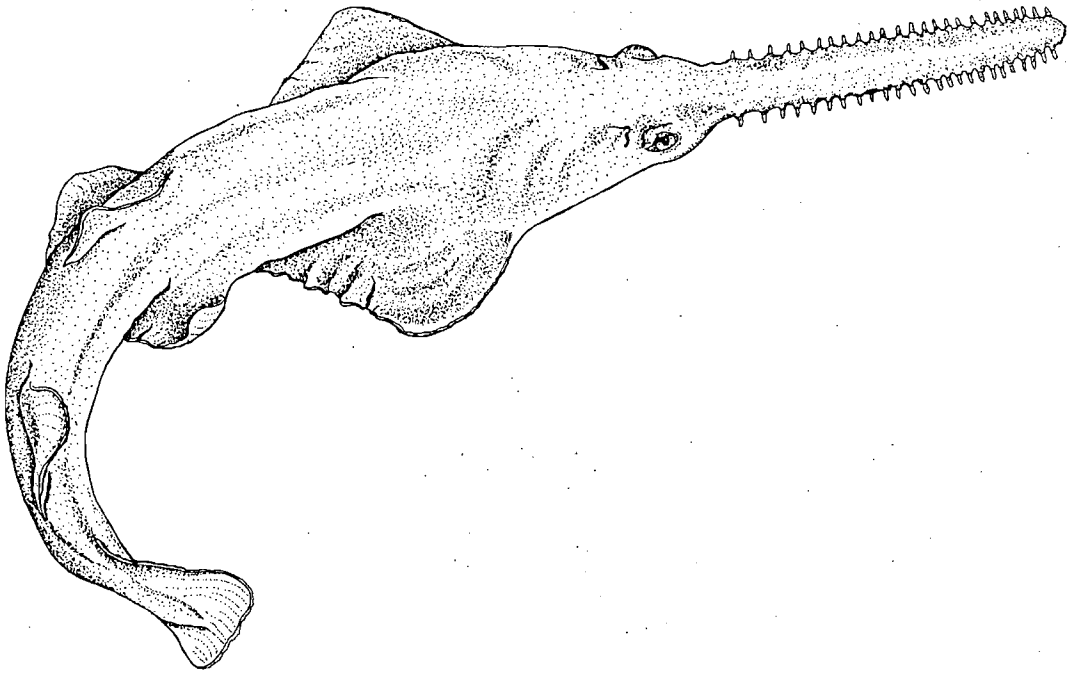
SMALLTOOTH SAWFISH RECOVERY PLAN

(Pristis pectinata)



National Marine Fisheries Service
National Oceanic and Atmospheric Administration

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National Marine Fisheries Service
National Oceanic and Atmospheric Administration

PREFACE

Congress passed the Endangered Species Act of 1973, as amended (ESA) to protect species of plants and animals endangered or threatened with extinction. The National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS) share responsibility for the administration of the ESA. NMFS is responsible for most marine and anadromous species including the smalltooth sawfish.

NMFS listed the U.S. distinct population segment (DPS) of smalltooth sawfish as endangered on April 1, 2003. Section 4(f) of the ESA directs NMFS and FWS to develop and implement recovery plans for species under their jurisdiction, unless such a plan would not promote the conservation of the species. NMFS determined that a recovery plan would promote conservation of the smalltooth sawfish and assembled the Smalltooth Sawfish Recovery Team (SSRT) to develop this recovery plan. The SSRT included smalltooth sawfish scientists and management experts from the state and federal government and the non-governmental sector.

NMFS and the SSRT agree that the success of the sawfish recovery plan will depend on cooperation from state and federal agencies, local governments, private sectors, and non-governmental organizations; as well as a long-term commitment to implementing and enforcing the plan's recommendations.

DISCLAIMER

Recovery plans delineate actions which the available information indicates are necessary for the conservation and survival of listed species. Plans are published by the National Marine Fisheries Service, sometimes prepared with the assistance of recovery teams, contractors, state agencies, and others. Objectives will be attained and any necessary funds will be made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Nothing in this plan should be construed as a commitment or requirement that any federal agency obligate or pay funds in contravention of the Anti-Deficiency Act, 31 U.S.C. 1341, or any other law or regulation. Recovery plans do not necessarily represent the views or the official positions or approval of any individuals or agencies involved in the plan formulation, other than the National Marine Fisheries Service. They represent the official position of the National Marine Fisheries Service only after they have been signed by the Assistant Administrator. Approved recovery plans are subject to modification as dictated by new information, changes in the species status, and the completion of recovery actions. Please check for updates and revisions at the website below before using.

LITERATURE CITATION SHOULD READ AS FOLLOWS:

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ADDITIONAL COPIES MAY BE OBTAINED FROM:

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Recovery plans can be downloaded from NMFS' website:
http://www.nmfs.noaa.gov/pr/recovery/plans.htm

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ABBREVIATION LIST

AFS	American Fisheries Society
CERP	Comprehensive Everglades Restoration Project
CITES	Convention on the International Trade of Endangered Species of Wild Fauna and Flora
COE	Corps of Engineers
CPUE	Catch per Unit Effort
DPS	Distinct Population Segment
EEZ	Exclusive Economic Zone
ENP	Everglades National Park
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FKNMS	Florida Keys National Marine Sanctuary
FMP	Fisheries Management Plan
FWC	Florida Fish and Wildlife Conservation Commission
FWCA	Fish and Wildlife Coordination Act
FWPCA	Federal Water Pollution Control Act
FWRI	Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute
FWS	U.S. Fish and Wildlife Service
GCSC	Gulf Coastal Shark Census
GMFMC	Gulf of Mexico Fisheries Management Council
HMS	Highly Migratory Species
HPUE	Harvest per Unit Effort
IRL	Indian River Lagoon
IUCN	World Conservation Union, previously the International Union for Conservation of Nature
MML	Mote Marine Laboratory
MPRSA	Marine Protection, Research, and Sanctuaries Act
MSA	Magnuson-Stevens Fisheries Conservation and Management Act
MRFSS	Marine Recreational Fisheries Statistics Survey
NEPA	National Environmental Policy Act
NGO	Non-Governmental Organization
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
PAT	Pop-up Archival Transmitter
PIT	Passive Integrated Transponder
PAT	Pop-up Satellite Archival Tags
PVA	Population Viability Analysis
SAFMC	South Atlantic Fisheries Management Council
SFWMD	South Florida Water Management District
SSIT	Smalltooth Sawfish Implementation Team
SSRT	Smalltooth Sawfish Recovery Team
TED	Turtle Excluder Device
TPWD	Texas Parks and Wildlife Department
USGS	United States Geological Survey
WMD	Water Management District

EXECUTIVE SUMMARY

Current Species Status: The U.S. DPS of smalltooth sawfish (*Pristis pectinata*), hereinafter "smalltooth sawfish" or "the species," was listed as endangered under the Endangered Species Act of 1973, as amended (ESA) on April 1, 2003 (68 FR 15674) in response to a 1999 listing petition from The Ocean Conservancy (formerly the Center for Marine Conservation). Smalltooth sawfish were once prevalent throughout Florida and were commonly encountered from Texas to North Carolina. Currently, smalltooth sawfish can only be found with any regularity in south Florida between the Caloosahatchee River and the Florida Keys. Based on the contraction in range and anecdotal data, it is likely that the population is currently at a level less than 5% of its size at the time of European settlement.

Habitat Requirements and Limiting Factors: Juvenile smalltooth sawfish generally inhabit the shallow coastal waters of bays, banks, estuaries, and river mouths, particularly shallow mud banks and mangrove habitats. Larger animals can be found in the same habitat, but are also found offshore at depths up to at least 122 meters.

The primary reason for the decline of the smalltooth sawfish population has been bycatch in various commercial and recreational fisheries. The secondary reason for the decline of the smalltooth sawfish population is habitat loss and degradation. Other threats to the species include entanglement in marine debris, injury from saw removal, pollution, and disturbance of natural behavior by divers and other marine activities.

Life history characteristics are a limiting factor for the species' ability to recover. Sawfish are slow growing, late maturing, and produce small numbers of young; hence, recovery will take decades, even if all threats are effectively eliminated.

Recovery Strategy: The recovery strategy has three main objectives which include actions to rebuild and monitor the population while also eliminating or managing the threats that resulted in listing. The first objective is to minimize human interactions and associated injury and mortality. The second is to protect and/or restore smalltooth sawfish habitats. The third objective is to ensure smalltooth sawfish abundance increases substantially and the species reoccupies areas from which it had previously been extirpated. Based on these objectives, the recovery team developed objective, measurable criteria to determine when the recovery objectives can be judged to have been met, and identified specific activities to accomplish the objectives. NMFS must work with federal, state, local, and private entities to monitor the smalltooth sawfish population and to coordinate research and recovery efforts to achieve these objectives.

Recovery Goals, Objectives, and Criteria: The goal of the recovery plan is to rebuild and assure the long-term viability of the U.S. DPS of smalltooth sawfish in the wild, allowing initially for reclassification from endangered to threatened status (downlisting) and ultimately recovery and subsequent removal from the List of Endangered and Threatened Wildlife (delisting). The three overarching recovery objectives are listed below with their associated downlisting and delisting recovery criteria. The plan provides additional detail on how the objectives, criteria, and actions address the species' status and the causal listing/delisting factors.

1. Minimize human interactions and associated injury and mortality.

Downlisting:

- Effective ongoing programs are in place to educate the public about population status and the prohibitions against capturing, harming, or harassing smalltooth sawfish.

- Safe handling and release guidelines have been developed, adopted, distributed, and are being effectively implemented in all state and Federal fisheries (commercial and recreational) that may interact with smalltooth sawfish within all recovery regions (See Figure 9).

- State and/or Federal fishing regulations specific to smalltooth sawfish are in place to ensure that injury and mortality from commercial and recreational fishing is maintained below or at levels that ensure the population increases at the rate, or stabilizes at the levels, described in the criteria identified in Objective 3.

Delisting:

- All downlisting criteria continue to be met.

- State and/or Federal measures (not including those provided under the ESA) are in place to prohibit harm or possession of smalltooth sawfish, or to ensure that impacts are appropriately assessed, authorized, and minimized.

- State and/or Federal measures (not including those provided under the ESA) are in place to maintain the population at levels at or above those required for delisting.

2. Protect and/or restore smalltooth sawfish habitats.

Downlisting:

- At least 95% of mangrove shoreline habitat existing at time of listing is maintained and effectively protected in recovery regions G, H, and I (See Figure 9 for map of Recovery Regions).

- Sufficient mangrove shoreline or alternate scientifically documented non-mangrove nursery habitat are available and accessible to support viable subpopulations of juvenile smalltooth sawfish in recovery regions J and K, and one additional recovery region (apart from G, H, I, J, and K). This level should be a minimum of 25% of the mangrove shoreline habitat that existed in 1940, in each of the above recovery regions. The level of non-mangrove nursery habitat must be determined once specific nursery habitat features are identified.

- Freshwater flow regimes (including timing, distribution, quality, and quantity) into recovery regions G, H, I, J, K and the one additional region used to meet the two previous criteria are appropriate to ensure natural behavior (e.g., feeding, resting, and predator avoidance) by maintaining salinities within preferred physiological limits of juvenile smalltooth sawfish.

- Habitat areas of adult smalltooth sawfish abundance, including those used for aggregation, mating and pupping, are identified, mapped, and effectively protected as appropriate.

Delisting:

- All habitat-based downlisting criteria continue to be met.

- Sufficient mangrove shoreline or alternate scientifically documented non-mangrove nursery habitat are available and accessible to support viable subpopulations of juvenile smalltooth sawfish in recovery regions J and K, and one additional recovery region (apart from G, H, I, J, and K). This level should be a minimum of 25% of the mangrove shoreline habitat that existed in 1940, in each of the above recovery regions. The level of non-mangrove nursery habitat must be determined once specific nursery habitat features are identified.

- Freshwater flow regimes (including timing, distribution, quality and quantity) into recovery regions G, H, I, J, K and the four additional used to meet the previous delisting criteria are appropriate to ensure natural behavior (e.g. feeding, breeding and pupping) by maintaining salinities within preferred physiological limits of juvenile smalltooth sawfish.

3. Ensure smalltooth sawfish abundance increases substantially and the species reoccupies areas from which it had been previously extirpated.

Downlisting:

- In recovery regions G, H, I, J, and K and at least one other recovery region the relative abundance of small juvenile smalltooth sawfish (<200 cm[1]) either is increasing at an average annual rate of at least 5% over a 27-year period with greater than 95% certainty or is at greater than 80% of carrying capacity.

- Relative abundance of adult smalltooth sawfish in combined recovery regions J through L (east coast of Florida) has increased to a level at least 15-times higher than the level at the time of listing with greater than 95% certainty that abundance at this level has been sustained for a period of at least 14 years.

- Relative abundance of adult smalltooth sawfish in combined recovery regions F through H (west coast of Florida) has increased to a level at least 15-times higher than the baseline level determined in Action 3.2.4 with greater than 95% certainty that abundance at this level has been sustained for a period of at least 14 years.

- Verified records of adult smalltooth sawfish are observed in 12 out of 14 years, with consecutive records occurring in the last 3 years in recovery regions M or N, and in at least one of recovery regions A, B, C, or D.

Delisting:

- In addition to the 6 downlisting recovery regions (G, H, I, J, and K and one additional region), the relative abundance of small juvenile smalltooth sawfish (<200 cm) in 3 other recovery regions, at

[1] All lengths unless otherwise indicated are in total length.

least one of which must be west of Florida, is either increasing at an average annual rate of at least 5% over a 27-year period with greater than 95% certainty or at greater than 80% of carrying capacity.

- In recovery regions G, H, I, J, and K and at least 4 other recovery regions, one of which must be west of Florida, the relative abundance of small juvenile smalltooth sawfish (<200 cm) is stable or increasing over a period of 14 years following downlisting.

- Relative abundance of adult smalltooth sawfish (>340 cm) [2]in combined recovery regions J through L (east coast of Florida) is at least 20-times higher than the baseline level with greater than 95% certainty that abundance at this level has been sustained for a period of at least 14 years.

- Relative abundance of adult smalltooth sawfish (>340 cm) in combined recovery regions F through H (west coast of Florida) is at least 20-times higher than the baseline level with greater than 95% certainty that abundance at this level has been sustained for a period of at least 14 years.

- Verified records of adult smalltooth sawfish are observed in 12 out of 14 years, with consecutive records in the last 3 years, in recovery regions M or N, and in at least one of recovery regions A, B, C or D.

See Section III of the plan, "Recovery Goals and Criteria" for detailed information on the recovery criteria for downlisting and delisting.

Actions Needed: The list of actions below are designed to stop and reverse the downward population trends of the remnant smalltooth sawfish population and minimize the potential for human activities to result in the degradation or destruction of smalltooth sawfish habitat necessary for the conservation and survival of the species. This list is a subset of all of the actions required for full recovery of the species. A complete list of the required recovery actions can be found in the Implementation Schedule.

- Prevent or reduce mortality of the species in fisheries to ensure their long-term viability.

- Monitor trade to ensure trade in sawfish and sawfish parts does not threaten the long-term viability of the population.

- Minimize interactions, injury, and mortality through outreach and education.

- Reduce threats from research efforts.

- Develop non-ESA protection measures and a post-delisting monitoring plan.

- Verify that nursery habitat of sufficient size and quality exists to enable the recovery of the species.

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[2] Based on unpublished data (MML and NMFS) adult male smalltooth sawfish are considered to be greater than 340 cm and females are greater than 360 cm.l

- Minimize the disruption of natural/historic freshwater flow regimes including timing, quality, and quantity) and maintain or restore water quality.

- Identify and protect the habitats (particularly mating and pupping areas) of adult smalltooth sawfish.

- Investigate the relationship (movements) between the U.S. DPS of smalltooth sawfish and populations in surrounding countries and coordinate conservation and recovery efforts to ensure U.S. smalltooth sawfish recovery efforts are not hindered.

- Determine that sufficient numbers of adult smalltooth sawfish exist to ensure recovery.

- Develop a spatially-structured PVA for the species to estimate extinction probabilities.

- Verify that sufficient numbers of juvenile smalltooth sawfish exist to ensure recovery and that sufficient nursery areas are occupied to protect against negative stochastic events.

Date of Recovery: Recovery is expected to take approximately 100 years (4 generations). Recovery could occur around year 2106 if all recovery actions are fully funded and implemented.

Total Cost of Recovery: Approximately 70 million dollars (over 100 years). This total was obtained by calculating the recovery costs in Table 2, Implementation Schedule, based on a recovery date of 2106.

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I. BACKGROUND

The overall goal of the ESA is to provide a means by which endangered and threatened species and the ecosystems upon which they depend may be conserved. To help achieve this goal, the ESA requires a recovery plan be prepared for each listed species unless such a plan will not promote its conservation.

Recovery plans guide the implementation of actions required to recover listed species to the point at which they are self-sustainable in the wild and can be safely removed from the list of endangered and threatened species. Recovery plans are advisory documents only, and recommendations contained therein are not obligatory. However, failure to implement recovery actions may result in the species not recovering and remaining listed indefinitely or going extinct.

A. Brief Overview

The smalltooth sawfish (*Pristis pectinata*) is one of seven sawfish species that occur worldwide in tropical and sub-tropical rivers, lakes, and coastal areas. Sawfish are elasmobranchs, as are sharks and rays. Sawfish and sharks share similar life history characteristics. They are long-lived, slow growing, slow to mature, and bear few young. These traits make all sawfish extremely vulnerable to overfishing and slow to recover from depletion. Whereas sawfish were once abundant in many areas around the world, they are now very rare, prompting the World Conservation Union (IUCN) to include all sawfish species as "Critically Endangered" on the IUCN Red List criteria.. The serious depletion of the U.S. population of smalltooth sawfish was the basis for The Ocean Conservancy's 1999 petition to list the species as endangered under the ESA, and the NMFS' decision to do so on April 1, 2003 (68 FR 15674).

The smalltooth sawfish has a recovery priority number of seven. The recovery priority number is based on the criteria in the Recovery Priority Guidelines (NMFS 2006). This recovery priority is based on the magnitude of threats being "moderate," recovery potential being "low-moderate," and the potential for economic conflicts while implementing recovery actions.

1. Listing history

On November 30, 1999, NMFS received a petition from The Ocean Conservancy requesting that NMFS list the North American populations of smalltooth sawfish and largetooth sawfish as endangered under the ESA. On March 10, 2000, NMFS published its determination that the petition presented substantial information indicating that listing may be warranted for smalltooth sawfish and initiated a review of the status of this species (65 FR 12959). NMFS also determined that the petition did not present substantial information supporting the listing of largetooth sawfish. The largetooth sawfish is currently listed on the NMFS "Species of Concern" list which highlights its rare status and promotes collection of additional information.

NMFS completed the smalltooth sawfish status review in December 2000 (NMFS 2000). The status review determined that smalltooth sawfish in U.S. waters comprise a distinct population segment (DPS), and that the smalltooth sawfish population is in danger of extinction throughout its range. The status review found the species' endangered status resulted from four of the ESA's five causal listing factors (disease or predation, one factor under the ESA, was not found to be a factor causing the species' endangered status). The listing factors and how they relate to the smalltooth sawfish are identified below.

Factor 1 – The present or threatened destruction, modification, or curtailment of habitat or range.

- Smalltooth sawfish habitat has been degraded or modified throughout the southeastern U.S. from agriculture, urban development, commercial activities, channel dredging, boating activities, and the diversion of freshwater run-off. While the degradation and modification

of habitat is not likely the primary reason for the decline of smalltooth sawfish abundance and their contracted distribution, it has likely been a contributing factor.

Factor 2 – Overutilization for commercial, recreational, scientific, or educational purposes.

- The primary reason for the decline in smalltooth sawfish abundance has been bycatch in various commercial fisheries, including gillnets, otter trawls, trammel nets, and seines. Smalltooth sawfish have also been caught as bycatch and occasionally landed in recreational fisheries.

Factor 3 – Disease or predation

- Disease and predation were not factors causing the species' endangered status. However, destruction of mangroves may have resulted in increased predation risk for juveniles.

Factor 4 – Inadequacy of existing regulatory mechanisms

- Existing federal and state laws, regulations and policies were inadequate to protect smalltooth sawfish throughout their range. There are no federal regulations or state conservation plans specifically for the protection of sawfish. With the exception of Florida and Louisiana, smalltooth sawfish could be harvested in state waters[3]. Smalltooth sawfish bycatch in gillnets has likely been reduced due to recent regulations prohibiting or limiting the use of gillnets in state waters, but bycatch in other gears such as trawls still poses a threat to this species.

Factor 5 – Other natural or manmade factors affecting its continued existence

- Inferences about the life history of the species indicate that it has a slow growth rate, is late to mature, and has a long life span and low fecundity. The recovery of smalltooth sawfish is limited by these life history characteristics and the current small population size.

2. Recovery planning

NMFS assembled the SSRT in September 2003. The team used the threats and causal listing factors that were identified in the final listing rule and any new information on current threats to develop the recovery strategy (objectives, measurable criteria, and recovery actions) for the species. The team developed the plan expecting that when all of the measurable criteria are met the delisting process would result in removal of the species from the list of endangered and threatened species. The delisting analysis will determine if the species is endangered or threatened because of any of the five causal listing factors.

Because only the US DPS of smalltooth sawfish is listed under the ESA this recovery plan and the recovery criteria are relevant only to this population. However, smalltooth sawfish that exist outside the U.S. and other sawfish species around the world face similar threats and may benefit from the plan.

B. Description and Taxonomy

All modern sawfish belong to the Suborder Pristoidea, Family Pristidae, and are represented by two genera: *Pristis* and *Anoxypristis*. Although they are rays, sawfish appear in some respects to be more shark-like than ray-like, with only the trunk and especially the head ventrally flattened. All sawfish

[3] Alabama prohibited the catch of smalltooth sawfish in 2004.

snouts are extended as a long, narrow, flattened, rostral blade with a series of transverse teeth along either edge. The rostrum has a saw-like appearance and hence the name of sawfish.

Species in the genus *Pristis* are separable into two groups according to whether the caudal fin has a distinct lower lobe or not. The smalltooth sawfish, *Pristis pectinata*, is the sole known representative on the western side of the Atlantic of the group lacking a defined lower caudal lobe. The group in which the caudal fin has a lower lobe is similarly represented in the western side of the Atlantic by a single known species, the largetooth sawfish, *P. perotteti* (alternatively referred to as *P. pristis*). The smalltooth sawfish is also distinguished from the largetooth sawfish by having the first dorsal fin origin located over the origin of the pelvic fins (versus considerably in front of the origin of pelvics in the largetooth sawfish) and by having 20 to 34 rostral teeth on each side of the rostrum (versus 14-23 in largetooth sawfish) (Bigelow and Schroeder 1953; Thorson 1973; McEachran and Fechhelm 1998; Compagno and Last 1999; Matthew McDavitt pers. comm.). The rostrum of the smalltooth sawfish is about 1/4 of the total length of an adult specimen, somewhat longer than the rostrum of largetooth sawfish, which is about 1/5 of its total length (Bigelow and Schroeder 1953).

The systematic status of sawfishes in general and of *P. pectinata* in particular is still in a state of flux. Systematic studies addressing the taxonomic status of sawfishes are currently in progress and these may result in changes to the number of recognized species and their ranges.

C. Distribution and Habitat Use

1. Distribution

The smalltooth sawfish is a tropical marine and estuarine elasmobranch fish that has been reported to have a circumtropical distribution (Figure 1). In the western Atlantic, the smalltooth sawfish has been reported from Brazil through the Caribbean and Central America, the Gulf of Mexico, and the Atlantic coast of the United States. The smalltooth sawfish has also been recorded from Bermuda (Bigelow and Schroeder 1953). Forms of smalltooth sawfish have been reported from the eastern Atlantic in Europe and West Africa; the Mediterranean; South Africa; and the Indo-West Pacific, including the Red Sea, India, Burma, and the Philippines (Bigelow and Schroeder 1953; Van der Elst 1981; Compagno and Cook 1995). Whether populations outside the Atlantic are truly smalltooth sawfish or closely related species is unknown (Adams and Wilson 1995). Pacific coast records of smalltooth sawfish off Central America need confirmation (Bigelow and Schroeder 1953; Compagno and Cook 1995).

The range of the smalltooth sawfish in the Atlantic has contracted markedly over the past century. The northwestern terminus of their Atlantic range is located in the waters of the eastern United States. Historic capture records within the U.S. range from Texas to New York (Figure 2). Water temperatures no lower than 16-18 °C and the availability of appropriate coastal habitat serve as the major environmental constraints limiting the northern movements of smalltooth sawfish in the western North Atlantic. As a result, most records of this species from areas north of Florida occur during spring and summer periods (May to August) when inshore waters reach appropriately high temperatures. Most specimens captured along the Atlantic coast north of Florida have also been large (> 10 ft or 3 m) adults and likely represent seasonal migrants, wanderers, or colonizers from an historic Florida core population(s) to the south rather than being members of a continuous, even-density population (Bigelow and Schroeder 1953). The SSRT determined for the purpose of this document, the core of the historic range is defined as the waters off Florida. It is likely that these individuals migrated southward toward Florida as water temperatures declined in the fall, as there is only one winter record from the Atlantic coast north of Florida. The Status Review Team (NMFS 2000) collected and compiled literature accounts, museum collection specimens, and other records of the species to document the changes in distribution and abundance. At about the same time, two groups of researchers began collecting reports of sawfish encounters and captures in Florida to assess the current distribution of this species. On the

basis of the Status Review Team's analysis and the more recent encounter database research (Seitz and Poulakis 2002; Poulakis and Seitz 2004; Simpfendorfer and Wiley 2005a), the historic and current distributions of smalltooth sawfish in four regions of the eastern U.S. are described below.

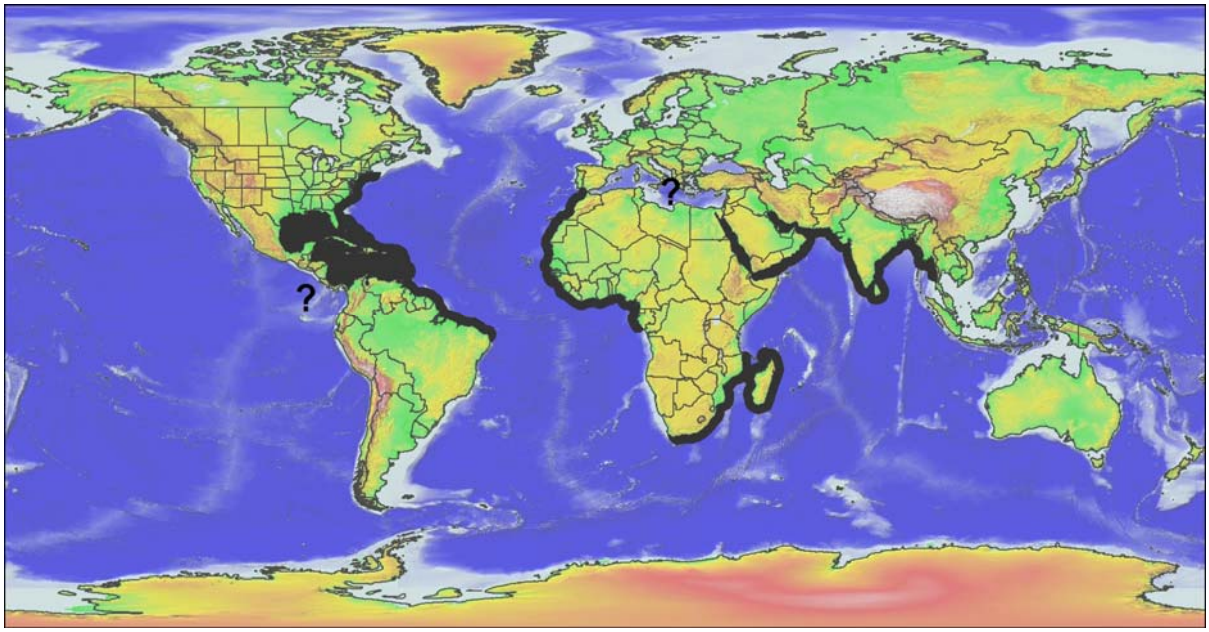

Figure 1. Historical World Distribution Map for the Smalltooth Sawfish. From Burgess and Curtis (2003).

New York to Virginia

The northernmost U.S. record of the smalltooth sawfish is based upon a 15 ft (4.5 m) specimen from New York taken in July 1782 (Schopf 1788). This early record is the only record of smalltooth sawfish from New York waters. There is always concern with early reports of any species from "New York" because those reports often were based on market specimens that were shipped to New York from other areas. Documented reports of the species from the bordering state of New Jersey, however, and the historical presence of many large, inshore, tropical species in the New York region prior to human-induced environmental degradation suggest the New York record may be valid. Records of smalltooth sawfish from the mid-Atlantic are only from the late 1800's and early 1900's. There are two records from New Jersey. Shields (1879) reported a 16 ft (4.8 m), 700 lb. (311 kg) specimen in Grassy Sound near Cape May, and Fowler (1906) noted the occurrence of two sawfish in the ocean off Cape May in or about August 1900. References to smalltooth sawfish in Maryland and Virginia are similarly dated. Uhler and Lugger (1876) reported that it "occasionally enters Chesapeake Bay," and Fowler (1914) and Truitt and Fowler (1929) reported on a 10 ft (3.0 m) Ocean City specimen. Hildebrand and Schroeder (1928) later noted that it was rarely taken in lower Chesapeake Bay, "sometimes one or two fish a year and sometimes none." There have been no reports of smalltooth sawfish in New Jersey, Maryland or Virginia since Hildebrand and Schroeder (1928).

