Status Review of Smalltooth Sawfish (*Pristis pectinata*)

December 2000

Table of Contents

Introduction

This document provides a summary of information gathered for an Endangered Species Act (ESA) status review for smalltooth sawfish (*Pristis pectinata*). The National Marine Fisheries Service (NMFS) added smalltooth sawfish and largetooth sawfish (*Pristis perotteti*) to its list of candidate species in 1991 (56 FR 26797), removed them in 1997(62 FR 37561), and placed them back on the revised list published June 23, 1999 (64 FR 33466). The candidate species list serves to notify the public that NMFS has concerns regarding these species/vertebrate populations that may warrant listing in the future. Inclusion of a species on the candidate species list is intended to facilitate voluntary conservation efforts that, if effective, may prevent an ESA listing. NMFS believes it is important to highlight species for which listing may be warranted in the future so that Federal and state agencies, Native American tribes, and the private sector are aware of unlisted species that could benefit from proactive conservation efforts.

On November 30, 1999, NMFS received a petition from the Center for Marine Conservation requesting NMFS to list North American populations of smalltooth sawfish and largetooth sawfish as endangered under the ESA. The petitioner's request was based on four criteria: (1) the present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) the inadequacy of existing regulatory mechanisms; and (4) other natural or manmade factors affecting its continued existence. A review of the status of a species is required by section 4(b)(1)(A) of the ESA whenever a listing petition is found to contain substantial information and consists of reviewing all the available information on a species to determine if protection under the ESA is warranted. On March 10, 2000, NMFS published its determination that the petition presented substantial information indicating that listing may be warranted for smalltooth sawfish, and announced the initiation of a smalltooth sawfish formal status review (65 FR 12959). Contrarily, NMFS found that the petition did not present substantial information in the petition for largetooth sawfish. Instead, NMFS maintained the largetooth sawfish on the candidate species list and requested additional information and comments.

The ESA defines an "endangered species" as "any species which is in danger of extinction throughout all or a significant portion of its range". A "threatened species" is defined as "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range. Section 4(a)(1) of the ESA states that a species is threatened or endangered if any one or more of the following factors causes it to be, or likely to become, in danger of extinction throughout all or a significant portion of its range: (A) the present or threatened destruction, modification, or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) the inadequacy of existing regulatory mechanisms; and (E) other natural or manmade factors affecting its continued existence. Section 4(b)(1)(A) of the ESA requires that NMFS make listing determinations based solely on the basis of the best scientific and commercial data available, after conducting a review of the status of the species and after taking into account those efforts, if any, being made by any state or foreign nation to protect such

species, whether by predator control, protection of habitat and food supply, or other conservation practices, within any area under its jurisdiction, or on the high seas.

In order to conduct a comprehensive review, a status review team was created to investigate the status of the species with regard to the listing criteria provided by the ESA. Team members are listed on the following page. In addition to their own resources and data, the status review team gathered all known records and data of smalltooth sawfish by contacting fishery managers, museums and other research collectors. This status review contains the best scientific and commercial information available on smalltooth sawfish. This document addresses the status of the species, the five listing determination criteria, and the effect of efforts underway to protect the species.

Smalltooth Sawfish Status Review Team Members

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The status review team would like to acknowledge Colin A. Simpfendorfer (Center for Shark Research, Mote Marine laboratory, Sarasota, FL) who contributed data and text to this document.

The status review team would like to acknowledge the following individuals who contributed data to this document:

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The status review team would like to acknowledge Rebecca Murray (FMNH) and Rachel Worthen (FMNH) who assisted with the literature review, Kevin Coyne (FMNH) and Craig Knickle (FMNH) who assisted with data analyses, and Jamie Barichivich (FMNH) for his geographic information systems work.

The status review team would also like to acknowledge all curators of museums who provided sawfish records and all curators of aquaria who provided information regarding smalltooth sawfish captivity.

Life History and Biology

Very little empirical data are available on life history parameters for the smalltooth sawfish. Large numbers of this species were caught as bycatch in the early part of this century, severely reducing its abundance, before it was studied. Other factors which have precluded biologists from studying the smalltooth sawfish include: it is not commercially important relative to food species; it is not a traditional sport fish; and its large size and toothed rostrum make it difficult to handle.

The information presented below on smalltooth sawfish stems mainly from Bigelow and Schroeder (1953). Information is also presented from the late Dr. Thorson's work (Thorson, 1982a) on the largetooth sawfish in Lake Nicaragua. Sharing the same genus as the smalltooth sawfish, its life history and biological characteristics are likely similar.

TAXONOMY AND DISTINCTIVE CHARACTERISTICS

All modern sawfish belong to the Suborder Pristoidea, Family Pristidae, Genus *Pristis*. Although they are rays, sawfish appear to be more shark-like than ray-like, with only the trunk and especially the head ventrally flattened. The snout of all sawfish is extended as a long narrow flattened rostral blade with a series of transverse teeth along either edge, hence the vernacular name. 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.* 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 (considerably in front of the origin of pelvics in the largetooth sawfish) and by having 24 to 32 rostral teeth on each side of the rostrum (not more than 19 or 20 in largetooth sawfish). The rostrum of the smalltooth sawfish is about 1/4 of the total length of an adult specimen, somewhat shorter than the rostrum of largetooth sawfish (Bigelow and Schroeder, 1953).

HABITS AND HABITAT

The smalltooth sawfish has a circumtropical distribution and has been reported from shallow coastal and estuarine habitats. In the western Atlantic, the smalltooth sawfish has been reported from Brazil through the Caribbean, the Gulf of Mexico, and the Atlantic coast of the United States. The smalltooth sawfish has also been documented from Bermuda (Bigelow & 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 Phillippines (Bigelow and Schroeder 1953, Vander Elst 1981, Compagno and Cook 1995). Whether populations outside of the Atlantic are truly smalltooth sawfish or closely related species is unknown (Adams, 1995). Pacific coast records of smalltooth sawfish off Central America need confirmation (Bigelow and Schroeder 1953, Compagno and Cook 1995).

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 10 meters. They are often found in sheltered bays, on shallow banks, and in estuaries or river mouths. Some species enter fresh water. Certain species of sawfish are known to ascend inland in large river systems, and they are among the few elasmobranchs that are known from freshwater systems in many parts of the world. A resident population of the largetooth sawfish has been documented from Lake Nicaragua (Thorson, 1982a).

In the United States, smalltooth sawfish are generally a shallow water fish of inshore bars, mangrove edges, and seagrass beds, but are occasionally found in deeper coastal waters (see Distribution and Abundance section, figure 1, and Appendix A). The smalltooth sawfish was said to be commonly found in shallow water throughout the northern Gulf of Mexico, especially near river mouths and in large bays and was common in peninsular Florida (Walls, 1975). Historical records indicate that smalltooth sawfish have been found in the lower reaches of the Mississippi and St. Johns Rivers and the Indian River lagoonal system. Individuals have also historically been reported to migrate northward along the Atlantic seaboard in the warmer months. Estimating from the latitudinal limits within which they are year-round residents and from the summer-winter temperatures of the Carolinian waters that they visit during the warmer half of the year, the lower thermal limit to their normal range is probably about 16-18 C. Over the past century the population has been reduced by fishing and habitat alteration and degradation, and currently smalltooth sawfish are primarily found in southern Florida in the Everglades and Florida Keys (see Distribution and Abundance section).

REPRODUCTIVE BIOLOGY

As in all elasmobranchs, fertilization 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 lower caudal lobe. During embryonic development the rostral blade is soft and flexible. The rostral teeth are also soft and entirely enclosed in the skin until birth. Shortly after birth, the teeth attain their full size proportionate to the size of the saw. Gravid smalltooth sawfish females have been found with 15-20 embryos (Bigelow and Schroeder, 1953). Studies of largetooth sawfish in Lake Nicaragua (Thorson, 1976) report litter sizes of 1-13 individuals, with a mean of 7.3 individuals. The gestation period for largetooth sawfish was approximately 5 months and females likely produce litters every second year. Although there are no such studies on smalltooth sawfish, its similarity in size and habitat to the largetooth sawfish implies that their reproductive biology may be similar.

AGE AND GROWTH

Smalltooth sawfish are generally about 2 feet long at birth and may grow to a length of 18 feet or greater (Bigelow and Schroeder, 1953). Individuals have been maintained in public aquaria for up to 20 years (Cerkleski, pers. comm., 2000). Although no formal studies on the age and growth of the smalltooth sawfish have been conducted to date, growth studies of largetooth sawfish also suggest slow growth, late maturity (10 years) and long lifespan (30 years) (Thorson, 1982a, Simpfendorfer, 2000). These characteristics suggest very low intrinsic rate of increase (Simpfendorfer, 2000) and rebound potentials (Smith et. al 1998) (see Other

Natural or Manmade Factors Affecting Its Continued Existence section).

DIET AND FEEDING BEHAVIOR

Bigelow and Schroeder (1953) report that sawfish in general subsist chiefly on whatever small schooling fish may be abundant locally, such as mullets and the smaller members of the herring family. Bigelow and Schroeder also reported that they feed to some extent on crustacea and other bottom dwelling inhabitants. The smalltooth sawfish is noted as often being seen "stirring the mud with its saw" to locate its prey. Bigelow and Schroeder also noted the smalltooth sawfish has been reported to attack schools of small fishes by slashing sideways with its saw and then eating the wounded fish.

Distribution and Abundance

Smalltooth sawfish are tropical marine and estuarine fish that have the northwestern terminus of their Atlantic range in the waters of the eastern United States. Historic capture records within the U.S. range from Texas to New York (Figure 1, 2a, and Appendix A). Water temperatures probably higher than 16-18 degrees C and the availability of appropriate coastal habitat (see previous section,) 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 are from late spring to summer periods (May to August) when inshore waters reach appropriately high temperatures (Appendix A). Most specimens captured along the Atlantic coast north of Florida have been large (> 3 m) adults and likely represent wanderers or colonizers from a core population(s) to the south rather than being members of a continuous, even-density population (Bigelow and Schroeder, 1953). It is likely that these individuals migrated southward to Florida as water temperatures declined in the fall, as there is only one winter record from the Atlantic coast north of Florida.

Quantitative data are not available to conduct a formal stock assessment for smalltooth sawfish. In order to assess both the historic and the current distribution and abundance of the smalltooth sawfish, the status review team collected and compiled literature accounts, museum collection specimens, and other records of the species. These records are listed in Appendix A. A review of these data is provided below to illustrate the reduction in the range of smalltooth sawfish, as well as the decline in their population abundance over time.

NEW YORK TO VIRGINIA

The northernmost U.S. record of the smalltooth sawfish is based upon a 15 ft 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 man-induced environmental degradation suggests the New York record likely is 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., 700 lb. specimen in Grassy Sound near Cape May, and Fowler (1906b) 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 ten foot 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 but two published records of capture in North Carolina: one in 1937 (Fowler, 1945) and the other in 1963 (Schwartz, 1984).

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 Georgia record of sawfish, a 915 mm juvenile, was from March 1908 (Fowler, 1945).

The range of the smalltooth sawfish in the Atlantic has contracted markedly over the past century (Figure 1 and 2). The presence of the large toothed rostrum (a valuable curio), the large size of the animal, and its rarity in northern waters makes it highly probable that most captures were documented over the last 50-75 years, as such captures would have attracted a lot of attention. Single specimens captured in North Carolina in 1963 and in South Carolina in 1948, 1950 and 1958 represent the last confirmed records of the smalltooth sawfish north of Florida.

TEXAS TO THE FLORIDA PANHANDLE

Based on turn of the century literature and museum collections from the late 1800's and early 1900's, it is apparent that the abundance level of smalltooth sawfish has declined rapidly, not just in northern areas, but also in the southern and western portions of the species' U.S. range. Seasonal records of smalltooth sawfish in the Gulf of Mexico from Texas to the Florida Panhandle exhibit a similar pattern of occurrence as documented on the eastern seaboard north of Florida. More than two-thirds of the records are from April through August. 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 (see later paragraph in this section). Nevertheless, smalltooth sawfish apparently were more common in the Texas to Florida panhandle region than north of Florida in the Atlantic. Considering the paucity of winter records, it is not understood whether Gulf smalltooth sawfish are members of a local subpopulation or represent seasonal immigrants from populations to the south or east.

The smalltooth sawfish was first recorded regionally 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]. The smalltooth sawfish was taken in Mobile Bay, Alabama as early as 1853 (MCZ 105). Numerous subsequent records of smalltooth sawfish exist from the Gulf of Mexico: Goode and Bean (1882), Jordan and Gilbert (1883), Jordan (1887), Evermann and Kendall (1894: Galveston), Jordan and Evermann (1900: Pensacola), Gowanloch (1932: LA), Gunter (1935, 1936: LA; 1941: TX), 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).

Smalltooth sawfish in the northern and western Gulf of Mexico have become rare in the last 30 years. Expansion of commercial fishing and an increase in scientific exploratory fishing in the Gulf of Mexico in the 1950's and 1960's produced many records of smalltooth sawfish, primarily from the northwestern Gulf in Texas, Louisiana, Mississippi, and Alabama. Since 1971, however, there have been only three published or museum reports of smalltooth sawfish capture from this region, all from Texas (1978, 1979, 1984).

Sawfish catches have historically been reasonably common in Texas, Louisiana and Mississippi. As a result, they may not have been viewed with as much curiosity and reported as often as in the Atlantic coast north of Florida. Therefore, the catch documentation for these states may not be all inclusive. Regardless, reports of captures have dropped dramatically and the trend of decline in the region is apparent. Louisiana, an area of historical localized abundance, has experienced a marked decline in sawfish landings and landings per unit effort (Simpfendorfer, 2000(b); see Overutilization section). The lack of smalltooth sawfish records since 1984 from the area west of peninsular Florida is a clear indication of decline of the species abundance in the northwestern Gulf.

PENINSULAR FLORIDA

Peninsular Florida has been the U.S. region with the largest numbers of capture records of smalltooth sawfish and apparently is the only 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, 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. While tagging studies have only been initiated this year for the first time (see Current Conservation Efforts section), it appears that there remains a resident population of smalltooth sawfish in south Florida. Most likely, summer-caught smalltooth sawfish taken along the U.S. East Coast north of Florida and from TX to the Florida panhandle originated from this group. It is unlikely smalltooth sawfish from along the U.S. East Coast north of Florida and from TX to the Florida panhandle are year-round residents, considering the paucity of winter records from that area. The most likely source of these fish is south Florida, which has the largest known population. NMFS does not have any information available to support that there is a population in Mexico.

The earliest record of smalltooth sawfish in Florida is an 1834 museum specimen from Key West (see Appendix A). 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 (1884: Key West), Jordan and Swain (1884: Cedar Keys), Henshall (1891: Big Gasparilla, FL west coast), Bean (1892: San Carlos Bay), Lonnberg (1894: Punta Gorda), Henshall (1895: Tampa), McCormick, in Smith (1896: Biscayne Bay), Evermann and Bean (1897: 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 on the east coast of Florida was an area of smalltooth sawfish abundance. Bean (1884) reported that in "the Indian River and its tributaries the Saw-fish is said to be very common" and Evermann and Bean (1896) 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 the Daytona Beach and Jacksonville) and southerly (Biscayne Bay) peninsular east coast localities during the late 1800's. Bean (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. Snelson and Williams (1981) did not capture any sawfish in an extensive multi-year study of the Indian River lagoon system. They speculated that the species' absence was caused by "heavy mortality associated with incidental captures by commercial fishermen" since the decline seemed to predate most of the manmade habitat alterations of the area. There are eight reports of smalltooth sawfish along the Florida east coast in the 1990's, most from coastal rather than lagoonal areas.

Smalltooth sawfish also occur on the west coast of Florida, but were apparently never as common in this region as in the east coast lagoons and south Florida (see following paragraph). One of the earliest (1882) published U.S. records was from Pensacola in the Florida panhandle and another 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 have been only five documented captures of sawfish from the area north of Charlotte Harbor since 1966: from off Alligator Peninsula in the panhandle (1977), in Waccassassa Bay (1990), off Crystal River (1972 and 1983), and in Tampa Bay (1999).

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. Bean (1884) stated that in "the Everglades these fish are said to be exceedingly abundant." There has been a continuous and frequent record of occurrences of sawfish in the Everglades since the first report

in 1834, and the vicinity now serves as the last U.S. stronghold for the species. Long-term abundance data are not available, but there are recent (1989-1999) recreational catch per unit effort (CPUE) data for the Everglades (T. Schmidt, pers. comm., 2000). These CPUE data (Figure 3) indicate that a sustaining population still exists there, with consistent annual catches by private recreational anglers and guide boats. Recent Florida Keys and Dry Tortugas records indicate that sawfish still are found in the region, commonly enough that specimens can be targeted and captured. Also, as of November, 2000, five smalltooth sawfish have been tagged as a result of cooperating tagging efforts initiated this year by Mote Marine Laboratory's Center for Shark Research, funded by NMFS, Office of Protected Resources. Two of these captures were from part of the Ten Thousand Islands area outside of the Everglades National Park, two from Florida Bay, and one from the mouth of the Shark River region. Figure 2c shows a detailed map of the smalltooth's current distribution.

