoon. Bulletin of Marine Science 57(1):153-170.

GMFMC. 1998. Generic amendment for addressing essential fish habitat requirements in the following Fishery Management plans of the Gulf of Mexico: Shrimp Fishery of the Gulf

of Mexico, United States waters; Red Drum Fishery of the Gulf of Mexico, Reef Fish Fishery of the Gulf of Mexico, Coastal Migratory Pelagic Resources (Mackerel) in the Gulf of Mexico and South Atlantic; Stone Crab Fishery of the Gulf of Mexico; Spiny Lobster Fishery of the Gulf of Mexico; Coral and Coral Reefs of the Gulf of Mexico. Gulf of Mexico Fishery Management Council, Tampa, Florida.

GMFMC. 2005. Generic Amendment 3 for addressing EFH requirements, HAPCs , and adverse effects of fishing in the following FMPs of the Gulf of Mexico: Shrimp, Red Drum, Reef Fish, Stone Crab, Coral and Coral Reefs in the GOM and Spiny Lobster and the Coastal Migratory Pelagic resources of the GOM and South Atlantic. Gulf of Mexico Fishery Management Council, Tampa, FL.

Harty, C. 2004. Planning strategies for mangrove and saltmarsh changes in southeast Australia. Coastal Management 32(4):405-415.

Hoegh-Guldberg, O., and coauthors. 2007. Coral reefs under rapid climate change and ocean acidification. Science 318(5857):1737-1742.

Hutchings, P. A., and P. Saenger. 1987. Ecology of Mangroves. St. Lucia, Queensland, Australia; New York: University of Queensland Press.

IPCC. 2007. Climate Change 2007: Climate Change Impacts, Adaptation and Vulnerability. Summary for Policymakers. S. Solomon, and coeditors, editors. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the IPPC (Intergovernmental Panel on Climate Change). Cambridge University Press, Cambridge, UK and New York, NY.

IPCC. 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. Pages 1535 *in* T. F. Stocker, and coeditors, editors. Cambridge University Press, Cambridge, United Kingdom; New York, NY.

IPCC. 2014. Climate change 2014: Impacts, adaptation, and vulnerability. IPCC Working Group II contribution to AR5. Intergovernmental Panel on Climate Change.

McLeod, E., and R. V. Salm. 2006. Managing mangroves for resilience to climate change. IUCN, Gland, Switzerland.

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, United Kingdom and New York, NY.

Ning, Z. H., R. E. Turner, T. Doyle, and K. K. Abdollahi. 2003. Integrated assessment of the climate change impacts on the Gulf Coast Region: findings of the Gulf Coast Regional Assessment. LSU Graphic Services, Baton Rouge, Louisiana.

NMFS. 2000. Smalltooth Sawfish Status Review. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Southeast Regional Office, Saint Petrsburg, FL.

NMFS. 2009. Smalltooth Sawfish Recovery Plan (*Pristis pectinata*). National Marine Fisheries Service, Silver Spring, Maryland.

NMFS. 2014. Biological Opinion on Regional General Permit SAJ-82 (SAJ-2007-1590), Florida Keys, Monroe County, Florida. National Marine Fisheries Service, St Petersburg, FL.

Norton, S. L., and coauthors. 2012. Designating critical habitat for juvenile endangered smalltooth sawfish in the United States. Marine and Coastal Fisheries 4(1):473-480.

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. T. Harper, and S. O'Neel. 2008. Kinematic Constraints on Glacier Contributions to 21st-Century Sea-Level Rise. Science 321(5894):1340-1343.

Poulakis, G. R. 2012. Distribution, Habitat Use, and Movements of Juvenile Smalltooth Sawfish, *Pristis pectinata*, in the Charlotte Harbor Estuarine System, Florida. Florida Institute of Technology, Melbourne, FL.

Poulakis, G. R., and J. C. Seitz. 2004. Recent occurrence of the smalltooth sawfish, *Pristis pectinata* (Elasmobranchiomorphi: Pristidae), in Florida Bay and the Florida Keys, with comments on sawfish ecology. Florida Scientist 67(27):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. 2011. 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.