North Carolina to Georgia

Lawson's (1709) early reference to a "sword-fish" in North Carolina undoubtedly applied to a sawfish since he was primarily describing inshore fishes. There are multiple reports of sawfish in North Carolina

waters from the late 1800's and early 1900's, some being reiterations of earlier reports: Yarrow (1877: Core Sound, Bogue Sound, New River), Jenkins (1885: Beaufort), Wilson (1900: Beaufort), Smith (1907: Core Sound, Bogue Sound, New River, Beaufort, Cape Lookout), Gudger (1912: Cape Lookout), Coles (1915: Cape Lookout), Radcliffe (1916: Cape Lookout), and Gudger (1933: Cape Lookout). Yarrow (1877) indicated the sawfish was "abundant in brackish waters emptying into Bogue and Cove [= Core] Sounds" and that they were "frequently taken in the New River." Wilson (1900) also noted that it "is frequently taken" in North Carolina. Smith (1907) later reported that "this fish is not rare in the sounds and brackish waters of North Carolina" and that "in the Beaufort region and at Cape Lookout the species is observed almost every year, and some seasons is common." Since 1915 there have been only three published records of captures in North Carolina: one in 1937 (Fowler 1945), one in 1963 (Schwartz 1984), and a recent report from 1999 (Schwartz 2003). Records from South Carolina and Georgia are sparse. Jordan and Gilbert (1882) and True (1883) were the first publications to report sawfish in South Carolina waters, but there are records of the species in state waters from as early as 1817. The species was taken with some regularity, based on multiple museum and newspaper state records, until about 1938, with the last reported capture in 1958. The single published Georgia record of sawfish, a 3 ft (0.91 m) juvenile, was from March 1908 (Fowler 1945). The only capture since 2002 came from a bottom longline fishery observer who documented the capture of a second Georgia specimen, a ca. 13 ft (4.0 m) adult from depths of 152 - 242 ft (45.6 - 72.6 m) (Burgess unpublished data).

Peninsular Florida

Peninsular Florida has been the U.S. region with the largest numbers of capture records of smalltooth sawfish and apparently is the main area that historically hosted the species year round. The region's subtropical to tropical climate and availability of desirable habitat, including large expanses of lagoons, bays, mangroves, and nearshore reefs are suitable for the species. Although no longer common, smalltooth sawfish were once characteristic and prominent elements of the inshore Florida ichthyofauna. Recent records of smalltooth sawfish indicate there is a resident reproducing population of smalltooth sawfish in south Florida (Seitz and Poulakis 2002; Poulakis and Seitz 2004; Simpfendorfer and Wiley 2005a). Many of the summer-caught smalltooth sawfishes taken along the U.S. East Coast north of Florida and possibly those from Texas to the Florida panhandle may have originated from this group, but supporting data are lacking.

The earliest record of smalltooth sawfish from Florida is an 1834 museum specimen from Key West. Published reports of the species in Florida were common over the next 100 years: Goode (1879a: FL; 1879b: east coast FL; 1884: Indian River, St. Johns River, Everglades, St. Andrews Bay), Jordan and Swain (1884: Cedar Keys), Henshall (1891: Big Gasparilla, FL west coast), Bean (1892: San Carlos Bay), Lönnberg (1894: Punta Gorda), Henshall (1895: Tampa), McCormick in Smith (1896: Biscayne Bay), Evermann and Bean (1898: Eau Gallie, Eden, Stuart in Indian River), Smith (1896: Biscayne Bay), Jordan and Evermann (1900: Pensacola), Evermann and Kendall (1900: east FL), Evermann and Marsh (1900: Indian River), Fowler (1906: FL Keys; 1915: Ft. Pierce), Radcliffe (1916: FL), Nichols (1917: Sandy Key), and Fowler (1945: Plantation Key). Museum records from this time period are also reasonably common. Historically, the Indian River Lagoon (IRL) on the east coast of Florida was an area of smalltooth sawfish abundance. Goode (1884) reported that in "the Indian River and its tributaries the Saw-fish is said to be very common" and Evermann and Bean (1898) noted the sawfish was "an abundant species," with a single commercial fisher having captured 300 smalltooth sawfish in a single fishing season. Published and museum records of sawfish are plentiful from the lagoons south of Cape Canaveral throughout this time period. Records also exist from more northerly (off Daytona Beach and Jacksonville) and southerly (Biscayne Bay) peninsular east coast localities during the late 1800's. Goode (1884) reported that in "the St. John's River individuals of all sizes…are taken as high up as Jacksonville." Post-1907 records from this region, however, have been far more limited and occurrences north of the Florida Keys are noteworthy events these days. During a 1973-1976 Florida Bay fish survey

Schmidt (1979) reported three juvenile and adult specimens captured along the northern Florida Bay shoreline. Snelson and Williams (1981) did not capture any sawfish in an extensive multi-year study of the IRL system. They speculated that the species' absence was caused by "heavy mortality associated with incidental captures by commercial fishermen" since the decline seemed to pre-date most of the man-made habitat alterations of the area. Current records from the east coast of Florida remain relatively scarce compared to the west coast, Florida Bay, and the Florida Keys (Figure 3). Most of the encounter records for the east coast are for larger sized animals occurring along the beaches and at offshore reefs, but more recently a few smaller juvenile-sized individuals have been reported inside the IRL system (Simpfendorfer and Wiley 2005a; Simpfendorfer unpublished; Poulakis and Seitz unpublished data).

The U.S. region that has always harbored the largest numbers of smalltooth sawfish lies in south and southwest Florida from Charlotte Harbor through the Dry Tortugas. Goode (1884) stated that in "the Everglades these fish are said to be exceedingly abundant." There has been a continuous and frequent record of sawfish occurrences in the Everglades since the first report in 1834, and the vicinity now serves as the last U.S. stronghold for the species (Seitz and Poulakis 2002; Poulakis and Seitz 2004; Simpfendorfer and Wiley 2005a).

Smalltooth sawfish also occur on the west coast of Florida north of Charlotte Harbor, but historically appear to never have been as common in this region as in the east coast lagoons and south Florida. One of the earliest published records from the west coast was reported in 1883 from the Cedar Keys off the northwestern Florida peninsula. Other 1800's captures were documented in Tampa Bay and in the southwest coast off Charlotte Harbor and San Carlos Bay. Henshall (1895) relates reports of hundreds occurring on the Gulf coast of peninsular Florida. Records of capture since that time period have been limited. There are few documented captures of sawfish from the area north of Charlotte Harbor. The recent work to document sawfish encounters has increased the numbers of reported occurrences in the upper half of the west coast of the Florida Peninsula (Figure 3) and in the area north of Charlotte Harbor.

Texas to the Florida Panhandle

Records of smalltooth sawfish in the Gulf of Mexico from Texas to the Florida Panhandle exhibit a similar seasonal pattern of occurrence - more than two-thirds of the records are from April through August. While less common, winter records from the northern Gulf of Mexico (including juveniles) do suggest that at least a portion of the population may have been resident year-round in the region. However, many of the sawfish that occurred in this region may have originated from Peninsular Florida and possibly Mexico. While smalltooth sawfish historically occurred in Mexican waters, there is no information to suggest that there is currently a resident population remaining in Mexican waters. Smalltooth sawfish were described as "abundant" by Jordan and Evermann (1896) and "common" by Breder (1952) in the Gulf of Mexico. These authors may have been a bit generous in attributing these levels of abundance, as the records of smalltooth sawfish in this area are substantially fewer than in waters off peninsular Florida. Nevertheless, smalltooth sawfish apparently were more common in the Texas and northern Gulf region than in the Atlantic area north of Florida.

The smalltooth sawfish was first recorded within this region by Rafinesque (1820) in the lower Mississippi River upstream as far as the Red River, Arkansas (his report of the species in the Ohio River is thought to be erroneous). Numerous records of smalltooth sawfish exist from the Gulf of Mexico: Goode and Bean (1882), Jordan and Gilbert (1883), Jordan (1886), Evermann and Kendall (1894: Galveston), Jordan and Evermann (1900: Pensacola), Gowanloch (1932: LA), Gunter (1936: LA), Baughman (1943: TX), and Boschung (1957, 1993: AL). Baughman (1943) reported that smalltooth sawfish were "frequently taken" and "plentiful" in Texas waters. Bigelow and Schroeder (1953) later regarded smalltooth sawfish as "abundant" in Texas. As recently as the late 1950's sawfish were characterized as being "not uncommon" in Alabama waters (Boschung 1957), and recreational fishers

reportedly took “many sawfish” prior to the 1960’s in Texas (Caldwell 1990). However, smalltooth sawfish in the northern and western Gulf of Mexico have become rare in the last 30 years. Since 1971, there have been only three published or museum reports of smalltooth sawfish captured from this region, and all have been from Texas (1978, 1979, 1984 – see NMFS 2000 [status review]). Recent studies to document encounters with smalltooth sawfish since 1990 have yielded only a handful of records. The MML database has single verified records from Texas, Louisiana, and Alabama, and several from the Florida Panhandle (Simpfendorfer and Wiley 2005a; Simpfendorfer unpublished data). Most records from the Panhandle are juveniles, from all times of the year.

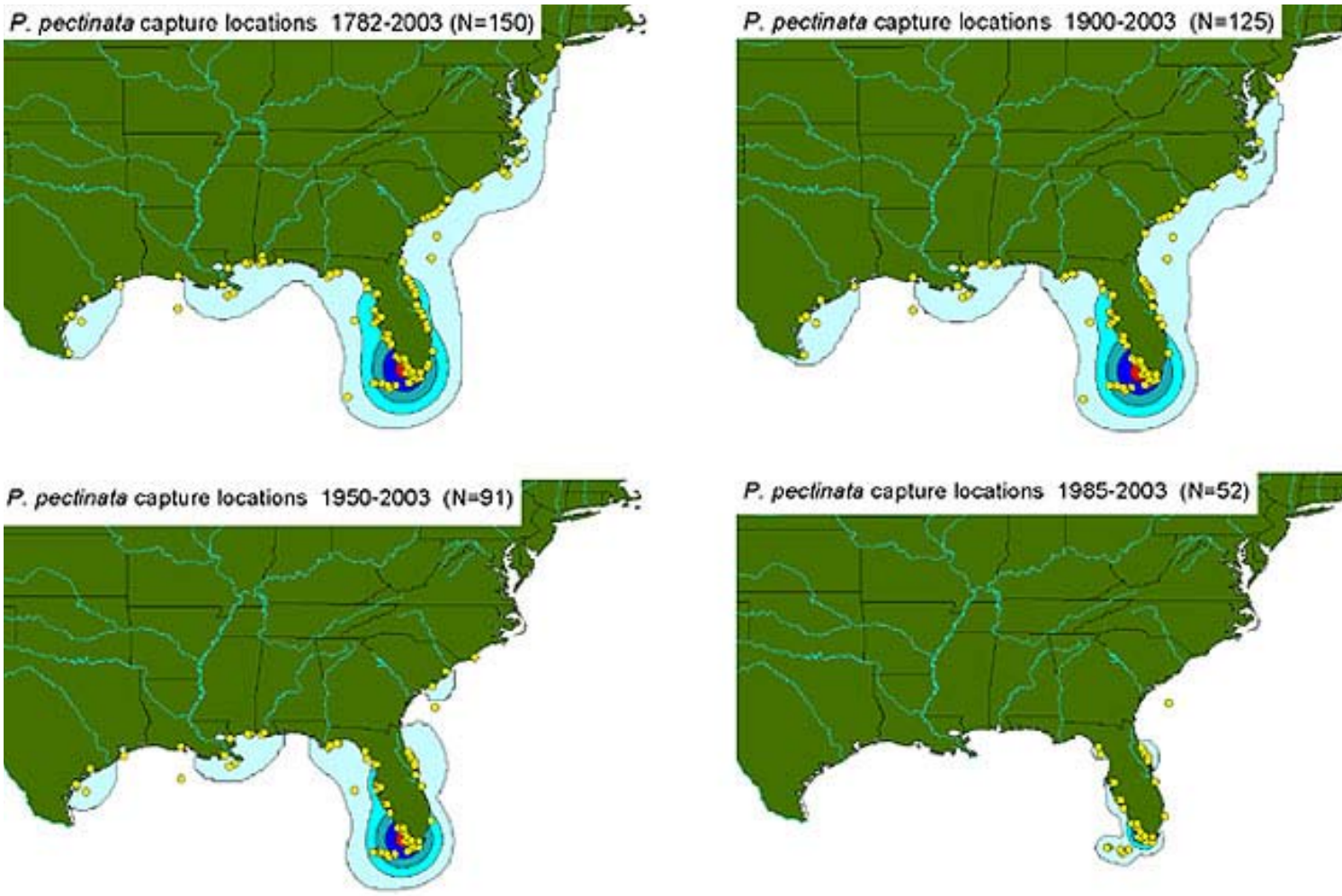

Figure 2. Historic and Current Distribution of Smalltooth Sawfish in the U.S. Darker areas indicate greater concentration of records. From Burgess and Curtis (2003).

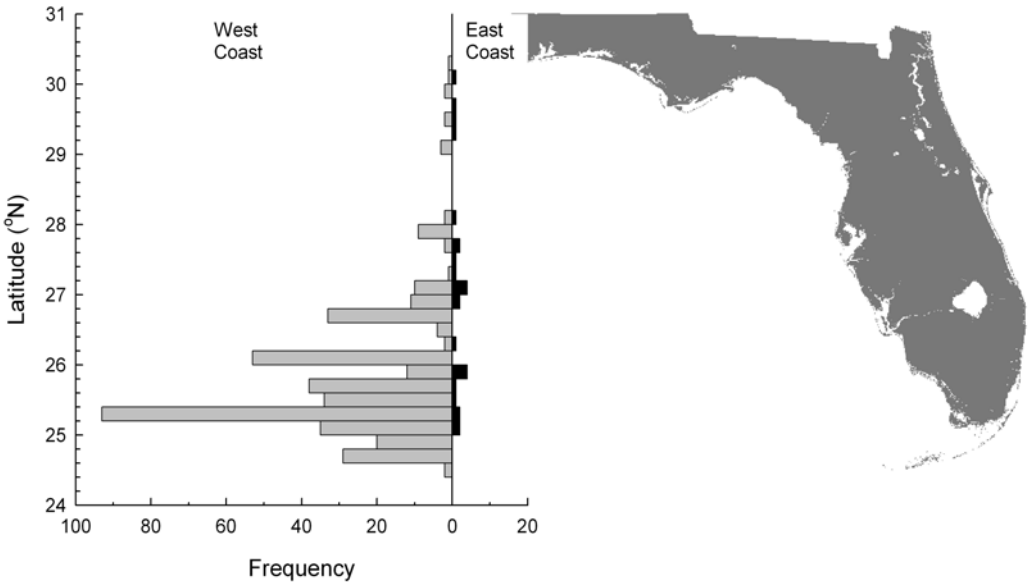

Figure 3. Latitudinal Distribution of Smalltooth Sawfish (*Pristis pectinata*) Encounters on the East and West Coasts of Florida, 1998-2004. The map of Florida is adjacent for orientation only. From Simpfendorfer and Wiley (2005a).

2. Habitat use

At the time of listing the status review document (NMFS 2000) summarized smalltooth sawfish's habitat use in the following way:

> "Sawfish in general inhabit the shallow coastal waters of most warm seas throughout the world. They are found very close to shore in muddy and sandy bottoms, seldom descending to depths greater than 32 ft (10 m). They are often found in sheltered bays, on shallow banks, and in estuaries or river mouths."

In the years since the status review additional research on habitat use by smalltooth sawfish has been undertaken. This research has revealed a more complex pattern of habitat use than previously known, with different life history stages having different patterns of habitat use. Ongoing research will undoubtedly inform recovery efforts in the future.

A variety of methods have been applied to studying habitat use patterns of smalltooth sawfish, including acoustic telemetry (Simpfendorfer 2003), acoustic monitoring (Simpfendorfer, unpublished data; Poulakis, unpublished data), public encounter databases (Seitz and Poulakis 2002; Poulakis and Seitz 2004; Simpfendorfer and Wiley 2005a), and satellite archival tagging (Simpfendorfer and Wiley 2005b). The majority of this research has been targeted at juvenile sawfish, but some information on adult habitat use has also been obtained.

General habitat use observations

Encounter databases have provided some general insight into the habitat use patterns of smalltooth sawfish. Poulakis and Seitz (2004) reported that where the substrate type of encounters was known 61% were on mud, 11% on sand, 10% seagrass, 7% limestone, 4% rock, 4% coral reef, and 2% sponge. Simpfendorfer and Wiley (2005a) reported closer associations between encounters and mangroves, seagrasses, and the shoreline than expected at random. Encounter data have also demonstrated that

smaller smalltooth sawfish occur in shallower water, and larger sawfish occur regularly at depths greater than 32 ft (10 m). Poulakis and Seitz (2004) reported that almost all of the sawfish <10 ft (3 m) in length were found in water less than 32 ft (10 m) deep and 46% of encounters with sawfish >10 ft (3 m) in Florida Bay and the Florida Keys occurred at depths between 200 to 400 ft (70 to 122 m). Simpfendorfer and Wiley (2005a) also reported a substantial number of larger sawfish in depths greater than 32 ft (10 m). They demonstrated a statistically significant relationship between the estimated size of sawfish and depth (Figure 4), with smaller sawfish on average occurring in shallower waters than large sawfish.

Encounter data has also identified river mouths as areas where many people observe sawfish. Seitz and Poulakis (2002) noted that many of the encounters occurred at or near river mouths in southwest Florida. Simpfendorfer and Wiley (2005a) reported a similar pattern of distribution along the entire west coast of Florida. It is unclear whether this observation represents a preference for river mouths because of physical characteristics (e.g., salinity) or habitat (e.g., mangroves or prey) factors or both.

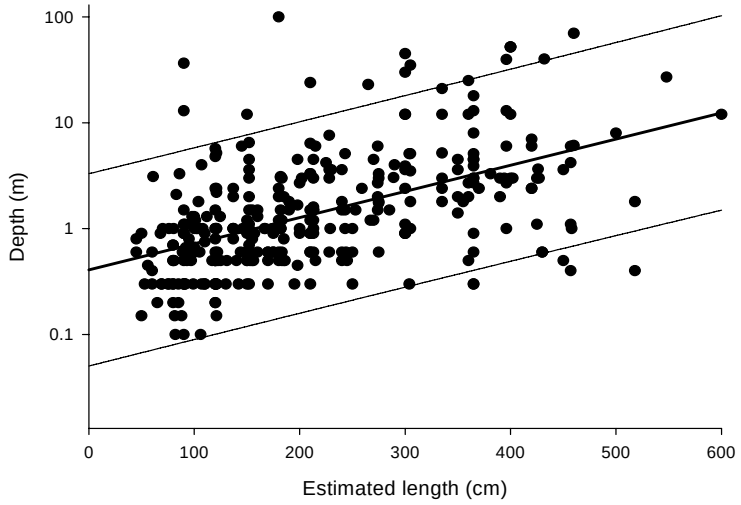

Figure 4. Relationship Between Estimated Sawfish Size and Depth of Encounter. Upper and lower lines represent 95% confidence intervals. From Simpfendorfer and Wiley (2005a).

Juvenile habitat use

Very small juveniles < 39 in (100 cm)

Very small sawfish are those that are less than 39 in (100 cm), and are young-of-the-year. Like all elasmobranchs of this age they are likely to experience relatively high levels of mortality due to factors such as predation (Heupel and Simpfendorfer 2002) and starvation (Lowe 2002). Many elasmobranchs utilize specific nursery areas that have reduced numbers of predators and abundant food resources (Simpfendorfer and Milward 1993). Acoustic tracking results for very small smalltooth sawfish indicate that shallow depths and red mangrove root systems are potentially important in helping them avoid predators (Simpfendorfer 2003). At this size smalltooth sawfish spend the vast majority of their time on shallow mud or sand banks that are less than 1 ft (30 cm) deep. Since water depth on these banks varies with the tide, the movement of the very small sawfish appears to be directed towards remaining in shallow water. It is hypothesized that by staying in these very shallow areas the sawfish restrict the access of their predators (mostly sharks) and so increase survival. The dorso-ventrally compressed body

shape helps them in inhabiting these shallow areas, and they can often be observed swimming in only a few inches of water.

The use of red mangrove prop root habitat is also likely to aid very small sawfish in avoiding predators. Simpfendorfer (2003) observed very small sawfish moving into prop root habitats when shallow habitats were less available (especially at high tide). One small animal tracked over three days moved into a small mangrove creek on high tides when the mud bank on which it spent low tide periods was inundated at depths greater than 1 ft (30 cm). While in this creek it moved into areas with high prop root density. The complexity of the prop root habitat is likely to restrict the access of predators and so protect the sawfish.

Very small sawfish show high levels of site fidelity, at least over periods of days and potentially for much longer. Acoustic tracking studies have shown that at this size sawfish will remain associated with the same mud bank over periods of several days. These banks are often very small and daily home range sizes can be of the magnitude of 100 – 1000 m^2 (Simpfendorfer 2003). The longer-term fidelity to these sites, however, is poorly understood and there is some suggestion from acoustic monitoring data that these sawfish move to different locations (probably with the same habitat characteristics) after periods of residency from a few weeks to a few months (Simpfendorfer unpublished data).

Small juveniles 39-79 in (100 - 200 cm)

Small juveniles have many of the same habitat use characteristics seen in the very small sawfish. Their association with very shallow water (< 1 ft deep) is weaker, possibly because they are better suited to predator avoidance due to their larger size and greater experience. They do still have a preference for shallow water, remaining in depths mostly less than 3ft (90 cm). They will, however, move into deeper areas at times. One small sawfish acoustically tracked in the Caloosahatchee River spent the majority of its time in the shallow waters near the riverbank, but for a period of a few hours it moved into water 4-6 ft deep (Simpfendorfer 2003). During this time it was constantly swimming, a stark contrast to active periods in shallow water that lasted only a few minutes before resting on the bottom for long periods.

Site fidelity has been studied in more detail in small sawfish. Several sawfish approximately 59 in (150 cm) in length fitted with acoustic tags have been relocated in the same general areas over periods of several months, suggesting a high level of site fidelity (Simpfendorfer 2003). The daily home ranges of these animals are considerably larger (1 - 5 km^2) than for the very small sawfish and there is less overlap in home ranges between days. The recent implementation of acoustic monitoring systems to study the longer term site fidelity of sawfish has confirmed these observations, and also identified that changes in environmental conditions (especially salinity) may be important in driving changes in local distribution and, therefore, habitat use patterns (Simpfendorfer, unpublished data).

Large juveniles >79 in (200cm)

There is little data on the habitat use patterns of large juvenile sawfish. No acoustic telemetry or acoustic monitoring studies have examined this size group. Thus there is no detailed tracking data to identify habitat use and preference. However, some data are available from the deployment of pop-up archival transmitting (PAT) tags. These tags record depth, temperature and light data which is stored on the tag until it detaches from the animal, floats to the surface and sends data summaries back via the ARGOS satellite system. More detailed data can be obtained if the tag is recovered. A PAT tag deployed on a 79 in (200 cm) sawfish in the Marquesas Keys collected 120 days of data. The light data indicated that the animal had remained in the general vicinity of the outer Keys (more detailed location data is not available) for this entire period. Depth data from the tag indicated that this animal remained in depths less than 17 ft (5 m) for the majority of this period, making only two excursions to water up to 50 ft (15 m) (Figure 5). There is no information on site fidelity in this size class of sawfish. More data is needed from large juveniles before conclusions about their habitat use and preferences can be made.

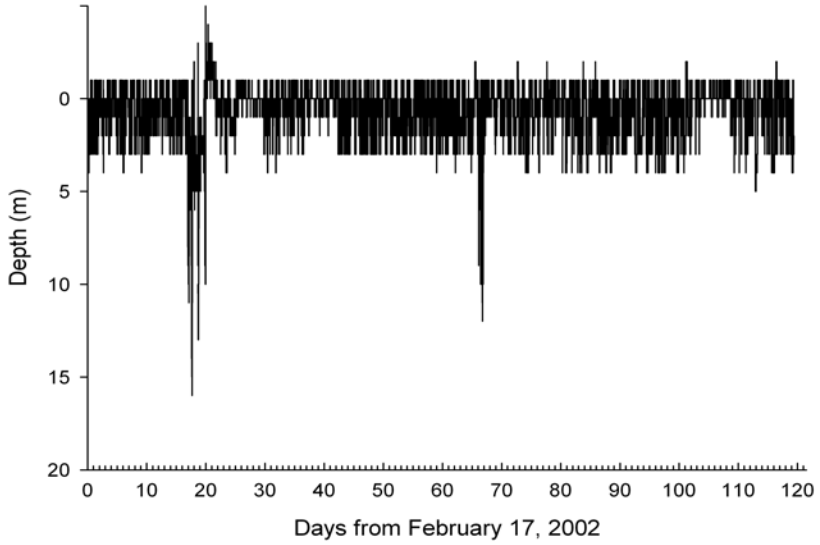

Figure 5. Depth Track of a 79 in (200 cm) Sawfish Tagged at the Marquesas Keys on February 17, 2002 with a Wildlife Computers PAT tag. From Simpfendorfer and Wiley (2005b).

Adult habitat use

Information on the habitat use of adult smalltooth sawfish comes from encounter data, observers on board fishing vessels and from PAT tags. The encounter data suggests that adult sawfish occur from shallow coastal waters to deeper shelf waters. Poulakis and Seitz (2004) observed that nearly half of the encounters with adult-sized sawfish in Florida Bay and the Florida Keys occurred in depths from 200 to 400 ft (70 to 122 m). Simpfendorfer and Wiley (2005a) also reported encounters in deeper water off the Florida Keys, noting that these were mostly reported during winter. Observations on commercial longline fishing vessels and fishery independent sampling in the Florida Straits report large sawfish in depths up to 130 ft (~40 meters) (Carlson and Burgess, unpublished data). There is little information on the habitat use patterns of the adults from the encounter data.

PAT tags have been successfully deployed on several sawfish and have provided some data on movements and habitat use. One large mature female was fitted with a tag near East Cape Sable in November 2001. The tag detached from this animal 60 days later near the Marquesas Keys, a straight-line distance of 80 nautical miles (148 km). The data from this tag indicated that it was most likely to have traveled across Florida Bay to the Florida Keys and then along the island chain until it reached the outer Keys. The depth data indicated that it spent most of its time at depths less than 30 ft (10 m), but that once it arrived in the outer Keys it made excursions (1-2 days) into water as deep as 180 ft (60 m).

There is limited data available on the site fidelity of adult sawfish. Seitz and Poulakis (2002) reported that one adult-sized animal with a broken rostrum was captured in the same location over a period of a month near Big Carlos Pass suggesting that they may have some level of site fidelity for relatively short periods. However, the occurrence of seasonal migrations along the U.S. east coast also suggests that adults may be more nomadic than the juveniles with their distribution controlled, at least in part, by water temperatures.

D. Critical Habitat

NMFS stated in the smalltooth sawfish listing document (68 FR 15674; April 1, 2003) that critical habitat for the species was not determinable at the time of listing. NMFS also stated the need to continue ongoing research to determine the habitat use requirements of smalltooth sawfish, and in particular to attempt to identify smalltooth sawfish nursery and breeding areas. NMFS proposed critical habitat on November 20, 2008, The final critical habitat rule will be submitted for publication by September 1, 2009, in accordance with a settlement agreement.

E. Life History

1. Age and growth

Smalltooth sawfish are approximately 31 in. (80 cm) long at birth (Simpfendorfer 2002) and may grow to a length of 18 feet (540 cm) or greater (Bigelow and Schroeder 1953). Individuals have been maintained in public aquaria for up to 20 yrs (Cerkleski pers. comm. 2000). To date, no formal studies on the age and growth of wild smalltooth sawfish have been conducted. However, the rate of growth of captive smalltooth sawfish has been reported. Bohoroquez (2001) reported three specimens in Colombia grew at an average rate of 7.7 in per year (19.6 cm) [the three animals grew from 33 in to 126 in (84 cm to 320 cm) in 12 years]. In a more comprehensive study, Clark *et al*. (2004) reported growth rates of 16 captive smalltooth sawfish in North American aquaria. They reported an average growth rate of 13.9 cm per year for animals ranging in size from 31 in to 162 in (80 cm to 412 cm). Using a maximum likelihood method they estimated von Bertalanffy growth parameters of L_∞ = 413 cm, K = 0.067 per year and t_0 = -2.76 per year. Apart from captive animals, little is known of the age parameters (age specific growth rates, age at maturity, and maximum age). Simpfendorfer (2000) estimated age at maturity between 10 and 20 years, and a maximum age of 30 to 60 yr. Unpublished data from Mote Marine Laboratory indicates male smalltooth sawfish do not reach maturity until at least 340 cm total length. Based on their growth parameters, Clark *et al*. (2004) estimated an age at maturity of 19 yr for males and 33 yr for females. The limited data from other sawfish species supports these magnitudes of values for age and growth parameters. For example, Tanaka (1991) estimated growth of *Pristis microdon* of 7 in per year (18 cm) for juveniles, a maximum age of 44 yrs, and growth coefficients (K) of 0.047-0.066 per year. A recent study by Simpfendorfer *et al*. (2008) suggests rapid juvenile growth for smalltooth sawfish for the first two years after birth.