SUMMARY

Although time-series abundance data are lacking, publication and museum records, negative scientific survey records, anecdotal fisher observations, and limited landings per unit effort (LPUE) (from Louisiana; see Overutilization section) indicate that smalltooth sawfish have declined dramatically in U.S. waters over the last century. This population decline is clearly demonstrated by its shrinking distribution and the reduction in the number of captures (see Figures 1 and 2, Appendix A). The level of abundance has declined rapidly not just in northern areas, but also in the southern and western portions of the species' U.S. range. The decline is likely greater than indicated by numbers or frequencies of catches. During the past century, both fishing and scientific sampling effort have increased by orders of magnitude. The fact that documented smalltooth catch records have declined during this period despite these tremendous increases in fishing effort underscores the population reduction in smalltooth sawfish.

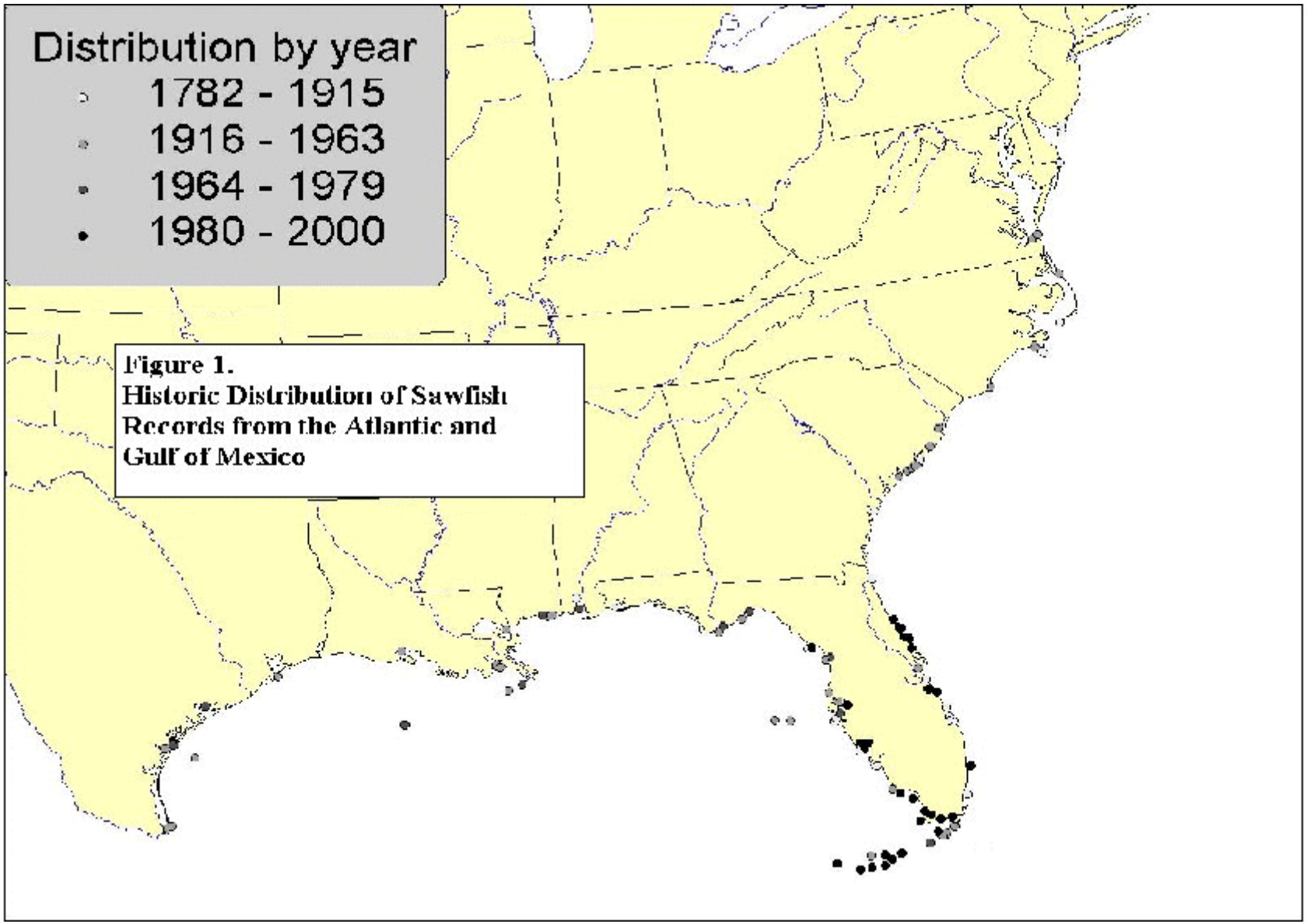
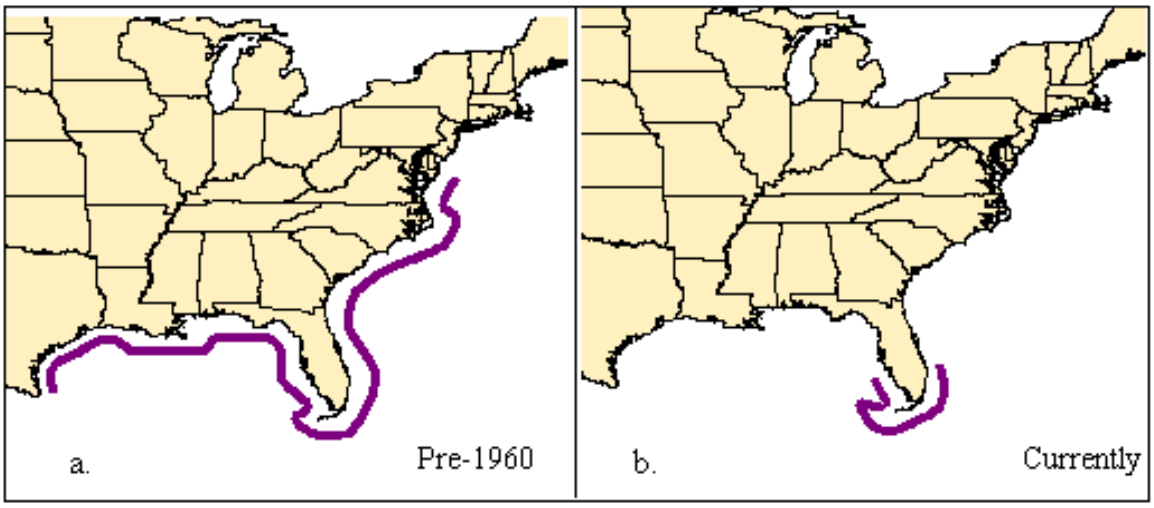


Figure 1.
Historic Distribution of Sawfish Records from the Atlantic and Gulf of Mexico

Figure 2: **Change in the distribution of smalltooth sawfish (Pristis pectinata).** (a) Distribution prior to 1960; (b) current distribution based on records obtained by Simpfendorfer; and (c) detailed current distribution in southern Florida. The light grey indicates the distribution, the dark grey indicates areas where they are most commonly observed; and the dotted line indicates the approximate boundary of the Everglades National Park (Simpfendorfer, C.A. and Castro, J. I. 2000. Progress Report. Unpublished report. 5pp.)



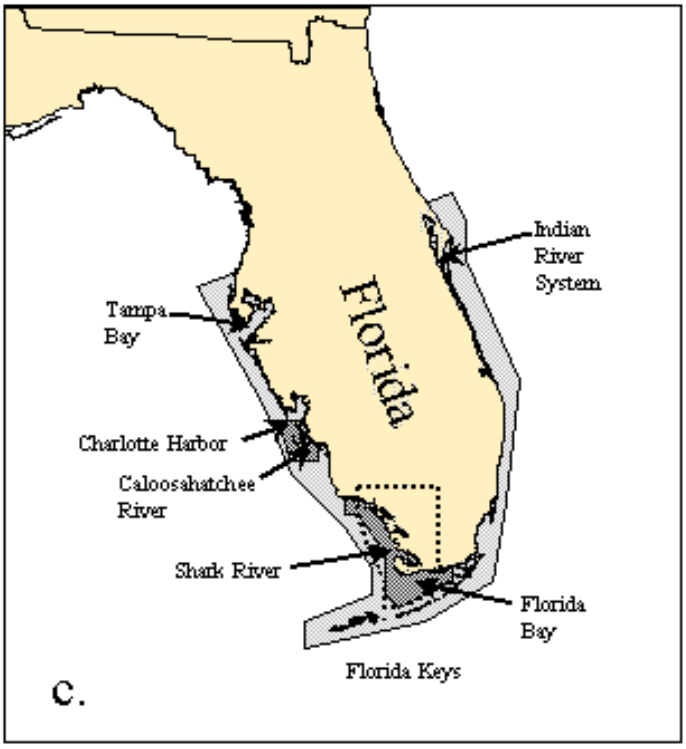
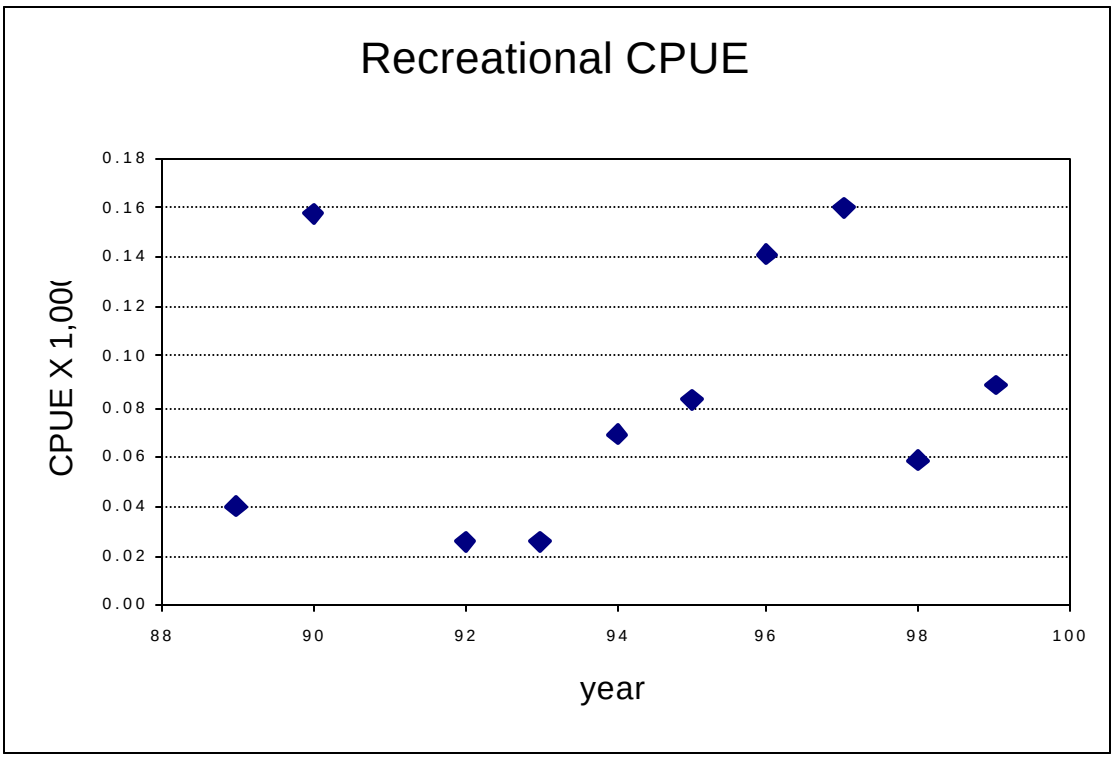


Figure 3 **Catch per Unit Effort of Smalltooth Sawfish in the Everglades National Park**
(Based on data provided by T. Schmidt; see Appendix B)



Distinct Vertebrate Population Segment

The NMFS was petitioned to list North American populations of sawfish as endangered in order to grant the full protection provided under the ESA for sawfish in U.S. waters. The Endangered Species Act (ESA) considers "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife that interbreeds when mature" to be a species. One of the purposes of establishing distinct population segments is to conserve genetic diversity. On February 7, 1996, the U.S. Fish and Wildlife Service and NMFS published a joint policy to clarify the phrase "distinct population segment (DPS)" for the purposes of listing, delisting and reclassifying species under the ESA (51 FR 4722). The policy identified the following three elements to be considered in deciding whether to list a possible DPS as endangered or threatened under the ESA: (1) the discreteness of the population segment in relation to the remainder of the species or subspecies to which it belongs; (2) the significance of the population segment to the species or subspecies to which it belongs; and (3) the conservation status of the population segment in relation to the ESA's standards for listing.

A population segment of a vertebrate species may be considered discrete if it satisfies either one of the following conditions: (1) It is markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors. Quantitative measures of genetic or morphological discontinuity may provide evidence of this separation; or (2) it is delineated by international governmental boundaries within which differences in control of exploitation, management of habitat, conservation status, or regulatory mechanisms.

There are few scientific data to support or oppose subdividing the species into distinct units on the basis of genetics, morphology, behavior, or other biological characteristics. As explained in the Life History and Biology section, data is extremely limited. Nevertheless, the DPS policy allows for the delineation of a DPS based on international governmental boundaries within which differences in control of exploitation, management of habitat, conservation status, or regulatory mechanisms exist. Review of the available information on smalltooth sawfish did not produce any evidence of interactions between U.S. populations and populations elsewhere nor of any impacts to the U.S. population from activities in neighboring nations. The United States has no control on smalltooth sawfish exploitation outside its jurisdiction, except by U.S. citizens subject to the jurisdiction of the United States. U.S. citizens are not known to travel to foreign nations in search of this species. There is no trade data indicating that smalltooth sawfish is imported or exported from the United States. Listing smalltooth as endangered range wide, therefore, would provide no additional benefit for smalltooth sawfish. Retention of smalltooth sawfish outside of the United States is not prohibited. Based on these differences in control of exploitation and regulatory mechanisms, the U.S. population of smalltooth sawfish meets the requirements of discreteness on an

international boundary basis.

The second element that must be considered in deciding whether to list a possible DPS as endangered or threatened under the ESA is the significance of the population segment to the species or subspecies to which it belongs. Because precise circumstances are likely to vary considerably from case to case, it is not possible to describe prospectively all the classes of information that might bear on the biological and ecological importance of a discrete population segment. Examples of some considerations, however, that may be examined in evaluating a distinct population segment's importance were given. Evidence that loss of the discrete population segment would result in a significant gap in the range of a taxon was one of the considerations listed in the DPS policy.

The U.S. population of smalltooth sawfish is the northernmost smalltooth sawfish population in the Western Hemisphere (see habits and habitat section) and the only population verified by recent records. In gathering data on smalltooth sawfish, the status review team was unable to find any recent records of smalltooth sawfish outside of U.S. waters. Smalltooth sawfish in U.S. waters, while extremely depleted, may be the largest population of smalltooth sawfish in the Western Atlantic. Its loss would result in a major gap in the range of the species. The smalltooth sawfish has already been wholly or nearly extirpated from large areas of its former range in the North Atlantic (Mediterranean, US Atlantic and Gulf of Mexico) and the Southwest Atlantic coast by fishing and habitat modification. Its status elsewhere is uncertain but likely to be similarly reduced. Reports of this species from outside the Atlantic may be misidentifications of other pristids. Sawfish, in general, are suffering worldwide declines and preservation of the U.S. smalltooth sawfish population is important in preserving global biological diversity. For these reasons, the U.S. population of smalltooth sawfish is considered significant.

Based on the above analysis of the discreteness and significance of smalltooth sawfish, for the purposes of this status review, smalltooth sawfish that occur in waters of the eastern United States are considered to be a discrete and significant population, and therefore, constitute a distinct population segment. As such, consideration of the conservation status of the U.S. population in relationship to the ESA's listing standards is appropriate. The conservation status of this distinct population segment (DPS) of smalltooth sawfish is reviewed in subsequent sections that analyze listing factors and any management efforts, planned or underway, that would aid in protecting and restoring this species.

Analysis of Listing Factors

The ESA defines endangered species as any species in danger of extinction throughout all or a significant portion of its range; and a threatened species as any species likely to become endangered within the foreseeable future. Section 4(b)(1)(a) of the ESA requires that determinations of whether a species is threatened or endangered be based solely on the best scientific and commercial data available and after taking into account those efforts, if any, being made to protect the species. A species may be determined to be endangered or threatened due to one or more of the following five factors described in section 4(a)(1) of the ESA:

(1) The present or threatened destruction, modification, or curtailment of habitat or range;

(2) Overutilization for commercial, recreational, scientific, or educational purposes;

(3) Disease, competition, or predation

(4) The inadequacy of existing regulatory mechanisms, and

(5) Other natural or manmade factors affecting its continued existence.

In the following sections, each of these five factors is examined for its historic, current, and/or potential impact on smalltooth sawfish. It should be noted that current and potential threats, along with current species distribution and abundance, determine present vulnerability to extinction. Information about historic threats is included to assist and interpret population trends. The relationship between historic threats and population trends also provides insights that may help project future population changes in response to current and potential threats.

Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

The principal habitats for 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 of coastal habitat through such activities as agricultural and urban development, commercial activities, dredge and fill operations, boating, erosion, and diversions of freshwater run-off (SAFMC, 1998). Loss and/or degradation of habitat has contributed to the decline of many marine species, and is unknown, but fully expected, to have impacted the distribution and abundance of smalltooth sawfish. Historically common in shallow coastal areas from the Gulf of Mexico and eastern seaboard up to North Carolina and seasonally as far as New York, smalltooth sawfish remain in the U.S. today only in protected or sparsely populated areas of the southern tip of Florida (see Distribution and Abundance section). Smalltooth sawfish may be especially vulnerable to coastal habitat degradation due to their affinity to shallow, estuarine systems. With the K-selected life history strategy of smalltooth sawfish, including slow growth, late maturation, and low fecundity (see later section titled Other Natural or Manmade Factors affecting its Continued Existence), long-term commitments to habitat protection are necessary for the eventual recovery 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

The major agricultural activities that present a threat to sawfish include wetland conversion, excessive eutrophication, hypoxia, increased turbidity and sedimentation, stimulation of hazardous algal blooms, and delivery of chemical pollutants (SAFMC, 1998). Agriculture accounted for 87% of all wetland losses in the U.S. between the mid-1950's and mid-1970's. The most extensive losses in the southeast were in North Carolina and Florida (Tiner, 1984). 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 sawfish (Scott, 1997). All of Florida Bay has undergone biological, chemical, and physical change due to large scale agricultural practices and hydrologic modifications in the Everglades (Fourgureon and Robblee, 1999). Florida Bay appears to be the last remaining refuge for this species in the U.S. (Musick et al., 2000).

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).

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). 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 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 and McIvor 1982). Direct destruction of mangrove habitat is no longer allowed, 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 by conversion to open water. During those years, another 1234 square miles of Louisiana coastline 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). In an analysis of 18 major southeastern estuaries, Olando 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 subaqueous habitats by disposal of excavated materials, turbidity and siltation effects, contaminant release, and alteration of hydrodynamic regimes and physical habitats (SAFMC, 1998).

BOATING ACTIVITIES

Several environmental impacts have been associated with boating activities (EPA, 1993). These include pollutants associated with boat use and maintenance, pollutants carried by storm water runoff from boating support facilities (marinas etc.), and physical alteration and destruction of estuarine marine habitats.

DIVERSION OF FRESHWATER RUN-OFF

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). Of particular concern are sawfish habitats in the Indian River lagoon (Gilmore, 1995), where the species was once abundant, but now appears to have been extirpated (Snelson and Williams, 1981). Of additional principal concern are Biscayne Bay (Serafy et al., 1997) and Florida Bay (Fourgureon and Robblee, 1999). The latter area appears to support the last remaining population of smalltooth sawfish in U.S. waters (Musick, et al., 2000).

SOUTH FLORIDA HABITAT SPECIFIC INFORMATION

The following information describes specific south Florida areas, where recent sawfish records have been reported and thus most likely still support smalltooth sawfish, and a summary of present and threatened habitat issues.

Tampa Bay System

Tampa Bay, Florida's largest open water estuary, spans almost 1,036 square km. and receives drainage from a 5,698 square km. watershed, more than five times the Bay's size (Zarbock et al., 1994). The Tampa Bay National Estuary Program (TBNEP) was established in 1991 to assist the community in developing a comprehensive plan to restore and protect Tampa Bay (TBNEP, 1996). Tampa Bay is divided into three sections- Old Tampa Bay, Middle Tampa Bay, and Lower Tampa Bay. There are also three additional segments that drain into Tampa Bay- Hillsborough Bay, Boca Ciega Bay, Terra Ceia Bay, and the Manatee River.

Sawfish Distribution in Tampa Bay

Since 1995, there has been one record (1999) in the Tampa Bay area.

Present physical condition

The Tampa Bay area may have lost as much as 50% of its intertidal vegetation over the last 100 years (Lewis et al., 1988). Tampa Bay contains sediments contaminated with heavy metals and organic compounds. Dredging and filling operations have resulted in submerged habitat loss and increased pollutant loading (Wheeler et al., 1998). An assessment by the TBNEP shows that ecosystems within the Bay have been altered due to sedimentation and eutrophication. The program has conducted extensive technical investigations to define Bay conditions, impacts, and environmental needs. According to the TBEP Bay-wide Environmental Monitoring Report, from 1993-1998, the water quality parameters of dissolved oxygen, total phosphorus, and chlorophyll conditions have improved between the late 1970's-early 1980's and 1993-1998 (TBNEP, 1999).

Point sources of pollution to Tampa Bay are comprised of domestic, industrial, and spring discharges. Point sources contribute discharge through either direct surface discharge to surface water bodies such as through streams, creeks, rivers, or bay waters, or through application to land as in discharge to a settling pond or to an irrigation system (TBNEP, 1999).

Charlotte Harbor System

The Charlotte Harbor Estuarine System has a surface area of 699 square km and is connected to deep water of the Gulf of Mexico through passes and inlets between barrier islands (McPherson, et al., 1996). After Tampa Bay, Charlotte Harbor Estuary is the second largest

open water estuary in Florida. The Charlotte Harbor Estuary and contiguous coastal waters serve as a home, feeding ground, and/or nursery area for more than 270 species of resident, migrant, and commercial fishes of the Gulf of Mexico.

Sawfish distribution in Charlotte Harbor

Since 1995, there have been 3 records in the Charlotte Harbor area (all 3 in 1999).

Present physical condition

Alterations to aquifers and excess freshwater have changed the hydrology in the basin. Also, Charlotte Harbor exhibits the lowest acreage of well-drained soils, when compared with other estuarine basins in Florida. According to Post et al., (1999), the three priority problems which have the greatest potential for degrading the Charlotte Harbor system include hydrologic alterations, water quality degradation, and terrestrial and aquatic habitat loss. All of these may result from development, conversion of natural shorelines, cumulative impacts of docks and boats, invasion of exotic species, and other cumulative and future impacts.

Florida Bay and Ten Thousand Island Area (Cape Romano to Cape Sable) (Information herein summarized primarily from Fourqurean and Robblee 1999).

Florida Bay is a subtropical estuary that has undergone a high degree of natural and anthropogenically induced fluctuations over the last 100 years. Florida Bay and the adjacent Ten Thousand Islands area, located between Cape Romano and Cape Sable, are the only areas of the Gulf of Mexico still known to host a population of smalltooth sawfish. Most of this area is contained within the Everglades National Park.

Sawfish Distribution in Florida Bay and Ten Thousand Island Area

Catch records maintained by the Everglades National Park indicate that sawfish catches are more common north of Cape Sable in the Ten Thousand Island area than south of Cape Sable in Florida Bay proper, but apparently the species is occasionally taken in the more southern area. Since 1995, there have been 108 records in the Ten Thousand Island area and 44 from Cape Sable through Florida Bay including the Keys.

Present physical condition

Florida Bay consists of a series of compartmentalized basins or "lakes" divided by shallow mud banks that support sea grass communities. The mud on these banks is of biogenic origin. Silt-clay content is approximately 50 percent of the total of sediment samples, and organic material comprises about 10-25 percent of the total. The mud banks restrict circulation and tidal flushing in many of the lakes and especially the mangrove swamp areas along the mainland. Annual rainfall is about 1.2 meters per year, with most rainfall occurring during the warm summer months (May to October). Average low water temperatures are about 20 degrees Celsius in January with highs of about 28 degrees Celsius in August. Seagrass communities dominate in Florida Bay, and the structure of these communities has often been used to delineate ecological zones. In western Florida Bay, Conchie and Joe Kemp Channels have relatively high tidal flow and the water is moderately to highly turbid. Salinities in these higher flow areas range normally from 30 to 40 parts per thousand.

The Ten Thousand Island area includes a wide variety of habitats from natural channels as deep as 2-3 meters, to shallow mangrove marshes. Water circulation varies accordingly. More landlocked water areas such as Whitewater Bay or Coot Bay have poor circulation, relatively higher temperatures, and lower salinities that do not fluctuate greatly within an area, but may be quite different from adjacent areas. Salinities do fluctuate on a seasonal basis, ranging from 5 to 30 parts per thousand. The descriptions available for these two bays (eg. Tabb and Manning 1961; Odum, 1982; Thayer et al., 1987) are assumed to also characterize the areas north to Cape Romano. A sediment layer in these areas is 0.5 to 1.5 meters in depth, with the depth of the sediment corresponding to the amount of current flow and the nearness of sources of sediment inputs and detrital material. Seagrass beds in these areas are less abundant. The mangrove swamp area along the shores of these inlets and lakes are characterized by shallow water (< 0.5 meters) over a soft mud bottom containing a high level of organic content with marsh gases and low dissolved oxygen commonly occurring. Salinities will vary depending on the local rainfall, proximity to mainland run-off, and freshwater inflow.

SUMMARY AND EVALUATION

The U.S. DPS of smalltooth sawfish has experienced a ninety percent curtailment of its range and severe declines in abundance (see Distribution and Abundance section). Agriculture, urban development, commercial activities, channel dredging, boating activities, and the diversion of freshwater run-off have resulted in the destruction and modification of smalltooth habitat throughout the southeastern U.S. Although habitat degradation is not likely the primary reason for the decline of smalltooth sawfish abundance and their contracted distribution, it has likely been a contributing factor. Over 50% of the U.S. human population live within fifty miles of the ocean or Great Lakes. Migration to the coastlines for home, livelihood or recreation is predicted to increase by the year 2010 (National Ocean Service, 2000). Increases in coastal human populations will likely result in additional losses of marine habitats and increased pollution, further threatening the survival of smalltooth sawfish.

Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

COMMERCIAL FISHERIES

Smalltooth sawfish were historically often caught as bycatch in various fishing gears, including gillnet, otter trawl, trammel net, seine, and, to a lesser degree, hand line. Sawfish in general are extremely vulnerable to incidental capture in gillnets (Cook and Compagno 1994; 1995). Their long, toothed rostrum makes it difficult to avoid entanglement in virtually all kinds of large mesh gillnet gear. The saw penetrates easily though nets and causes the animal to become entangled when it attempts to escape. Shrimp trawling is another source of incidental mortality on smalltooth sawfish. Entangled specimens 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 removal of their saw (Adams and Wilson, 1995).

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 (1894) 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 (1896) noted that smalltooth sawfish were an abundant, permanent resident in the Indian River on the east coast of Florida and also noted that they did considerable damage to fishermen by becoming entangled in their 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 fishermen interviewed by Evermann and Bean reported taking an estimated 300 smalltooth sawfish in just one netting season on the Indian River. Smalltooth sawfish are now believed to be extirpated from the Indian River (Snelson and Williams, 1981; Schmid et al. 1988). Snelson and Williams (1981) attributed the loss of smalltooth sawfish in the Indian River 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".

Given the above references to smalltooth sawfish as a nuisance to commercial fishermen, it is highly unlikely that the species was ever targeted. Large-scale directed fisheries for smalltooth sawfish have not existed; however, smalltooth sawfish bycatch has been commercially landed in various regions, primarily in Louisiana. Appendix C contains the results from a query of NMFS Fisheries Statistics & Economics Division's database for all smalltooth

sawfish commercial landings data. The majority of the smalltooth sawfish landings were from otter trawl fisheries (categorized as other, shrimp, or fish). There were also landings from trammel nets, beach haul seines, 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 (see Appendix C for more detail).

Simpfendorfer (2000b) extracted a data set from "Fisheries Statistics of the United States" (1945-1978) of smalltooth sawfish landings in Louisiana by shrimp trawlers. The data set contains both landings data and crude information on effort (number of vessels, vessel tonnage, number of gear units). Smalltooth landings in Louisiana reported over time declined from a high of 34,900 lb in 1949 to less than 1,500 lbs in most years after 1967 (Figure 4a). During this period of time, the number of fishing vessels, the size of the fishing vessels and the amount of gear that they deployed increased substantially (Figure 4b). The one exception to the low landings since the late 1960s was 9,000 lb caught in 1977 and the accuracy of this data point has not yet been validated. Landings per unit effort (LPUE) data were calculated using three different units of effort (number of vessels, tonnage of vessels and number of gear units). All three data series showed dramatic declines in LPUE, from high levels in the 1950s to very low levels in the 1970s (Figure 5). The magnitude of these declines is such that the 1970s LPUE values are less than 1% of those in the 1950's, demonstrating a severe decline in the population. The lack of landings since 1978 shows that smalltooth sawfish have been commercially extinct for over 20 years.

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 1980's. Smalltooth sawfish are still occasionally documented in shrimp trawls in Florida, with four reports in the 1990's.

RECREATIONAL FISHERIES

Smalltooth sawfish have historically occurred occasionally as bycatch in the hook-and-line recreational fishery (Caldwell 1990). Occasional directed takes with harpoon or hook-and-line by recreational fishers in Florida were recorded during the first half of the 20th century (Heilver Van Campen 1917; Anon 1940). 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) states that many sawfish were taken incidentally by sport fishermen in the bays and surf prior to the 1960's. A few were retained and displayed as trophy fish, but most were released. Caldwell notes 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.

Today, recreational catches of sawfish are very rare, and poorly documented for the most part, except within the Everglades National Park. Between 1991 and 1999, during the June Gulf Coast Shark Census (operating out of Sarasota), only five smalltooth sawfish were captured (and

released) in 20,000 line hours of recreational fishing effort. Two of the smalltooth sawfish were already missing their saws when the angler caught them, implying previous capture. All of these captures were from either inside the barrier islands or just offshore from the barrier islands, along the southwest Florida coast between Cape Romano and St. Petersburg. Surveys in the Everglades National Park indicate that a sustaining population still exists there, with consistent annual catches by private recreational anglers and guide boats. Over ten years (1989-1998), the U.S. Park Service recorded 76 smalltooth sawfish from their angler surveys and 133 smalltooth sawfish from their guide surveys of Everglades National Park (Appendix B). Possession of smalltooth sawfish has been prohibited in Florida since April 1992. Only one smalltooth sawfish according to the records in the angler survey database was kept; this record was from 1990. There were 14 smalltooth sawfish recorded as kept in the guide survey database; one in 1991, one 1992, and twelve in 1997. There are no studies on sawfish post-release mortality.

COMMERCIAL TRADE

Information regarding the direct commercial utilization of smalltooth sawfish is limited. After reviewing all available information, it appears that smalltooth sawfish saws have been used for a few purposes over the years, but mainly on a very small scale. Lawson (1709) reported "swordfish", which almost certainly was a sawfish given Lawson was describing inshore fish, as among the fish consumed by Native Americans in the Carolinas. In Florida, Henshall (1892) reported that only the saw of smalltooth sawfish was marketed, preserved and sold as a curiosity. Baughman (1952) noted that sawfish fins were commercially valuable and exported to China for soup and that sawfish saws, besides being sold as curios, were sold for traditional medicines in Asia. Bigelow and Schroeder (1953) described smalltooth sawfish as having "no commercial value in the western Atlantic", but also noted that "small ones have been described as being delicious panfish and the larger ones as yielding good steaks". In India and Asia, other uses for their skin (leather) and oil (wood lubricant) are noted for sawfish in general, but no attempts were made to obtain their skins or oil on a large scale (Bigelow and Schroeder, 1953; Last and Stevens, 1994). The smalltooth sawfish status review team is not aware of any quantitative data on international trade of sawfish parts. McDavit (1996) notes the skins of sawfish have been harvested for leather on a small scale throughout their range, citing Beard (1992), a book detailing the American cowboy boot industry that lists sawfish leather as one of the exotic skins available to the adventurous consumer. Smalltooth sawfish have also been taken by collectors and sold for live display in aquaria. A more detailed description of the use of smalltooth sawfish in aquaria is provided below.

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. Being lethargic bottom-dwellers, they survive well in captive conditions, requiring little specialized care. The exact number of smalltooth sawfish in captivity is unknown. The American Elasmobranch Society generates a Captive Elasmobranch Census to assist information exchange among those facilities maintaining elasmobranchs for various purposes ranging from basic research to public education. Participation is voluntary, however, and the information is confidential and not accessible to NMFS or the public. NMFS has

identified five aquaria that currently have smalltooth sawfish on display and seven additional aquariums that have had smalltooth sawfish in the recent past. In 1998, there were at least 14 smalltooth sawfish in captivity (1 at Key West, 2 at Marine World, 2 at National, 3 at Sea World in Florida, 2 at Sea World in Ohio, and four others outside the U.S.) (Lobue, pers. comm., 2000).