Quigley, D. T. G., and K. Flannery. 2002. Leucoptic harbour porpoise *Phocoena phocoena* (L.). Irish Naturalists' Journal 27(4):170.

Rahmstorf, S., and coauthors. 2009. Recent climate observations compared to projections. Science 316(5825):709.

Reddering, J. S. V. 1988. 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.

Saenger, P., and J. Moverley. 1985. Vegetative phenology of mangroves along the Queensland coastline. Pages 9 *in* M. G. Ridpath, and L. K. Corbett, editors. Ecology of the wet-dry

tropics: Proceedings of a joint symposium with the Australian Mammal Society in association with the Darwin Institute of Technology. Blackwell Scientific Book Distributors, Melbourne.

SAFMC. 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.

Scavia, D., and coauthors. 2002. Climate change impacts on US coastal and marine ecosystems. Estuaries 25(2):149-164.

Semeniuk, V. 1994. Predicting the effect of sea-level rise on mangroves in northwestern Australia. Journal of Coastal Research 10(4):1050-1076.

Simpfendorfer, C. A. 2001. Essential habitat of the smalltooth sawfish (*Pristis pectinata*). Report to the National Fisheries Service's Protected Resources Division. Mote Marine Laboratory Technical Report.

Simpfendorfer, C. A. 2003. Abundance, movement and habitat use of the smalltooth sawfish. Final Report. Mote Marine Laboratory Mote Technical Report No. 929, Sarasota, FL.

Simpfendorfer, C. A. 2006. Movement and habitat use of smalltooth sawfish. Final Report. Mote Marine Laboratory, Mote Marine Laboratory Technical Report 1070, Sarasota, FL.

Simpfendorfer, C. A., G. R. Poulakis, P. M. O'Donnell, and T. R. Wiley. 2008. Growth rates of juvenile smalltooth sawfish, *Pristis pectinata* (Latham), in the western Atlantic. Journal of Fish Biology 72(3):711-723.

Simpfendorfer, C. A., T. R. Wiley, and B. G. Yeiser. 2010. Improving conservation planning for an endangered sawfish using data from acoustic telemetry. Biological Conservation 143:1460-1469.

Simpfendorfer, C. A., and coauthors. 2011. Environmental Influences on the Spatial Ecology of Juvenile Smalltooth Sawfish (*Pristis pectinata*): Results from Acoustic Monitoring. PLoS ONE 6(2):e16918.

Snedaker, S. 1995. Mangroves and climate change in the Florida and Caribbean region: scenarios and hypotheses. Hydrobiologia 295(1-3):43-49.

Stedman, S., and T. E. Dahl. 2008. Status and trends of wetlands in the coastal watersheds of the Eastern United States 1998-2004. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, and U.S. Department of the Interior, U.S. Fish and Wildlife Service.

Trenberth, K. 2005. Uncertainty in Hurricanes and Global Warming. Science 308(5729):1753-1754.

UNESCO. 1992. Coastal systems studies and sustainable development. . Pages 276 *in* COMAR Interregional Scientific Conference. UNESCO, Paris, 21-25 May, 1991.

USEPA. 1994. Freshwater Inflow Action Agenda For The Gulf of Mexico; First Generation-Management Committee Report. U.S. Environmental Protection Agency.

USFWS. 1999. South Florida Multi-Species Recovery Plan Atlanta, Georgia. 2172p.

Vargas-Moreno, J. C., and M. Flaxman. 2010. Addressing the challenges of climate change in the greater everglades landscape. Massachusetts Institute of Technology, Cambridge, Massachusetts.

Wanless, H. R., B. M. Vlaswinkel, and K. L. Jackson. 2005. Coastal Landscape and Channel Evolution Affecting Critical Habitats at Cape Sable, Everglades National Park, Florida. University of Miami.

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. 2007. The ecology of elasmobranchs occurring in the Everglades National Park, Florida: implications for conservation and management. Bulletin of Marine Science 80(1):171-189.