2. Diet and feeding behavior

Bigelow and Schroeder (1953) reported that sawfish in general subsist chiefly on small schooling fish, such as mullets and clupeids. Bigelow and Schroeder also reported that they feed to some extent on crustaceans and other bottom dwelling inhabitants. Breder (1952), in summarizing the literature on observations of sawfish feeding behavior, noted that they attack fish by slashing sideways through schools, and often impale the fish on their rostral teeth. These are subsequently scraped off the teeth by rubbing them on the bottom and then ingested whole. The oral teeth of sawfish are ray-like, having flattened cusps that are better suited to crushing or gripping. The literature also contains reports that the saw is used as a defensive weapon. This has led some authors to suggest a more offensive weapon, with sawfish battling with their saws. Such behavior is unlikely, and as Norman and Fraser (1937) noted, “the saw may occasionally be used as a defensive weapon, but as a general rule its purpose is to obtain food.”

3. Reproductive biology

As in all elasmobranchs, fertilization in smalltooth sawfish is internal. Development in sawfish is believed to be ovoviviparous. The embryos of smalltooth sawfish, while still bearing the large yolk sac, already resemble adults relative to the position of their fins and absence of the lower caudal lobe. During embryonic development the rostral blade is soft and flexible. The rostral teeth are also encapsulated or enclosed in a sheath until birth. Shortly after birth, the teeth become exposed and attain their full size proportionate to the size of the saw. The size at birth is approximately 31 in (80 cm), with the smallest

free-living specimens reported during field studies in Florida being 30 – 33 in (69 - 84 cm) (Simpfendorfer *et al* (2008)). Bigelow and Schroeder (1953) reported gravid females carry 15-20 embryos. However, the source of their data is unclear and may represent an over-estimate of litter size. Studies of largetooth sawfish in Lake Nicaragua (Thorson 1976) report brood sizes of 1-13 individuals, with a mean of 7.3 individuals. The gestation period for largetooth sawfish is approximately 5 months and females likely produce litters every second year. Although there are no such studies on smalltooth sawfish, its similarity to the largetooth sawfish implies that their reproductive biology may be similar.

4. Life history limitations

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 as 0.08 to 0.13 per year and population doubling times from 5.4 years to 8.5 years. These low intrinsic rates of population increase are associated with the life history strategy known as "k-selection." K-selected animals are usually successful at maintaining relatively small, persistent population sizes in relatively constant environments. Consequently, they are not able to respond effectively (rapidly) to additional and new sources of mortality resulting from changes in their environment. Musick (1999) and Musick *et al*. (2000) noted that intrinsic rates of increase less than ten percent were low, and such species are particularly vulnerable to excessive mortalities and rapid population declines, after which recovery may take decades. As such, smalltooth sawfish populations will recover slowly from depletion, confounding recovery efforts. Simpfendorfer (2000) concluded that recovery was likely to take decades or longer depending on how effectively sawfish could be protected.

F. Abundance and Trends

1. Abundance

Section 1.C. of this plan, Distribution and Habitat Use, documents the general observations of sawfish abundance in four regions of the U.S. east coast and Gulf of Mexico. That sawfish were once common inhabitants of most of these areas is clear from these descriptions. It is also clear that the abundance of smalltooth sawfish in U.S. waters has decreased dramatically over the past century. There is currently no estimate of smalltooth sawfish abundance.

2. Trends in abundance

There are few long-term abundance data sets that include smalltooth sawfish. One data set from shrimp trawlers off Louisiana from the late 1940s through the 1970s (Figure 6) suggests a rapid decline in the species from the period 1950-1964. However, this data set has not been validated nor subjected to statistical analysis to correct for factors unrelated to abundance.

The Everglades National Park has established a fisheries monitoring program based on sport fisher dock-side interviews since 1972 (Schmidt *et al*. 2000). An analysis of these data using a log-normal generalized linear model to correct for factors unrelated to abundance (e.g., change in fishing practices) indicate a slight increasing trend in abundance for smalltooth sawfish in the ENP in the past decade (Carlson *et al*. 2007). From 1989-2004, smalltooth sawfish relative abundance increased by about 5% per year (Figure 7).

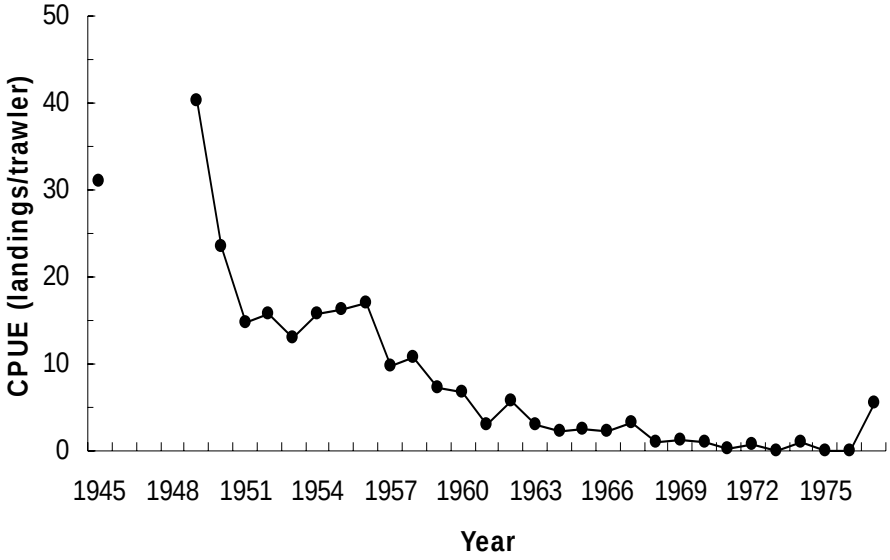

Figure 6. Mean Annual Landing of Sawfish per Trawler in Louisiana Waters. From Simpfendorfer (2002).

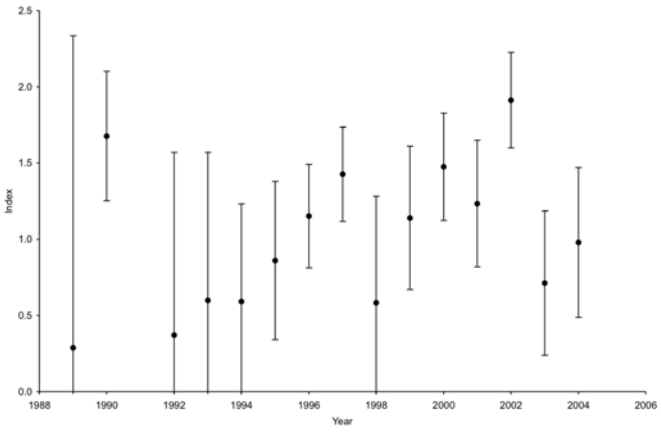

Figure 7. Standardized Relative Abundance of Smalltooth Sawfish Caught by Anglers in the Everglades National Park. Vertical bars represent the coefficient of variation. (From Carlson *et al*., 2007).

G. Listing/Delisting Factors: Threats Assessment

As part of the recovery planning process, threats comprising the listing factors leading to the species' endangered status have been assessed with regard to their geographic extent, severity, life stage affected, and responsiveness to management. A threats assessment includes consideration of both natural and

human threats, which can result from either intentional or unintentional actions. The current or potential severity of each threat on the species is affected by a variety of characteristics of that threat including the immediate or long-term impact on the species (e.g., whether the threat is lethal or adds some stress to the species), the geographic extent of the threat (i.e., how many populations are affected by the threat) and the consideration of the specific life stage(s) affected by that threat. Generally, the greater the geographic extent of a threat, the higher the concern with that specific threat, and the later in life that a threat impacts the species, the greater the effect to the persistence and recovery of the species overall. However, there are exceptions to both of these cases.

An assessment of an individual threat not only includes consideration of its severity, but also the responsiveness of that threat to potential management actions and the feasibility of implementing those actions. While there may be concern with a particular threat to a species, if there are no effective measures that can be implemented to minimize or mitigate that threat, then abatement of this threat may not be a high priority recovery action. The ability to implement management actions to address a threat and the likelihood that those actions will be effective are critical considerations when formulating a strategy for the recovery of a listed species.

An assessment of threats must also recognize the interrelationship among various threats. There may be synergistic effects that must be taken into consideration. For example, alteration of freshwater flow leads to greater impacts on juvenile development as well as habitat degradation, resulting in more of a significant threat to the species. Evaluation of the individual threats in isolation may lead to an underestimate of their impact on smalltooth sawfish. Attention needs to be paid to cumulative impacts of threats or interrelationships between threats in order to ensure an accurate assessment.

Table 1 lists the source of threat/stress and the associated listing factor for each threat/stress identified for the smalltooth sawfish, as determined by the SSRT. The table also identifies the severity and restoration feasibility for each threat. Following the threats tables is a narrative that describes many of these threats in more detail. This narrative is largely based on the work of the Status Review Team.

Table 1: Threats assessment for smalltooth sawfish. The listing factors are listed in the Listing History section of this document. The threats listed in the table include those identified at the time of listing and current threats. The threat score was determined by assigning a value to both the severity and restoration feasibility (low-1, medium-2, and high-3) and summing. Higher score values indicate potential priority threats (i.e. those that pose the greatest risk to the population and can be mitigated effectively). The threats associated with fishing have higher scores because they may occur more frequently and their effects can be lethal. All threats have a component that addresses listing factor 4--inadequacy of existing regulatory mechanisms.

Threat/Stress	Listing Factor	Source of Threat/Stress	Severity	Restoration feasibility	Score	Comments
Fisheries interactions						
Injury from hooking/longline gear entanglement	2	Longline fisheries	Medium	High	5	Mitigation: education, dehookers, gear cutters, corrodible hooks, closed areas, safe handling and release guidelines, etc.
Injury from trawl entanglement	2	Shrimp trawl fisheries	High	Medium	5	Mitigation: time/area closures, education, tow times, observer information
Injury from drift gillnet entanglement	2	Drift gillnet fishery	Low	High	4	Mitigation: very small fishery, low interaction as nets not on bottom, has good observer coverage
Injury from entanglement in bottom gillnets	2	Bottom gillnet fisheries	Medium	Medium	4	Already ban in most states through historic range (esp. Florida), still gillnets in federal waters off parts of Florida and some other states (e.g. ocean shad)
Injury from entanglement in cast nets	2	Castnetting (recreational and commercial)	Low	High	4	Education on safe release
Injury from entanglement in trap float lines	2	Blue crab, stone crab and lobster trap fisheries	Low	High	4	Education on safe release
Injury from hooking/hook and line entanglement	2	Commercial hook and line fishery	Low	High	4	See longline, observer information needed
Injury from hooking/hook and line entanglement	2	Recreational hook and line fishery	Medium	High	5	Education

Threat/Stress	Listing Factor	Source of Threat/Stress	Severity	Restoration feasibility	Score	Comments
Direct Injury or Disturbance						
Injury or mortality from saw removal	2	All fisheries; curio demand; release technique	Low	Medium	3	Education (esp. safe release), enforcement, marketing prohibition
Loss to the population by aquarium collecting	2	Aquarium collection	Low	High	4	Already banned; monitoring and enforcement
Injury during capture and handling during collection	2	Fishing; scientific monitoring and research; aquarium collection	Low	Medium	3	Targeted research and monitoring covered by permitting; research providing data on safe handling, etc.; non-target research needs education
Disturbance of natural behavior	5	Divers, other marine activities	Low	Medium	3	Harassment – violation of "personal space," needs education
Habitat						
Loss of juvenile habitat	1,3	Destruction of mangroves	High	Medium	5	Increased risk of predation, reduced food supply, reduced survival
Loss of juvenile habitat	1	Dredge and fill	Medium	Medium	4	Juvenile preference for very shallow habitats
Alteration of freshwater flow	1	CERP, Lake Okeechobee releases, water management district policies	Medium	Medium	4	Juveniles prefer estuarine salinities, occur at river mouths
Loss of adult habitat	1	Loss of reefs, trawl modification of habitat	Low	Medium	3	Poorly understood and needs more research
Pollution						
Reduction in reproductive output	1	Point source pollution	Unknown	Low	?	Evidence from other elasmobranchs of endocrine disruption

Threat/Stress	Listing Factor	Source of Threat/Stress	Severity	Restoration feasibility	Score	Comments
Compromised health	1	Warm water discharge from power stations	Low	Low	2	Entrainment in warm water discharge areas that precludes natural movement patterns; indirect evidence based on effects from bull sharks; many records from power station discharges; low feasibility due to manatee regulations
Mortality in fish kill events	1,5	Point and Non-point source pollution	Low	Low	2	Algal blooms, decreased water clarity, red tides, fish kills, low oxygen
Injury from entanglement in marine debris	5	Marine debris; maritime traffic	Medium	Low	3	Discarded fishing gear (e.g. ghost gear, monofilament), trash (e.g. 6-pack holders, PVC pipe, bait box straps, coffee cans, plastic); low because already lots of education and low success

1. Present or threatened destruction, modification, or curtailment of habitat or range

The principal habitats for juvenile smalltooth sawfish in the southeast U.S. are the shallow coastal areas and estuaries, with some specimens moving upriver in freshwater (Bigelow and Schroeder 1953). The continued urbanization of the southeastern coastal states has resulted in substantial loss or modification of these coastal habitats. Activities such as agricultural and urban development, commercial activities, dredge and fill operations, boating, erosion, and diversions of freshwater run-off contribute to these losses [South Atlantic Fisheries Management Council, (SAFMC) 1998]. Loss and degradation of habitat have contributed to the decline of many marine species and are believed but not confirmed to have affected the distribution and abundance of smalltooth sawfish. Smalltooth sawfish remain in the U.S. today typically in protected or sparsely populated areas of the southern tip of Florida (see Distribution and Abundance section); the only known exception is a documented nursery area in the Caloosahatchee River in an area of waterfront residences and seawalls. Smalltooth sawfish may be especially vulnerable to coastal habitat degradation due to their affinity for shallow estuarine systems. Long-term commitments to habitat protection are necessary for the eventual recovery and conservation of the species.

The following subsections review the impacts of agricultural and urban development, commercial activities, dredge and fill operations, boating, erosion, and diversions of freshwater run-off on shallow coastal areas and habitats inhabited (or previously inhabited) by smalltooth sawfish.

Agriculture

Agricultural activities convert wetlands, and shed nutrient, pesticide, and sediment-laden runoff. These in turn lead to excessive eutrophication, hypoxia, increased sedimentation and turbidity, stimulation of hazardous algal blooms, and delivery of chemical pollutants (SAFMC 1998). Freshwater wetlands associated with southeastern rivers have been extensively converted to agriculture or degraded by flood control and diversion projects in support of agriculture. Likewise, coastal wetlands have been converted to agricultural fields and degraded by flow alterations linked to agriculture. Agriculture is the single largest contributor of nutrients in southeastern watersheds (SAFMC 1998). Animal wastes and fertilizers are the largest sources of non-point source nutrient loading (USGS 1997). Agricultural non-point discharges are responsible for the introduction of a wide range of toxic chemicals into habitats important to smalltooth sawfish (Scott 1997). Even areas not immediately adjacent to agricultural areas can be affected by these activities. For example, all of Florida Bay has undergone biological, chemical, and physical change due to large scale agricultural practices and hydrologic modifications in the Everglades (Fourqurean and Robblee 1999).

Urban development

Urban development in the southeast coastal zone is more than four times the national average (Chambers 1992). Threats from development include loss of wetlands, point and non-point sources of toxins, eutrophication, and hydrologic modification. A major concern is the destruction of wetlands by filling for urban and suburban development (SAFMC 1998). In addition, seawalls and canals for waterfront homes have replaced marsh and mangrove intertidal shorelines and shallow estuarine waters. Of particular concern are sawfish habitats in places such as the Indian River Lagoon (Gilmore 1995), where the species was once abundant, but now appears to have been extirpated (Snelson and Williams 1981). Many of the wetland habitats in the Indian River Lagoon were impounded for mosquito control (Brockmeyer *et al*. 1997), and the effects of these alterations on the smalltooth sawfish there are unknown.

Commercial activities

Commercial development affects sawfish habitat in many ways. Loss of wetlands, non-point and point sources of pollution, and atmospheric deposition of industrial emissions are major impacts of commercial activities (SAFMC 1998). There is evidence from other elasmobranchs that pollution disrupts endocrine systems and potentially leads to reproductive failure (Gelsleichter et al. 2006). Sawfish may also alter seasonal migration patterns in response to warm water discharges from power stations (Simpfendorfer and Wiley 2005a). The total amount of marine and estuarine fish habitat eliminated and degraded by commercial activities in the southeast is unknown but substantial (SAFMC 1998). In Florida, between 1943 and 1970, approximately 10,000 ha of this habitat were lost due to dredge fill and other activities related to accommodating the increasing human population. While loss of mangrove ecosystems throughout Florida is not overwhelming, losses at specific locations have been substantial (Odum *et al*. 1982). Direct destruction of mangrove habitat is no longer allowed without a permit, but indirect damage to mangrove habitat from increased urbanization and the resulting overall habitat degradation still occurs. Given the documented losses that occurred during early developmental phases in Florida (1940-1970), it can only be assumed that, over the last 30 years, those losses have continued, and that the amount of available mangrove habitat is less than documented by these older studies. Between 1956 and 1978, about 875 square miles of marsh were lost along Louisiana's coast, mostly through subsidence, rising sea level, and oil and gas canals which cumulatively resulted in conversion of wetlands to open water. During those years, another 1,234 square miles of Louisiana coastal lands have been converted to agricultural, urban, or industrial uses (Boesch *et al*. 1994). The smalltooth sawfish's decline may be in part attributable to these habitat losses.

Channel dredging
Riverine, nearshore, and offshore areas are dredged for navigation, construction of infrastructure, and marine mining. The total environmental impact of dredging in the southeast is unknown, "but undoubtedly great" (SAFMC 1998). An analysis of 18 major southeastern estuaries (Orlando *et al*. 1994) recorded over 703 miles of navigation channels and 9,844 miles of shoreline modifications. 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 (SAFMC 1998). Cumulatively, these effects have degraded habitat areas for smalltooth sawfish.

Boating activities
Several environmental impacts have been associated with boating activities. These include pollutants associated with boat use and maintenance; pollutants carried by stormwater runoff from marinas; boating support facilities; and physical alteration and destruction of estuarine and marine habitats by boat propellers and dredging for navigation. Boat registrations have increased dramatically in Florida, and new boat designs allow ever faster boats to use ever shallower waters.

Modification of freshwater flows
Modifications of natural freshwater flows into estuarine and marine waters through construction of canals and other controlled devices have changed temperature, salinity, and nutrient regimes; reduced both wetlands and submerged aquatic vegetation; and degraded vast areas of coastal habitat (Gilmore 1995; Reddering 1988; Whitfield and Bruton 1989). Profound impacts to hydrological regimes have been produced in South Florida through the construction of a 1,400 mile network of canals, levees, locks, and other water control structures which modulate freshwater flow from Lake Okeechobee, the Everglades, and other coastal areas (Serafy *et al*. 1997). The Comprehensive Everglades Restoration Project (CERP) is a major reconstruction project jointly led by the Army Corps of Engineers (COE) and the South Florida Water Management District (SFWMD), which has the potential to restore habitats and hydrological regimes in South Florida. Of particular concern is Biscayne Bay (Serafy *et al*. 1997), Florida Bay, the Ten Thousand Islands (Fourqurean and Robblee 1999), and Charlotte Harbor – areas most affected by discharge through the Everglades. Three of these four areas support the last remaining populations of smalltooth sawfish in U.S. waters (Seitz and Poulakis 2002; Poulakis and Seitz 2004; Simpfendorfer and Wiley 2005a).

2. Over-utilization for commercial, recreational, scientific, or educational purposes
Commercial fisheries
Historically, smalltooth sawfish were often bycatch in various fishing gears, including otter trawl, trammel net, seine, and, to a lesser degree, hand line. Reports of smalltooth sawfish becoming entangled in fishing nets are common in early literature from areas where smalltooth sawfish were once common, but are now rare, if not extirpated. Henshall (1895) described smalltooth sawfish as being common along both coasts of Florida and noted that the smalltooth sawfish "does considerable damage to turtle nets and other set nets by becoming entangled in the meshes and is capable of inflicting severe wounds with its saw, if interfered with." Henshall further reported that smalltooth sawfish were always killed by fishermen when captured because of this problem. Evermann and Bean (1898) noted that smalltooth sawfish were an abundant, permanent resident in the Indian River Lagoon (IRL) on the east coast of Florida and also noted that they did considerable damage to fishing gear by becoming entangled in nets: "The larger smalltooth sawfish tore or cut the nets, while the smaller individuals became entangled and were difficult to remove." Large catches of smalltooth sawfish occurred sporadically; one fisherman interviewed by Evermann and Bean reported taking an estimated 300 smalltooth sawfish in just one netting season on the IRL. Smalltooth sawfish are now nearly extirpated from the IRL (Snelson and Williams, 1981; Schmid *et al*. 1988) with only a few recent records (Simpfendorfer and Wiley 2005a).

Snelson and Williams (1981) attributed the loss of smalltooth sawfish in the IRL to heavy mortality associated with incidental captures by commercial fishermen. Baughman (1943) discussed, documented, and reported accounts of smalltooth sawfish being taken in shrimp trawls along the Texas coast. Bigelow and Schroeder (1953), who described smalltooth sawfish as "plentiful in Florida waters," noted they were of "considerable concern to fishermen as nuisances because of the damage they do to drift- and turtle-nets, to seines, and to shrimp trawls in which they often become entangled and because of the difficulty of disentangling them without being injured by their saws."

Large-scale directed fisheries for smalltooth sawfish have not existed; however, sawfish bycatch has been documented in commercial landings in various regions, with the greatest amount of data available from Louisiana (this does not mean the greatest catches were made in Louisiana, just that this is where the best records were kept). The majority of the documented landings of smalltooth sawfish were from otter trawl fisheries (categorized as other, shrimp, or fish). There were also landings from trammel nets, beach haul seines, pelagic longlines, cast nets, trap float lines, and hand lines. Total Gulf of Mexico landings dropped continually from 1950 to 1978 from around 5 metric tons to less than 0.2 metric tons during this time period. NMFS does not have any records of landings since 1978. Simpfendorfer (2002) extracted a data set from "Fisheries Statistics of the United States," taken from 1945-1978, of smalltooth sawfish landings in Louisiana by shrimp trawlers (See Figure 6). The data set contains both landings data and crude information on effort (number of vessels, vessel tonnage, number of gear units). Smalltooth sawfish landings in Louisiana reported over time declined from a high of 34,900 lbs in 1949 to less than 1,500 lbs in most years after 1967. Drastic reductions in Louisiana waters are demonstrated by the lack of landings since 1978. Anecdotal information collected by NMFS port agents indicates that smalltooth sawfish are now taken very rarely in the shrimp trawl fishery. The most recent records from Texas are from the 1980s. Smalltooth sawfish are still occasionally documented in shrimp trawls in Florida, with four reports in the 1990s.

Smalltooth sawfish are also taken in various federal shark fisheries. Two fisheries identified as incidentally capturing sawfish are the shark drift gillnet fishery and shark bottom longline fishery (NMFS Highly Migratory Species [HMS] Biological Opinion [BiOp] 2003). Interactions with smalltooth sawfish have been recorded by observers onboard fishing vessels in the South Atlantic region targeting shark with bottom longline gear. Interactions are low, no more than four in any one year for bottom longline gear and one interaction observed in the shark drift net fishery in 2003.

As previously mentioned, the long, toothed rostrum of the smalltooth sawfish causes this species to be particularly vulnerable to both gear types. The large mesh size used to catch sharks allows the saw to easily penetrate through nets, causing the animal to become entangled when it attempts to escape. The toothed saw makes it difficult to easily remove the fishing gear without causing mortal damage to the animal, or damaging gear. Entangled specimens frequently have to be cut free, causing extensive damage to nets and presenting a substantial hazard if brought on board. When captured on longlines, the gangion frequently becomes wrapped around the animal's saw (G. Burgess, pers. comm.). This may be due to slashing during the fight, from spinning on the line, or any other action that brings the rostrum in contact with the line. Information on the post-release effects (long- and short-term) of these interactions is unknown.

Recreational fisheries

Smalltooth sawfish have historically occurred as occasional bycatch in the hook-and-line recreational fishery (Caldwell 1990). Bigelow and Schroeder (1953) described sawfish as being "too sluggish to be held in any regard as game fish by anglers" and that "once hooked they swim so powerfully, though slowly and are so enduring, that the capture of a large one entails a long and often wearisome struggle." Based on the observations of Caldwell (1990), however, Bigelow and Schroeder may have been too quick

to disregard recreational fishing. In Texas, Caldwell (1990) stated that sport fishermen in the bays and surf prior to the 1960's took many sawfish incidentally. A few were retained and displayed as trophy fish, but most were released. Caldwell noted that the saws of smalltooth sawfish were consistently removed prior to their live release and marks this as one of the reasons for their decline. Since completion of the status review, a substantial amount of data has been collected from recreational fisheries (Seitz and Poulakis 2002; Poulakis and Seitz 2004; Simpfendorfer and Wiley 2005a). These data indicate that smalltooth sawfish are still taken as bycatch, mostly by shark, red drum, snook, and tarpon fishers. There are no studies on post-release mortality, but mortality is probably low. Expanding and continuing education of anglers regarding the status of the smalltooth sawfish may help to minimize any negative effects of the recreational fishery on the sawfish population. Today, recreational catches of sawfish are rare and poorly documented for the most part, except within the ENP. Surveys in the ENP indicate that a sustaining population still exists there, with consistent annual catches by private recreational anglers and guide boats. Possession of smalltooth sawfish has been prohibited in Florida since April 1992. The records in the angler survey database indicate that only one sawfish was kept; this record was from 1990. There were 14 smalltooth sawfish recorded as kept in the guide survey database; one in 1991, one in 1992, and twelve in 1997.

Commercial trade

Information regarding the direct commercial utilization of smalltooth sawfish has been limited. Recently, McDavitt (2005) reviewed the information related to the commercial trade in sawfish, including the smalltooth sawfish. He identified two forms of trade – whole live sawfish for the aquarium trade and sawfish parts derived mostly from sawfish captured as bycatch in fisheries. Issues related to the aquarium trade are covered in the next section. The parts of sawfish that McDavitt (2005) identified in trade were:

- Fins. The fins of sawfish are used to produce shark fin soup. Sawfish fins are highly favored in Asian markets and are some of the most valuable shark fins. Demand for sawfish fins is high..

- Whole rostra (saws). Sawfish rostra are often traded as curios, ceremonial weapons, or for use in traditional medicines. Their trade as ceremonial weapons is focused in Asia; McDavitt (2005) reported that demand is currently outstripping supply, resulting in replica rostra becoming available. The prices of large rostra can reach several thousand dollars, given their current rarity. Some smalltooth rostra have been traded online in recent years, but most appear to be antiques captured many years previously. However, there has been some trade in recently caught sawfish rostra, mostly out of Australia. In January 2006, eBay responded to conservationists' requests and agreed to officially ban the sale of smalltooth sawfish parts and products on their on-line auction site in accordance with eBay's wildlife policies. Because of the similarity of appearance among sawfish species, this prohibition will require careful monitoring in order to be effective. The use of rostra in traditional medicine includes some use in China, Ethiopia, Mexico, and Brazil. There is no specific information on the trade of smalltooth sawfish rostra from the U.S. DPS.

- Rostral teeth. Rostral teeth are used and traded for use in cockfighting in Peru. The teeth are used as spurs that are strapped to the cock's legs. The teeth are obtained from South American and Caribbean countries and are likely to include smalltooth sawfish teeth. Whether any were historically sourced from the U.S. DPS is unknown. McDavitt (2005) estimated that if all the teeth from a rostrum were utilized they would be valued from $2000 to $7000. It is unclear if the use of rostral teeth in cockfighting extends beyond Peru, and how much demand there is for these products.

- Meat. Sawfish are regularly used for their meat; however, most of the consumption is local and so they appear to be only occasionally traded beyond local markets. Sawfish meat has been utilized historically in the U.S.; Romer (1936) reported that sawfish were the second most common elasmobranch species taken in the shark fishery in the Florida Keys during the 1930's.

- Organs. Chinese traditional medicine also uses other sawfish parts, including liver, ova and gall bladder. Sawfish liver has also been used as a source of liver oil. The fishery in the Florida Keys described by Romer (1936) used livers as a source of vitamin A. The use of livers as a source of vitamin A stopped during the 1940's when cheap synthetic forms became available. There are no data available on the trade in these parts for any species of sawfish.

- Skin. Sawfish skin has been used to produce leather, which, like shark leather, is considered of very high quality. The leather is used to make belts, boots, purses, and even to cover books. Although historically shark leather (including sawfish) was produced in the U.S., there is currently limited demand and little production. Tanneries in other countries, however, continue to produce shark leather, but the use of sawfish is unknown.

On the basis of these trade data, it appears that the commercial trade in smalltooth sawfish parts from the U.S. DPS is currently minimal due to their rarity. However, the demand for fins and saws provides a motivation to kill sawfish, a threat that will become increasingly significant as the population recovers.

Public display/aquarium trade
Sawfish have been exhibited in large public aquaria for over 50 years. Their large size, bizarre shape, and shark-like features have made them popular additions to shark aquaria exhibits worldwide. Currently, there are approximately 10 smalltooth sawfish in U.S. public aquaria, and all were originally captured in Florida. Since the ESA listing, NMFS has not granted any permits to take live smalltooth sawfish for public display. There has been some trade between institutions that house these sawfish, but no new specimens have been added. To meet the demand for sawfish for public display, U.S. aquaria have turned to suppliers in Australia who have supplied *Pristis microdon* and *P. zijsron*. At current prices these animals are estimated to be worth $1,600 to $1,800 per foot.

Scientific research
Scientific study of smalltooth sawfish has been sparse and has yet to pose a significant threat to the U.S. DPS. Current scientific studies are limited to a small number of researchers who carry out non-lethal research in the wild. All research carried out on smalltooth sawfish requires a permit from NMFS due to the protections afforded under the ESA. Other permits are also required for research on smalltooth sawfish (e.g., state agencies for work in state waters and protected area management agencies). Requests for sawfish research permits are carefully reviewed, and the effects of the research on the population are considered before issuance.