Smalltooth sawfish in captivity have been reported to live for up to 20 years (Cerkleski, pers. comm). The majority of smalltooth sawfish in captivity were collected back in the mid 1980's, although there is at least one individual that was collected as recently as 1999. The origin of this individual fish is unknown. Some aquarium curators who were contacted and had previously maintained smalltooth sawfish in captivity expressed interest in obtaining additional individuals in the future, but noted that they were difficult to obtain. For those collectors who are able to locate smalltooth sawfish, there is a high monetary incentive. A smalltooth sawfish was sold to an aquarium for $11,500 (Handsel, pers. comm., 2000). An aquarium curator commented that the current value for sawfish is approximately one thousand dollars per foot (Davis, pers. comm., 2000). Given their current price per foot and the fact that most sawfish caught are usually a minimum of 8 feet long, each fish is quite valuable. This may explain the recent increase in collectors seeking exempted fishing permits to collect smalltooth sawfish for public display in aquariums. NMFS received 2 requests for sawfish collections in 1998 from professional collectors. One request was for 7 sawfish and the other for an unspecified number (they requested a total of 40 animals and included a list of about 10 species, one of which was sawfish). The requests were not approved because there is no Federal permit required; sawfish are not regulated under the Magnuson-Stevens Act (see Section V (D); Analysis of Existing Regulatory Authorities, Laws and Policies and their Adequacy to Protect Smalltooth Sawfish). In 1999, NMFS received two more requests and in 2000, one more request, each for ten sawfish, All of these requests were again not approved. The state of Florida received 6 requests in the past year for exempted fishing permits to collect sawfish, as opposed to the occasional one or two requests in past years. Concerned with the effects of these collections on smalltooth sawfish, Florida has denied all of these requests.

There is not sufficient information to evaluate the impact (including positive educational impact) aquaria with smalltooth sawfish have on the species. It appears, however, that the recent high price aquaria are willing to pay for this species may be providing increased incentive for their collection. Although the harvest of smalltooth sawfish is prohibited in Florida, collection of smalltooth sawfish is likely most feasible in this state, in terms of abundance, and could entice poachers.

SCIENTIFIC RESEARCH

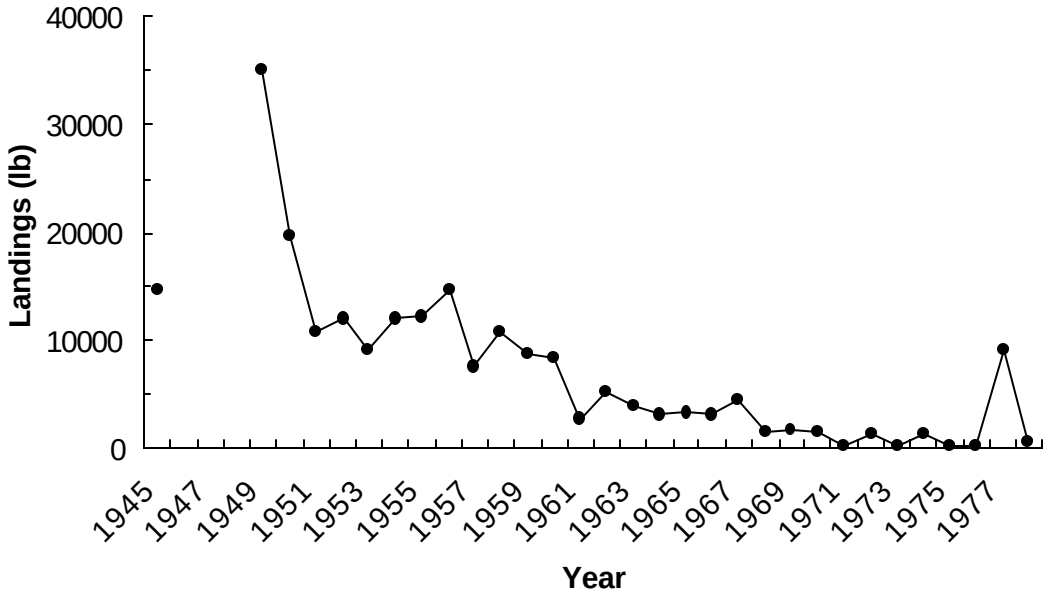
The smalltooth sawfish has rarely been used for scientific purposes. As noted earlier in the life history section, large numbers of this species were caught as bycatch in the early part of this century, severely reducing its abundance, before it was studied. Other factors which have precluded biologists from studying the smalltooth sawfish include: it is not commercially important relative to food species; it is not a traditional sport fish; and its large size and toothed rostrum make it difficult to handle.

SUMMARY

The primary reason for the decline in smalltooth sawfish abundance has been bycatch in various fisheries, including gillnets, otter trawls, trammel nets, and seines. There are frequent accounts in early literature of smalltooth sawfish being entangled in these gears in areas where smalltooth sawfish were once common, but are now rare or extirpated. Quantitative data are limited, but indicate that smalltooth sawfish have been taken by commercial fishermen and that this species has experienced severe declines in its abundance. Smalltooth sawfish have also been caught as bycatch and occasionally landed in recreational fisheries. Recent reports of smalltooth sawfish caught with their saws already removed also indicate that smalltooth sawfish are still being harmed by commercial and/or recreational fishing activities. Direct take of smalltooth sawfish has been of little importance or remains obscure. Although there is a market for smalltooth sawfish saws, the species is not commonly taken and any such captures are incidental. The recent high value aquaria are willing to pay for this species may be providing increased incentive for their collection. The smalltooth sawfish has rarely been used for scientific purposes.

Figure 4: Reported (a) landings of smalltooth sawfish in Louisiana by shrimp trawls, and (b) effort in the shrimp trawl fishery (Simpfendorfer, 2000(b)).

a.



b.

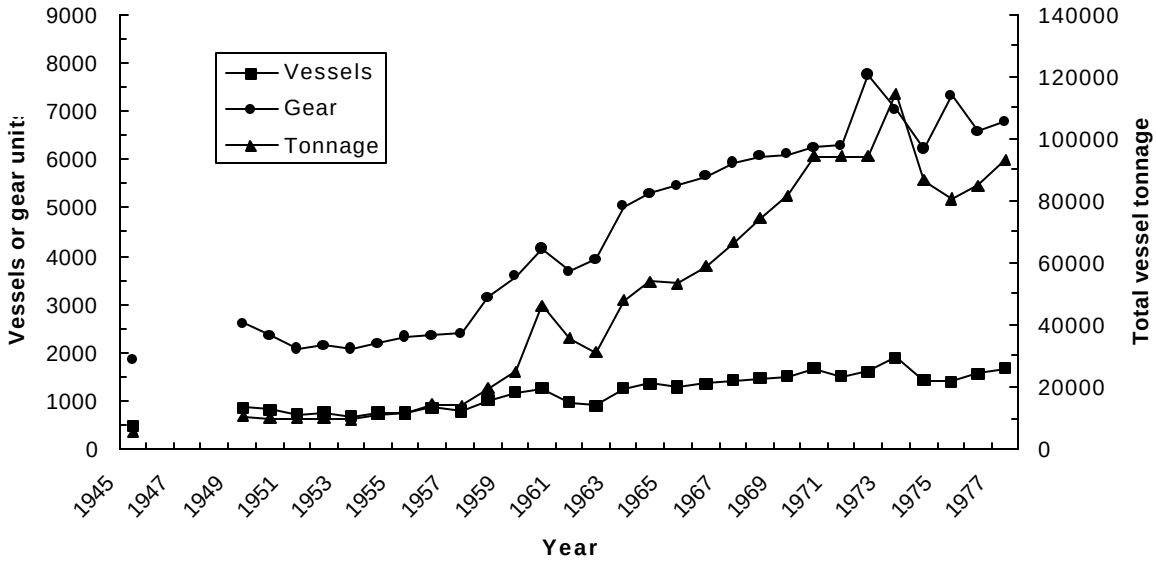
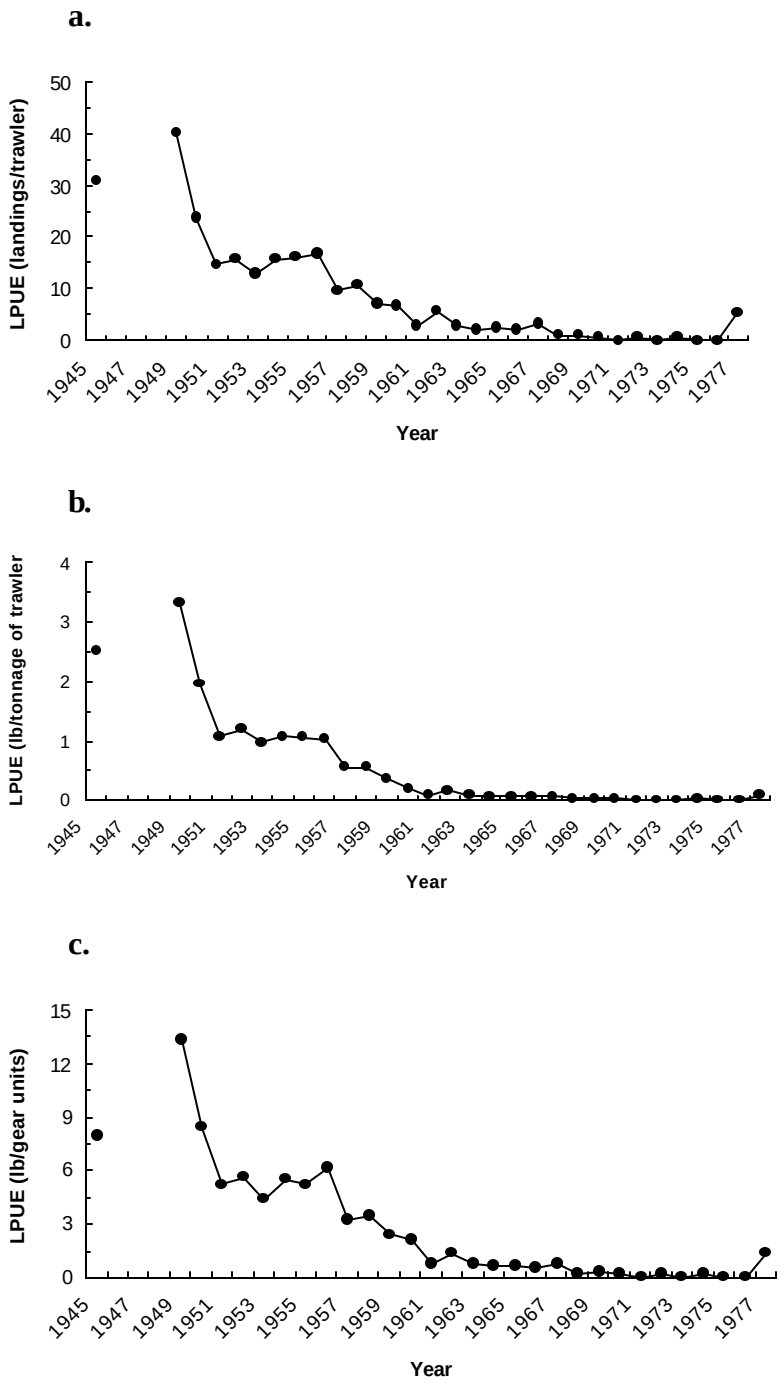


Figure 4: LPUE of smalltooth sawfish in the Louisiana shrimp trawl fishery 1945 – 1977. Three different effort units were used (a) number of vessels, (b) total vessel tonnage, and (c) number of gear units (Simpfendorfer, 2000(b)).



Competition, Predation or Disease

Nothing is known about competition, predation, and disease in smalltooth sawfish. The decline of the species, however, appears to have been one of slow attrition over the course of the twentieth century (primarily from bycatch in fisheries and secondarily by coastal habitat destruction) rather than some acute epizootic event. The few living specimens examined appear to be in good health (Simpfendorfer and Castro, pers. comm., 2000).

An Analysis of Existing Regulatory Authorities, Laws and Policies and Their Inadequacy to Protect Smalltooth Sawfish

Numerous Federal, state, and inter-jurisdictional laws, regulations and policies govern activities in U.S. waters and have the potential ability to affect the abundance and survival of smalltooth sawfish and their habitat. While these laws, regulations, and policies lead to overall environmental enhancements indirectly aiding smalltooth sawfish, only a few state prohibitions have been applied specifically for the protection of smalltooth sawfish. A summary of fundamental laws, regulations and policies governing activities in U.S. waters are provided below, followed by an assessment of their application to smalltooth sawfish and their adequacy to protect smalltooth sawfish from further declines.

INTERNATIONAL AUTHORITIES

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

CITES regulates import, export, re-export, and introduction from 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 which 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. The United States proposed listing sawfish on CITES Appendix I at the tenth regular meeting of the Conference of the Parties (COP10), June 9-20, 1997, in order to prevent the commercial take and trade in sawfish for curios, meat, and oils. Although new listing criteria (Res. Conf. 9.24) make it clear that it is not necessary for trade to be the driving force behind the decline of a species proposed for listing, the U.S. request that sawfish be listed on CITES was rejected at the 1997 CITES meeting due to the scarcity of trade and biological data for sawfish. Quantitative data on sawfish trade are lacking due to their low commercial importance relative to other marine fishes. Prompted by a public request, the NMFS CITES committee considered proposing sawfish be listed under CITES again in 1999 and conducted a preliminary review. The committee decided against re-proposing the species for listing under CITES on the basis that there was still too little known trade of this species to support such a proposal.

U.S. FEDERAL AUTHORITIES

Magnuson-Stevens Act (16 U.S.C. 1801 et. Seq.)

This act provides regional fishery management councils with authority to prepare plans for the conservation and management of fisheries in the EEZ, including the establishment of

necessary habitat conservation measures. Section 304(f) gives the Secretary of Commerce management authority over Atlantic highly migratory species which are defined to include billfish, swordfish, tuna, and oceanic sharks. Essential Fish Habitat, including freshwater habitats for anadromous species, may also be delineated for species with approved federal Fishery Management Plans.

Smalltooth sawfish are not managed under a federal Fishery Management Plan (FMP), therefore, there are no federal restrictions on taking this species. A July 1980 Draft FMP for the Shark and other Elasmobranch Fisheries of the Gulf of Mexico, prepared by the Gulf of Mexico Fishery Management Council, included smalltooth sawfish as part of a skates, rays, and miscellaneous elasmobranchs management group, but the plan was never implemented.

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. The majority of these closed areas, however, are offshore of areas where sawfish are more commonly found, and thus they 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 later discussed in this section under state laws, however, smalltooth sawfish are only prohibited in Florida (since 1992) and Louisiana (since 1999). A search of the NMFS enforcement database found no Lacey Act cases, seizures, etc., involving sawfish.

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

The Endangered Species Act provides for the conservation of plant and animal species federally listed as threatened or endangered. The smalltooth sawfish, as an unlisted species, may derive some benefits from federal agency consultation requirements and regulations for listed species, where their ranges and conservation needs coincide. For example, regulations promulgated under the ESA to protect endangered and threatened sea turtles may also provide some benefit for smalltooth sawfish. Both sea turtles and smalltooth sawfish are susceptible to shrimp trawl gear. It is not known whether the use of turtle excluder devices (TEDs), required on shrimp trawls since 1989, allows for the escapement of smalltooth sawfish. Given the large size of this species and their rostrum teeth, however, it is highly unlikely that smalltooth sawfish are able to pass through TEDS without getting entangled.

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

The FWCA requires that wildlife, including fish, receive equal consideration and be coordinated with other aspects of water resource development. Under this Act, the 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 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 action 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. Recommendations specifically for the protection of smalltooth sawfish have not been included in any FWCA reports. Any general recommendations implemented that reduce habitat loss in shallow coastal areas, however, may benefit smalltooth sawfish by curbing increased habitat degradation.

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

The purpose of the MPRSA 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 SPA regulate ocean transportation and dumping of dredged material, sewage sludge, and other materials. The MPRSA also included Title III, later called the National Marine Sanctuaries Act, which charged the Secretary of the Department of Commerce to identify, designate, and manage marine sites based on conservation, ecological, recreational, historical, aesthetic, scientific or educational value within significant national ocean and Great Lake waters. NOAA administers the National Marine Sanctuary Program through the Sanctuaries and Reserves Division of the Office of Ocean and Coastal Resource Management. Sanctuaries, frequently compared to underwater parks, are managed according to Management Plans, prepared by NOAA on a site-by-site basis. 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.

In November 1990, the Florida Keys National Marine Sanctuary (FKNMS) was designated by legislation known as the Florida Keys National Marine Sanctuary and Protection Act (Public Law 101-605). This is the only National Marine Sanctuary (out of 13) that is in an area where smalltooth sawfish may benefit from its management. The Florida Keys National Marine Sanctuary includes the entire Florida Keys marine ecosystem, constituting approximately

2,600 square nautical miles, encompassing the world's third largest barrier reef system, and extending from Biscayne Bay (north) to the Dry Tortugas (south). The sanctuary 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 sanctuary was established to stem mounting threats to the health and ecological future of the coral reef ecosystem. Major issues facing the sanctuary include declines in healthy corals brought on by an increase in coral disease and coral bleaching, invasion of algae in seagrass beds and coral reefs, overfishing, reduced freshwater inflow from Florida Bay, and damage to coral from careless boaters, snorkelers, divers and occasional large ship groundings. Reauthorization of the MPRSA in 1992 improved coordination between NOAA, the Environmental Protection Agency and other interested parties in protecting and restoring water quality in the Florida Keys Sanctuary. While smalltooth sawfish are not known to reside in coral reefs, progress towards restoring water quality in the Florida Keys Sanctuary may have a beneficial impact on smalltooth sawfish.

On May 26, 2000, a new executive order was signed with the intended purpose to: strengthen the management, protection, and conservation of existing marine protected areas and establish new or expanded marine protected areas (MPAs); develop a scientifically based, comprehensive national system of MPAs representing diverse U.S. marine ecosystems and the Nation's natural and cultural resources; and avoid causing harm to MPAs through federally conducted, approved, or funded activities. Marine protected areas are defined as "any area of the marine environment that has been reserved by Federal, State, territorial, tribal or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein". Smalltooth sawfish may derive some future benefits from this Executive Order if smalltooth sawfish are considered when avoiding causing harm to MPAs through federally conducted, approved, or funded activities.

Federal Water Pollution Control Act of 1972 (FWPCA) (33 U.S.C. 1251-1376)

Commonly known as the "Clean Water Act", the FWPCA is a very broad statute with the goal of maintaining and restoring waters of the United States. The FWPCA authorizes water quality and pollution research, provides grants for sewage treatment facilities, sets pollution discharge and water quality standards, addresses oil and hazardous substances liability, 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 Environmental Protection Agency 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 into navigable waters. NMFS and the U.S. Fish and Wildlife Service provide direct consultations to the Environmental Protection Agency 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. Smalltooth sawfish may benefit from reduced habitat degradation from consultations which result in the reduction of discharged dredge or fill materials in smalltooth sawfish habitat.

National Environmental Policy Act of 1969 (NEPA) (42 U.S.C. 4321-4347)

NEPA requires federal agencies to consult with each other and to employ systematic and

interdisciplinary techniques in planning and decision making. It also requires federal agencies to include in every major Federal action significantly affecting the quality of the human environment a detailed statement on: a) the environmental impact of the proposed action; b) any adverse environmental effects which cannot be avoided should the proposal be implemented; c) alternatives to the proposed action; d) the relationship between local short-term uses and enhancement of long-term productivity; and e) any irreversible and irretrievable commitments of resources involved in the proposed action. The agencies use the results of this analysis in decision-making and alternatives analysis which allows other options to be considered. NMFS plays a significant role in the implementation of NEPA through its consultative functions relating to conservation of marine resource habitats. Any general recommendations implemented that reduce habitat loss in shallow coastal areas may benefit smalltooth sawfish by curbing increased habitat degradation.

Coastal Zone Management Act (16 U.S.C. 1451-1464) and Estuarine Areas Act

Congress passed policy on values of estuaries and coastal areas through these Acts. Comprehensive planning programs, to be carried out at the state level, were established to enhance, protect, and utilize coastal resources. Federal activities must comply with the individual state programs. Habitat may be protected by planning and regulating development that could cause damage to sensitive coastal habitats. The Florida Coastal Management Program (FCMP) plays a role in coordinating the actions of nine agencies (including the Department of Environmental Protection and the Florida Fish and Wildlife Conservation Commission) and five water management districts using 23 statutes to protect Florida's coastal interests. Actions that reduce habitat loss in shallow coastal areas may benefit smalltooth sawfish by curbing increased habitat degradation.

Federal Land Management and Other Protective Designations

Protection and good stewardship of lands and waters managed by federal conservation agencies, the Departments of Defense and Energy (as well as State-protected park, wildlife and other natural areas) contribute to the health of nearby aquatic systems that support important smalltooth sawfish habitats. There are three National Wildlife Refuges surrounding the southern tip of Florida (the Key West National Wildlife Refuge, the National Key Deer Refuge, and the Great White Heron National Wildlife refuge) and one national park that may afford habitat protection for the smalltooth sawfish. All commercial fishing is prohibited in Everglades National Park. There is also a prohibition on the use and possession of spear guns and spear poles and all recreational seines and nets, except for dip nets, cast nets, and landing nets. In addition, no fishing is allowed in a few marine areas, including Eco, Mrazek or Coot Bay Ponds at any time and from the boardwalk at West Lake, or at the Flamingo Marina during daylight hours. The fact that smalltooth sawfish are currently found primarily in protected areas such as the ones noted under this subsection indicates that federal land management and other protective designations may provide a significant benefit to this species.

STATE AUTHORITIES/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 below by

state. Regulations reducing smalltooth sawfish interactions with fishing gear likely reduce mortality of this species, while the benefit derived from regulations only prohibiting their take are slightly more speculative. Studies have not been performed on post-release mortality rates of smalltooth sawfish for any gear. Simpfendorfer (2000) notes that "their toothed rostra make them easily entangled in nets, and almost impossible to remove without causing mortal damage". The fact that two out of four smalltooth sawfish reported in the GCSC had no rostra suggests that the practice of removing the saws prior to their release (Cadwell, 1990) still occurs today. Given their feeding behavior (see Life History/General Characteristics section), the long-term survival of smalltooth sawfish individuals that have lost their rostra is speculated by the status review team to be low.

Florida

Since April 1992, pursuant to section 370.027 (2)(f) of Florida statutes, smalltooth sawfish, as well as largetooth sawfish, are designated as protected species in Florida. 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 is to 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 (Florida Fish and Wildlife Conservation Commission (FFWCC), 2000). FFWCC, concerned that this species may be endangered, is also presently denying all requests for exempted permits to collect this species from Florida waters for public display (Dodrill, pers. comm., 2000). Since 1995, entangling nets (gill nets, trammel nets, and seines) greater than 500 square feet have been prohibited in Florida state waters (Camhi, 1998). The use of large trawls 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.

Louisiana

Smalltooth sawfish and largetooth sawfish have also been protected as prohibited species in Louisiana (title 56 of Louisiana Revised statutes) (Pausina, pers. comm., 2000), but only since March 1999. As of March 1997, no entanglement nets are allowed in Louisiana state waters, except for the pompano fishery during a limited area and season and limited use in the mullet fishery.

Alabama:

Alabama is proposing that smalltooth taken incidentally to other fishing activities be immediately returned to the water with the least possible injury to the animal. Harassment is defined by the state as any intentional action such as snagging, spearing, pursuit by a vessel, or any other intentional action which may cause injury to the animal. If approved, the regulation is proposed to be effective January 1, 2001 (Waller, pers. comm). Commercial gillnetting is not prohibited in the state of Alabama, but is limited by many regulations, recently amended. Longlining or other hook and line devices with more than five hooks are prohibited from use in state waters. 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) (Camhi, 1998).

Texas, Mississippi, Georgia, South Carolina, and North Carolina

There are no regulations for smalltooth sawfish in these five states. Georgia has prohibited the use of gill nets (except for shad and diamondback terrapins) and longlines in state waters since the 1950s (Camhi, 1998). Only in recent years have most other states within the historical range of the smalltooth sawfish promulgated regulations banning or restricting the use of gillnets and other entanglement nets. Commercial gillnets are still allowed in North Carolina. Recent legislation in South Carolina has prohibited the use of commercial shark gillnets in state waters. Gill nets in other fisheries must be no longer than 100 feet with a 3-inch minimum stretched mesh size and may be used only in unrestricted areas of the Atlantic ocean or in special designated areas. There are also a number of restrictions on the recreational use of gill nets, including size constraints and area closures, where the use of fish traps, longlines, gillnets, and trawls are prohibited (Camhi, 1998). In Mississippi state waters, gill net use, while not prohibited, has been greatly reduced since January 1, 1997 , by a regulation requiring that gill nets be made of degradeable materials such as cotton and linen (Quavis, 2000). All entanglement nets have been prohibited in Texas since September 1988 (Hammerschmidt, pers.comm).

SUMMARY AND EVALUATION

There are no federal regulations or conservation plans specifically for the protection of sawfish. Any general recommendations implemented that reduce habitat loss in shallow coastal areas may provide some benefit to smalltooth sawfish by curbing increased habitat degradation, but most recommendations NMFS gives under the laws, regulations, and policies reviewed above are not binding. With the exception of Florida, Louisiana, and possibly Alabama in the near future, smalltooth sawfish can be harvested in state waters. As noted earlier in this document, a century of net fisheries combined with the low reproductive potential of the sawfish (typical of most elasmobranchs) resulted in a very severe decline in sawfish populations. Smalltooth sawfish bycatch in gillnets has likely been reduced due to recent regulations prohibiting or limiting the use of gillnets in state waters and the depressed abundance of this species, but bycatch in other gears such as trawls may still pose a threat to this species. Recent reports of smalltooth sawfish caught with their saws already removed indicate that smalltooth sawfish are still harmed by commercial or recreational fishing activities. Based on this information, existing federal and state laws, regulations and policies appear inadequate to protect smalltooth sawfish, with the possible exception of within the Everglades National Park, where smalltooth are still found to occur.

Other Natural or Manmade Factors Affecting Its Continued Existence

Life History Limitations

The current and future abundance of smalltooth sawfish is limited by its life history characteristics. Smalltooth sawfish likely have slow growth, late maturity, a long life span, and a small brood size. These combined characteristics 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. Consequently, they are not able to respond effectively (rapidly) to additional and new sources of mortality resulting from changes in their environment. Such changes include overexploitation and habitat degradation (Musick, 1999). Smalltooth sawfish have been (and are currently) subjected to both overexploitation 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 mortalities and rapid stock collapse, after which recovery may take decades (Musick et al., 2000). 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), and regional extirpation has been reported for two large batoid species (Casey and Meyers, 1998). Musick(1999) noted that intrinsic rates of increase less than ten percent were low, and placed species at risk.

Simpfendorfer (2000a) 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 litter size of smalltooth sawfish in the literature is given as 15 – 20 and a mean of 17.5 was used by Simpfendorfer. However, the data on which this litter size is based are somewhat dubious. To account for uncertainty in the life-history parameters several different scenarios were tested, covering longevities from 30 to 70 years and ages-at-maturity from 10 to 27 years. The results indicated that the intrinsic rate of population increase ranged from 0.08/year to 0.13/ year, and population doubling times ranged from 5.4 years to 8.5 years. These models assume the literature value for litter size is correct; doubling times would be longer if litter sizes are more in the range observed for largetooth sawfish (1 to 13, with a mean of 7.3). Simpfendorfer concluded:

> The estimated population doubling times for smalltooth sawfish indicate that the recovery times for this population will be very long. There are no data available on the size of the remaining populations, but anecdotal information indicates that smalltooth sawfish survive today in small fragmented areas where the impact of humans, particularly from net fishing, has been less severe. Fragmenting of the population will increase the time that it takes for recovery since the demographic models used in the

study above assume a single inter-breeding population. The genetic effects of recovery from very small population sizes may also impact conservation efforts. 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.

Current Conservation Efforts

Current conservation efforts to protect the smalltooth sawfish are confined to actions directed at increasing general awareness of this species and the risks it faces, possession prohibitions in the state waters of Florida and Louisiana (see Existing Regulatory Authorities, Laws and Policies and their Inadequacy to Protect Smalltooth Sawfish section), and limited research and monitoring activities. There are no Federal or state conservation plans for the smalltooth sawfish. Current conservation efforts are constrained, in part, from the severe lack of scientific data and research needed for development of effective conservation plans. A list identifying some of these data and research needs is included at the end of this section.

AWARENESS INITIATIVES

The World Conservation Monitoring Center provides information services on conservation and sustainable use of the worlds's living resources and helps others to develop information systems of their own. The World Conservation Union's (IUCN) 1996 Red List of Threatened Animals lists smalltooth sawfish as endangered, reporting that the species has been wholly or nearly extirpated from large areas of its former range in the Northeast Atlantic, Mediterranean, U.S. Atlantic and Gulf of Mexico (Baillie and Groombridge 1996). The main purpose of the IUCN Red List of Threatened Animals is to catalogue the species that are regarded as threatened at a global level, or, in other words, at risk of overall extinction.

The American Fisheries Society (AFS) has recently fulfilled an initiative to identify marine fish stocks that may be at risk of extinction in North America. A list of marine, estuarine, and diadromous fish that may be at risk of extinction in North America was published in the November 2000 issue of *Fisheries*. Criteria used to assess extinction risk include rarity, small range and endemics, specialized habitat requirements, and population decline. Smalltooth sawfish in the U.S. were listed as endangered, being at high risk of extinction in the near future (Musick et al., 2000). The objectives in preparing the list were to identify stocks at risk at a sufficiently early stage of decline to avoid listing as threatened or endangered, minimize the possibility of under- or overestimating the risk of extinction, use the best existing knowledge of stock dynamics at low population levels, and allow experts on stocks to bring to bear all the available knowledge about life history and conservation status in order to categorize the risk of extinction (Musick et al., 2000).

SMALLTOOTH SAWFISH RESEARCH AND MONITORING ACTIVITIES

Researchers at the Mote Marine Laboratory's Center for Shark Research are currently conducting surveys using longlines, setlines and seine nets in areas of Florida Bay and the Everglades where sawfish are believed to occur to determine their distribution and abundance. This study is funded by NMFS, Office of Protected Resources. Sampling will be expanded to include the outer Florida Keys, Charlotte Harbor and the Ten Thousand Islands. Some of the sawfish caught will be fitted with acoustic transmitters to monitor their movements to determine home range, diurnal and tidal movement patterns, and habitat preferences. Cooperating guides and researchers, operating out of Chockloskee, Florida, the Florida Keys, and the Rookery Bay

Laboratory are also tagging and reporting sawfish when they encounter them . Mote researchers have confirmed the existence of a population of smalltooth sawfish in southern Florida. As of November, 2000, five smalltooth sawfish have been tagged, either with fin tags or dart tags depending on their size. (Jose Castro, pers. comm., 2000).

OTHER DATA COLLECTION EFFORTS

Mote Marine Laboratory

Since Mote Marine Laboratory (MML) was established in 1955, data on smalltooth sawfish have been obtained opportunistically and from the Gulf Coast Shark Census (GCSC). The GCSC was a catch and release shark fishing tournament, held annually in June, between the years 1989 and 1999. MML has a total of 24 records in its database of smalltooth sawfish, five from GCSC, and 19 from other MML records. Non-GCSC records were mostly specimens held in the research aquaria, collected generally from commercial gillnet and stop net fishers, although a few came from recreational fishers.

NMFS

NMFS' predecessor agencies, the U.S. Fish Commission and 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 landing surveys prior to 1977 are listed in the publication, "Fisheries Statistics of the U.S., 1977." Subsequent publications have been annual. The collection of U.S. commercial fisheries landings data is a joint state and federal responsibility. Field offices of NMFS, in cooperation with various states, collect and compile data on U.S. commercial landings and processed fishery products. State fishery agencies are usually the primary collectors of landings data, but in some states NMFS and state personnel cooperatively collect the data. Survey methodology differs by state, but NMFS makes supplemental surveys to ensure that the data from different states and years are comparable. A limited number of smalltooth sawfish landings were collected as a result of the data collection efforts described above, mainly from Louisiana (see Overutilization section and Appendix C). The last landing recorded was in 1978.

The NMFS Fisheries Statistics Division in Silver Spring, MD, manages the collection and compilation of recreational statistics and tabulates and prepares all data for its annual publication. 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; excludes Texas). A query of MRFSS data from 1981 through August of 2000 for smalltooth sawfish records found only 1 catch.

The Everglades National Park (ENP)

The objectives of fisheries monitoring in the park are to estimate catch rates (CPUE), relative abundance, age structure, total harvest, and boating and fishing activity. Recreational fishermen are interviewed at boat launch sites (Flamingo and Chokoloskee/Everglades City;

Schmidt et al., 2000) upon completion of their trip every weekend. Data recorded includes area fished, fish kept and released, effort (in angler-hours), species preference, angler residence, and fish lengths. Professional guides are required to obtain an annual permit from the park and report their monthly catch and effort on a per trip basis via logbooks supplied with a permit. Prior to 1980 reporting was voluntary. Recreational sawfish data are available from 1989 onward (Appendix B**)**. Prior to that date, the coding system was inconclusive for documentation of sawfish.

SCIENTIFIC DATA AND RESEARCH NEEDS

The Status Review team believes that fulfillment of the following scientific data and research items is important and would assist conservation efforts for smalltooth sawfish.

Habitat

Identification and characterization of existing smalltooth sawfish pupping grounds and nursery areas

Identification of other areas that could provide suitable pupping and nursery habitat if corrective measures or management measures were taken.

Identification of the most cost-effective places to improve habitat.

Stock Assessment and Population Dynamics

Sawfish stock assessment

Development of a system for monitoring of future incidental takes.

Noninvasive methods to determine maturity of captured specimens need to be developed.

Genetic analysis of smalltooth sawfish to determine if separate populations exist.

Development of standardized survey techniques to track population trends.

Implementation of a long-term tagging program to detect and track any migratory movements.

Biology/Community Ecology

Determination and identification of the use of different prey species at different levels of maturity. Identification of preferred prey species during each life stage

Identification of factors (natural predators, degraded water quality, losses to commercial or recreational fishing, or disease) limiting recruitment of young smalltooth sawfish into the breeding stock.