3. Disease or Predation
The final listing rule for the species did not determine that disease or predation was a causal listing factor. However, current data from acoustic monitoring, public encounter database data, and satellite archival tagging data indicate that small juveniles use red mangrove prop root habitat to avoid predators (see Habitat use section), and therefore indicate that predation, via habitat loss, is likely a threat to the species. Data are not available on predation of other size classes.

4. Inadequacy of Existing Regulatory Mechanisms

Numerous international, federal, state, and inter-jurisdictional laws, regulations and policies have the potential to affect the abundance and survival of smalltooth sawfish in U.S. waters. While many state measures may lead to overall environmental enhancements indirectly aiding smalltooth sawfish recovery, only a few state prohibitions have been applied specifically for the protection of smalltooth sawfish. National protections for smalltooth sawfish have been adopted in a few other countries, but the species remains completely unprotected in nations governing waters adjacent to the U.S. (such as Mexico, Cuba and the Bahamas). A summary of these fundamental laws, regulations, and policies is provided in Appendix C, followed by an assessment of their application to smalltooth sawfish and their potential to protect smalltooth sawfish from further decline. Figures 8 a-c identify most of the various state and federal marine protected areas located along Florida's coastline within the range of smalltooth sawfish.

5. Other Natural or Manmade Factors Affecting Its Continued Existence

Life history limitations

The current and future abundance of the smalltooth sawfish is limited by its life history characteristics and small population size. Smalltooth sawfish have slow growth, late maturity, a long life span, and a small brood size. These characteristics, combined, result in a very low intrinsic rate of population increase and are associated with the life history strategy known as "k-selection." K-selected animals are usually successful at maintaining relatively small, persistent population sizes in relatively constant environments. However, they are not able to sustain additional and new sources of mortality resulting from changes in their environment, such as overexploitation and habitat degradation (Musick 1999). Smalltooth sawfish have been subjected to both overexploitation (primarily bycatch but some limited directed fishing) and habitat degradation.

The intrinsic rate of population growth can be a useful parameter to estimate the capacity of species to withstand exploitation. Animals with low intrinsic rates of increase are particularly vulnerable to excessive mortality and rapid stock collapse, after which recovery may take decades. For example, rapid stock collapses have been documented for many elasmobranchs shown to have low intrinsic rates of increase, particularly larger species (Musick *et al*. 2000). Musick (1999) noted that intrinsic rates of increase less than 0.1 were low, and placed species at risk. Simpfendorfer (2000) used a demographic approach to estimate intrinsic rate of natural increase and population doubling time. Since there are very limited life history data for smalltooth sawfish, much of the data (e.g., reproductive periodicity, longevity, and age-at-maturity) were inferred from the more well-known largetooth sawfish. The results indicated that the intrinsic rate of population increase ranged from 0.08 - 0.13 yr -1, and population doubling times ranged from 5.4 yr to 8.5 yr. Simpfendorfer (2000) concluded that "recovery to levels where there is little risk of extinction will take at least several decades."

There are no firm estimates of the size of the remaining population, but all available evidence indicates that smalltooth sawfish survive today in small fragmented areas where the impact of humans, particularly from net fishing, has been less severe. The existence or development of separate subpopulations would increase the time that it takes for recovery since the demographic models used in the study above assume a single inter-breeding population. Another barrier to recovery from very small population size maybe deleterious effects of potential inbreeding. It is likely that even if an effective conservation plan can be introduced in the near future, recovery to a level where the risk of extinction is low will take decades, while recovery to pre-European settlement levels would probably take several centuries.

Marine pollution and debris

Because of their toothed rostra, smalltooth sawfish are susceptible to entanglement in a variety of marine pollution and debris. Examples include discarded fishing gear (e.g., monofilament line, braided line) and various cylindrical objects such as polyvinyl chloride pipe and elastic bands (Seitz and Poulakis 2006).

The impact of these types of interactions on the recovery of this species is unknown, but has the potential to be significant given the importance of coastal habitats to the species.

Stochastic events
Stochastic events such as red tides are common throughout the range of the 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 recovery of the species is unknown; however, they have the potential to impede recovery directly if animals die as a result.

H. Conservation Measures
Federal listing and protection for smalltooth sawfish under the ESA has bolstered previously promulgated protection for the species in Florida and Louisiana waters and has prompted protective state regulations in Alabama and Texas. The sawfish listing has also helped to stimulate awareness and research and monitoring activities throughout the region and in other parts of the world. Further protective action, studies, and outreach efforts are, however, still urgently needed in federal and state waters to ensure recovery of the species.

1. Awareness initiatives
Smalltooth sawfish were classified as "Endangered" worldwide and "Critically Endangered" in the western Atlantic on the 2000 IUCN Red List of Threatened Animals (IUCN 2000). All sawfish species were recently uplisted to "Critically Endangered" (IUCN 2006). The main purpose of the IUCN Red List is to catalogue and raise awareness of species that are threatened with extinction. The U.S. population of smalltooth sawfish was also listed as "endangered" (defined as being at "high risk of extinction in the near future") as part of an American Fisheries Society (AFS) 2000 review of North American marine fish stocks (Musick *et al*. 2000).

Information regarding the status of smalltooth sawfish and what the public can do to help the species is available on the following websites: NMFS[4], MML[5], The Ocean Conservancy[6], FWC[7], and the Florida Museum of Natural History[8]. Reliable sawfish information is also available at websites maintained by sawfish enthusiasts, Matthew McDavitt[9] and Jason Seitz[10]. These organizations and individuals also educate the public about sawfish status and conservation through regular presentations at various meetings and events.

2. Research and monitoring efforts
Research on smalltooth sawfish is contributing significantly to the development of conservation measures, with the increased knowledge being used to formulate management actions. Research efforts conducted under ESA section 10 permits are focused within a small group of agencies and organizations, including NMFS, ENP, MML, Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute (FWRI), and the Rookery Bay National Estuarine Research Reserve. Brief summaries of each organization's research and monitoring efforts are provided.

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[4] http://www.nmfs.noaa.gov/pr/species/fish/Smalltooth_sawfish.html
[5] http:// mote.org/sawfish
[6] http://www.oceanconservancy.org/site/PageServer?pagename=fw_sawfish
[7] http://research.myfwc.com/features/view_article.asp?id=26177
[8] http://www.flmnh.ufl.edu/fish/Gallery/Descript/STSawfish/STSawfish.html
[9] http://hometown.aol.com/nokogiri/page12.html
[10] http://www.floridasawfish.com/

National Marine Fisheries Service
NMFS' predecessor agencies, the U.S. Fish Commission and the Bureau of Commercial Fisheries, began collecting fisheries landings data in 1880. Landings data were collected during surveys of a limited number of states and years between 1880 and 1951. Comprehensive surveys of all coastal states have been conducted since 1951. Years, areas, and completeness of landings surveys prior to 1977 are listed in the publication, "Fisheries Statistics of the U.S., 1977." Subsequent publications have been annual. Recreational saltwater angling data have been collected through the Marine Recreational Fishery Statistics Survey (MRFSS) since 1979. The MRFSS is designed to provide regional and state-wide estimates of recreational catch for the entire spectrum of marine fish species in the Atlantic Ocean and Gulf of Mexico (from Maine to Louisiana; Texas is excluded). A query of MRFSS data from 1981 through August of 2000 for reports of smalltooth sawfish found only one. Research conducted by NMFS-Southeast Fisheries Science Center (in collaboration with Mote Marine Laboratory and University of Florida) is attempting to identify migration corridors and adult habitat using archival satellite pop-off tags.

Everglades National Park
The objectives of fisheries monitoring in ENP are to provide catch and effort data including catch/harvest rates (CPUE/HPUE), relative abundance, annual estimated total harvest and catch, age structure, total catch and harvest, and boating and fishing activity. Recreational fishers are interviewed at boat launch sites (Flamingo and Chokoloskee/Everglades City; Schmidt *et al*., 2000) upon completion of their trip. Data recorded includes area fished, fish kept and released, effort (in angler-hours), species preference, angler residence, and fish lengths. Professional guides must obtain an annual permit from the park and report their monthly catch and effort on a per trip basis via logbooks supplied with the permit. Prior to 1980, reporting was voluntary.

Mote Marine Laboratory
MML's Center for Shark Research is actively involved in research program on smalltooth sawfish. Ths research commenced in 1999 and is ongoing. The MML research team conducts a range of research activities that include longline surveys, tagging, acoustic tracking and monitoring, satellite telemetry, population modeling, genetics (in collaboration with Florida State University, Florida Fish and Wildlife Conservation Commission, Chicago Field Museum and NOVA Southeastern University), and the collection of public encounter data. The research activities are used to study habitat use, movement and migration patterns, abundance, distribution, population structure, life history parameters, effects of hurricanes, population dynamics, and more. MML's research is focused in Florida from Sarasota to the Keys. The results of this work have produced scientific publications, technical reports, and databases that have been used in the compilation of this recovery plan.

Florida Fish and Wildlife Conservation Commission
The FWRI (formerly Florida Marine Research Institute) is responsible for collecting a wide variety of estuarine and marine fisheries data for the State of Florida (e.g., stock assessments, life history, fisheries-dependent monitoring, fisheries-independent monitoring). Headquartered in St. Petersburg, the FWRI has seven field laboratories located in East Point, Cedar Key, Port Charlotte, Marathon, Tequesta, Melbourne, and Jacksonville, which conduct estuarine and marine research and monitoring activities in their regions. The fisheries sampling conducted statewide by the State of Florida has the potential to provide a significant amount of data on smalltooth sawfish, especially as recovery of the species progresses and sawfish move beyond their current south Florida range.

The FWC's Fisheries-Independent Monitoring (FIM) Program was initiated in 1989 and is an ongoing, long-term sampling program that monitors the relative abundance of fishery resources in Florida's major estuarine, coastal, and reef systems. FIM scientists at the FWC's Charlotte Harbor Field Laboratory in

Port Charlotte are currently focusing on smalltooth sawfish in the Charlotte Harbor estuarine system, especially the Caloosahatchee River. Funding provided through NMFS' ESA section 6 program has allowed the FIM program to expand its sampling in Charlotte Harbor. Increased sampling with a variety of gear and techniques will increase the likelihood of encountering sawfish in Charlotte Harbor and provide important data to support valid estimates of relative abundance, length frequencies, juvenile recruitment, sex ratios, habitat preferences, and spatial and temporal distributions. Randomly selected sites will ensure broad coverage of the estuary and a directed sampling effort will target 'hot spots' or areas of high sawfish abundance or recent capture. The goal of the directed sampling is to collect a broad range of ecological and life history data using techniques that include acoustic tracking and monitoring. During the first year, 23 smalltooth sawfish were captured, tagged, and released during NMFS-funded studies.

The FWC's Fisheries-Dependent Monitoring Program, in cooperation with NMFS, collects and compiles data on recreational landings, commercial landings, and processed fishery products in Florida. The recreational landings are collected as part of the MRFSS program. Efforts are ongoing to expand the questionnaire provided to recreational fishers to capture information on sawfish encounters in Florida.

Rookery Bay National Estuarine Research Reserve

Within the Rookery Bay National Estuarine Research Reserve, three bays comprise the majority of the upper Ten Thousand Islands estuary and from north to south are named Pumpkin Bay, Faka Union Bay, and Fakahatchee Bay. A very large restoration project was established in July 1998, to document baseline distributions and abundances of fishes and certain commercially and recreationally important invertebrates (blue crab, stone crab and pink shrimp) prior to the restoration (Shirley *et al*. 2005). Random trawl sets are conducted in each bay (Rookery Bay added in January 2000) on a monthly basis. A separate monthly survey of the apex predators in this area began in May 2000 to determine the effect of a hydrologic restoration on the relative abundance and movements of sharks in the Ten Thousand Islands. Monthly longline sets are used to capture sharks utilizing the back bays of the Ten Thousand Islands as nursery grounds. Smalltooth sawfish are occasionally caught as bycatch and are tagged in collaboration with scientists from MML. In addition to fisheries and shark monitoring, water quality measurements (salinity, temperature, dissolved oxygen, ph, and turbidity) are taken continuously (every 30 minutes) in each bay system.

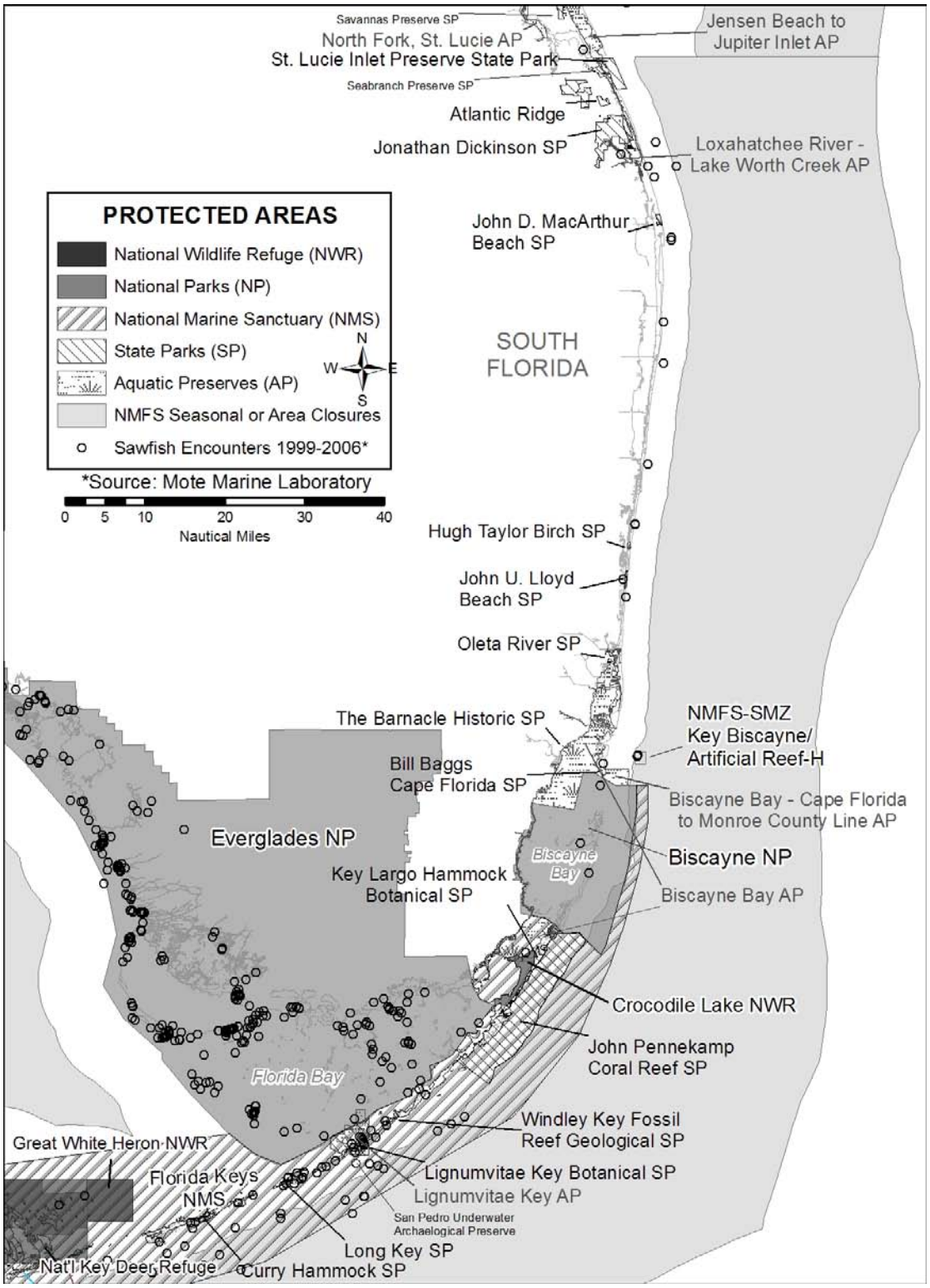

Figure 8a. Protected Areas in Southeast Florida.

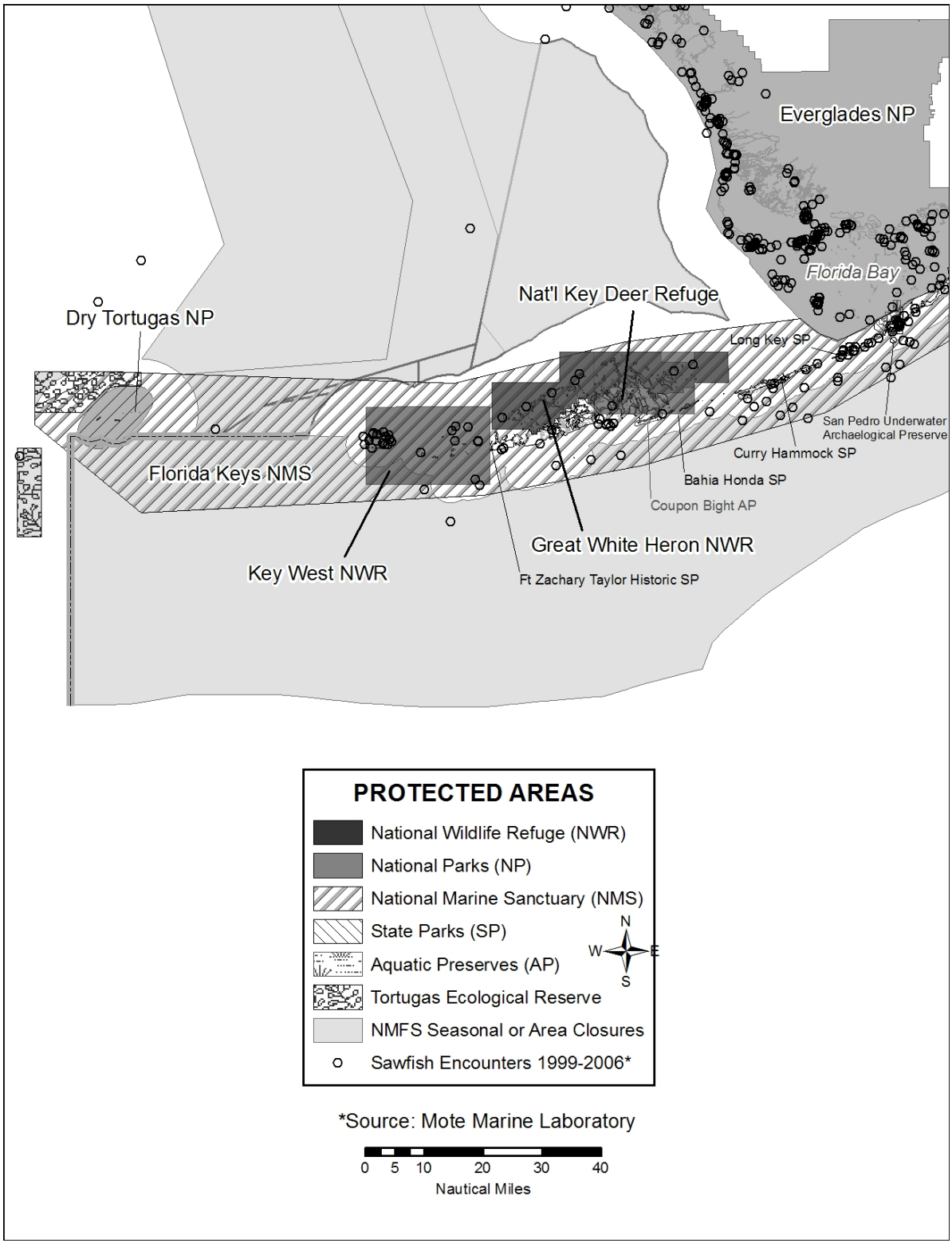

Figure 8b. Protected Areas in the Florida Keys.

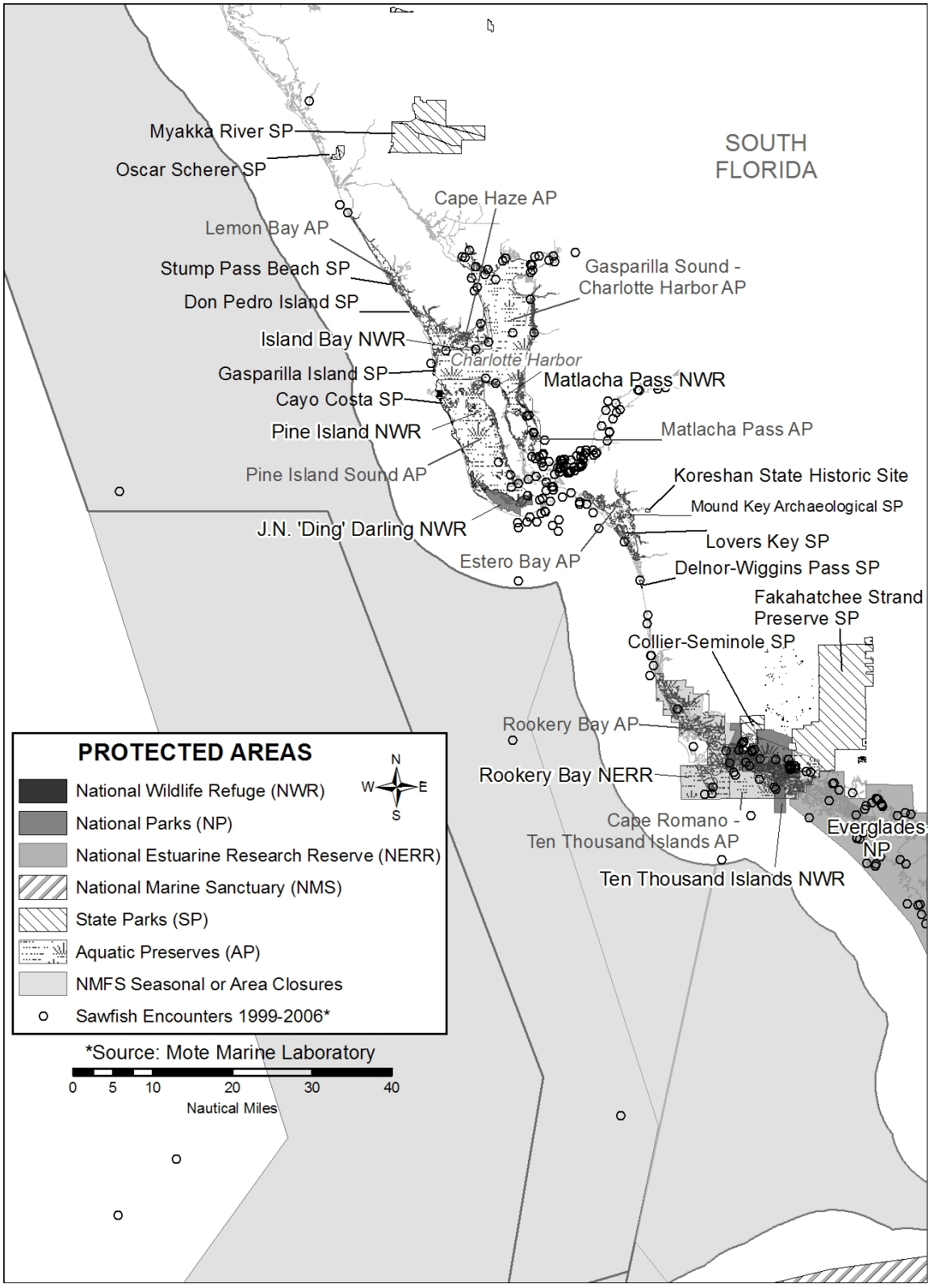

Figure 8c. Protected Areas in Southwest Florida.

II. RECOVERY STRATEGY

The goal of this recovery plan is to rebuild and assure the long-term viability of the U.S. DPS of smalltooth sawfish in the wild, allowing initially for its reclassification to "threatened" status, and ultimately for its removal from the federal list of endangered and threatened species.

A. Key Facts and Assumptions

The following key facts and assumptions (discussed in more detail in the previous section) were particularly important in guiding the development of this recovery strategy.

1. **Range Contraction** - Smalltooth sawfish in the U.S. used to be common from Texas to the Carolinas and ranged occasionally as far north as New York. The range has contracted by approximately 90% and is now restricted primarily to peninsular Florida. Smalltooth sawfish can only be found with any regularity off the extreme southern portion of Florida.

2. **Population Decline** - Available data indicate that smalltooth sawfish have declined dramatically in U.S. waters over the last century. In Louisiana, the one state which regularly collected fishery data for sawfish, catches declined by more than 99% from the 1950s to the 1970s. There have been no verified catches in Louisiana since 1978.

3. **Threats from Fisheries** - There has never been a substantial directed fishery for smalltooth sawfish. However, smalltooth sawfish are caught as bycatch in various commercial fishing gears, including gillnet, otter trawl, trammel net, seine, and longlines. Historically, sawfish caught in nets or trawls frequently had to be cut free, causing extensive damage to nets, and presenting a substantial hazard if brought on board. For these reasons, most smalltooth sawfish caught by fishermen were either killed outright or released only after often-lethal removal of their saws.

   Smalltooth sawfish are also taken as bycatch in recreational and commercial hook-and-line fisheries. Historically, most of these fish were released alive, but often after lethal removal of the saws, presumably for personal use as trophies or sale as curios. Although there is a market for smalltooth sawfish saws, the species is not directly targeted in the U.S., and any captures appear to be incidental.

4. **Habitat Loss** - Juvenile smalltooth sawfish in their current range are found mainly inshore and in or adjacent to shallow mangrove habitats. The loss of mangrove habitats is likely a significant contributing factor for the decline of the species.

5. **Biological Considerations** - The life history characteristics of sawfish have clearly contributed to population depletion and are certain to hamper recovery. Sawfish are "k-selected" species. That is, they grow slowly, mature late, bear few young, and live long lives. These characteristics make sawfish populations extremely vulnerable to threats, particularly overfishing, and slow to recover once depleted. Even if all threats were removed, it will take decades for the population to significantly increase.

   Paradoxically, the species' menacing saw and potentially massive size contribute to its vulnerability. Its saw is easily entangled in many types of fishing gear, and it is a large enough animal to tear through nets and injure fishermen. These factors have led many fishermen over the years to remove the saw from incidentally captured sawfish, or to kill them outright. On the other hand, sawfish are relatively robust animals that can usually survive capture as long as they are kept in the water and handled with care.

B. Main Objectives

In developing the recovery plan, the SSRT considered the status of the sawfish relative to the ESA's definition of endangered or threatened species, the causal listing factors, identified threats, and the ultimate goal of delisting to develop the three main objectives of the plan. Recovery of smalltooth sawfish will be achieved by accomplishing three main objectives.

1. The first objective is to minimize human interactions and associated injury and mortality. The primary threats to the species are posed by commercial and recreational fishing and must be minimized. Whereas sawfish have rarely been targeted in fishing, their toothed rostra make them highly susceptible to capture in most forms of fishing gear. Historically, captured sawfish were killed, either for their parts, safety concerns, or because they damage fishing gear. Addressing this key threat will involve both preventing the capture of sawfish in fisheries and minimizing harm to sawfish that are caught. Additionally, marine debris and red tide events can entangle or cause injury or mortality. This objective addresses listing factors 2, 4, and 5.

2. The second objective protects and/or restores smalltooth sawfish habitats. Habitats, especially those that have been demonstrated to be important for juveniles, must be protected and, if necessary, restored. Protected, suitable habitats throughout the target range will be necessary to support recruitment of young individuals to the recovering population. Without sufficient habitat, the population is unlikely to increase to a level associated with low extinction risk and delisting. This objective primarily addresses listing factor 1 but also addresses factor 3 because mangroves may serve as a refuge from predators.

3. The third objective is to ensure that smalltooth sawfish abundance increases substantially and the species reoccupies areas from which it had previously been extirpated. Substantial population increases and reoccupation of areas where they have been extirpated must occur to ensure the population's viability. This objective addresses listing factor 2 and 5.

All objectives have components that address listing factor 4 -- inadequacy of regulatory mechanisms. The three main objectives must be met to ensure the recovery of the population. The Recovery Program (Section IV of this plan) describes the specific actions needed to accomplish the three main objectives of the plan.

C. Distributional Requirements

The SSRT also recognized that the species can recover to the point at which it does not need protection under the ESA even if the population is not restored throughout its entire historic range (New York to Texas). This assumes the successful implementation of the plan and the reduction of threats identified at the time of listing. The SSRT determined that recovery of the population should include the areas throughout the core of its historic range and some additional areas outside of the core to ensure that the risk of extinction would be eliminated. Recovery criteria and actions are focused within this area, but not restricted to it. It is also noted that recovery efforts within this historic core range may need to be focused in specific areas. For example, historic data indicates that smalltooth sawfish very commonly used the IRL system on the east coast of Florida, but current data indicate that they are rarely observed in this area. Stochastic natural disasters (such as red tides and hurricanes) that regularly occur throughout much of the range of the species can also pose a threat to sawfish recovery and were therefore considered. Nursery areas used and available to smalltooth sawfish should not be concentrated in a single, limited geographic region (e.g., the Everglades coast) as these types of events could heavily affect these areas. Fourteen recovery regions (Figure 9) are designated throughout the historic range to ensure that conservation

efforts would be geographically dispersed and thereby protect against serious population damage from stochastic events. The recovery regions took into account biogeographic boundaries and information about the historic and current distribution of smalltooth sawfish. Because the historic core of abundance and the most important juvenile habitat have always been located along both coasts of peninsular Florida – even when sawfish were plentiful -- Florida contains eight of the 14 recovery regions, along both the Gulf and Atlantic coasts.