Identification of the principle causes of mortality among adult smalltooth sawfish

Captive Propagation

Research to determine whether potential exists for captive propagation.

Collection and compilation of aquarium curators' knowledge of smalltooth sawfish. acquired from aquarium-held specimens.

Summary

The smalltooth sawfish has a circumtropical distribution and has been reported from shallow coastal and estuarine habitats. The northwestern terminus of their Atlantic range is in the waters of the eastern United States. Sawfish live chiefly on sandy or muddy bottoms in relatively shallow near shore waters. They are most abundant in sheltered bays and estuaries, often in brackish water. In the United States, smalltooth sawfish are generally a shallow water fish of inshore bars, mangrove edges, and seagrass beds, but are occasionally found in deeper coastal waters.

The status review identifies smalltooth sawfish that occur in waters of the United States as a distinct population segment (DPS). The U.S. population of smalltooth sawfish is discrete and significant and therefore satisfies criteria for distinctness as outlined in the NMFS and FWS DPS policy. Therefore, it is a DPS.

In order to assess both the historic and the current distribution and abundance of the smalltooth sawfish, the status review team collected and compiled literature accounts, museum collection specimens, and other records of the species. The historic range of the smalltooth sawfish in the U.S. DPS extended from the shallow waters of the Gulf of Mexico and eastern seaboard north to North Carolina, and seasonally as far north as New York. The current range has contracted dramatically; the smalltooth sawfish has disappeared from over 90% of its range. Their distribution has contracted to pennisular Florida and, within that area, can only be found with any regularity off the extreme southern portion of the state. The current distribution is centered in the Everglades National Park (including Florida Bay). Although time-series abundance data are lacking, publication and museum records, negative scientific survey records, anecdotal fisher observations, and limited LPUE data indicate that smalltooth sawfish have declined dramatically in U.S. waters over the last century.

Each of the five listing factors was analyzed for its impact on the smalltooth sawfish. Under the first listing factor (present or threatened destruction, modification, or curtailment of range), the following threats to smalltooth sawfish habitat within the U.S. DPS were identified: (1)loss of wetlands, (2) eutrophication, (3) point and non point sources of pollution, (4) increased sedimentation and turbidity, and (5) hydrologic modifications. Although habitat degradation is not likely the primary reason for the decline of smalltooth sawfish abundance , it has likely been a contributing factor.

Under the second listing factor (overutilization for commercial recreational, scientific, or educational purposes), bycatch in commercial fisheries was found to have played the primary role in the decline of the U.S. DPS of smalltooth sawfish. Their rostrums are easily entangled in nets making them very vulnerable to accidental capture by fishing interests. There are frequent accounts in early literature of smalltooth sawfish being entangled in these gears in areas where smalltooth sawfish were once common, but are now rare or extirpated. Quantitative data are limited, but indicate that smalltooth sawfish have been taken by commercial fishermen and that

this species has experienced severe declines in its abundance. Recent reports of smalltooth sawfish caught with their saws already removed also indicate that smalltooth sawfish are still being harmed by commercial and/or recreational fishing activities. Direct take of smalltooth sawfish has been of little importance or remains obscure. Although there is a market for smalltooth sawfish saws, the species is not commonly taken and any such captures are incidental. The smalltooth sawfish has rarely been used for scientific purposes. The recent high value aquaria are willing to pay for this species may, however, be providing increased incentive for their collection.

The third factor examined was disease and predation. There is no evidence that predation or disease is currently threatening the species continued existence.

Under the fourth listing factor, NMFS examined regulatory mechanisms for their ability to protect the U.S. DPS of smalltooth sawfish. Numerous Federal, state, and inter-jurisdictional laws, regulations and policies govern activities in U.S. waters and have the potential ability to affect the abundance and survival of smalltooth sawfish and their habitat. While these laws, regulations, and policies lead to overall environmental enhancements indirectly aiding smalltooth sawfish, very few have been applied specifically for the protection of smalltooth sawfish. Existing conservation efforts appear inadequate, with the exception of within th Everglades National Park, where smalltooth are still found to occur.

Limitations associated with life history strategy of smalltooth sawfish were examined under the fifth listing factor (other natural or manmade factors affecting the continued existence of the DPS. Based on the species' low intrinsic rate of increase resulting from its slow growth, late maturation, and low fecundity, population recovery potential for the species is limited and place the species at risk.

In addition to the above five factors, the status review team assessed protective measures in place and current smalltooth sawfish conservation efforts. Current protective measures and conservation efforts underway to protect the U.S. DPS of smalltooth sawfish are confined to: actions directed at increasing general awareness of this species and the risks it faces; possession prohibitions in the state waters of Florida, Louisiana; and research being pursued by the Mote Marine Laboratory's Center for Shark Research. There are no Federal or state conservation plans for the smalltooth sawfish.

After reviewing the best scientific and commercial information, the status review team has determined that the continued existence of the U.S. DPS of smalltooth sawfish is in danger of extinction throughout all or a significant portion of its range from a combination of the following four listing factors: the present or threatened destruction, modification, or curtailment of habitat or range; overutilization for commercial recreational scientific or educational purposes; inadequacy of existing regulatory mechanisms; and other natural or manmade factors affecting its continued existence.

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Appendix A: Existing smalltooth records

RECORD#	GENUS_SPEC	YEAR	DATE	STATE	COUNTY	LOCATION	LAT/LONG	ASSIGNED/G	H2ODEPTH_(m)	#_OF_INDIV	SIZE(CM)	SEX	WEIGHT(kg)	CATOLOGUE_	SOURCE
1	P. pectinata	1782	July	NY			40 30' N; 074 05' W			1	450				Schopf, 1788
2	P. pectinata	1817	March	SC	Charleston	Charleston Harbour	32 45' N; 079 52' W	assigned		1	~450				Sanders, 2000 (pers.com.)(Schirmer Records,The Charleston Museum)
3	P. pectinata	1834	04-May	FL	Monroe	Key West	24 33' N; 081 45' W	given		1				AMNH 55558	
4	P. pectinata	1853		AL		Mobile	30 41' N; 088 02' W	given		1	68	male		MCZ-105	Bigelow and Schroeder (pre 1953)
5	P. sp.	1870	summer	TX	Cameron	Brazos Santiago Harbor	26 04' N; 097 10' W	assigned		1				USNM 0029091	
6	P. pectinata	1871	June	SC	Charleston	Charleston Harbour	32 45' N; 079 52' W	assigned		1					Sanders, 2000 (pers.com.)(Schirmer Records,The Charleston Museum)
7	P. pectinata	1876.1		VA/MD		Lower Chesapeake Bay Region	unknown								Uhler and Lugger, 1876
8	P. pectinata	1878		NJ		Grassy Sound	39 00' N; 074 49' W	given		1	480				Goode, G.B., 1884, Fish and Fish Industries US (I:668); Shields, 18779
9	P. pectinata	1879		FL	Duval	Jacksonville, St. John's River	30 24' N; 081 24' W	assigned		1				USNM 12453	Bigelow and Schroeder/MCZ(pre 1953); Goode, G.B., 1880, Bull USNM (21:41); Goode, G.B., 1879, Proc USNM,(73:120), collected by H. A. Ward
10	P. pectinata	1882		FL	Escambia	Pensacola	30 25' N; 087 12' W	given		1	72			USNM 0030678	Jordan & Evermann, 1900, Bull. USNM 47(4):pl.,fig. 37; Radcliffe, 1916,FIDE Jeff Clayton USNM; Goode, G. B., 1884 (Collected 1882 by Silas Stearns)
11	P. pectinata	1883	November	FL	Levy	Cedar Keys	29 07' N; 083 03' W	assigned		1					Evermann & Kendall, 1899, US Comm Fish & Fish;Jordan & Swain, 1884;
12	P. pectinata	1883		FL	Volusia		unknown			1				CU 440	Jordan/Proc. USNM, 1884, (7:105)
13	P. pectinata	1884	December	FL	Monroe	Key West	24 33' N; 081 45' W	assigned		1					Evermann & Kendall, 1889, US Comm Fish & Fish; Jordan and Swain/Proc. USNM, 1884, (7:320)
14	P. pectinata	1884	June	SC	Charleston	Off Long Island, Near Sullivans Island	32 45' N; 079 50' W	assigned		1	660				Sanders, 2000 (pers.com.)(Schirmer Records, The Charleston Museum)
15	P. pectinata	1884.1		FL	Duval	Jacksonville, St. John's River	30 24' N; 081 24' W	assigned							Goode, G.B., 1884, Fish & Fish Industries US (I:668) (pre 1884)
16	P. pectinata	1884.1		FL	Duval	New Berlin	30 24' N; 081 33' W	assigned		1					Goode, G.B., 1884, Fish & Fish Industries US (I:668) (pre 1884)
17	P. pectinata	1884.1		FL	Bay	St. Andrew's Bay	30 07' N; 085 42' W	assigned		1	457				Goode, G.B., 1884, Fish & Fish Industries US (I:668) (pre 1884)
18	P. pectinata	1885	summer	NC	Carteret	Beaufort	34 43' N; 076 39' W	given		1					Jenkins, O.P., 1885
19	P. pectinata	1888	19-Jul	SC	Charleston	Off Fort Johnson	32 43' N; 079 51' W	assigned		1	619				Sanders, 2000 (pers.com.)(Schirmer Records,The Charleston Museum)
20	P. pectinata	1889	22-Mar	FL	Lee	San Carlos Bay	26 27' N; 081 59' W	assigned		1	470		~270		Evermann & Kendall, 1899, US Comm Fish & Fish; Henshall/ Bull. US Fish Comm., 1891, (9:372)
21	P. pectinata	1889		FL	Charlotte	Big Gasparilla	26 49' N; 082 17' W	assigned		>1	100-160				Evermann & Kendall, 1899, US Comm Fish & Fish; Henshall/ Bull. US Fish Comm., 1891, (9:372)
22	P. pectinata	1889		FL	Charlotte	Big Gasparilla	26 49' N; 082 17' W	assigned		1	550				Bean/Bull. US Fish Comm, 1892, (10)
23	P. pectinata	1890.1		FL		Florida Reefs (Atlantic Coast)	unknown			1				USNM 0042374	FIDE Jeff Clayton USNM (Collected pre 1890, cataloged 7/16/1890)
24	P. pectinata	1892	Winter	FL	Hillsborough	Tampa Bay	27 35' N; 082 40' W	assigned		1					Evermann & Kendall, 1899, US Comm Fish & Fish; Henshall/ Bull. US Fish Comm., 1895, (14:210)
25	P. pectinata	1893	May	NC	Hyde	Ocracoke	35 06' N; 075 58' W	given						NCSM 8130	
26	P. pectinata	1895	February	FL	Dade	Biscayne Bay	25 35' N; 080 10' W	assigned		1					Evermann & Kendall, 1899, US Comm Fish & Fish; Smith/Rep. US Comm. Fish, 1896 (Listed as McCormick specimen)
27	P. pectinata	1895	October	FL	Brevard	Eau Gallie	28 08' N; 080 38' W	given		1	420		191		Evermann & Kendall, 1899, US Comm Fish & Fish; Everman and Bean, 1896 (1898); Jordan & Evermann,1896: Evermann & Marsh, 1900
28	P. pectinata	1896	17-Jan	FL	Brevard	Indian River at Cocoa	27 11' N; 080 10' W	assigned		1	110	female		FMNH 1939	Bigelow and Schroeder/MCZ(pre 1953)
29	P. pectinata	1896.1	fishing season	FL	Brevard	Eau Gallie	unknown			300					Evermann &Kendall, 1899, US Comm Fish & Fish; Everman and Bean, 1896 (1898)
30	P. pectinata	1896.1		FL	Martin	Eden	27 17' N; 080 15' W								Evermann & Kendall, 1899, US Comm Fish & Fish; Everman and Bean, 1896 (1898)
31	P. pectinata	1896.1		FL	Martin	Stuart	27 12' N; 080 15' W								Evermann & Kendall, 1899, US Comm Fish & Fish; Evermann and Bean, 1896 (1898)
32	P. pectinata	1897	May	NC	Carteret	Beaufort	34 43' N; 076 39' W	given						NCSM 140	
33	P. pectinata	1899	21-Jun	NC	Brunswick	Cape Creek, Near Southport	33 53' N; 078 00' W	assigned		1	~450		~157.5		Sunday Star News, Wimington NC, 6/2/99
34	P. pectinata	1900	August	NJ	Cape May	Cape May	39 09' N; 074 47' W	given		2					Fowler, 1908 (I in Aug., another same time and area)
35	P. pectinata	1902	Summer	NC	Carteret	Beaufort	34 43' N; 076 39' W			1					Gudger, 1912
36	P. pectinata	1904		FL	Monroe	Grassy Key west to the Marquesas	unknown								Fowler/Proc. ANSP, 1906 (58:80)
37	P. pectinata	1907.1		FL	St Lucie	Fort Pierce	27 29' N; 080 17' W	assigned		2					Fowler/Proc. ANSP, 1915 (67:245); Collected by G.B. Wood (1904-1907)
38	P. pectinata	1908	January	NC	Carteret	Cape Lookout	34 35' N; 076 32' W	assigned		1	415	female		AMNH 225808	Fowler, 1945
39	P. pectinata	1908	January	NC			unknown			1				CU 2911	(Brimley Bros. Specimen)
40	P. pectinata	1908	March	GA	Bryan County	Atlantic side of Ossabaw Island	31 48' N; 081 05' W	assigned		1	92				Gudger, 1912 (Coles Specimen)
41	P. pectinata	1909		FL			unknown			1				FMNH 9367	
42	P. pectinata	1910	01-Feb	FL		Southern Florida	unknown			1				AMNH 4665	
43	P. pectinata	1911		MD	Worchester	Ocean City	38 23' N; 075 03' W	given		1	300				Fowler, 1914
44	P. pectinata	1912		FL	Manatee	Anna Maria Island	27 31' N; 082 44' W	assigned		1				UF 48061	
45	P. pectinata	1915.1		NC	Carteret	Cape Lookout Shoals	34 30' N; 076 28' W	given		9	390-490				Coles, 1915(Bigelow and Schroeder 1953)
46	P. pectinata	1917	03-Apr	FL	Monroe	Sand Key	24 33' N; 081 45' W	assigned	1.8	1	70				Nichols/Bull AMNH, 1917 (37:268)
47	P. pectinata	1917	13-Apr	FL			unknown			1	520	female			Nichols/Bull AMNH, 1917 (37:268)
48	P. pectinata	1924	08-Aug	TX	Cameron	Point Isabel, Laguna Madre	26 07' N; 097 05' W	assigned		1				FMNH 1092	
49	P. pectinata	1924	25-Aug	TX	Cameron	Point Isabel, Laguna Madre	26 07' N; 097 05' W	assigned		1				FMNH 1092	
50	P. pectinata	1924	11-Sep	TX	Cameron	Point Isabel, Laguna Madre	26 07' N; 097 05' W	assigned		1				FMNH 1092	
51	P. pectinata	1924		TX	Cameron	Point Isabel, Laguna Madre	26 07' N; 097 05' W	assigned		1				FMNH 5118	
52	P. pectinata	1926	September	SC	Beaufort	St Helena Sound	32 27' N; 080 24' W	assigned		1	516				Sanders, 2000 (pers.com.)(Schirmer Records,The Charleston Museum)
53	P. pectinata	1927.1	January	FL	Collier	Marco	25 56' N; 081 43' W	given		3	~60				Hilldebrand and Schroeder, 1927, XLIII
54	P. pectinata	1927.1		FL	Monroe	Key West	24 33' N; 081 45' W	given		1	420				Hilldebrand and Schroeder, 1927, XLIII
55	P. pectinata	1927.1		VA	Princess Anne	Lynnhaven Roads	36 55' N; 076 10' W	assigned							Hilldebrand and Schroeder, 1927, XLIII
56	P. pectinata	1927.1		VA	Princess Anne	Ocean View	37 00' N; 076 00' W	assigned							Hilldebrand and Schroeder, 1927, XLIII
57	P. pectinata	1928	25-Jul	SC	Charleston	Off Mouth of Stono River	32 38' N; 079 58' W	assigned		1	~300				Sanders, 2000 (pers.com.)(Schirmer Records,The Charleston Museum)
58	P. pectinata	1929	24-Mar	SC	Charleston	Charleston Harbour	32 45' N; 079 52' W	assigned		1				CM29.122	Sanders, 2000 (pers.com.)
59	P. pectinata	1930	07-Jul	LA	Plaquemines	Quatre Bayou Pass	29 19' N; 089 51' W	assigned		1				USNM 127141	
60	P. pectinata	1930		FL	Monroe	Key West	24 33' N; 081 45' W	given		1				FMNH 3662	
61	P. pectinata	1930.1		FL	Pinellas	Tarpon Springs	28 08' N; 082 45' W	given		3				USNM 00232685	(pre 1930)
62	P. pectinata	1933	28-Jul	SC	Georgetown	Off Georgetown County	33 20' N; 079 17' W	assigned		1					Sanders, 2000 (pers.com.)(Burton Records, The Charleston Museum)
63	P. pectinata	1933	June	SC											
64	P. pectinata	1933	October	LA	Jefferson	Barataria Bay	29 22' N; 089 56' W	given		1					Gunter, 1942, Amer. Midl. Nat. 26:196TX; Gunter, G. 1935, Copeia:39 - LA
65	P. pectinata	1936	August	SC	Charleston	Charleston Harbour	32 45' N; 079 52' W	assigned		1					Sanders, 2000 (pers.com.)
66	P. pectinata	1937	03-Jul	NC	Dare	Kitty Hawk Beach	36 06' N; 075 43' W	given		1	405			NCSM (CW)	
67	P. pectinata	1937	June	SC	Charleston	Off Bulls Bay	32 59' N; 079 34' W	assigned		1	450				Sanders, 2000 (pers.com.)
68	P. pectinata	1938		SC	Charleston	North Edisto River	32 33' N; 080 11' W	assigned		1				CM45.29	Sanders, 2000 (pers.com.)
69	P. pectinata	1938.1		SC	Charleston	Cape Romania Light House	32 58' N; 079 34' W	assigned		1				USNM 00260348	
70	P. sp.	1938.1		NC	Carteret	Ft. Macon	34 40' N; 076 40' W	assigned		1				USNM 00232968	
71	P. pectinata	1938.1		FL			unknown			1				USNM 00110149	
72	P. pectinata	1941	09-Jan	FL	Monroe	Plantation Key	24 58' N; 080 33' W	assigned		1					Fowler/Mogr. ANSP, 1945 (7:264)
73	P. pectinata	1942	05-May	TX	Cameron	Brown Ceder Cut, off of Laguna Madre	26 05 N; 097 10' W	assigned		1					Baughman, 1943
74	P. pectinata	1945		FL	Pinellas	150 miles West of Pass-a-Grille	27 40' N; 084 00' W	assigned		1					NMFS Roman & Fairclough, GSMFC (pers.com.)
75	P. pectinata	1947		TX	Galveston	Galveston	29 18' N; 094 47' W	given		1	140	male		MCZ 36659	Bigelow and Schroeder/MCZ(pre 1953); Jordan & Kendall, 1894, Bull. US Fish Comm 12:95
76	P. pectinata	1948	August	SC	Charleston	Off Kiawah Island	32 35' N; 080 04' W	assigned		1	320	male	383		Sanders, 2000 (pers.com.)
77	P. pectinata	1949	10-Apr	TX	Nueces	Corpus Christi Bay off NMFS lab	27 46' N; 097 15' W	assigned	0.5468	1				TCWC 6565	
78	P. pectinata	1950	27-Nov	TX	Nueces	Courpus Christi	27 34' N; 096 36' W	given	54.86	1		male			Spinger and Bullis, 1956
79	P. pectinata	1950	07-Dec	LA	Plaquemines	Southwest Pass	28 49' N; 089 42.5' W	given	65.83	1					Spinger and Bullis, 1956
80	P. pectinata	1950	July	SC	Charleston	Off Folly Island	32 39' N; 079 55' W	assigned		1	484				Sanders, 2000 (pers.com.)
81	P. pectinata	1950.1		FL		Gulf	unknown			1					NMFS Roman & Fairclough, GSMFC (pers.com.)(year 1950's)
82	P. pectinata	1950.1		FL	Monroe	West of Key West	24 35' N; 082 24' W	assigned		3	1@300, 2@260				NMFS Roman & Fairclough, GSMFC (pers.com.)(year 1950's)
83	P. pectinata	1953	01-May	FL	Citrus	Gulf, between Crystal River and Homosassa River	28 50' N; 082 43' W	assigned		1				UF 2792	
84	P. pectinata	1953.1		FL	Brevard	Cocoa	28 23' N; 080 44' W	given		1				USNM 00205192	Jeff Clayton/NMNH(pre 1953)
85	P. pectinata	1953.1		TX	Galveston	Galveston	29 18' N; 094 47' W	given		6	96-104			MCZ 36960	Bigelow and Schroeder/MCZ(pre 1953)
86	P. pectinata	1953.1		FL	Monroe	Key West	24 33' N; 081 45' W	given		2	370-410				Bigelow and Schroeder/MCZ(pre 1953)
87	P. pectinata	1953.1		LA	Jefferson	Lake Ponchartrain, misc bayou's	30 07' N; 089 40' W	assigned							Bigelow and Schroeder/MCZ(pre 1953)
88	P. pectinata	1953.1		MS	Jackson	Pascagoula Bay	30 22' N; 088 37' W	assigned		1	~380	female		MCZ 1220	Bigelow and Schroeder/MCZ(pre 1953)
89	P. pectinata	1953.1		FL		Southern Florida	unknown			1	420	unk.		MCZ	Bigelow and Schroeder/MCZ(pre 1953)
90	P. pectinata	1958	07-Aug	SC	Georgetown	Georgetown	33 22' N; 079 17' W	given		1	457				SCW&MRD
91	P. pectinata	1958	12-Sep	FL	Hillsborough	Gulf Coast (off Tampa Bay)	27 39' N; 083 40' W	given	15.84	1		female	202.5		NMFS Pascagoula
92	P. pectinata	1959	27-May	FL	Pinellas	Old Tampa Bay, Safety Harbour	27 54' N; 082 35' W	given		2	897 and 810			FSBC 0134	
93	P. pectinata	1960	06-Jul	MS	Jackson	Mississippi Sound, Belle Fontaine Beach	30 20' N; 088 43' W	assigned	0.91	1	92			GCRL 176	
94	P. pectinata	1960	19-Jul	MS	Jackson	Mississippi Sound at Belle Fontaine Point	30 20' N; 088 43' W	assigned		1				GCRL 336	
95	P. pectinata	1960	June	FL	Franklin	Apalachicola Bay	29 40' N; 084 57' W	given		1				UF 58004	
96	P. pectinata	1961	25-Mar	FL	Monroe	S end of Lower Matecumbe Key; Atlantic side	24 49' N; 080 45' W		0.5 - 2.5	1				UF 208305	

97	P. pectinata	1961	25-Mar	FL	Monroe	Slough on Atlantic side of Long Key	24 48' N; 080 51' W	assigned		1				ANSP 153754	Collectors, W Courtenay, et al
98	P. pectinata	1961	January	FL	Monroe	Atlantic Ocean side of Lower Matecumbe Key	24 51' N; 080 44' W			1	144				Springer and McErlean, 1962
99	P. pectinata	1962	July 10-23	LA	Vermillion	Vermilion Bay	29 45' N; 092 02' W	assigned		1					Copeia
100	P. pectinata	1963	27-Jun	NC	New Hanover	.5 miles off Carolina Beach	34 02' N; 077 53' W	given		1	460				Schwartz, 1984
101	P. pectinata	1963	May	FL	Franklin	Gulf Beach, Alligator Peninsula	29 54' N; 084 25' W	assigned		1				UF 59431	
102	P. pectinata	1964	27-Aug	FL	Pinellas	Tampa Bay	27 41' N; 082 34' W	given		1				UF 20026	
103	P. pectinata	1966	21-May	FL	Franklin	Mud Cove ca 5mi E of Alligator Pt.	29 48' N; 084 51' W	given		1				UF 64062	
104	P. pectinata	1966	10-Aug	MS	Harrison	Mississippi Sound, off east end of Deer Island, Biloxi	30 22' N; 088 50' W	given		1				GCRL 1548	
105	P. pectinata	1967	August	LA	Jefferson	Barataria Basin	29 20' N; 089 55' W	assigned		1	106				Blanchet/LDWF/ (Perret et al., 1971)
106	P. pectinata	1968	July	AL	Mobile	Mobile Bay	30 26' N; 088 00' W	assigned		2					Swindle, AL Marine Resources Bull., August 1971
107	P. pectinata	1969	28-Jan	LA		Gulf Of Mexico	28 12' N; 092 01' W	given	21.33	1		female	180		NMFS Pascagoula
108	P. pectinata	1971	21-Jan	LA	Plaquemines	2 mi. Southwest Pass of Mississippi R, Plaquemines	28 55' N; 089 25' W	assigned		1				UIAC 3987.01	Madden/pers.com(Boschung, 1993)
109	P. pectinata	1972	07-Dec	FL	Citrus	Crystal River, NW of Florida Power Co	28 53' N; 082 36' W	given		1				UF 30880	
110	P. pectinata	1977	01-Jan	FL	Monroe	Grassy flats off SW side of Boot Key, ~1 mi S of 7 mile brdg.	24 41' N; 081 08' W	assigned		1	146			CU 54926	
111	P. pectinata	1977	02-Apr	FL	Franklin	Beach at FSU Marine Lab	84 13' N; 030 03' W	assigned		1				UF 76361	
112	P. pectinata	1978	23-Jan	TX	San Patricio	Mustang Island, .5 mi SW of Free Fish	27 50' N; 097 03' W	assigned		1				TCWC 2082	
113	P. pectinata	1979	07-Aug	TX	Matagorda	Carancahua Bay	28 40' N; 096 23' W	given		1	170				Green/TPWD (pers.com)
114	P. pectinata	1980.1		FL	Monroe	Northwest of Key West near Wreck/Sea Buoy	24 40' N; 082 25' W	assigned		1	350-400				NMFS Roman & Fairclough, GSMFC (pers.com)
115	P. pectinata	1983	08-Dec	FL	Citrus	Crystal River	28 53' N; 082 36' W	given		1				UF 40293	Fairclough/GSMFC/per.com
116	P. pectinata	1983		FL	Volusia	4 miles NE of Daytona Beach	29 17' N; 080 57' W	assigned	18.28	1	~400				Fairclough/GSMFC/per. com.
117	P. pectinata	1984	24-Apr	TX	Aransas	Aransas Bay	27 55' N; 097 04' W	given		1	150	female			Green/TPWD (pers.com)
118	P. pectinata	1988		FL	Monroe	West of Keys	unknown		30.48	25					NMFS Roman & Fairclough, GSMFC (pers.com)
119	P. pectinata	1989	14-Nov	FL	Lee	Charlotte Harbour	26 52.81 N; 082 9.96 W	given		1	200				FLF&WCC,FMRI
120	P. pectinata	1989		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		2					T. W. Schmidt (pers.com.)
121	P. pectinata	1990	25-Apr	FL	Charlotte	Charlotte Harbour,Myakka River	26 58.65 N; 082 13.78	given		1	78				FLF&WCC,FMRI
122	P. pectinata	1990	June	FL	Levy	Waccasassa Bay, at S Bar Light off Cedar Key	29.1202180 N, -82.9806020 \	assigned		1	560				~~Jamie (pers.com)~~
123	P. pectinata	1990		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		6					T. W. Schmidt (pers.com.)
124	P. pectinata	1990		FL	Monroe	North Florida Bay/Everglades Nat. Park	25 10' N; 080 35' W	assigned		1					T. W. Schmidt (pers.com.)
125	P. pectinata	1990		FL	Monroe	North Florida Bay/Everglades Nat. Park	25 10' N; 080 35' W	assigned		1					T. W. Schmidt (pers.com.)
126	P. pectinata	1990		FL	Monroe	Northwest Everglades Nat. Park	25 40' N; 081 20' W	assigned		1					T. W. Schmidt (pers.com.)
127	P. pectinata	1990		FL	Monroe	Northwest Everglades Nat. Park	25 40' N; 081 20' W	assigned		1					T. W. Schmidt (pers.com.)
128	P. pectinata	1990		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		2					T. W. Schmidt (pers.com.)
129	P. pectinata	1990		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1					T. W. Schmidt (pers.com.)
130	P. pectinata	1990		FL	Monroe	South Florida Bay/Everglades Nat. Park	24 55' N; 080 35' W	assigned		1					T. W. Schmidt (pers.com.)
131	P. pectinata	1990		FL	Monroe	South Florida Bay/Everglades Nat. Park	24 55' N; 080 35' W	assigned		1					T. W. Schmidt (pers.com.)
132	P. pectinata	1990.9				Gulf Of Mexico	unknown			1					Fairclough/GSMFC/per.com. (1990's)
133	P. pectinata	1990.9		FL	Volusia	Just off Ponce Inlet	29 05' N; 080 55' W	assigned		1			~315		Fairclough/GSMFC/per.com. (1990's)
134	P. pectinata	1990.9				South Atlantic	unknown			1					Fairclough/GSMFC/per.com. (1990's)
135	P. pectinata	1991		FL	Monroe	Whitewater Bay/Everglades Nat. Park	25 17' N; 081 00' W	assigned		1					T. W. Schmidt (pers.com.)
136	P. pectinata	1991		FL	Monroe	Whitewater Bay/Everglades Nat. Park	25 17' N; 081 00' W	assigned		1					T. W. Schmidt (pers.com.)
137	P. pectinata	1992		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		1					T. W. Schmidt (pers.com.)
138	P. pectinata	1992		FL	Monroe	North Florida Bay/Everglades Nat. Park	25 10' N; 080 35' W	assigned		1					T. W. Schmidt (pers.com.)
139	P. pectinata	1992		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1					T. W. Schmidt (pers.com.)
140	P. pectinata	1993	06-Oct	FL	Lee	Charlotte Harbour	26 55.23 N; 082 8.43 W	given		1	128				FLF&WCC,FMRI
141	P. pectinata	1993	06-Oct	FL	Lee	Charlotte Harbour	26 55.23 N; 082 8.43 W	given		1	135	female			FLF&WCC,FMRI
142	P. pectinata	1993		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		1					T. W. Schmidt (pers.com.)
143	P. pectinata	1993		FL	Monroe	North Florida Bay/Everglades Nat. Park	25 10' N; 080 35' W	assigned		2					T. W. Schmidt (pers.com.)
144	P. pectinata	1993		FL	Monroe	North Florida Bay/Everglades Nat. Park	25 10' N; 080 35' W	assigned		4					T. W. Schmidt (pers.com.)
145	P. pectinata	1993		FL	Monroe	Northwest Everglades Nat. Park	25 40' N; 081 20' W	assigned		1					T. W. Schmidt (pers.com.)
146	P. pectinata	1993		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1					T. W. Schmidt (pers.com.)
147	P. pectinata	1994	27-Jan	FL	Monroe	Between Key West and Dry Tortugas	24 40' N; 082 40' W	assigned	14.63	1	431			FDNR	
148	P. pectinata	1994		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		1					T. W. Schmidt (pers.com.)
149	P. pectinata	1994		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		1					T. W. Schmidt (pers.com.)
150	P. pectinata	1994		FL	Monroe	Everglades	unknown			1					T. W. Schmidt (pers.com.)
151	P. pectinata	1994		FL	Monroe	Everglades	unknown			1					T. W. Schmidt (pers.com.)
152	P. pectinata	1994		FL	Monroe	North Florida Bay/Everglades Nat. Park	25 10' N; 080 35' W	assigned		1					T. W. Schmidt (pers.com.)
153	P. pectinata	1994		FL	Monroe	North Florida Bay/Everglades Nat. Park	25 10' N; 080 35' W	assigned		1					T. W. Schmidt (pers.com.)
154	P. pectinata	1994		FL	Monroe	North Florida Bay/Everglades Nat. Park	25 10' N; 080 35' W	assigned		1					T. W. Schmidt (pers.com.)
155	P. pectinata	1994		FL	Monroe	Northwest Everglades Nat. Park	25 40' N; 081 20' W	assigned		2					T. W. Schmidt (pers.com.)
156	P. pectinata	1994		FL	Monroe	Northwest Everglades Nat. Park	25 40' N; 081 20' W	assigned		1					T. W. Schmidt (pers.com.)
157	P. pectinata	1994		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1					T. W. Schmidt (pers.com.)
158	P. pectinata	1994		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1					T. W. Schmidt (pers.com.)
159	P. pectinata	1995		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		1					T. W. Schmidt (pers.com.)
160	P. pectinata	1995		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		1					T. W. Schmidt (pers.com.)
161	P. pectinata	1995		FL	Monroe	North Florida Bay/Everglades Nat. Park	25 10' N; 080 35' W	assigned		1					T. W. Schmidt (pers.com.)
162	P. pectinata	1995		FL	Monroe	Northwest Everglades Nat. Park	25 40' N; 081 20' W	assigned		1					T. W. Schmidt (pers.com.)
163	P. pectinata	1995		FL	Monroe	On a gulf side flat off the Marquesas	24 34' N; 082 06' W	assigned		1	260-320				E. Little (pers.com)
164	P. pectinata	1995		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1					T. W. Schmidt (pers.com.)
165	P. pectinata	1995		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1					T. W. Schmidt (pers.com.)
166	P. pectinata	1995		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1					T. W. Schmidt (pers.com.)
167	P. pectinata	1995		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1					T. W. Schmidt (pers.com.)
168	P. pectinata	1996	03-Mar	FL	Monroe	~ 7 mi. SW of Key West	24 27.28' N; 081 59.85' W	given	11.58	1	~900				FLMNH/SOP
169	P. pectinata	1996		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		1					T. W. Schmidt (pers.com.)
170	P. pectinata	1996		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		1					T. W. Schmidt (pers.com.)
171	P. pectinata	1996		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		1					T. W. Schmidt (pers.com.)
172	P. pectinata	1996		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		2					T. W. Schmidt (pers.com.)
173	P. pectinata	1996		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		1					T. W. Schmidt (pers.com.)
174	P. pectinata	1996		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		1					T. W. Schmidt (pers.com.)
175	P. pectinata	1996		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		1					T. W. Schmidt (pers.com.)
176	P. pectinata	1996		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		1					T. W. Schmidt (pers.com.)
177	P. pectinata	1996		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		1					T. W. Schmidt (pers.com.)
178	P. pectinata	1996		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		1					T. W. Schmidt (pers.com.)
179	P. pectinata	1996		FL	Monroe	North Florida Bay/Everglades Nat. Park	25 10' N; 080 35' W	assigned		1					T. W. Schmidt (pers.com.)
180	P. pectinata	1996		FL	Monroe	Northwest Everglades Nat. Park	25 40' N; 081 20' W	assigned		1					T. W. Schmidt (pers.com.)
181	P. pectinata	1996		FL	Monroe	Northwest Everglades Nat. Park	25 40' N; 081 20' W	assigned		1					T. W. Schmidt (pers.com.)
182	P. pectinata	1996		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1					T. W. Schmidt (pers.com.)
183	P. pectinata	1996		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1					T. W. Schmidt (pers.com.)
184	P. pectinata	1996		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1					T. W. Schmidt (pers.com.)
185	P. pectinata	1996		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1					T. W. Schmidt (pers.com.)
186	P. pectinata	1996		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1					T. W. Schmidt (pers.com.)
187	P. pectinata	1996		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		2					T. W. Schmidt (pers.com.)
188	P. pectinata	1996		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1					T. W. Schmidt (pers.com.)
189	P. pectinata	1996		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1					T. W. Schmidt (pers.com.)
190	P. pectinata	1996		FL	Monroe	South Florida Bay/Everglades Nat. Park	24 55' N; 080 35' W	assigned		1					T. W. Schmidt (pers.com.)
191	P. pectinata	1996		FL	Monroe	South Florida Bay/Everglades Nat. Park	24 55' N; 080 35' W	assigned		1					T. W. Schmidt (pers.com.)
192	P. pectinata	1996		FL	Monroe	South Florida Bay/Everglades Nat. Park	24 55' N; 080 35' W	assigned		1					T. W. Schmidt (pers.com.)
193	P. pectinata	1996		FL	Monroe	South Florida Bay/Everglades Nat. Park	24 55' N; 080 35' W	assigned		1					T. W. Schmidt (pers.com.)
194	P. pectinata	1996		FL	Monroe	Whitewater Bay/Everglades Nat. Park	25 17' N; 081 00' W	assigned		1					T. W. Schmidt (pers.com.)
195	P. pectinata	1996		FL	Monroe	Whitewater Bay/Everglades Nat. Park	25 17' N; 081 00' W	assigned		1					T. W. Schmidt (pers.com.)