POINT	RECO Region	LATITUDE	LONGITUDE	FEATURE
1	A	25.95329	-97.14700	Rio Grande River, TX/MX border
2	A/B	28.58937	-95.98619	Colorado River
3	B/C	29.47573	-91.29340	Atchafalaya River
4	C/D	30.17699	-89.53124	Pearl River, LA/MS border
5	D/E	30.27473	-87.55220	Perdido Bay
6	E/F	29.32010	-83.14484	Suwannee River
7	F/G	27.53173	-82.64664	Manatee River
8	G/H	26.09167	-81.80260	Gordon Pass
9	H/I	24.91609	-80.93878	ENP/Sprigger Bank Light
10	I/J	25.38718	-80.23140	Caesar Creek/Old Rhodes Key
11	J/K	26.94366	-80.07115	Jupiter Inlet
12	K/L	29.07430	-80.91345	Ponce Inlet
13	L/M	30.70069	-81.42649	St. Mary's River, FL/GA border
14	M/N	33.88818	-78.01890	Cape Fear River
15	N	36.55076	-75.86704	NC/VA border

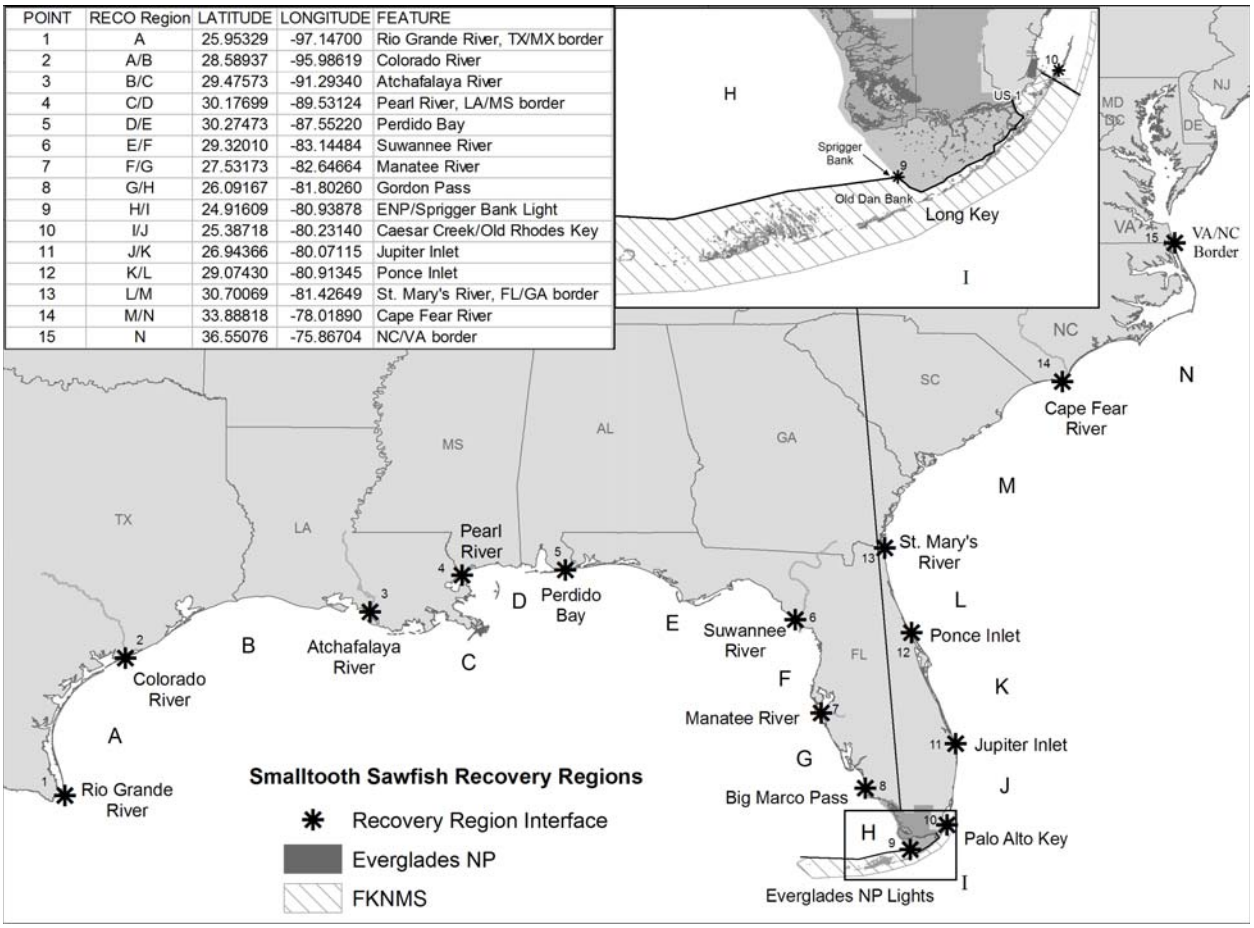

Figure 9. Recovery Regions for Smalltooth Sawfish Along the Gulf of Mexico and U.S. Atlantic Coast.

D. Additional Considerations

During the discussion of recovery options for smalltooth sawfish, the SSRT considered active restoration (i.e., restocking). However, after much discussion the group considered this to be of limited usefulness for the recovery efforts for several reasons:

- Practical difficulties for a captive breeding program would likely be prohibitive due to the slow growth, late maturity, and large size of this species.
- Smalltooth sawfish show some level of site fidelity when young, but in general are mobile and can move over relatively large distances. Thus sawfish restocked in one area are not likely to stay within that area for long periods.

- The lack of information on the current or historic stock structure of the species, and on what impact restocking may have on the genetic structure of the population creates significant conservation concerns.

Finally, in developing the strategy to recover the U.S. DPS of smalltooth sawfish, the SSRT faced two threshold challenges: 1) There was only a small amount of information available on smalltooth sawfish both within U.S. waters and worldwide. This lack of information limited understanding of the relative importance of different threats to the population, identification of the most effective conservation measures, and predictions regarding how the population would respond to these conservation measures. Research underway at the time of writing was used to help draft the recovery plan and will further inform recovery efforts in the future. 2) The smalltooth sawfish is the first fully marine fish species in U.S. waters and the first elasmobranch listed under the ESA; thus there was limited relevant recovery planning experience from which to draw in writing the plan. In the face of these challenges, the recovery plan was developed based on the best available science, the collective expertise of SSRT members, and collaborative deliberation. It is recognized and recommended that future research should be used to refine and amend the recovery plan

III. RECOVERY GOAL, OBJECTIVES, AND CRITERIA

A. Goal

The goal of the recovery plan is to rebuild and assure the long-term viability of the U.S. DPS of smalltooth sawfish in the wild, allowing initially for reclassification from endangered to threatened status (downlisting) and ultimately recovery and subsequent removal from the List of Endangered and Threatened Wildlife (delisting). Achievement of recovery as defined here does not require the return of a species to its entire historic range. Recovery of smalltooth sawfish throughout the core of its historic range (defined as the waters off the coast of Florida) plus the presence and protection of sawfish outside of its core historic range will ensure that the species is not in danger of extinction and may be delisted.

B. Objectives

The three main objectives were used to develop the recovery criteria for the species. Each of these objectives has a number of associated sub-objectives and recovery criteria (both downlisting and delisting). The sub-objectives are presented below. In each section that follows, the sub-objectives are first identified and described, and then the recovery criteria for the objective are presented. The recovery criteria are linked to their associated sub-objective and listing factor. The recovery criteria listed under Objective 3 are not associated directly with a specific causal listing factor but address the status of the species and indirectly address causal listing factors 1, 2, and 5. This objective ultimately addresses abundance which is vital to delisting. Recovery criteria are objective, measurable standards for determining that recovery objectives have been met. The criteria listed below address all causal listing factors identified at the time of listing and current threats that must be addressed to ensure the recovery of the species.

1. Minimize Human Interactions and Associated Injury and Mortality

Sub-Objectives

a. 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., fishers, divers, boaters).

   Public education will be a critical factor in reducing the threat to smalltooth sawfish posed by people's lack of awareness of regulations and the species' conservation needs. Education efforts should be spread broadly across the spectrum of public groups, but should be focused on those sectors most likely to encounter sawfish, such as fishermen, divers, boaters, ecotourism operators, marine construction workers, and researchers.

b. Develop and seek adoption of guidelines for safe handling and release of smalltooth sawfish to reduce injury and mortality associated with fishing.

   Smalltooth sawfish can be released alive and in good health if they are carefully handled and released from capture. Safe handling and release guidelines need to be in place throughout the historic range of the smalltooth sawfish because adults are mobile and therefore are likely to venture into all recovery regions, even those closest to the edges of their range. To ensure the adoption of these guidelines, the states (especially Florida) should be strongly encouraged to apply for Section 10 (a) (1)(B) permits (i.e., habitat conservation plans).

c. Minimize injury and mortality in all commercial and recreational fisheries.

Federal and state fishery agencies must take steps to minimize incidental mortality of smalltooth sawfish and ensure that the cumulative take across all commercial and recreational fishing gear does not threaten the long term viability of the species. Mortality should be considered across all fisheries combined as calculating it individually would result in the negative impacts being under-estimated.

d. Reduce, eliminate or prevent the threat from trade in sawfish or sawfish parts.

Trade in sawfish may drive take of smalltooth sawfish from the U.S. DPS. Trade criteria are not limited to the regulation of smalltooth sawfish as other sawfish species can look very similar and may need to be included to protect smalltooth sawfish. Until delisting, the capture of smalltooth sawfish for aquaria would be covered by permitting under ESA.

e. Reduce or prevent injury and mortality from research activities.

Scientific research (both directed and indirect) may result in mortality of smalltooth sawfish. Whereas it is unlikely that research activities alone will cause population declines, research must be considered in combination with other sources of mortality. The requirement for permitting smalltooth sawfish research under the ESA should assist in achieving this objective. In addition, the recommended development and distribution of standardized research protocols, designed to minimize sawfish harm, will also address this need.

f. Establish post-delisting monitoring and protection measures.

Smalltooth sawfish was listed as endangered in part due to the inadequacy of existing regulatory mechanisms. Currently, the ESA provides protection to the species from many threats. State and Federal agencies may need to implement and/or maintain regulations to protect sawfish to ensure continued population viability once the species is delisted and the protections afforded by the ESA are removed. Some level of sawfish take may be allowed after delisting, as long as the effects on the population are clearly demonstrated; such operations must also be permitted and regularly assessed. State regulations, in addition to Federal measures, may be needed given that much of the population will occur in state waters. State measures need to be at least as stringent as federal regulations.

<u>Downlisting criteria</u>

A. Effective ongoing programs are in place to educate the public about population status and the prohibitions against capturing, harming, or harassing smalltooth sawfish (Sub-objectives a-c, e; Listing factor 2).

B. Safe handling and release guidelines have been developed, adopted, distributed, and are being effectively implemented in all state and Federal fisheries (commercial and recreational) that may interact with smalltooth sawfish within all recovery regions listed in Figure 9 (Sub-objective d; Listing Factors 2 and 4).

C. State and/or Federal fishing regulations specific to smalltooth sawfish are in place to ensure that injury and mortality from commercial and recreational fishing is maintained below or at levels

that ensure the population increases at the rate, or stabilizes at the levels, described in the criteria identified in Objective 3 (Sub-objective f; Listing factors 2 and 4).

Delisting criteria

A. All downlisting criteria continue to be met (Sub-objectives a-c, e; Listing factors 2 and 4).

B. State and/or Federal measures (not including those provided under the ESA) are in place to either prohibit harm or possession of smalltooth sawfish, or ensure that impacts are appropriately assessed, authorized, and minimized (Sub-objective d; Listing Factors 2 and 4).

C. State and/or Federal measures (not including those provided under the ESA) are in place to maintain the population at levels at or above those required for delisting (Sub-objective f; Listing factors 2 and, 4) .

2. Protect and/or restore smalltooth sawfish habitats

Sub-Objectives

a. Assess nursery habitats to determine whether they are of sufficient size and quality to provide sufficient food, shelter, and other essential requirements of juvenile sawfish such that the population may increase, consistent with Objective 3.

Recovery of the smalltooth sawfish depends on the availability and quality of nursery habitats, much of which have been lost or significantly degraded throughout the species' historic range. Habitat protection and restoration criteria associated with this objective are designed to match the recovery regions used to assess the status of juvenile sawfish in the demographic objectives and are therefore focused primarily on Florida. Juvenile sawfish historically were documented in mangrove and non-mangrove habitats in the southeastern U.S. Current reports of juvenile encounters indicate a strong association with red mangrove and shallow euryhaline waters in southwest Florida. Very few juvenile encounters have been documented in areas north of the current range of mangroves (approximately 29ºN). Thus, there is a need to determine the important habitat features in these non-mangrove habitats utilized by juvenile sawfish.

Much historic juvenile sawfish habitat in southwest Florida (covering three recovery regions) remains high quality. Given habitat loss elsewhere, it is essential that the remaining high-quality nursery habitats in these recovery regions be strongly protected and maintained at near existing levels to allow for the species' recovery. Other habitats, while important, do not need to be completely restored under this recovery plan. To address these regional differences in habitat requirements, this plan takes a tiered approach to habitat-based criteria: 1) retain and protect a core of "high-quality" habitat in three recovery regions in southwest Florida; and 2) protect and/or restore habitats in three (downlisting) or six (delisting) other recovery regions to at least a level of "moderate-quality."

For the three recovery regions with remaining high-quality habitats, juvenile habitats must be maintained over the long term at or above 95% of the acreage available at the time of listing. For recovery regions with moderate-quality habitats, juvenile habitat must be maintained and/or restored at or above 25% of the levels identified in 1940, which appears to be the earliest and most reliable data and therefore will be used as the baseline. These levels were selected based on the best professional judgment of the SSRT, given the goals of this plan and an understanding of sawfish habitat needs. This tiered approach reflects the fact that reversing the majority of the

substantial modification to Florida's coastal environments is likely not feasible. However, if habitats in southwest Florida remain very high quality, 25% of historic habitat in these other regions should be sufficient to allow recovery of the DPS. This assumption may be revised based on research results and sawfish population growth. Identification and protection of non-mangrove nursery habitats must be maintained and protected, once the specific features utilized by juveniles has been identified.

b. In nursery habitats, minimize or eliminate disruption of natural/historic freshwater flow regimes (including timing, distribution, quality, and quantity) and maintain or restore water quality to ensure the long-term viability of smalltooth sawfish.

   Changes to freshwater flows throughout the historic range of smalltooth sawfish, and in peninsular Florida in particular, may have affected how juvenile sawfish use nursery habitats (or even if they can). Little scientific research is available on the salinity preferences and tolerances of this species. This information needs to be collected and used to set appropriate freshwater flow regimes.

c. Protect the habitats (particularly mating and pupping areas) of adult smalltooth sawfish.

   Habitats that are important to adult smalltooth sawfish and/or those areas in which sawfish may be particularly vulnerable to over-exploitation (such as aggregation sites) need to be identified and protected. Information is currently inadequate to identify these sites. However, ongoing and future research should provide this information and thereby guide an adult sawfish habitat conservation strategy. Sawfish are more susceptible to capture and negative impacts caused by habitat disturbance (e.g., habitat destruction, pollution) in areas where they aggregate. Therefore, these areas need to be protected.

<u>Downlisting criteria</u>

A. At least 95% of mangrove shoreline habitat existing at time of listing is maintained and effectively protected in recovery regions G, H, and I (See figure 9 for map of Recovery Regions) (Sub-objectives a-c; Listing factors 1, 3, and 4).

B. Sufficient mangrove shoreline or alternate scientifically documented non-mangrove nursery habitat are available and accessible to support viable subpopulations of juvenile smalltooth sawfish in recovery regions J and K, and one additional recovery region (apart from G, H, I, J, and K). This level should be a minimum of 25% of the mangrove shoreline habitat that existed in 1940, in each of the above recovery regions. The level of non-mangrove nursery habitat must be determined once specific nursery habitat features are identified. (Sub-objective a; Listing factors 1, 3, and 4).

C. Freshwater flow regimes (including timing, distribution, quality, and quantity) into recovery regions G, H, I, J, K and the one additional regions used to meet the two previous criteria are appropriate to ensure natural behavior (e.g., feeding, resting, and predator avoidance) by maintaining salinities within preferred physiological limits of juvenile smalltooth sawfish (Sub-objective b; Listing factor 1).

D Habitat areas of adult smalltooth sawfish abundance, including those used for aggregation, mating and pupping are identified, mapped, and effectively protected as appropriate. (Sub-objective c; Listing factors 1 and 4).

Delisting criteria

A. All habitat-based downlisting criteria continue to be met (Sub-objectives a-c; Listing factors 1, 3, and 4).

B. Sufficient mangrove shoreline or alternate scientifically documented non-mangrove nursery habitat are available and accessible to support viable subpopulations of juvenile smalltooth sawfish in recovery regions J and K, and one additional recovery region (apart from G, H, I, J, and K). This level should be a minimum of 25% of the mangrove shoreline that existed in 1940, in each of the above recovery regions. The level of non-mangrove nursery habitat must be determined once specific nursery habitat features are identified. (Sub-objective a; Listing factors 1, 3, and 4).

C. Freshwater flow regimes (including timing, distribution, quality and quantity) into recovery regions G, H, I, J, K and the four additional used to meet the previous delisting criteria appropriate to ensure natural behavior (e.g. feeding, breeding and pupping) by maintaining salinities within preferred physiological limits of juvenile smalltooth sawfish (Sub-objective b; Listing factor 1).

3. Ensure smalltooth sawfish abundance increases substantially and the species reoccupies areas from which it had previously been extirpated.

Sub-Objectives

a. 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.

   Productive juvenile sawfish populations need to be protected in several recovery regions so that these important populations are distributed across a diverse geographic area throughout the historic core of the species' range. This approach minimizes the risk of stochastic disasters (e.g., hurricanes, fish kills) by ensuring that some nursery populations are available even if one or two are not available or productive for some time after a hurricane or other disturbance. It is not required under this recovery plan that all historic nursery areas be repopulated, but rather that they are sufficiently represented and dispersed to ensure juvenile sawfish survival and population growth.

   Each recovery region counted toward downlisting and delisting criteria (6 and 9 recovery regions, respectively) must support sufficiently large numbers of juvenile sawfish to ensure that the species is viable in the long-term and can maintain genetic diversity. To meet this goal, each of these recovery regions should support annual juvenile population growth of at least 5% -- approximately half of the intrinsic rate of natural increase calculated by Simpfendorfer (2000). In addition, the growth rate should be maintained at this level, on average, for one generation time (27 years).

As juvenile sawfish in each nursery area approach the habitat's carrying capacity[13], population growth rates are expected to taper off. To account for this situation, the downlisting and delisting criteria can also be met if surveys indicate the nursery area is at 80% carrying capacity, even if average population growth rate is below 5%. This level was selected based on the best professional judgment of the scientists on the SSRT as the minimum that would ensure a high probability of juvenile survival in each recovery region. To meet the delisting criteria, the population must be maintained at 80% or more of carrying capacity for 14 years -- approximately one half of a generation.

b. 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.

   Sufficient numbers of adult smalltooth sawfish must be present throughout the historic core of the species' range to ensure the DPS will not be in danger of extinction. Criteria associated with this objective were developed through a different approach than the criteria used for juvenile sawfish. The level of increase is different than that used to evaluate the abundance of juveniles, due to the greater degree of movements observed in adult sawfish versus the use of individual recovery regions by juveniles.

   There is little information specific to adult smalltooth sawfish from which to develop delisting or downlisting criteria for this objective. In the absence of species-specific information, criteria were developed for this objective by adapting the approach described by the American Fisheries Society's (AFS) criteria for assessing risk of extinction for marine fish (Musick *et al*. 2000) based on life history characteristics. For "low productivity" species, such as smalltooth sawfish, the AFS criteria suggest that a population decline to 15% of virgin numbers is consistent with a species vulnerable to extinction.

   The U.S. DPS of smalltooth sawfish may have declined by as much as 95 % (Simpfendorfer 2002). Therefore, a 15-fold increase in adult smalltooth sawfish off both the east and west coasts of Florida would result in an adult population that is approximately 15% of its virgin numbers in these regions, and would be a population that could be safely downlisted (assuming the threats and habitat downlisting criteria are also met). Given the uncertainty associated with the species population estimate, and taking a precautionary approach, the adult population must increase by 20-fold, for delisting. For both downlisting and delisting criteria to be met, these adult population numbers must be maintained for 14 years (approximately one-half a generation time).

   The baseline relative abundance index level should be determined through the use of surveys within five years. Data currently available from the ENP have shown that current population levels have likely been stable over the recent past, and that sawfish population growth is expected to be low under even ideal conditions. Therefore, abundance at the time of listing can be reasonably estimated by post-listing surveys if they are conducted in the near future.

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[13] The amount and quality of habitat strongly affects the carrying capacity of an area. Because juvenile recovery criteria are based on carrying capacity, it is the habitat-based criteria associated with habitat quality objectives that will largely determine the eventual numbers of juvenile sawfish in each Recovery Region.

c. 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.

Most sawfish recovery efforts and recovery criteria in this recovery plan focus on the waters off of Florida. However, the species historically occurred commonly from Texas to North Carolina. While it is not necessary under this recovery plan to restore the DPS throughout its historic range, it is necessary that sawfish are at least present and protected in areas outside of Florida before downlisting or delisting can occur. Such presence outside of Florida would indicate that the DPS is adequately protected, and/or is undertaking seasonal migrations outside of Florida waters that were reported to be common historically. Repeated sightings of smalltooth sawfish over 14 years (half a generation time) in the recovery regions identified in the accompanying recovery criteria areas are required before downlisting or delisting can occur.

If a scientifically robust PVA model for the U.S. DPS of smalltooth sawfish is available that provides additional information and greater certainty that the species can be safely downlisted or delisted it should be used. PVAs have been used effectively in recovery planning for other species as a tool to help assess extinction risk and develop recovery criteria.

Downlisting criteria

A. In recovery regions G, H, I, J, and K and at least one other recovery region the relative abundance of small juvenile smalltooth sawfish (<200 cm) either has increased at an average annual rate of at least 5% over a 27-year period with greater than 95% certainty or is at greater than 80% of carrying capacity .

B. Relative abundance of adult smalltooth sawfish in combined recovery regions J through L (east coast of Florida) has increased to a level at least 15-times higher than the level at the time of listing with greater than 95% certainty that abundance at this level has been sustained for a period of at least 14 years.

C. Relative abundance of adult smalltooth sawfish in combined recovery regions F through H (west coast of Florida) has increased to a level at least 15-times higher than the baseline level determined in Action 3.2.4 with greater than 95% certainty that abundance at this level has been sustained for a period of at least 14 years.

D. Verified records of adult smalltooth sawfish are observed in 12 out of 14 years, with consecutive records occurring in the last 3 years in recovery regions M or N, and in at least one of recovery regions A, B, C, or D.

Delisting criteria

A. In recovery regions G, H, I, J, and K and at least 4 other recovery regions, one of which must be west of Florida, the relative abundance of small juvenile smalltooth sawfish (<200 cm) is stable or increasing over a period of 14 years following downlisting.

B. Relative abundance of adult smalltooth sawfish (>340 cm) in combined recovery regions J through L (east coast of Florida) is at least 20-times higher than the baseline level with greater than 95% certainty that abundance at this level has been sustained for a period of at least 14 years.

C. Relative abundance of adult smalltooth sawfish (>340 cm) in combined recovery regions F through H (west coast of Florida) is at least 20-times higher than the baseline level with greater than 95% certainty that abundance at this level has been sustained for a period of at least 14 years.

D. Verified records of adult smalltooth sawfish are observed in 12 out of 14 years, with consecutive records in the last 3 years, in recovery regions M or N, and in at least one of recovery regions A, B, C, or D.

E. In addition to the 6 downlisting recovery regions (G, H, I, J, and K and one additional region), the relative abundance of small juvenile smalltooth sawfish (<200 cm) in 3 other recovery regions, at least one of which must be west of Florida, is either increasing at an average annual rate of at least 5% over a 27-year period with greater than 95% certainty or at greater than 80% of carrying capacity.

IV. RECOVERY PROGRAM

The recovery program for the smalltooth sawfish describes the recovery actions that were determined to be necessary to achieve the plan's goals and objectives. This section of the plan is comprised of the recovery action narrative and the implementation schedule. The recovery action narrative is organized around each of the main recovery objectives (see II. Recovery Strategy) and describes in detail the specific recovery actions. The implementation schedule states the recovery priority associated with each action, the responsible parties, the estimated time to complete the action, the estimated cost to complete the action, and the timeframes to complete the actions. NMFS believes that the recovery plan should be a dynamic document that will change over time based on progress of recovery and the availability of new information. As new information is obtained, additional actions will be identified and incorporated into the plan. As is the case for all recovery plans under the ESA, this plan will be regularly reviewed and the relative success of these actions in protecting smalltooth sawfish assessed. Adjustments will be made and/or additional actions will be added accordingly. A Smalltooth Sawfish Implementation Team (SSIT) will be established to promote the implementation of the plan.

A. Recovery Action Narrative

1. Minimize human interactions associated injury and mortality.

1.1 Prevent or reduce mortality of the species in fisheries to ensure their long-term viability.

Bycatch in a variety of fisheries was the primary cause of the decline of the species. Minimizing mortality from fisheries is essential for sawfish recovery. Related remedies will involve actions or techniques for all fisheries, as well as gear specific measures. Implementation of a strategy to reduce sawfish bycatch and mortality should include means to monitor the effectiveness and the contribution to recovery of the new measures.

All commercial and recreational fisheries.

In considering the effect of fishing on the species, it is important all types of fishing be considered together, as well as on an individual basis. Initially, it will be important to gather information on the current level of sawfish take and the fate of animals caught. Encounter databases should continue to provide data related to fishery catches, especially by the recreational sector. Monitoring and observer programs should also be implemented for commercial and recreational fisheries to provide quantitative estimates of take and fate. The many existing commercial observer programs for fisheries that take smalltooth sawfish should be used to assist in monitoring efforts. Training of observers in data collection, handling, safe release, and other aspects of sawfish conservation will be required. Research to determine the post-release mortality of sawfish from a variety of fishing gears should be undertaken. These studies could involve tagging, tracking, and electronic tagging of animals, potentially in collaboration with sawfish population monitoring programs. Data from the observer and monitoring programs and post-release mortality studies should be used in population assessments (e.g., PVA models) to determine the effect of sawfish takes on the population, and calculate levels of take that would allow the recovery criteria to be met. Data from observer and monitoring programs should be used to identify areas where there are significant interactions between fisheries and sawfish. Based on the analysis of the effect of takes on sawfish in these areas, appropriate restrictions should be implemented. Specific fishing gears that should be investigated are trawl, longline, and recreational line fishing.

Work with federal and state agencies that regulate fisheries to implement regulations that allow for the recovery of the smalltooth sawfish. Necessary measures may be specific (such as time-area closures) or general (such as broad reductions in fishing capacity). The SSRT identified the implementation of conservation plans by states (especially Florida in the early stages of recovery) under section 10(a)(1)(B) of the ESA as a priority action with significant potential to enhance recovery. Given that sawfish are often observed with old fishing gear entangled on their saw or other parts of their body, the SSRIT should work with agencies (e.g., NOAA's Marine Debris Program) and conservation groups to minimize and mitigate the impact of discarded or lost fishing gear.

1.1.1 Monitor the take and fate of the species in commercial and recreational fisheries throughout the species' range.

1.1.2 Improve the capacity and geographic coverage of the sawfish encounter data collection program to enable full investigation, review, and evaluation of each report of smalltooth sawfish fishery interactions.

1.1.3 Determine the post-release mortality of smalltooth sawfish from various types of fishing gear.

1.1.4 Integrate collection of data on smalltooth sawfish into current commercial fishery observer programs and implement new programs where required.

1.1.5 Integrate collection of data on smalltooth sawfish into current recreational fishing creel surveys and implement new program where required.

1.1.6 Implement and adequately fund observer programs over the long-term.

1.1.7 Use PVA or other types of population models to evaluate the effect of fishery takes on the species' viability.

1.1.8 Implement strategies to reduce bycatch, mortality, and injury, in specific fisheries to ensure the species' viability.

1.1.9 Encourage the FWC, the Atlantic and Gulf States Marine Fisheries Commissions, and/or other appropriate state entities, to develop and implement conservation plans as described under ESA section 10(a)(1)(B) for state managed fisheries that incidentally take smalltooth sawfish.

1.1.10 Develop and implement programs, in cooperation with other interested parties, to assess, minimize, and mitigate the effects of lost fishing gear.

Longline fisheries

Observer data from the commercial shark longline fishery indicate occasional capture of large sawfish. A number of procedures that could be used by longline fishermen to facilitate the safe release of sawfish have been identified (G. Burgess, Florida Museum of Natural History; J. Carlson, National Marine Fisheries Service). The SSIT should work with state and federal resource management agencies to have these guidelines included in regulations for longline fisheries. In addition, research to identify ways to reduce the capture and harm of smalltooth sawfish during longline fishing should be pursued. Where sawfish bycatch reduction techniques and/or gear modifications are identified, the SSIT should work with management agencies to ensure prompt implementation.

1.1.12 Monitor longline fisheries to ensure they do not threaten the viability of the population.

1.1.13 Reduce mortality by using dehookers, line cutters, and investigate the use of corrodible circle hooks, as well as training in their use, for all commercial bottom longline vessels.

1.1.14 Investigate fishing modifications, devices and techniques that may work to avoid interaction with smalltooth sawfish and/or enhance the likelihood of successful release of healthy sawfish.

1.1.15 Require fishing devices, modifications, and/or techniques found to be effective at reducing bycatch of smalltooth sawfish and/or mitigating the effects of hooking them in areas frequented by sawfish, other important sawfish habitats, and in longline fisheries encountering significant numbers of sawfish.

Trawl fisheries

Available data on interactions between trawl fisheries and the U.S. DPS of smalltooth sawfish are very limited, but shrimp trawl fisheries are associated with high sawfish mortality per interaction. Data from other parts of the world (e.g., Australia's Northern Prawn Fishery) indicates that sawfish are commonly taken in shrimp trawls. Thus, to facilitate recovery efforts, methods to reduce the take or harm of smalltooth sawfish in trawls should be researched, tested, and implemented as warranted.

1.1.16 Monitor trawl fisheries to ensure they do not threaten the viability of the population.

1.1.17 Investigate fishing devices, gear modifications, and techniques (physical, electronic, chemical, net configuration, etc.) that reduce the likelihood of sawfish capture, improve the chances of sawfish escapement, minimize harm to sawfish and humans from capture, and facilitate successful release of healthy sawfish.

1.1.18 Recommend the use of fishing devices, gear modifications, and/or techniques found to be effective at reducing bycatch of smalltooth sawfish and/or mitigating the effects of capture in areas frequented by sawfish, other important sawfish habitats, and in trawl fisheries encountering significant numbers of sawfish.

Gillnet Fisheries

Gillnet fisheries are believed to have been a major cause of the decline of smalltooth sawfish. In the mid-1990s, Florida banned entangling nets (including gillnets) in all state waters. Any reversal or weakening of this ban would have a significant detrimental effect on the recovery of the smalltooth sawfish population. The SSIT should therefore work to ensure this ban remains in place. Gillnets used in other states and in Federal waters may also contribute to mortality of smalltooth sawfish. Given the current limited distribution of smalltooth sawfish, it is unlikely use of such gear outside Florida is currently of any significance to the species. However, as recovery of the population proceeds gillnet fisheries outside Florida waters will become an increasing threat to sawfish recovery. Thus, action to minimize the potential for capture of sawfish in gillnets throughout their range should be pursued. Research on techniques that reduce the capture and/or harm of sawfish in gillnets should also be undertaken. Methods and/or modifications that are identified as useful to recovery efforts should be promptly implemented by state and federal management agencies.

1.1.19 Monitor gillnet fisheries to ensure they do not threaten the viability of the population.

1.1.20 Develop regulations, if necessary, to minimize sawfish bycatch in state waters.

1.1.21 Develop regulations, if necessary, to minimize sawfish bycatch in federal waters.

1.1.22 Continue to investigate avenues to reduce the risk of capture, injury, and mortality in gillnet fisheries.

1.1.23 Recommend the use of fishing devices, modifications, and/or techniques found to be effective at reducing bycatch of smalltooth sawfish and/or mitigating the effects of entanglement in areas frequented by sawfish, other important sawfish habitats, and in gillnet fisheries encountering significant numbers of sawfish.

1.1.24 Continue to minimize gillnet effects by gillnet bans in Florida.

Recreational fisheries

Recreational fishing currently accounts for the highest known take levels of smalltooth sawfish within U.S. waters. Encounter database reports indicate that the vast majority of captured sawfish are released, probably unharmed. However, given the size and importance of the fishery, it is vital to research methods for reducing the impact of sawfish capture. In particular the effectiveness of corrodible and/or circle hooks for conserving sawfish should be investigated. Other techniques to reduce the chances of sawfish capture and/or associated harm should also be explored. Techniques identified as effective should be implemented through recreational fishing regulations and publicized.

1.1.25 Monitor recreational fisheries to ensure they do not threaten the viability of the population.

1.1.26 Investigate and, if practical, require devices that reduce the capture, injury, and mortality from recreational fisheries (e.g., corrodible and circle hooks).

1.2 Monitor trade to ensure trade in sawfish and sawfish parts does not threaten the long-term viability of the population.

Trade in sawfish and of sawfish parts is poorly documented. However, it is known that sawfish fins and saws attract high prices in Asian markets where they are used for shark fin soup and traditional medicine, respectively. While it is unlikely that trade in sawfish or sawfish parts from the U.S. DPS of smalltooth sawfish is currently significantly detrimental, removing the incentive to kill sawfish by ending trade in sawfish parts will be increasingly important as the population recovers. One well-investigated aspect of sawfish trade is the auction of parts through internet sites catering to individual sellers. eBay, a major internet auction site, agreed in January of 2006 to ban all sales of smalltooth sawfish parts on their site. Enforcement of sawfish trade prohibitions on the internet and traditional wildlife markets will require vigilance. Public aquaria engage in a small amount of trade in live sawfish originally from Florida for display; almost all of today's aquarium trade involves specimens from Australia. The trade in sawfish for aquaria should be carefully monitored to ensure that it does not reduce the viability of the U.S. DPS due to over-harvesting for display.

1.2.1 Promote the continued listing of smalltooth sawfish under Appendix I of CITES.

1.2.2 Ensure enforcement of prohibitions of illegal sales of smalltooth sawfish on auction outlets, if any.

1.2.3 Promote the investigation and prosecution of persons engaging in interstate commerce of smalltooth sawfish, if any.

1.2.4 Work with the aquarium community and the American Zoo and Aquarium Association to ensure that movement and/or trade in sawfish currently in captivity, or their progeny, do not threaten the long-term viability of the population.

1.3 Minimize interactions, injury, and mortality through outreach and education.

One of the cornerstones of the recovery strategy for the species is the minimization of sawfish bycatch mortality in commercial and recreational fisheries. There are no directed fisheries for sawfish. Education is a key component to reducing mortality from incidental catch in fisheries and other human interactions. Education of the public, especially those sectors that potentially interact with smalltooth sawfish, is an important factor in the recovery strategy for smalltooth sawfish. Information related to the plight of the sawfish population, the need for conservation measures, and what citizens can do to help save this endangered species will all be important to changing human behavior. There are many government agencies, conservation organizations, fishing groups, and commercial enterprises that can assist in educational efforts. The SSIT should cooperate with these groups in developing an education plan aimed at improving sawfish survival.

Because fishermen are the group most likely to encounter smalltooth sawfish and have the greatest potential to cause mortality, the development of handling and release guidelines offers a substantial benefit to recovery. The SSIT developed a set of guidelines for minimizing harm to sawfish and fishermen (Appendix B). These guidelines are being distributed as widely as possible to both commercial and recreational fishermen. The guidelines should be included in fishery management plans and operational procedures wherever possible. The SSRIT should work with agencies, such as NOAA's Sea Grant, which have extensive networks, to achieve broad distribution.

1.3.1 Develop and distribute programs and materials to educate the public about smalltooth sawfish status and protections, with a focus on groups most likely to encounter this species (e.g., fishers, divers, boaters).

1.3.2 Develop safe handling and husbandry guidelines for sawfish, and related educational materials.

1.3.3 Develop, distribute, and implement Safe Handling and Release Guidelines for smalltooth sawfish for commercial and recreational fisheries to minimize interactions, injury, and mortality.

1.3.4 Improve effective implementation of safe handling and release techniques through information distribution and training seminars associated with recreational and commercial fishing events, trade shows, tackle and bait shops, boating stores, and related outlets.

1.4 Reduce threats from research efforts.

Research activities, whether targeted at sawfish or not, have the potential to threaten the population. Currently, research targeting sawfish is prohibited unless NMFS issues an ESA research permit. NMFS evaluates permit applications for sawfish research with a view toward ensuring that the research has no detrimental impact on the population. As the population recovers, an increasing number of researchers will encounter sawfish incidentally. Training materials, including handling guidelines should be developed to ensure such encounters end with careful release of healthy sawfish and the proper recordings of appropriate information.

1.4.1 Monitor mortality of the species from both targeted and non-targeted research programs.

1.4.2 Develop standardized research protocols for authorized smalltooth sawfish researchers to ensure that studies are coordinated, that take for research is minimized and associated harm is minimized, and that cumulative effects are considered.

1.4.3 Develop a training course for researchers who handle sawfish to ensure minimization of injury and mortality in research activities.

1.5 Develop non-ESA protection measures and a post-delisting monitoring plan.

Once a species is delisted, statutory and regulatory protections provided by the ESA are lifted. The SSRIT should work with federal, state, and local agencies to ensure that appropriate protections for sawfish, necessary to prevent the population from once again becoming threatened or endangered, remain in place after delisting.

1.5.1 Develop protective measures with state, local, and other appropriate agencies that will continue after the ESA protections are removed.

1.5.2 Develop a post-delisting monitoring plan as required by ESA(4)(g).

2. Protect and/or restore smalltooth sawfish habitats.

2.1 Ensure that nursery habitat of sufficient size and quality exists to enable the recovery of the species.

Juvenile sawfish, especially those less than 79 in (200 cm) in length, have strong links to specific coastal and estuarine habitats (see Distribution and Habitat Use Section). To enable recovery of the species, the nursery habitats used by juvenile sawfish need to be protected and in some cases restored. Without sufficient high quality habitat, survival rates of juvenile sawfish will be below those which will enable the population to recover to a level at which it is no longer endangered or threatened. Research on the habitat requirements of juvenile smalltooth sawfish has focused in southwest Florida in the current core of the range, and has identified mangroves as an important component of sawfish nursery areas. However, encounter report databases (e.g., Simpfendorfer and Wiley 2005a) have demonstrated that small juvenile sawfish occur in areas north of where mangroves can grow because of physiological constraints (approximately 29ºN). Thus there is a need to expand research to identify important components of sawfish nursery habitats in these areas.

Research to identify nursery habitats throughout the current and historic range of smalltooth sawfish will be important for the planning and implementation of recovery efforts. For the purposes of this document, the year 1940 is the baseline for sawfish habitats because mapping coverages from this year appear to be the most encompassing (Davis and Wilson 1943). Public encounter databases will provide preliminary data on the occurrence of juvenile smalltooth sawfish in areas in and outside of the normal range of mangroves. This information can then be used to focus surveys to better understand the habitat needs of sawfish in these areas. Habitat modeling may also provide the ability to predict important nursery habitats in areas that sawfish currently do not occupy in sufficient numbers to be suitable for surveys. This approach would allow habitat conservation efforts to work ahead of population recovery and ensure that habitat availability does not limit sawfish recovery. Finally, coastal development (e.g., shoreline habitat modification or removal, seawalls, canals, dredge and fill, and channelization) has occurred throughout much of the historic range of smalltooth sawfish. Research on the effects of this development on juvenile sawfish, especially in relation to their survival, is required to understand the carrying capacity of nursery habitats.

2.1.1 Conduct surveys throughout the current range of the species to determine the locations of current potential nursery habitats.

2.1.2 Determine which habitats, apart from shoreline mangroves, are currently used as nursery areas.

2.1.3 Construct habitat models based on survey data to identify potential nursery habitats in areas unsurveyed or outside of the current range.

2.1.4 Document the effect of coastal development on use of nursery habitats by juveniles.

2.1.5 Estimate the historic distribution of native shoreline habitats throughout the core range of smalltooth sawfish.

2.1.6 Estimate the extent of native shoreline habitats at the time of listing compared to historic levels.

2.1.7 Monitor losses and gains of mangrove shoreline habitat in recovery regions G, H, I, J, and K.

2.1.8 Restore mangrove shoreline habitats in recovery regions where levels are insufficient to support juvenile recruitment.

2.1.9 Ensure that appropriate regulations are in place to protect (and potentially recover) mangrove shoreline habitats in recovery regions G - K.

2.1.10 Monitor losses and gains of nursery habitats, apart from shoreline mangroves, in all recovery regions.

2.1.11 Restore non-mangrove nursery habitats within the recovery regions located in Florida .

2.1.12 Ensure that appropriate regulations are in place to protect (and potentially recover) non-mangrove nursery habitats in all recovery regions.

2.2 Minimize the disruption of natural/historic freshwater flow regimes (including timing, quality, and quantity) and maintain or restore water quality.

Public encounter databases and surveys have shown that juvenile sawfish occur most frequently in euryhaline (estuarine) areas. However, there is insufficient information to determine the level of importance of lower salinity areas to smalltooth sawfish. Thus there is a need to conduct research on the salinity tolerances and preferences of juvenile smalltooth sawfish. In addition to research on salinity, other water quality preferences, if any (e.g., temperature, dissolved oxygen, pH), of sawfish should also be explored. On the basis of the research results it may be necessary to regulate salinity levels within nursery areas for smalltooth sawfish. Because salinity levels in estuaries are mostly a function of freshwater flow rates, it may be necessary to regulate flow levels where it is possible.

Research on the salinity preferences and tolerances of smalltooth sawfish using both laboratory and field studies will enable the determination of optimum water quality conditions for sawfish. Research on bull sharks (a euryhaline shark that occurs in many of the same habitats as juvenile smalltooth sawfish) has demonstrated changing salinity preferences during juvenile phases (e.g., Simpfendorfer *et al*. 2005); similar research should be conducted for a variety of sizes of smalltooth sawfish. Research should explore the upper and lower bounds of salinity that are tolerated and detrimental to sawfish in the short and long term. Laboratory experiments on the bioenergetics of smalltooth sawfish at varying salinity levels will enable the determination of conditions that would be physiologically suitable for sawfish growth and survival.

Once research has identified the optimal water quality conditions for smalltooth sawfish, authorities must be encouraged to include them in relevant standard regulations, and water management programs. The many existing monitoring systems for water quality throughout the current and historic range of smalltooth sawfish should be used to monitor conditions with respect to sawfish. The SSRIT should work with federal, state, and local agencies responsible for regulating and permitting freshwater flows and withdrawals and water quality to ensure that environmental conditions are maintained at levels suitable for sawfish survival and recovery. In particular, the SSRIT should ensure that work conducted under the Comprehensive Everglades Restoration Program fully accounts for the recovery needs of smalltooth sawfish. Freshwater flows from Lake Okeechobee, specifically, have potential to influence sawfish habitat throughout south Florida. Further research is required to determine appropriate management of flows that are conducive to sawfish recovery.

2.2.1 Determine salinity preferences and tolerances of juveniles of all sizes using laboratory experiments.

2.2.2 Monitor the salinity and other water quality preferences of juveniles in the field.

2.2.3 Monitor freshwater flow into, and salinity of, nursery habitats in all recovery regions.

2.2.4 Work with state and local agencies to evaluate whether regulations are in place to maintain appropriate water quality in sawfish nursery habitats.

2.3 Identify and protect the habitats (particularly mating and pupping areas) of adult smalltooth sawfish.

Unlike juvenile smalltooth sawfish, for which we have some information on specific habitat requirements, adults appear to have broader, less specific, habitat use patterns, and move over large distances between shallow coastal areas and deeper outer shelf areas. Thus, recovery efforts to protect adult habitats require surveys and research to determine whether specific areas are used for particular activities, potentially those where they aggregate to mate, give birth, or feed. Research currently underway is providing some information on the distribution, habitat requirements, and movement patterns of adult smalltooth sawfish; more information is needed to assist in recovery efforts. Specific areas where adults occur and are potentially vulnerable to threatening processes (e.g., habitat loss, fishing) one identified, may need to be protected.

Research to document the distribution, habitat requirements, and movement patterns of adult smalltooth sawfish is required to advance recovery efforts. Habitats where adults aggregate for mating, pupping, and feeding may be the most beneficial to explore in terms of protection. Research has already identified potential pupping areas, and further work will reveal more. Surveys and public encounter databases can provide information on the distribution of adults. The area around the Florida Keys, in particular, should be investigated to determine if it represents an important winter habitat for smalltooth sawfish. Tagging and tracking studies will provide critical information on habitat requirements and movement patterns. Adult sawfish are known to migrate seasonally along the U.S. east coast. These migrations should be studied using electronic tagging technology to determine migratory pathways, environmental cues (especially temperature) that may regulate their onset, and the proportion of the population from different regions that undertake them. Habitat models based on research data will provide important abundance and distribution information.

As soon as adult habitats that are important to recovery of smalltooth sawfish are identified they should be regularly monitored and protected in some manner. In some situations recovery may be aided by restoration of the habitat in these areas. The SSRIT should work with federal, state and local agencies responsible for regulating use of these habitats to develop appropriate regulations to ensure smalltooth sawfish recovery.

2.3.1 Conduct surveys throughout the current range of smalltooth sawfish to determine the distribution of adult smalltooth sawfish and identify habitats of aggregation or local abundance.

2.3.2 Investigate short-term movement patterns of adult sawfish to provide information on habitat use patterns.

2.3.3 Investigate the seasonal migrations of adults along the U.S. east coast and in the Gulf of Mexico, including documenting the temperature tolerances that may drive these patterns.

2.3.4 Investigate seasonal patterns of occurrence and habitat use of adults.

2.3.5 Construct habitat-based movement models to identify seasonal changes in crucial habitat areas for adults.

2.3.6 Monitor abundance of adult smalltooth sawfish in aggregation areas.

2.3.7 Monitor changes in habitat and environmental parameters in aggregation areas.

2.3.8 Restore degraded habitats in aggregation areas if determined necessary for recovery.

2.3.9 Ensure appropriate federal, state, and local regulations are in place to protect adult aggregation habitats.

3. Ensure smalltooth sawfish abundance increases substantially and the species reoccupies areas from which it had been previously extirpated.

3.1 Investigate the relationship (movements) between the U.S. DPS of smalltooth sawfish and populations in surrounding countries and coordinate conservation and recovery efforts to ensure U.S. recovery efforts are not hindered.

This recovery plan deals explicitly with the U.S. DPS of smalltooth sawfish. However, smalltooth sawfish occur off countries adjacent to the U.S.A., including Mexico, Cuba, the Bahamas, and other Caribbean nations. Currently, data are insufficient to determine the relationships among the U.S. DPS of smalltooth sawfish and the populations in these other countries' waters. If there is movement among these populations then activities in other countries may negatively affect the U.S. DPS, thereby hindering U.S. recovery efforts.

There is need for research into the relationship, if any, between the U.S. DPS of smalltooth sawfish and the sawfish that occur in nearby countries. Two potential avenues of investigation have been used in other species of elasmobranchs – tagging and genetic comparisons. Genetic techniques are currently being used to investigate the population genetics of smalltooth sawfish (V. Faria, pers. comm.) and the collection of genetic material from outside of the U.S. DPS would enable comparisons to be made. Genetic studies will need to include the use of appropriate techniques and sample sizes to allow differences to be sufficiently resolved if they exist. Tagging studies using conventional identification tags can provide a direct indication of movement between countries, but can require the release of a large number of tags if exchange rates are low. Newer electronic tagging technology, especially popup satellite archival tags (PAT) that would detach from sawfish after preset periods and report their location may offer a more effective approach. While PAT tags are expensive, far fewer are required to be released and they do not rely on recapture to obtain the data. Tagging (conventional or electronic) in both the U.S. and surrounding countries would be required to determine exchange rates into or out of the U.S.

3.1.1 Conduct genetic comparisons between the U.S. DPS and populations in surrounding countries.

3.1.2 Establish and continue tagging studies (Gulf of Mexico and Caribbean).

3.1.3 Encourage protection of smalltooth sawfish and promote the reduction of sawfish bycatch in neighboring countries.

3.2 Determine that sufficient numbers of adult smalltooth sawfish exist to ensure recovery.

Adult sawfish provide the reproduction that is required to ensure the viability of the species. It is imperative that the numbers of adult sawfish are effectively monitored to ensure that the population recovers. The recovery plan calls for two levels of monitoring of the adult population:

intensive monitoring off the east and west coasts of Florida in the historic core of the distribution, and qualitative monitoring in the peripheral sections of the range.

Data on the distribution and abundance of smalltooth sawfish in U.S. waters is currently limited. Public encounter databases currently provide the best data on distribution but are not useful in estimating abundance. Surveys to identify areas where adults regularly occur are required to inform the design of monitoring programs. Using existing monitoring programs for other species will be the most efficient way to monitor the adult sawfish population. Existing survey programs (both fishery-independent and fishery observer programs) should be evaluated to determine if they can be expanded to incorporate sawfish monitoring. If existing programs cannot meet the requirements or are otherwise incompatible, then specialized monitoring systems for adult sawfish will need to be implemented. All actions related to the investigation of the changes in size of the smalltooth sawfish population are described in terms of relative abundance because of the difficulties associated with determining absolute abundance with a rare, widely dispersed, benthic species.

Monitoring programs in the Gulf of Mexico and Atlantic will be needed to measure and track the abundance of adult smalltooth sawfish. Surveys should be conducted annually and the data analyzed and compared to the recovery criteria.

This recovery plan also requires that the species occur in peripheral sections of their historic range as a condition for delisting. Several different approaches to monitoring sawfish occurrence in these areas are possible, given that there is no requirement to determine abundance. Possible approaches to determining the occurrence of smalltooth sawfish in the peripheral sections of their range include tagging studies, public encounter databases, and fishery surveys (both fishery-independent and fishery-dependent). The approach that is potentially the most straightforward uses information from the public encounter databases and also evaluates data from ongoing independent -fishery monitoring programs. The use of electronic tags, especially PAT technology, holds promise for demonstrating the occurrence of adult sawfish in peripheral areas without requiring any physical presence (observers, encounters, surveyors, etc.) in the region. A combination of these approaches may ultimately be required to determine when recovery criteria related to sawfish occurrence in outlying areas are met.

3.2.1 Assess the east and west coasts of Florida to determine the most appropriate location and timing of surveys for adult smalltooth sawfish.

3.2.2 Evaluate fishery observer programs to determine their suitability to act as surveys of relative abundance of adult smalltooth sawfish.

3.2.3 Evaluate state and federal fishery-independent monitoring programs to determine their suitability to act as surveys of relative abundance of adult smalltooth sawfish.

3.2.4 Conduct regular surveys to determine a baseline and subsequent relative abundance levels of smalltooth sawfish off the east and west coasts of Florida.

3.2.5 Analyze annual relative abundance data for adult smalltooth sawfish and determine if it meets the criteria in Objective 3.

3.2.6 Conduct tagging studies, potentially using satellite and/or archival technology, to study seasonal migrations along the U.S. east coast and within the Gulf of Mexico.

3.2.7 Continue existing effective sawfish encounter reporting systems with outreach efforts throughout the historic range, with special efforts focused on the north central Gulf of Mexico, Georgia, South Carolina, and North Carolina.

3.2.8 Assess research survey and fishery independent monitoring datasets to obtain records of adult smalltooth sawfish in the north central Gulf of Mexico, Georgia, South Carolina, and North Carolina.

3.3 Develop a spatially-structured PVA for the species and estimate extinction probabilities.

PVA is a common method used to determine the extinction risk (or quasi-extinction risk) of a species. To build an effective PVA model requires the collection of a large amount of data on biological, habitat, and fishery aspects of smalltooth sawfish. Once the data have been collected and the model constructed it should be thoroughly tested and externally reviewed by an independent internationally-recognized expert(s) to ensure that it provides reliable estimates. In the event that the PVA model does not provide estimates with sufficient certainty it should not be used to evaluate recovery criteria. However, it may, if desired, be used for planning purposes to evaluate conservation and management alternatives.

3.3.1 Collect life history data, including age, growth, reproductive and natural mortality.

3.3.2 Determine movement rates by size class between recovery regions.

3.3.3 Identify and collect other biological or ecological data as required for the PVA.

3.3.4 Collect information on catches and mortality in recreational and commercial fisheries for use in the PVA.

3.3.5 Build a spatially structured PVA model for smalltooth sawfish.

3.3.6 Obtain independent scientific review of the PVA model and analysis.

3.4 Determine that sufficient numbers of juvenile smalltooth sawfish exist to ensure recovery and that sufficient nursery areas are occupied to protect against stochastic events.

Like many species of sharks and rays, smalltooth sawfish use specific habitats commonly referred to as nursery areas. Research to date has identified a number of factors that are believed to be important in identifying nursery areas for smalltooth sawfish; these include depths less than one meter, mangrove shorelines, and euryhaline salinity regimes (Simpfendorfer and Wiley 2005a). Further research, however, is required to better understand the role and importance of nursery areas for smalltooth sawfish.

The occurrence of juvenile sawfish in nursery areas is an indicator of successful breeding and recruitment in the population. Although mortality rates (both natural and from human influence) for smalltooth sawfish are poorly known, only a small proportion of the animals born reach maturity and so contribute to future reproduction. It will be important to monitor the abundance of juvenile smalltooth sawfish to determine if sufficient recruitment is occurring to sustain the population. Given that specific nursery areas are occupied and that there is likely to be a high level of dependence on these habitats for survival, it will be important that recovery is not reliant

on the continued existence of just a few nursery areas. Stochastic natural disasters such as hurricanes and red tides occur through much of the range of the species and could lead to widespread mortality of juveniles. Thus, to adequately recover the population, it will be necessary to ensure that sufficient nursery areas are available.

Research to date has identified nursery areas in the current core of the range of the species. Public encounter databases show the potential current distribution of smalltooth sawfish nursery areas, but only those in the core of the range have been surveyed to any extent. To develop an effective monitoring program for juvenile smalltooth sawfish, there is a need to determine the areas and times of the year to be monitored. This will require thorough, wide-spread surveys to document the full extent of nursery areas in the current range and determine when juveniles are present through the year. In addition, research into juvenile sawfish use of nursery habitats, their level of site fidelity, and movement patterns will be needed to properly design the juvenile monitoring program. Finally, research to determine the carrying capacity of nursery areas is required to evaluate some of the recovery criteria. Determination of carrying capacity will depend on estimating the density of juvenile sawfish that a given area or other measure of habitat (e.g., kilometers of mangrove shoreline) can support over the long-term.

Techniques to measure the abundance of smalltooth sawfish need to be in place to determine when recovery criteria related to juvenile abundance have been met. Given the long timeframes that are likely to be involved with smalltooth sawfish recovery, standardized protocols that can be compared over the long-term will be essential. The most efficient way to implement these protocols would be as part of monitoring systems that already exist. The SSRIT should work with state and federal agencies responsible for fishery-independent monitoring programs in smalltooth sawfish nursery areas to determine if these programs can be modified to collect relevant abundance data. The efficiency of gear currently used, and the potential for other types of gear, should be assessed to ensure that monitoring protocols are the most efficient and reliable. If existing programs cannot meet the requirements or are otherwise incompatible, then specialized monitoring systems for adult sawfish will need to be implemented.

Monitoring the relative abundance of juveniles in each of the designated recovery regions will be essential for determining when they reach the levels specified in the recovery criteria. Surveys will need to occur regularly and the data promptly analyzed to determine if criteria are being met.

3.4.1 Determine the habitat use patterns, site fidelity and movement patterns (including seasonal) of juveniles of all sizes in nursery habitats.

3.4.2 Determine the carrying capacity of nursery habitats in each of the recovery regions used to meet the criteria in Objective 3.

3.4.3 Determine the most appropriate time of year to carry out surveys for juvenile smalltooth sawfish in each of the recovery regions used to meet the criteria in Objective 3.

3.4.4 Compare efficiency of different types of gear (e.g., gillnets, seine nets) to identify most appropriate type of monitoring gear of juvenile smalltooth sawfish.

3.4.5 Evaluate state and Federal agency fishery-independent monitoring programs for their potential to act as measures of juvenile relative abundance.

3.4.6 Conduct annual surveys to determine the relative abundance of juvenile sawfish numbers in nursery habitats in each of the recovery regions used to meet the criteria in Objective 3

3.4.7 Analyze trends in annual relative abundance of juvenile sawfish and determine if the annual rate of increase meets the conditions set in the criteria.

B. Implementation Schedule

An implementation schedule is used to direct and monitor implementation and completion of recovery tasks. Priorities in the first column of the following implementation schedule are assigned as follows:

Priority 1 – An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.

Priority 2 – An action that must be taken to prevent a significant decline in population numbers or habitat quality, or to prevent other significant negative impacts short of extinction.

Priority 3 – All other actions necessary to provide for full recovery of the species.

Funding is estimated according to the number of years necessary to complete the task once implementation has begun, and does not account for inflation. Estimates are based on information available at the time this plan was finalized; the amount needed to actually complete the task may change as specific actions are pursued. The provision of cost estimates is not meant to imply that appropriate levels of funding will necessarily be available for all smalltooth sawfish recovery tasks. Parties with authority, responsibility, or expressed interest to implement a specific recovery action are identified in the implementation schedule. The listing of a party in the implementation schedule does not require the identified party to implement the action(s) or to secure the funding for the implementing action(s). The costs associated with the various recovery tasks listed below are for those to be implemented in U.S. waters only. Costs associated with promotion of international action have not been estimated.

The Implementation Schedule that follows outlines actions and estimated costs for the recovery program for the smalltooth sawfish, as set forth in the plan. It is a guide for meeting the recovery goals outlined in the plan. This schedule indicates action priorities, action numbers, action descriptions, duration of actions, the parties responsible for the actions (either funding or carrying out) and estimated costs. Parties with authority, responsibility, or expressed interest to implement a specific recovery action are identified in the Implementation Schedule. The listing of a party in the Implementation Schedule does not require the identified party to implement the action(s) or to secure funding for implementing the actions(s).

Table 2 Implementation Schedule

				Responsible Parties		Estimated Cost			
Priority	**Action**	**Action Description**	**Duration**	**Federal**	**State & Other**	**Year 1**	**Year 2**	**Year 3**	**Comments**
	Objective 1	**Minimize human interactions and associated injury and mortality.**							
	1.1	Prevent or reduce mortality of the species in fisheries to ensure its long-term viability							
		All commercial and recreational fisheries							
1	1.1.1	Monitor the take and fate of smalltooth sawfish in commercial and recreational fisheries throughout the species' range.	Long-term	NMFS	FWC, other state fishery agencies	TBD	TBD	TBD	Ongoing via section 7 consultations
2	1.1.2	Improve the capacity and geographic coverage of the sawfish encounter data collection program to enable full investigation, review and evaluation of each report of smalltooth sawfish fishery interactions.	Long-term	NMFS	FWC, MML, FMNH	75K	75K	75K	
1	1.1.3	Determine the post-release mortality of smalltooth sawfish from various types of fishing gear.	3 years	NMFS	MML, FWC	75K	75K	75K	
1	1.1.4	Integrate collection of data on smalltooth sawfish into current commercial fishery observer programs and implement new programs where required.	Long-term	NMFS	FWC, other state fishery agencies	TBD	TBD	TBD	
1	1.1.5	Integrate collection of data on smalltooth sawfish into current recreational fishing creel surveys and implement new program where required.	Long-term	NMFS	FWC, other state fishery agencies	TBD	TBD	TBD	Ongoing in the ENP
2	1.1.6	Implement and adequately fund observer programs over the long term.	Long-term	NMFS	State fishery agencies	TBD	TBD	TBD	
3	1.1.7	Use PVA or other types of population models to evaluate the effect of fishery takes on the species' viability.	2 years	NMFS	MML	15K	15K		

Table 2 Implementation Schedule

				Responsible Parties		Estimated Cost			
Priority	**Action**	**Action Description**	**Duration**	**Federal**	**State & Other**	**Year 1**	**Year 2**	**Year 3**	**Comments**
1	1.1.8	Implement strategies to reduce bycatch, mortality, and injury, in specific fisheries to ensure the species' viability.	Long-term	NMFS		*	*	*	Ongoing via section 7 consultations
2	1.1.9	Encourage the FWC, the Atlantic and Gulf States Marine Fisheries Commissions and/or other appropriate state entities, to develop and implement conservation plans as described under ESA section 10(a)(1)(B) for state managed fisheries that incidentally take smalltooth sawfish.	2 years	NMFS	FWC, Other State Agencies, Atlantic and Gulf States Fisheries Commissions	*	*		Discussions initiated with the State of Florida
3	1.1.10	Develop and implement programs, in cooperation with other interested parties to assess, minimize and mitigate the effects of lost fishing gear.	Long-term	NMFS	TBD	15K	15K	15K	
		Longline Fisheries							
1	1.1.12	Monitor longline fisheries to ensure they do not threaten the viability of the population.	Long-term	NMFS		*	*	*	Ongoing via section 7 consultations
1	1.1.13	Reduce mortality by using dehookers, line cutters, and investigate the use of corrodible circle hooks, as well as training in their use, for all commercial bottom longline vessels	Long-term	NMFS	FWC, Atlantic and Gulf States Fisheries Commissions	20K	20K	20K	Initiated in 2006
2	1.1.14	Investigate fishing modifications, devices, and techniques that may work to avoid interaction with smalltooth sawfish and/or enhance the likelihood of successful release of healthy sawfish.	Long-term	NMFS		100K	100K	100K	
2	1.1.15	Minimize mortality by using fishing devices, modifications, and/or techniques found to be effective at reducing bycatch of smalltooth sawfish and/or mitigating the effects of hooking them in areas frequented by sawfish, other important sawfish habitats, and in longline fisheries encountering significant numbers of sawfish.	Long-term	NMFS		*	*	*	Initiated in 2006
		Trawl fisheries							
1	1.1.16	Monitor trawl fisheries to ensure they do not threaten the viability of the population.	Long-term	NMFS	State Fisheries Commissions	*	*	*	

Table 2 Implementation Schedule

				Responsible Parties		Estimated Cost			
Priority	**Action**	**Action Description**	**Duration**	**Federal**	**State & Other**	**Year 1**	**Year 2**	**Year 3**	**Comments**
2	1.1.17	Investigate fishing devices, gear modifications and techniques (physical, electronic, chemical, net configuration, etc) that reduce the likelihood of sawfish capture, improve the chances of sawfish escapement, minimize harm to sawfish and humans from capture, and facilitate successful release of healthy sawfish.	2 years	NMFS	TBD		100K	100K	
1	1.1.18	Recommend the use of fishing devices, gear modifications and/or techniques found to be effective at reducing bycatch of smalltooth sawfish and/or mitigating the effects of capture in areas frequented by sawfish, other important sawfish habitats, and in trawl fisheries encountering significant numbers of sawfish.	2 years	NMFS	TBD	*	*		
		Gillnet fisheries							
1	1.1.19	Monitor gillnet fisheries to ensure they do not threaten the viability of the population.	Long-term	NMFS	State fishery agencies	*	*	*	Ongoing via section 7 consultations
3	1.1.20	Develop regulations, if necessary, to minimize sawfish bycatch in state waters.	Long-term	NMFS	State fishery agencies, Atlantic and Gulf States Fisheries Commissions	TBD	TBD	TBD	
3	1.1.21	Develop regulations, if necessary, to minimize sawfish bycatch in federal waters.	Long-term	NMFS, SAFMC, and MAFMC			*	*	
2	1.1.22	Continue to investigate avenues to reduce the risk of capture, injury, and mortality in gillnet fisheries	Long-term	NMFS	State fishery agencies	*	*	*	
2	1.1.23	Recommend the use of fishing devices, modifications and/or techniques found to be effective at reducing bycatch of smalltooth sawfish and/or mitigating the effects of entanglement in areas frequented by sawfish, other important sawfish habitats, and in gillnet fisheries encountering significant numbers of sawfish.	Long-term	NMFS	* State fishery agencies	*	*	*	
2	1.1.24	Continue to minimize gillnet effects by gillnet bans in Florida.	Long-term		FWC	*	*	*	Ongoing

Table 2 Implementation Schedule

Priority	Action	Action Description	Duration	Responsible Parties		Estimated Cost			Comments
				Federal	State & Other	Year 1	Year 2	Year 3	
		Recreational Fisheries							
2	1.1.25	Monitor recreational fisheries to ensure they do not threaten the viability of the population.	Long-term	NMFS, ENP	FWC, State fishery agencies	TBD	TBD	TBD	
2	1.1.26	Investigate and, if practical, require devices that reduce the capture, injury, and mortality from recreational fisheries (e.g., corrodible and circle hooks).	Long-term	NMFS	FWC,MML, State fishery agencies	TBD	TBD	TBD	
	1.2	Monitor trade to ensure trade in sawfish parts does not threaten the long-term viability of the population.							
3	1.2.1	Promote the continued listing of smalltooth sawfish under Appendix I of CITES.	long-term	NMFS, Dept of Interior, Dept. of State, and NOAA's Office of International Affairs	Conservation NGOs	*	*		Smalltooth sawfish were listed in Appendix 1 of Cites in 2007
3	1.2.2	Encourage NOAA's Office of Law Enforcement to ensure enforcement of prohibitions of illegal sales of smalltooth sawfish on auction outlets, if any.	Long-term	NMFS		*	*	*	Ongoing
3	1.2.3	Encourage NOAA's Office of Law Enforcement to investigate and prosecute persons engaging in interstate commerce of smalltooth sawfish, if any.	Long-term	NMFS		*	*	*	Ongoing
3	1.2.4	Work with the aquarium community and the American Zoo and Aquarium Association to ensure that movement and/or trade in sawfish currently in captivity, or their progeny, do not threaten the long-term viability of the population.	Long-term	NMFS	American Zoo and Aquarium Association, MML	*	*	*	
		Minimize interactions, injury, and mortality through outreach and education.							

Table 2 Implementation Schedule

Priority	Action	Action Description	Duration	Responsible Parties		Estimated Cost			Comments
				Federal	State & Other	Year 1	Year 2	Year 3	
2	1.3.1	Develop programs and distribute materials to educate the public about smalltooth sawfish status and protections with a focus on those most likely to encounter this species (e.g., fishermen, divers, boaters)	Long-term	NMFS	FLMNH, MML	40K	40K	40K	Ongoing
3	1.3.2	Develop safe handling and husbandry guidelines for sawfish, and related educational materials.	1 year	NMFS	American Zoo and Aquarium Association, MML	15K			Ongoing
1	1.3.3	Develop, distribute, and implement Safe Handling and Release Guidelines for smalltooth sawfish for recreational and commercial fisheries to minimize interactions, injury, and mortality.	Long-term	NMFS	FWC, State fishery agencies	10K	10K	10K	Ongoing
1	1.3.4	Improve effective implementation of safe handling and release techniques through information distribution and training seminars associated with recreational and commercial fishing events, trade shows, tackle and bait shops, boating stores and related outlets.	Long-term	NMFS, NOAA's Sea Grant	State fishery agencies, Commercial and recreational fishing organizations	15K	15K	15K	Ongoing
		Reduce threats from research efforts.							
3	1.4.1	Monitor mortality of the species from both targeted and non-targeted research programs.	Long-term	NMFS	State fishery agencies	*	*	*	Ongoing
1.4 3	1.4.2	Develop standardized research protocols for authorized smalltooth sawfish researchers to ensure that studies are coordinated, that take for research is minimized and associated harm is minimized, and the cumulative effects are considered.	1 year	NMFS	State fishery agencies, MML	20K			
3	1.4.3	Develop a training course for researchers who handle sawfish to ensure minimization of injury and mortality from research activities.	1 year	NMFS		20K			
		Develop non-ESA protection measures and a post delisting monitoring plan.							
1.5		Develop protective measures with state, local, and other appropriate agencies that will continue after the ESA protections are removed.	Long-term	NMFS	State fishery agencies	*	*	*	Continuous
1.5.1									

Table 2 Implementation Schedule

				Responsible Parties		Estimated Cost			
Priority	**Action**	**Action Description**	**Duration**	**Federal**	**State & Other**	**Year 1**	**Year 2**	**Year 3**	**Comments**
		Develop a post-delisting monitoring plan as required by ESA (4)(g).	1 year	NMFS	State fishery agencies				Develop soon after downlisting
	Objective 2	**Protect and/or restore smalltooth sawfish habitats**.							
1.5.2		Ensure that nursery habitat of sufficient size and quality exists to enable the recovery of the species.							
1 2.1	2.1.1	Conduct surveys throughout the current range of the species to determine the locations of current sawfish potential nursery habitats.	5 years	NMFS	FWC, MML, State fishery agencies	200K	200K	200K	Ongoing studies in south Florida
1	2.1.2	Determine which habitats, apart from shoreline mangroves, are currently used as nursery areas.	5 years	NMFS	FWC, MML, State fishery agencies	25K	25K	25K	
3	2.1.3	Construct habitat models based on survey data to identify potential nursery habitats in areas unsurveyed or outside of the current range.	1 year	NMFS	FWC, MML, State fishery agencies			50K	Use survey data from 2.1.1
2	2.1.4	Document the effect of coastal development on use of nursery habitats by juveniles.	2 years	NMFS	FWC, MML, State fishery agencies	75K	75K		Ongoing in south Florida
2	2.1.5	Estimate the historic distribution of shoreline habitats (throughout the core range of smalltooth sawfish).	2 years	NMFS, NOS	FWC, MML, State fishery agencies			40K	
1	2.1.6	Estimate the extent of native shoreline habitats at the time of listing compared to historic levels.	1 year	NMFS, NOS	FDEP, other States	20K 40K			Ongoing
2	2.1.7	Monitor losses and gains of mangrove shoreline habitat in recovery regions G, H, I, J, and K.	Long-term	NMFS, NOS	FDEP	20K	20K	20K	Ongoing

Table 2 Implementation Schedule

				Responsible Parties		Estimated Cost			
Priority	**Action**	**Action Description**	**Duration**	**Federal**	**State & Other**	**Year 1**	**Year 2**	**Year 3**	**Comments**
2	2.1.8	Restore mangrove shoreline habitats in recovery regions where levels are insufficient to support juvenile recruitment.	TBD	COE, EPA, NMFS	FDEP	TBD	TBD	TBD	
1	2.1.9	Ensure that appropriate regulations are in place to protect (and potentially recover) mangrove shoreline habitats in recovery regions G - K.	Long-term	COE, EPA	FDEP	*	*	*	
1	2.1.10	Monitor losses and gains of nursery habitats, apart from shoreline mangroves, in all recovery regions.	Long-term (start in FY 08)	COE, EPA	FDEP		20K	20K	
3	2.1.11	Restore non-mangrove nursery habitats in all recovery regions located in Florida.	Long-term	COE, EPA, NMFS	FDEP	TBD	TBD	TBD	
1	2.1.12	Ensure that appropriate regulations are in place to protect (and potentially recover) non-mangrove nursery habitats in all recovery regions.	Long-term	COE, EPA	FDEP	*	*	*	
		Minimize the disruption of natural/historic freshwater flow regimes (including timing, quality, and quantity) and maintain or restore water quality.							
1 2.2	2.2.1	Determine the salinity preference and tolerance of juveniles of all sizes using laboratory experiments.	3 years (start in FY08)	NMFS, COE	MML, FWC, WMDS			125K	
1	2.2.2	Monitor the salinity and other water quality preferences of juveniles in the field.	3 years	NMFS, COE	MML, FWC, WMDS	100K 125K	100K	100K	
1	2.2.3	Monitor water flow into, and salinity of, nursery habitats in all recovery regions.	Long-term	COE	WMDS, FDEP, others	10K	10K	10K	
1	2.2.4	Work with state and local agencies to evaluate whether regulations are in place to maintain appropriate water quality in sawfish nursery habitats.	Long-term	NMFS, EPA	WMDS, FDEP, others	*	*	*	

Table 2 Implementation Schedule

Priority	Action	Action Description	Duration	Responsible Parties		Estimated Cost			Comments
				Federal	State & Other	Year 1	Year 2	Year 3	
		Identify and protect the habitats (particularly mating and pupping areas) of adult smalltooth sawfish.							
1 2.3	2.3.1	Conduct surveys throughout the current range of smalltooth sawfish to determine the distribution of adult smalltooth sawfish and identify habitats of aggregation or local abundance.	2 years	NMFS	FWC, MML	200K	200K		This action is also identified in Objective 3
2	2.3.2	Investigate short-term movement patterns of adult sawfish to provide information on habitat use patterns.	3 years	NMFS	FWC, MML	100K	100K	100K	Ongoing
3	2.3.3	Investigate the seasonal migrations of adults along the US east coast and in the Gulf of Mexico, including documenting the temperature tolerances that may drive these patterns.	3 years (start in FY 08)	NMFS	FWC, MML		75K	75K	
2	2.3.4	Investigate seasonal patterns of occurrence and habitat use of adults.	2 years	NMFS	FWC, MML	200K	200K		
3	2.3.5	Construct habitat-based movement models to identify seasonal changes in crucial habitat areas for adults.	1 year (FY10)	NMFS	FWC, MML	75K			
2	2.3.6	Monitor abundance of adult smalltooth sawfish in aggregation areas.	Long-term	NMFS	FWC, MML	TBD	TBD	TBD	
2	2.3.7	Monitor changes in habitat and environmental parameters in aggregation areas.	Long-term	NMFS	FWC, MML	TBD	TBD	TBD	
3	2.3.8	Restore degraded habitats in aggregation area, if determined necessary for recovery.	Long-term	TBD	TBD	TBD	TBD	TBD	
1	2.3.9	Ensure appropriate federal, state, and local regulations are in place to protect adult aggregation habitats.	Long-term	NMFS	FWC, MML	TBD	TBD	TBD	

Table 2 Implementation Schedule

Priority	Action	Action Description	Duration	Responsible Parties		Estimated Cost			Comments
				Federal	State & Other	Year 1	Year 2	Year 3	
	Objective 3	**Ensure smalltooth sawfish abundance increases substantially and the species reoccupies areas from which it had been previously extirpated.**							
		Investigate the relationship (movements) between the U.S. DPS of smalltooth sawfish and populations in surrounding countries and coordinate conservation and recovery efforts to ensure the U.S smalltooth sawfish recovery efforts are not hindered.							
3 3.1	3.1.1	Conduct genetic comparisons between US DPS and populations in surrounding countries.	3 years	NMFS	University or Research Org	25K	25K	25K	Ongoing
3	3.1.2	Establish and continue tagging studies (Gulf of Mexico and Caribbean).	5 years	NMFS	University or Research Org	75K	75K	75K	Ongoing
3	3.1.3	Encourage protection of smalltooth sawfish and promote the reduction of sawfish bycatch in neighboring countries	Long-term (start in FY 08)	Dept of State, NOAA	TBD		20K	20K	
		Determine that sufficient numbers of adult smalltooth sawfish exist to ensure recovery.							
2 3.2	3.2.1	Assess the east and west coasts of Florida to determine the most appropriate location and timing of surveys for adult smalltooth sawfish.	2 years (start in Fy08)	NMFS	FWC, MML		200K	200K	
2	3.2.2	Evaluate fishery observer programs to determine their suitability to act as surveys of relative abundance of adult smalltooth sawfish.	1 year	NMFS	State fishery agencies	5K			
2	3.2.3	Evaluate state and federal fishery-independent monitoring programs to determine their suitability to act as surveys of relative abundance of adult smalltooth sawfish.	2 years	NMFS	State Fisheries Agencies, TPWD	10K	10K		
1	3.2.4	Conduct regular surveys to determine a baseline and subsequent relative abundance levels of smalltooth sawfish off the east and west coasts of Florida.	Long-term	NMFS	FWC, MML	300K	300K	300K	Ongoing for parts of southwest Florida

Table 2 Implementation Schedule

				Responsible Parties		Estimated Cost			
Priority	**Action**	**Action Description**	**Duration**	**Federal**	**State & Other**	**Year 1**	**Year 2**	**Year 3**	**Comments**
1	3.2.5	Analyze annual relative abundance data for adult smalltooth sawfish and determine if it meets the criteria in Objective 3.	Long-term	NMFS		5K	5K	5K	
2	3.2.6	Conduct tagging studies, potentially using satellite and/or archival technology, to study seasonal migrations along the US east coast and within the Gulf of Mexico.	5 years	NMFS	MML, State Agencies	100K	100K	100K	
2	3.2.7	Continue existing effective sawfish encounter reporting systems with outreach efforts throughout the historic range, with special efforts focused on the north central Gulf of Mexico, Georgia, South Carolina and North Carolina.	Long-term	NMFS	MML, FMNH, others	100K	100K	100K	Ongoing
2	3.2.8	Access research survey and fishery independent monitoring datasets to obtain records of adult smalltooth sawfish in the north central Gulf of Mexico, Georgia, South Carolina and North Carolina.	Long-term	NMFS		10K	10K	10K	
		Develop a spatially-structured PVA for the species to estimate extinction probabilities.							
3 3.3	3.3.1	Collect life history data, including age, growth, reproductive and natural mortality.	3 years	NMFS	State fishery agencies, MML	20K	20K	20K	Ongoing
3	3.3.2	Determine movement rates by size class between recovery regions.	3 years	NMFS	FWC, MML	150K	150K	150K	
3	3.3.3	Collect other biological or ecological data as required for the PVA.	1 year	NMFS	MML	25K			Ongoing
3	3.3.4	Collect information on catches and mortality in recreational and commercial fisheries for use in the PVA.	3 years	NMFS	MML, State Agencies	150K	150K	150K	Ongoing

Table 2 Implementation Schedule

				Responsible Parties		Estimated Cost			
Priority	**Action**	**Action Description**	**Duration**	**Federal**	**State & Other**	**Year 1**	**Year 2**	**Year 3**	**Comments**
3	3.3.5	Build a spatially structured PVA model for smalltooth sawfish	2 years	NMFS	MML	50K	50K		
3	3.3.6	Obtain independent scientific review of the PVA model and analysis	1 year	NMFS	MML, TBD	*			
		Determine that sufficient numbers of juvenile smalltooth sawfish exist to ensure recovery and that sufficient nursery areas are occupied to protect against negative stochastic events.							
2 3.4	3.4.1	Determine the habitat use patterns, site fidelity and movement patterns (including seasonal) of juveniles of all sizes in nursery habitats.	3 years	NMFS	FWC, MML	250K	250K	250K	Ongoing in southwest Florida
2	3.4.2	Determine the carrying capacity of nursery habitats in each of the recovery regions used to meet criteria in Objective 3.	3 years	NMFS	FWC, MML	100K	100K	100K	
2	3.4.3	Determine the most appropriate time of year to carry out surveys for juvenile smalltooth sawfish in each of the Recovery Regions used to meet the criteria in Objective 3.	1 year (Start FY09)	NMFS	FWC			10K	
3	3.4.4	Compare efficiency of different types of gear (e.g. gillnets, seine nets) to identify most appropriate type to monitor juvenile smalltooth sawfish.	1 year(start in FY09)	NMFS	FWC, MML			20K	
3	3.4.5	Evaluate state and Federal agency fishery-independent monitoring programs for their potential to act as measures of relative abundance.	1 year (start in FY09)	NMFS	FWC, MML			15K	
2	3.4.6	Conduct annual surveys to determine the relative abundance of juvenile sawfish numbers in nursery habitats in each of the recovery regions used to meet criteria in Objective 3.	Long-term	NMFS	FWC, MML, State fishery agencies	TBD	TBD	TBD	
1	3.4.7	Analyze trends in annual relative abundance of juvenile sawfish and determine if the annual rate of increase meets the conditions set in criteria.	Long-term	NMFS		5K	5K	5K	

* No separate, direct costs (NMFS staff or others)

"Long-term" is defined as 100 years

V. Literature Cited

Adams, W. F. and C. Wilson. 1995. The status of the smalltooth sawfish, *Pristis pectinata* Latham 1794 (Pristiformes: Pristidae) in the United States. Chondros 6:1–5.

Baughman, J.L. 1943. Notes on sawfish *Pristis perotteti* Müller and Henle, not previously reported from the waters in the United States. Copeia 1943(1):43–48.

Bean, T.H. 1892. Observations upon fishes and fish-culture. Bull. U.S. Fish. Comm. 10:49–61.

Bigelow, H.B. and W.C. Schroeder. 1953. Fishes of the Western North Atlantic, Part 2. Sawfishes, Guitarfishes, Skates, Rays, and Chimaeroids. pp. 1–514. Mem. Sears Found. Mar. Res., Yale University, New Haven, CT, 514 pp.

Boesch, D.F., Josselyn, M.N., Mehta, A.J., Morris, J.T., Nuttle, W.K., Simenstad, C.A., Swift, D.J.P. 1994. Scientific Assessments of Coastal Wetland Loss, Restoration, and Management in Louisiana. Journal of Coastal Research. Special Issue No. 20.

Bohorquez, C. 2001. Growth of the sawfish (*Pristis pectinata*) at the Oceanario Islas Rosario, Columbia. Unpublished abstract, 1st International Elasmobranch Husbandry Symposium, Orlando, FL.

Boschung, H.T. 1957. The fishes of Mobile Bay and Gulf coast Alabama. Ph.D. dissertation, University of Alabama, Tuscaloosa, 626 pp.

Boschung, H.T. 1993. Catalog of freshwater fishes of Africa in the British Museum (Natural History), London, Longmans & Co., 1:1–3.

Breder, C.M. 1952. On the utility of the saw of the sawfish. Copeia 1952(2):90–91.

Brockmeyer, R.E. Jr., J.R. Rey, R.W.Virnstein, R.G. Gilmore and L. Earnest. 1997. Rehabilitation of impounded estuarine wetlands by hydraulic reconnection to the Indian River Lagoon, Florida (USA). Wetlands Ecology and Management 4:93–109.

Burgess, G.H., and T.H. Curtis. 2003. Temporal Reductions in the Distribution and Abundance of the U.S. Atlantic Sawfishes (*Pristis* spp.). Oral presentation at AES 2003. Manaus, Brazil.

Burgess, G. Personal Communication. Florida Museum of Natural History, Gainesville, FL.

Caldwell, S. 1990. Texas sawfish: Which way did they go? Tide (Jan.-Feb.):16–19.

Camhi, M. 1998. Sharks on the line: A state-by-state analysis of sharks and their fisheries. National Audubon Society, Living Oceans Program, Islip, NY, 156 pp.

Carlson, J. Personal Communication. National Marine Fisheries Service, Panama City, FL.

Carlson, J.K. J. Osbourne and T.W. Schmidt. 2007. Monitoring the recovery of smalltooth sawfish, *Pristis pectinata*, using standardized relative indices of abundance. Biological Conservation 136:195-202.

Cerkleski, R.F. 2000. Personal communication. Curator for the Key West Aquarium, Key West, FL.

Chambers. 1992. Coastal degradation and fish population losses. In: Stroud, R.H. (ed). Stemming the tide of coastal fish habitat loss. Proceedings of a Symposium on Conservation of Coastal Fish Habitat. pp. 45–50.

Clark, S., G. Violetta, A. Henningsen, V. Reischuck, P. Mohan, J. Keyon, and G. Kelly. 2004. Growth in captive smalltooth sawfish, *Pristis pectinata*. Presentation to the Smalltooth Sawfish Recovery Team, October 2004.

Coles, R. J. 1915. Notes on the sharks and rays of Cape Lookout, N.C. Proc. Biol. Soc. Wash. 28:89–94.

Compagno, L.J.V. and S.F. Cook. 1995. The exploitation and conservation of freshwater elasmobranchs: status of taxa and prospects for the future. In: M.I. Oetinger and G.D. Zorzi, (eds.), The biology of freshwater elasmobranchs. The Journal of Aquariculture and Aquatic Science 7: 62–90.

Compagno, L.J.V. and P.R. Last. 1999. Pristidae. Sawfishes. Pp. 1410–1417. In: Carpenter, K.E. and V. Niem (eds.), FAO Identification Guide for Fishery Purposes. The Living Marine Resources of the Western Central Pacific. FAO, Rome, Italy.

Davis, J.H. and W.D. Wilson. 1943. Vegetation Map of Southern Florida. Tallahassee, Fla. FL Geological Survey.

Evermann, B.W. and B.A. Bean. 1898. Indian River and its fishes. U.S. Comm. Fish Fisher. 22:227–248.

Evermann, B.W. and W.C. Kendall 1894. The fishes of Texas and the Rio Grande Basin, considered chiefly with reference to their geographic distribution Bull. U.S. Fish Comm. 12:57–121.

Evermann, B.W. and W.C. Kendall. 1900. Check-list of the fishes of Florida. Report of the Commissioner, U.S. Commission of Fish and Fisheries 25:35–103.

Evermann, B.W. and M.C. Marsh. 1900. The Fishes of Porto Rico. Bull. U.S. Fish Comm. 20:63–64.

Faria, V. Personal Communication. Florida State University, Tallahassee, FL.

Fourqurean, J.W. and M.B. Robblee. 1999. Florida Bay: a history of recent ecological changes. Estuaries 22:345–357.

Fowler, H.W. 1906. The Fishes of New Jersey. Ann. Rep. NJ State Mus. 1905:34–477, +103 pl.

Fowler, H.W. 1914. Notes on the fishes at Ocean City, Maryland. Copeia 2:2.

Fowler, H.W. 1915. Cold-blooded Vertebrates from Florida, the West Indies, Costa Rica, and eastern Brazil. Proc. Acad. Nat. Sci. Phila., 67:244–269.

Fowler, H.W. 1945. A study of the fishes of the southern Piedmont and Coastal Plain. Acad. Nat. Sci. Phila., Monogr. 7. 408 pp., +313 fig.

Fowler, S. 2006. Personal Communication during IUCN-World Conservation Union Shark Specialist Group Northeast Atlantic Red List Workshop. Peterborough, England, U.K. February 13, 2006.

Gelsleichter, J., Walsh, C.J., Szabo, N.J., and Rasmussen, L.E.L. 2006. Organochlorine concentrations, reproductive physiology, and immune function in unique populations of freshwater Atlantic stingrays (Dasyatis sabina) from Florida's St. Johns River. Chemosphere. 63: 1506-1522.

Gilmore, R.G. 1995. Environmental and biogeographic factors influencing ichthyofaunal diversity: Indian River Lagoon. Bull. Mar. Sci. 57:153–170.

Goode, G.B. 1879a. Catalogue of the collection to illustrate the animal resources and the fisheries of the United States, exhibited at Philadelphia in 1876 by the Smithsonian Institute and the United States Fish Commission, and forming a part of the United States National Museum. Bull. U.S. Natl. Mus. 14:10–70.

Goode, G.B. 1879b. A preliminary catalogue of the fishes of the St. John's River and the east coast of Florida, with the descriptions of a new genus and three new species. Proc. U.S. Natl. Mus. 2(73):108–121.

Goode, G.B. 1884. Natural history of useful aquatic animals. The Fisheries and Fishery Industries of the United States. Washington. 1-895 +pl.

Goode, G.B. and T.H. Bean. 1882. Descriptions of twenty-five new species of fish from the southern United States, and three new genera, /*Letharous, Ioglossus, Chriodus*/. Proc. U.S. Natl. Mus 5:412–437.

Gowanloch, J.N. 1932. Sea Fisheries and fishing in Louisiana. Bull. Louisianan Dep. Conserv. 23:208–209.

Gudger, E.W. 1912. Natural history notes on some Beaufort, N.C., fishes, 1910-1911. No. I. Elasmobranchii—with special reference to utero-gestation. Proc. Biol. Soc. Wash. 25:141–156.

Gudger, E.W. 1933. Journal of the Elisha Mitchell Scientific Society. 49:59.

Gunter, G. 1936. Records of fishes rarely caught in shrimp trawls in Louisiana. Copeia 1935:39–40.

Henshall, J.A. 1891. Report upon a collection of fishes made in southern Florida during 1889. Bull. U.S. Fish Comm. 9:371–389.

Henshall, J.A. 1895. Notes on fishes collected in Florida in 1892. Bull. U.S. Fish Comm. 14:209–221.

Heupel, M.R. and Simpfendorfer, C.A. 2002. Estimation of survival and mortality of juvenile blacktip sharks, *Carcharhinus limbatus*, within a nursery area based on telemetry data. Can. J. Fish. Aquat. Sci. 59:624–632.

Hildebrand, S.F. and W.C. Schroeder. 1928. Fishes of Chesapeake Bay. Bull. U.S. Bur. Fish. 43:1–36.

IUCN. 2000. Sharks, Rays and Chimaeras: The Status of the Chondrichthyan Fishes (compiled and edited by S.L. Fowler, R.D. Cavanagh, M. Camhi, G.H. Burgess, G.M. Cailliet, S.V. Fordham, C.A. Simpfendorfer, and J.A. Musick)

IUCN. 2006. 2006 IUCN Red List of Threatened Species. <www.iucnredlist.org>

Jenkins, O.P. 1885. Note on the fishes of Beaufort Harbor, N.C. Johns Hopkins Univ.Circ.(October):11.

Jordan, D.S. 1886. Notes on fishes collected at Beaufort, North Carolina, with a revised list of species known from that locality. Proceedings of the United States National Museum 9:25–30.

Jordan, D.S. and B.W. Evermann. 1896. The fishes of North and Middle America: A descriptive catalogue of the species of fish-like vertebrates found in the waters of North America, north of the Isthmus of Panama. Bull. Natl. Mus. 47:1–1240.

Jordan, D.S. and B.W Evermann. 1900. The fishes of North and Middle America: A descriptive catalogue of the species of fish-like vertebrates found in the waters of North America, north of the Isthmus of Panama. Bull. Natl. Mus. 47:I-ci +3137-3313, Pls. 1–392.

Jordan, D.S and C.H. Gilbert. 1882. Notes on the fishes observed about Pensacola, Florida, and Galveston, Texas, with description of new species. Proc. U.S. Natl. Mus. 5:241–307.

Jordan, D.S and C.H. Gilbert. 1883. Synopsis of the fishes of North America. Bull. U.S. Natl. Mus. No. 16:1–1018.

Jordan, D.S. and J. Swain. 1884. Notes on fishes collected by David S. Jordan at Cedar Keys, Florida. Proc. U.S. Nat. Mus. 7:230–234.

Lawson, J. 1709. A new voyage to Carolina. H.T. Lefler (ed.). University of North Carolina Press, Chapel Hill (Reprinted 1967).

Lönnberg, E. 1894. List of fishes observed and collected in south-Florida. Öfversigt af Kongl. Vetenskups-Akademieus Förhandlingar 3:109–131.

Lowe, C.G. 2002. Bioenergetics of free-ranging juvenile scalloped hammerhead sharks (*Sphyrna lewini*) in Kane'ohe Bay, O'ahu, HI. J. Exp. Mar. Biol. Ecol. 278:141–156.

McDavitt, M.T. 2005. Summary of trade in sawfishes and sawfish parts. Unpublished Report. 25 pp.

McDavitt, M.T. Personal Communication. University of Virginia School of Law.

McEachran, J.D., and J.D. Fechhelm. 1998. Fishes of the Gulf of Mexico. Volume 1: Myxiniformes to Gasterosteiformes. University of Texas Press, Austin, TX. 1112 pp.

Musick, J.A. 1999. Life in the slow lane: ecology and conservation of long-lived marine animals. American Fisheries Society Symposium 23. 265 pp.

Musick, J.A., M.M. Harbin, S.A. Berkeley, G.H. Burgess, A.M. Eklund, L. Findley, R.G. Gilmore, J.T. Golden, D.S. Ha, G.R. Huntsman, J.C. McGovern, S.J. Parker, S.G. Poss, E. Sala, T.W. Schmidt, G.R. Sedberry, H. Weeks, and S.G. Wright. 2000. Marine, estuarine, and diadromous fish stocks at risk of extinction in North America (exclusive of Pacific salmonids). Fisheries 25:6–30.

Nichols, J.T. 1917. Ichthyological notes from a cruise off southwest Florida, with description of *Gobiesox yuma* sp.nov. Bull. Amer. Mus. Nat. Hist. 37:873–877.

NMFS. 2000. Status Review of Smalltooth Sawfish (*Pristis pectinata*).

NMFS. 2006. Interim Endangered and Threatened Species Recovery Planning Guidance.

NMFS HMS BiOp. 2003. Endangered Species Act section 7 consultation on the continued operation of Atlantic shark fisheries (commercial shark bottom longline and drift fisheries and recreational shark fisheries) under the Fishery Management Plan for Atlantic Tunas, Swordfish, and Sharks (HMS FMP) and the Proposed Rule for Draft Amendment 1 to the HMS FMP. Biological Opinion. July 2003.

Norman, J.R. and F.C. Fraser. 1937. Giant Fishes, Whales and Dolphins. Putman and Co., Ltd., London. 361 pp.

Odum, W.E., C.C. McIvor, and T. J. Smith. 1982. The ecology of the mangroves of south Florida: a community profile. U.S. Fish and Wildlife Service, Office of Biological Services, Wash. D.C. FWS/OBS-8124. 144 pp.

Orlando, S.P, Jr., P.H. Wendt, C.J. Klein, M.E. Pattillo, K.C. Dennis, and G.H. Ward. 1994. Salinity characteristics of the south Atlantic estuaries. Silver Springs, MD: National Oceanic and Atmospheric Administration, Office of Ocean Resources Conservation and Assessment. 117 pp.

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 67:27–35.

Quavis, C. 2000. Personal Communication. Mississippi Department of Marine Resources, Biloxi, Mississippi.

Radcliffe, L. 1916. The sharks and rays of Beaufort, North Carolina. Bull. U.S. Bur. Fish. 34(822):239–284, +12 pl. and 26 figs.

Rafinesque, C.S. 1820. Natural history of the fishes inhabiting the river Ohio and its tributary streams, preceded by a physical description of the Ohio and it branches. Ichthyol. Ohioensis: 1–90.

Reddering, J.S.V. 1988. Prediction of the effects of reduced river discharge on estuaries of the south-eastern Cape Province, South Africa. S. Afr. J. Sci. 84:726–730.

Romer, G.W. 1936. Florida: The land of enchantment. New York, NY: Manhattan Post Card Pub. Co.

SAFMC (South Atlantic Fisheries 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. Prepared by the South Atlantic Fishery Management Council, October 1998. Available from: SAFMC, 1 Southpark Circle, Suite 306, Charleston, SC 29407.

Schmid, T.H., L.M. Ehrhardt, and F.F. Snelson. 1988. Notes on the occurrence of rays (Elasmobranchii, Batoidea) in the Indian River Lagoon system, Florida. Florida Scientist 51:121–128.

Schmidt, T.W. 1979. Ecological Study of Fishes and Water Quality Characteristics of Florida Bay, Everglades National Park, Florida. Technical Report: RSP-Ever-N-36-USNPS, South Florida Research Center, Homestead, Florida. 145 pp.

Schmidt, T.W., G.A. Degado, and J. Kalafarski. 2000. Annual Fisheries Report, Everglades National Park. South Florida Natural Resources Center, Homestead, Florida.

Schopf. 1788. Beschreiburg Nordamerikanische Fische. Schriftliche Gesellschaft Naturoforschende Freunde, Berlin 8:185.

Schwartz, F.J. 1984. Sharks, sawfish, skates, and rays of the Carolinas. Special Publication, Institute of Marine Sciences, University of North Carolina, Morehead City, NC.

Schwartz, F. J. 2003. Bilateral asymmetry in the rostrum of the smalltooth sawfish, *Pristis pectinata* (Pristiformes: Family Pristidae). J. North Carolina Acad. Sci. 119:41–47.

Scott, G.I. 1997. Assessment of risk reduction strategies for the management of agricultural non-point-source runoff in estuarine ecosystems of the southeastern U.S. Unpublished report of the National Marine Fisheries Service, Charleston Laboratory. 5 pp.

Seitz, J.C. and G.R. Poulakis. 2002. Recent occurrence of sawfishes (Elasmobranchiomorphi: Pristidae) along the southwest coast of Florida (USA). Florida Scientist 65:256–266.

Seitz, J.C. and G.R. Poulakis. 2006. Anthropogenic effects on the smalltooth sawfish (*Pristis pectinata*) in the United States. Marine Pollution Bulletin 52:1533–1540.

Serafy, J.E., K.C. Lindeman, T.E. Hopkins, and J.S. Ault. 1997. Effects of freshwater canal discharges on subtropical marine fish assemblages: field and laboratory observations. Mar. Ecol. Prog. Ser. 160: 161–172.

Shields, S.A. Jr. 1879. Large Sawfish. Amer. Nat. 13:262.

Shirley, M., P. O'Donnell, V. McGee, and T. Jones. 2005. Nekton species composition as a biological indicator of altered freshwater inflow: a comparison of three south Florida estuaries. In: Estuarine Indicators, S. Bortone (ed.), CRC Press, Boca Raton, Florida, pp. 351–364.

Simpfendorfer, C.A. 2000. Predicting recovery rates for endangered western Atlantic sawfishes using demographic analysis. Environmental Biology of Fishes 58:371–377.

Simpfendorfer, C.A. 2002. Smalltooth sawfish: the USA's first endangered elasmobranch? Endangered Species Update 19:45–49.

Simpfendorfer, C.A. 2003. Abundance, movement and habitat use of the smalltooth sawfish. Final Report to the National Marine Fisheries Service, Grant number WC133F-02-SE-0247. Mote Marine Laboratory Technical Report (929).

Simpfendorfer, C.A. and N.E. Milward. 1993. Utilization of a tropical bay as a nursery area by sharks of the families Carcharhinidae and Sphyrnidae. Environmental Biology of Fishes 37:337–345.

Simpfendorfer, C.A. and T.R. Wiley. 2005a. Determination of the distribution of Florida's remnant sawfish population and identification of areas critical to their conservation. Final Report. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

Simpfendorfer, C.A. and T.R. Wiley. 2005b. Identification of priority areas for smalltooth sawfish conservation. Mote Marine Laboratory Technical Report (1021).

Simpfendorfer, C.A., Freitas, G.G., Wiley, T.R., and Heupel, M.R. 2005. Distribution and habitat partitioning of immature bull sharks (*Carcharhinus leucas*) in a southwest Florida estuary. Estuaries 28:76–83.

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

Smith, H.M. 1896. Notes on Biscayne Bay, Florida, with reference to its adaptability as the site of a marine hatching and experiment station. Rep. U.S. Comm. Fish for 1885 (1886). pp. 169–191.

Smith, H.M. 1907. The Fishes of North Carolina. N.C. Geol. Econ. Surv. 2:1–453.

Snelson, F.F. and S.E. Williams. 1981. Notes on the occurrence, distribution, and biology of elasmobranch fishes in the Indian River lagoon system, Florida. Estuaries 4:110–120.

Tanaka, T. 1991. Age estimation of freshwater sawfish and sharks in northern Australia and Papua New Guinea. University Museum, University of Tokyo, Nature and Culture (3):71–82.

Thorson, T.B. 1973. Sexual dimorphism in number of rostral teeth of the sawfish, *Pristis perotteti* Müller and Henle, 1841. Transactions of the American Fisheries Society 103:612–614.

Thorson, T.B. 1976. Observations on the reproduction of the sawfish, *Pristis perotteti*, in Lake Nicaragua, with recommendations for its conservation, pp. 641–650. In: Thorson, T.B.(ed), Investigations of the Ichthyofauna of Nicaraguan Lakes, School of Life Sciences, Univ. Nebraska-Lincoln, Lincoln, NE.

True, F.W. 1883. A list of the vertebrate animals of South Carolina. In: Handbook of South Carolina. p. 261.

Triutt, B. and H.W. Fowler. 1929. The fishes of Maryland. Bull. Maryland Conserv. Dep. 3:1–120.

Uhler, P.R. and O. Lugger. 1876. List of fish of Maryland. Rep. Comm. Fish. Maryland. pp. 81 –208.

USGS (U.S. Geological Survey). 1997. Comparison of drainage basin nutrient inputs with instream nutrient loads for seven rivers in Georgia and Florida, 1986–90.

Van der Elst, R. 1981. A Guide to the Common Sea Fishes of Southern Africa. C. Struik Publishers Ltd., Cape Town, South Africa.

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.

Wilson, H.V. 1900. Marine Biology at Beaufort. Amer. Nat. 34(401):339–360.

Yarrow, H.C. 1877. Notes on the natural history of Fort Macon, NC and vicinity (No. 3). Proc. Acad. Nat. Sci. Phila. 29:203–218.

VI. APPENDICES

APPENDIX A

Listing Notice For *Pristis pectinata*
Federal Register 68(62): 15674

APPENDIX B

Sawfish Handling and Release Guidelines

SAWFISH HANDLING AND RELEASE GUIDELINES
(February 2007)

Smalltooth sawfish are listed as endangered under the Endangered Species Act, which makes it illegal to harm, harass or handle them in any way. It is therefore illegal to hook or net one, except with a permit, or in a fishery where incidental take has been authorized.

Accidental captures do occur while fishing for other species. These are large powerful animals that can cause serious injury, use caution if you do hook or net one of these animals. If a sawfish is hooked or netted it should be released immediately. Follow these guidelines when attempting to release the animal.

General Release Guidelines:

- Do not remove the saw (rostrum) or injure the animal in any way.
- Remove as much fishing gear as safely possible.
- Use extreme caution when handling and releasing sawfish as the saw can thrash violently from side to side.
- It is illegal to remove the fish's saw (rostrum).

If hooked:

- Leave the sawfish, especially the gills, in the water as much as possible.
- If it can be done safely, untangle your line if it is wrapped around the saw and try to remove the hook(s) with a long-handled dehooker if one is on board.
- If the hook cannot be removed safely, cut line as close to the hook as possible.
- If hooked internally, do NOT attempt to remove the hook, use line cutting pole or boat hook to remove as much line as possible.

If tangled in a net:

- Keep the sawfish, especially the gills, in the water as much as possible.
- Cut the net removing as much of it as possible from the animal, and release the sawfish quickly.

If tangled in a trawl net:

- Make every effort to free the animal from the gear with minimal damage to the animal.
- Use line cutting pole or knife to cut any net tangled along the saw by cutting the mesh along the length of the saw.

If possible, take a photograph of the sawfish, estimate the size of the animal, note your location, and report the encounter to the Sawfish Recovery Team at 727-551-5781.

APPENDIX C

International, U.S. Federal, and State Authorities or Laws with Potential to Affect the Abundance and Survival of the Smalltooth Sawfish in U.S. Waters

International authorities

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

CITES regulates import, export, re-export, and introduction from the sea of certain animal and plant species. Species for which trade is controlled are included in one of three appendices. Appendix I includes species threatened with extinction that are or may be affected by international trade. Appendix II includes those species that may become threatened if their trade is not regulated and monitored, as well as species listed because of their similarity of appearance to other Appendix II species for which international trade may be a threat. Appendix III includes species that any Party country identifies as being subject to regulation within its jurisdiction for purposes of preventing or restricting exploitation, and for which it needs the cooperation of other Parties to control trade. The United States, as a Party to CITES, may propose amendments to the appendices for consideration by the other Parties.

In June 1997, at the tenth meeting of the Conference of the Parties, the United States proposed listing sawfish on CITES Appendix I, in order to prevent the commercial take and trade in sawfish for curios, meat, and oil. Although, according to the CITES listing criteria (Res. Conf. 9.24), trade need not be the driving force behind the decline of a listed species, the U.S. proposal failed by a large margin (26-50) to receive the requisite two-thirds majority. NMFS considered proposing sawfish be listed under CITES again in 1999, but decided against it partly based on the continuing lack of trade data for the species.

In early 2004, the Shark Working Group of the CITES Animals Committee recommended that CITES Parties that are or have been range states for sawfish undertake, as a matter of urgency, a review of the status of these species in their waters and, if necessary, impose conservation and trade measures to reduce extinction risk.

At the fourteenth Conference of the Parties in 2007, the United States again proposed listing of all species of sawfish on CITES Appendix I. During the fourteenth Conference of the Parties meeting, the government of Australia proposed an amendment for an appendix II listing for *Pristis microdon* with an annotation for live trade only. The remaining species of sawfish remained on Appendix I. The United States supported the proposed amendment and a two-thirds majority adopted the proposal.

U.S. Federal authorities

The Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1801 et. Seq.)

The MSA provides regional fishery management councils with authority to prepare fishery management plans (FMPs) for fisheries in the U.S. Exclusive Economic Zone (EEZ) (water out to 200 miles offshore, outside state waters boundaries). These FMPs are evaluated, approved and administered by NMFS for the Department of Commerce. Essential fish habitat is to be identified and described for species with approved federal FMPs; habitat conservation measures can and should be included in FMPs. Section 304(f) gives the Secretary of Commerce direct management responsibility over Atlantic highly migratory species, defined to include billfish, swordfish, tuna, and oceanic sharks.

Because there is no directed fishing for smalltooth sawfish, they have never been managed under a federal FMP. However, NMFS consults on federal actions, such as amendments to FMPs through section 7 of the ESA. Thus, since the 2003 listing of the species, effects to bycaught sawfish from MSA actions have to be considered.

Limited seasonal closures to shrimp trawling under the Gulf of Mexico Shrimp FMP are in place in the EEZ for certain southwest Florida areas, and a substantial area around the Tortugas is closed year round.

These closures may reduce the overall bycatch of smalltooth sawfish in the shrimp fishery, but more study is needed. Improvements in bycatch recording were proposed as part of Amendment 13 to the Gulf Shrimp FMP, but the Amendment has yet to be approved and implemented by NMFS. In addition, most of the current closed areas are further from shore than areas where sawfish are commonly found, and thus may provide only limited benefit for this species.

Lacey Act of 1981 (16 U.S.C. 3371-3378

The Lacey Act makes it a federal crime to import, export, or engage in interstate transport of any fish or wildlife taken in violation of a state law. By providing for Federal prosecution of state fish and wildlife laws and more stringent penalties, the Lacey Act may deter interstate transport of illegally possessed smalltooth sawfish. As discussed later, smalltooth sawfish have been protected in Florida since 1992, in Louisiana since 1999, and in Alabama since 2003. Prior to ESA listing, there was one criminal Lacey Act case involving sawfish, which was prosecuted in Miami. The subject purchased a sawfish in Florida and attempted to enter it into foreign commerce. Florida state officials seized the sawfish; the subject pled guilty. No other Lacey Act cases involving sawfish have been reported as of May 2005.

Endangered Species Act of 1973 (16 U.S.C. 1531-1543)

The ESA provides for the conservation of plant and animal species federally listed as threatened or endangered. The smalltooth sawfish was listed as endangered in April 2003 (See section list 1.A.1., Listing History), making it illegal to take ("harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct"), import or export (from the United States), sell or offer for sale (in interstate or foreign commerce) smalltooth sawfish. It is also illegal to possess, sell, deliver, carry, transport, or ship smalltooth sawfish that have been taken illegally (68 FR 15674).

Fish and Wildlife Coordination Act (FWCA) (16 U.S.C. 661-666)

The FWCA requires that wildlife, including fish, receive equal consideration with other aspects of water resource development. Under this Act, federal regulatory and construction agencies must give consideration to fish and wildlife resources in their project planning and in the review of applications for federal permits and licenses. These agencies must consult with state and federal fish and wildlife agencies regarding the possible impacts of proposed actions and obtain recommendations for fish and wildlife protection and enhancement measures. The FWCA consultation requirement applies to water-related activities proposed by non-federal entities for which a federal permit or license is required; the most significant of these respecting marine waters are Section 404 and discharge permits under the Clean Water Act and Section 10 permits under the Rivers and Harbors Act. The USFWS and NMFS review, report, and advise on proposed permit actions and make recommendations to permitting agencies to avoid or mitigate any potential adverse effects of federal water development projects on fish and wildlife habitat. Agency reports and recommendations, which require concurrence of the state fish and wildlife agencies involved, are to be given full consideration by the permitting agency, as well as accompany a construction agency's request for congressional authorization, but are not binding.

Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA), Titles I and III, the Shore Protection Act of 1988, and the Marine Protected Areas Executive Order 13158

The purpose of the MPRSA Title I was to prevent "unregulated dumping of material into the oceans, coastal, and other waters" that endanger "human health, welfare, amenities, and the marine environment, ecological systems and economic potentialities." Both this Act and the Shore Protection Act regulate ocean transportation and dumping of dredged material, sewage sludge, and other materials. Title III of the MPRSA, the National Marine Sanctuaries Act, also charged the Secretary of Commerce to identify, designate, and protect nationally significant marine areas within U.S. oceans and Great Lake waters based on their conservation, ecological, recreational, historical, aesthetic, scientific or educational value.

Sanctuaries, frequently compared to underwater parks, are managed according to Management Plans, prepared by NOAA on a site-by-site basis.
Of relevance to smalltooth sawfish, Title III singles out endangered species for special attention. Since the act was enacted in 1972, it has been amended and reauthorized in 1980, 1984, 1988, 1992, 1996, and 2000. The 1988 amendments (Public Law 100-627, Title II) contained provisions for compensation for the destruction or loss of sanctuary resources. Of specific interest was the inclusion of vessel liability provisions, which apply to oil spills, groundings, or other actions that damage marine sanctuary resources. Reauthorization in 1992 (Public Law 102-587) required that federal agencies conducting activities likely to affect sanctuary resources consult with the Secretary of Commerce. If the Secretary finds a federal action is likely to destroy, cause the loss of, or injure a sanctuary resource, he or she must recommend reasonable and prudent alternatives that can be used by the agency, in implementing the action that will protect sanctuary resources.

Of the 13 designated National Marine Sanctuaries, the one situated in the Florida Keys is the most important for sawfish. Designated in 1990[12], the Florida Keys National Marine Sanctuary (FKNMS) includes much of the Florida Keys marine ecosystem. The FKNMS constitutes approximately 2800 square nautical miles, and encompasses one of the world's largest barrier reef systems, extending from Biscayne Bay (north) to the Dry Tortugas (south). The FKNMS extends 220 miles in a northeast to southwest arc between the southern tip of Key Biscayne, south of Miami, to beyond, but not including, the Dry Tortugas Islands.

The FKNMS was established to stem mounting threats to the health and ecological future of the coral reef and other marine ecosystems. Major issues facing the FKNMS include overfishing, declines in healthy corals from disease and coral bleaching, invasion of algae in seagrass beds and coral reefs, reduced freshwater inflow from Florida Bay, and habitat damage from careless boaters, snorkelers, divers, and ship groundings. The 1992 reauthorization of the MPRSA improved coordination between NOAA, the EPA, and other interested parties in protecting and restoring water quality in the FKNMS.

As smalltooth sawfish are known to inhabit coral reefs and other Florida Keys habitats, as well as adjacent waters on the Atlantic and Gulf sides of the Florida Keys (Poulakis and Seitz 2004), progress towards reducing fishing impacts, protecting habitat and restoring water quality in the FKNMS would benefit the species.

<u>Federal Water Pollution Control Act of 1972 (FWPCA) (33 U.S.C. 1251-1376)</u>
Commonly known as the "Clean Water Act", the FWPCA is a broad statute with the goal of maintaining and restoring waters of the United States. The FWPCA, among other things, authorizes water quality and pollution research, provides grants for sewage treatment facilities, sets pollution discharge and water quality standards, and establishes permit programs for water quality, point source pollutant discharges, ocean pollution discharges, and dredging or filling of wetlands. Section 401 prevents destruction of aquatic ecosystems including wetlands, unless the action will not individually or cumulatively adversely affect the ecosystem. Section 402 requires permits from the EPA for the discharge of pollutants into navigable waters. Section 404 also provides for the Corps of Engineers to issue permits for the discharge of dredge or fill materials

[12] Florida Keys National Marine Sanctuary and Protection Act (Public Law 101-605)

into navigable waters. NMFS and the FWS provide direct consultations to the EPA and the U.S. Army Corps of Engineers on the impacts to fish and wildlife of proposed activities and on methods for avoiding such impacts under provisions of the MSA, ESA, and FWCA.

National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321-4347)
NEPA is the basic national charter for protection of the environment. NEPA procedures must ensure that environmental information is available to public officials and citizens before federal actions are taken. The agencies use these findings in analyzing alternatives and making decisions, a process which allows for the consideration of a full range of options. One of the factors indicating whether a proposed action's impacts will be significant and require this detailed statement is the project's potential effects on the ESA-listed species.

Coastal Zone Management Act (16 U.S.C. 1451-1464) and Estuarine Areas Act
Through these Acts, Congress established policy on the value of estuaries and coastal areas and set up comprehensive, state level planning programs to enhance, protect, and use coastal resources. Under these statutes, federal activities must comply with individual state programs. State planning and regulation of coastal development can thereby mitigate damage to sensitive coastal habitats. The Florida Coastal Management Program helps to coordinate actions of nine state agencies (including the Department of Environmental Protection and the FWC) and five water management districts using 23 statutes. These statutes can benefit smalltooth sawfish by curbing sawfish habitat degradation (particularly in shallow coastal areas) through careful, coordinated planning of coastal zone development and protection.

Federal Land Management and Other Protective Designations
Sound stewardship of lands and waters managed by federal agencies (as well as state park and wildlife authorities) contribute to the health of the aquatic systems that support smalltooth sawfish habitat. The ENP appears to have played a key role in avoiding the extinction of smalltooth sawfish. Commercial fishing is not permitted in the ENP; recreational spear guns, spear poles, seines and nets (except for dip nets, cast nets, and landing nets) are also prohibited. No fishing is allowed in several marine areas of the ENP, including Eco, Mrazek, and Coot Bay Ponds at any time. Fishing is also not permitted from the boardwalk at West Lake or at the Flamingo Marina during daylight hours. In addition, three National Wildlife Refuges in the Florida Keys (the Key West National Wildlife Refuge, the National Key Deer Refuge, and the Great White Heron National Wildlife refuge) likely afford protection for sawfish. Smalltooth sawfish are currently found primarily in the protected areas noted in this section, indicating that federal park and land management and other protective designations provide significant benefits to this species.

State authorities or laws
State regulations prohibiting the take of smalltooth sawfish and other regulations restricting the use of gear known to catch smalltooth sawfish as bycatch are described and summarized below.

Florida
In April 1992, smalltooth and largetooth sawfish were designated as protected species in Florida waters[13] (within three nautical miles from shore on the East coast and nine nautical miles from shore on the Gulf coast). No person is allowed to harvest, possess, land, purchase, sell, or exchange any smalltooth sawfish or largetooth sawfish or any part of either of these species. The stated purpose of this designation was to

[13] Section 370.027 (2)(f) of Florida statutes

increase public awareness of the need for extensive conservation action in order to prevent this resource from becoming endangered and to encourage voluntary conservation practices (FWC 2000). The FWC also denies requests for exempted permits to collect this species from Florida waters for public display (L. Gregg pers. comm. 2005). Since 1995, entangling nets (gillnets, trammel nets, and seines) greater than 500 square feet have been prohibited in Florida state waters (Camhi 1998). The use of large trawls with more than 500 square feet of mesh area is also prohibited within three miles of the coast of the Gulf of Mexico and within one mile of the coast of the Atlantic Ocean. Longline gear with more than 10 hooks is prohibited in state waters unless in transit.[14]

Louisiana

Smalltooth sawfish and largetooth sawfish have been protected as prohibited species in Louisiana waters[15] (within three nautical miles from shore) since March 1999. As of March 1997, no entanglement nets are allowed in Louisiana state waters, except for limited fisheries for pompano and mullet.

Alabama

Alabama prohibited the commercial and recreational take of smalltooth and largetooth sawfish in 2003.[16] Commercial gillnetting is limited but not prohibited in Alabama state waters (within three miles from shore). There are also restrictions on the recreational use of gillnets in state waters, including time and area closures (gillnets may be used only within 300 feet of shore). Longlining or other hook and line devices with more than five hooks are prohibited from use in state waters (Camhi 1998).

Texas

As of January 30, 2006, Texas Parks and Wildlife Division has listed smalltooth sawfish as endangered under the Parks and Wildlife Code Chapter 68. Due to the extreme difficulty that lay-fishermen have in distinguishing the smalltooth sawfish from the largetooth sawfish, protection of both is believed to be the best means to protect the listed species. A proposal to protect largetooth sawfish was accepted in April 2006. All entanglement nets have been prohibited in Texas waters since September 1988 (Hammerschmidt pers. comm).

Mississippi, Georgia, South Carolina, and North Carolina

There are no regulations for smalltooth sawfish in the waters of these four states (within three nautical miles from shore for Georgia, South Carolina, and North Carolina).

Georgia has prohibited the use of gillnets (except for shad and diamondback terrapins) and longlines in state waters since the 1950s (Camhi 1998). Commercial gillnets are allowed in North Carolina, but with some restrictions, primarily to protect sea turtles. South Carolina prohibits the use of shark gillnets in state waters (Camhi 1998). Recreational gillnets in other South Carolina fisheries can be used in unrestricted areas of the Atlantic Ocean if no longer than 100 feet with a 3-inch minimum stretched mesh size; recreational gillnets of the same minimum mesh, no longer than 100 yards, may be used in special designated inshore areas.[17] In 2005, South Carolina banned commercial gillnets in the ocean shad fishery. Fish traps, longlines, gillnets and trawls are also prohibited in the "Special Management Zones" set up around artificial reefs in state waters (Camhi 1998). In Mississippi state waters, gillnet use, while not

[14] Florida Commercial Saltwater Fishing Regulations, Issue Two, July 2004
[15] Title 56 of Louisiana Revised Statues
[16] Regulation 220-3-.30 (2004-MR-3).
[17] South Carolina Department of Natural Resources, South Carolina Rules & Regulations, 2004-2005 (from SCDNR website)

prohibited, has been greatly reduced since January 1, 1997, by a regulation requiring that gillnets be made of degradable materials such as cotton and linen (Quavis 2000).