196	P. pectinata	1996		FL	Monroe	Whitewater Bay/Everglades Nat. Park	25 17' N; 081 00' W	assigned		1			T. W. Schmidt (pers.com.)
197	P. pectinata	1997	20-Jan	FL	Monroe	~ 5 mi. SW of Key West	24 25.00' N; 082 02.33' W	given	72.54	4	300-400		FLMNH/SOP
198	P. pectinata	1997		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		1			T. W. Schmidt (pers.com.)
199	P. pectinata	1997		FL	Monroe	Everglades	unknown			1			T. W. Schmidt (pers.com.)
200	P. pectinata	1997		FL	Monroe	North Florida Bay/Everglades Nat. Park	25 10' N; 080 35' W	assigned		1			T. W. Schmidt (pers.com.)
201	P. pectinata	1997		FL	Monroe	North Florida Bay/Everglades Nat. Park	25 10' N; 080 35' W	assigned		1			T. W. Schmidt (pers.com.)
202	P. pectinata	1997		FL	Monroe	North Florida Bay/Everglades Nat. Park	25 10' N; 080 35' W	assigned		1			T. W. Schmidt (pers.com.)
203	P. pectinata	1997		FL	Monroe	North Florida Bay/Everglades Nat. Park	25 10' N; 080 35' W	assigned		1			T. W. Schmidt (pers.com.)
204	P. pectinata	1997		FL	Monroe	Northwest Everglades Nat. Park	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
205	P. pectinata	1997		FL	Monroe	Northwest Everglades Nat. Park	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
206	P. pectinata	1997		FL	Monroe	Northwest Everglades Nat. Park	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
207	P. pectinata	1997		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
208	P. pectinata	1997		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		2			T. W. Schmidt (pers.com.)
209	P. pectinata	1997		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
210	P. pectinata	1997		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
211	P. pectinata	1997		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
212	P. pectinata	1997		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
213	P. pectinata	1997		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
214	P. pectinata	1997		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
215	P. pectinata	1997		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
216	P. pectinata	1997		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		2			T. W. Schmidt (pers.com.)
217	P. pectinata	1997		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		2			T. W. Schmidt (pers.com.)
218	P. pectinata	1997		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
219	P. pectinata	1997		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
220	P. pectinata	1997		FL	Monroe	Northwest Everglandes Nat. Park	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
221	P. pectinata	1997		FL	Monroe	Northwest Everglandes Nat. Park	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
222	P. pectinata	1997		FL	Monroe	Northwest Everglandes Nat. Park	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
223	P. pectinata	1997		FL	Monroe	Northwest Everglandes Nat. Park	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
224	P. pectinata	1997		FL	Monroe	Northwest Everglandes Nat. Park	25 40' N; 081 20' W	assigned		2			T. W. Schmidt (pers.com.)
225	P. pectinata	1997		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		2			T. W. Schmidt (pers.com.)
226	P. pectinata	1997		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		2			T. W. Schmidt (pers.com.)
227	P. pectinata	1997		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1			T. W. Schmidt (pers.com.)
228	P. pectinata	1997		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1			T. W. Schmidt (pers.com.)
229	P. pectinata	1997		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1			T. W. Schmidt (pers.com.)
230	P. pectinata	1997		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1			T. W. Schmidt (pers.com.)
231	P. pectinata	1997		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1			T. W. Schmidt (pers.com.)
232	P. pectinata	1997		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		3			T. W. Schmidt (pers.com.)
233	P. pectinata	1997		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		3			T. W. Schmidt (pers.com.)
234	P. pectinata	1997		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		5			T. W. Schmidt (pers.com.)
235	P. pectinata	1997		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		6			T. W. Schmidt (pers.com.)
236	P. pectinata	1997		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		3			T. W. Schmidt (pers.com.)
237	P. pectinata	1997		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		4			T. W. Schmidt (pers.com.)
238	P. pectinata	1997		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1			T. W. Schmidt (pers.com.)
239	P. pectinata	1997		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		2			T. W. Schmidt (pers.com.)
240	P. pectinata	1997		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		5			T. W. Schmidt (pers.com.)
241	P. pectinata	1997		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		2			T. W. Schmidt (pers.com.)
242	P. pectinata	1997		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1			T. W. Schmidt (pers.com.)
243	P. pectinata	1997		FL	Monroe	South Florida Bay/Everglades Nat. Park	24 55' N; 080 35' W	assigned		1			T. W. Schmidt (pers.com.)
244	P. pectinata	1997		FL	Monroe	South Florida Bay/Everglades Nat. Park	24 55' N; 080 35' W	assigned		3			T. W. Schmidt (pers.com.)
245	P. pectinata	1997		FL	Monroe	South Florida Bay/Everglades Nat. Park	24 55' N; 080 35' W	assigned		1			T. W. Schmidt (pers.com.)
246	P. pectinata	1997		FL	Monroe	South Florida Bay/Everglades Nat. Park	24 55' N; 080 35' W	assigned		1			T. W. Schmidt (pers.com.)
247	P. pectinata	1997		FL	Monroe	South Florida Bay/Everglades Nat. Park	24 55' N; 080 35' W	assigned		2			T. W. Schmidt (pers.com.)
248	P. pectinata	1997		FL	Monroe	Whitewater Bay/Everglades Nat. Park	25 17' N; 081 00' W	assigned		1			T. W. Schmidt (pers.com.)
249	P. pectinata	1997		FL	Monroe	Whitewater Bay/Everglades Nat. Park	25 17' N; 081 00' W	assigned		1			T. W. Schmidt (pers.com.)
250	P. pectinata	1997		FL	Monroe	Whitewater Bay/Everglades Nat. Park	25 17' N; 081 00' W	assigned		1			T. W. Schmidt (pers.com.)
251	P. pectinata	1997		FL	Monroe	Whitewater Bay/Everglades Nat. Park	25 17' N; 081 00' W	assigned		1			T. W. Schmidt (pers.com.)
252	P. pectinata	1997		FL	Monroe	Whitewater Bay/Everglades Nat. Park	25 17' N; 081 00' W	assigned		1			T. W. Schmidt (pers.com.)
253	P. pectinata	1997		FL	Monroe	Whitewater Bay/Everglades Nat. Park	25 17' N; 081 00' W	assigned		1			T. W. Schmidt (pers.com.)
254	P. pectinata	1997		FL	Monroe	Whitewater Bay/Everglades Nat. Park	25 17' N; 081 00' W	assigned		1			T. W. Schmidt (pers.com.)
255	P. pectinata	1997		FL	Monroe	Whitewater Bay/Everglades Nat. Park	25 17' N; 081 00' W	assigned		1			T. W. Schmidt (pers.com.)
256	P. pectinata	1998	22-May	FL	Indian River	3km S of Sebastian Inlet	27 49.5' N; 080 25.5'	assigned	3.04	1		UF 110738	
257	P. sp.	1998	01-Sep	FL	Broward		26 10' N; 080 00' W			1	400		J. Bennett (pers.com.)
258	P. pectinata	1998	July	FL	Collier	North Naples area	unknown						Naples News Daily, 7/03/98 (Sportfishermen sightings)
259	P. pectinata	1998		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		1			T. W. Schmidt (pers.com.)
260	P. pectinata	1998		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		1			T. W. Schmidt (pers.com.)
261	P. pectinata	1998		FL	Monroe	North Florida Bay/Everglades Nat. Park	25 10' N; 080 35' W	assigned		1			T. W. Schmidt (pers.com.)
262	P. pectinata	1998		FL	Monroe	Northwest Everglades Nat. Park	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
263	P. pectinata	1998		FL	Monroe	Northwest Everglades Nat. Park	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
264	P. pectinata	1998		FL	Monroe	Northwest Everglades Nat. Park	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
265	P. pectinata	1998		FL	Monroe	Northwest Everglades Nat. Park	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
266	P. pectinata	1998		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
267	P. pectinata	1998		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
268	P. pectinata	1998		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
269	P. pectinata	1998		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
270	P. pectinata	1998		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
271	P. pectinata	1998		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
272	P. pectinata	1998		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
273	P. pectinata	1998		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
274	P. pectinata	1998		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
275	P. pectinata	1998		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
276	P. pectinata	1998		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
277	P. pectinata	1998		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
278	P. pectinata	1998		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
279	P. pectinata	1998		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
280	P. pectinata	1998		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		2			T. W. Schmidt (pers.com.)
281	P. pectinata	1998		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
282	P. pectinata	1998		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
283	P. pectinata	1998		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
284	P. pectinata	1998		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1			T. W. Schmidt (pers.com.)
285	P. pectinata	1998		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1			T. W. Schmidt (pers.com.)
286	P. pectinata	1998		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		2			T. W. Schmidt (pers.com.)
287	P. pectinata	1998		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1			T. W. Schmidt (pers.com.)
288	P. pectinata	1998		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1			T. W. Schmidt (pers.com.)
289	P. pectinata	1998		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1			T. W. Schmidt (pers.com.)
290	P. sp.	1998		FL	Monroe	South Florida Bay/Everglades Nat. Park	24 55' N; 080 35' W	assigned		1			T. W. Schmidt (pers.com.)
291	P. pectinata	1998		FL	Collier/Monroe	Ten Thousand Islands/Evergaldes National Park	unknown			1	130		Naples News Daily 2/12/98
292	P. pectinata	1998		FL	Monroe	Whitewater Bay/Everglades Nat. Park	25 17' N; 081 00' W	assigned		1			T. W. Schmidt (pers.com.)
293	P. pectinata	1999	11-Feb	FL		Gulf of Mexico	24 31.67' N; 083 08.65' W	given	51.81	1	~400		FLMNH/SOP
294	P. pectinata	1999	17-Feb	FL		Tampa Bay	27 50.23' N; 082 28.15' W	given		1	81		FLF & WCC, FMRI

295	P. pectinata	1999	01-Sep	FL	Monroe	South of Key West	24 33' N; 081 45' W	given	52.42	1					FLMNH/SOP
296	P. sp.	1999	09-Sep	FL	Lee	Charlotte Harbor	26 57.23' N; 082 05.85' W	given		1	116	female			FLF & WCC, FMRI
297	P. pectinata	1999	June	FL	Collier	Off Marco Island	unknown			1	320				Naple News Daily 6/18/99
298	P. pectinata	1999	summer	FL	Volusia	5 miles SE of Ponce Inlet	29 01' N; 080 48' W	assigned	21.33	1			~300 lbs.		Fairclough/GSMFC (pers.com)
299	P. pectinata	1999	summer	FL	Flagler	Off Flagler Beach	29 29' N; 081 05' W	assigned		1					Fairclough/GSMFC (pers.com)
300	P. pectinata	1999	summer	FL	Volusia	Off Ormond Beach	29 18' N; 081 00' W	assigned		1					Fairclough/GSMFC (pers.com)
301	P. pectinata	1999		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		1					T. W. Schmidt (pers.com.)
302	P. pectinata	1999		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		1					T. W. Schmidt (pers.com.)
303	P. pectinata	1999		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		1					T. W. Schmidt (pers.com.)
304	P. pectinata	1999		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		1					T. W. Schmidt (pers.com.)
305	P. pectinata	1999		FL	Monroe	Cape Sable area/Everglades Nat. Park	25 10' N; 081 15' W	assigned		1					T. W. Schmidt (pers.com.)
306	P. pectinata	1999		FL	Monroe	Northwest Everglades Nat. Park	25 40' N; 081 20' W	assigned		1					T. W. Schmidt (pers.com.)
307	P. pectinata	1999		FL	Monroe	Northwest Everglades Nat. Park	25 40' N; 081 20' W	assigned		1					T. W. Schmidt (pers.com.)
308	P. pectinata	1999		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1					T. W. Schmidt (pers.com.)
309	P. pectinata	1999		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1					T. W. Schmidt (pers.com.)
310	P. pectinata	1999		FL	Monroe	Northwest Everglades Nat. Park.	25 40' N; 081 20' W	assigned		1					T. W. Schmidt (pers.com.)
311	P. pectinata	1999		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1					T. W. Schmidt (pers.com.)
312	P. pectinata	1999		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1					T. W. Schmidt (pers.com.)
313	P. pectinata	1999		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		1					T. W. Schmidt (pers.com.)
314	P. pectinata	1999		FL	Monroe	Shark River area/Everglades Nat. Park	25 22' N; 081 08' W	assigned		2					T. W. Schmidt (pers.com.)
315	P. pectinata	1999		FL	Monroe	Whitewater Bay/Everglades Nat. Park	25 17' N; 081 00' W	assigned		1					T. W. Schmidt (pers.com.)
316	P. sp.	1999.9		FL	Brevard	Mosquito Lagoon, Indian River	28 50' N; 080 48' W	assigned							Fairclough/GSMFC (pers.com) (1990's)
317	P. sp.	2000	June	FL	Collier	Ten Thousand Islands	25 50' N; 081 35' W	assigned		1	335				Naples News Daily, 7/02/98
318	P. pectinata	2000	May	FL	Collier/Monroe	Ten Thousand Islands/Evergaldes National Park	unknown	assigned		4	largest at 250				Naples News Daily, 5/12/00
319	P. pectinata	2000				Gulf Of Mexico	unknown			1					Fairclough/GSMFC/per.com.
320	P. pectinata			FL	Lee	Charlotte Harbor	26 46' N; 082 08' W	given		1				FMNH 609	
321	P. pectinata			FL	Monroe	Key West	24 33' N; 081 45' W	given		1				MCZ-1336	
322	P. pectinata			FL	Monroe	Key West	24 33' N; 081 45' W	given		1	420			MCZ 89872	
323	P. pectinata			FL		Marineland; St. Augustine	29 39' N; 081 13' W	given		1				UF 33948	
324	P. pectinata			FL (?)			unknown			1				MCZ 15366	
325	P. pectinata			TX			unknown			1				MCZ 95237	
326	P. pectinata			MS			unknown			1				MCZ-1220	

Appendix B : National Everglades Park Recreational Fishing Data
(Data provided by T. Schmidt)

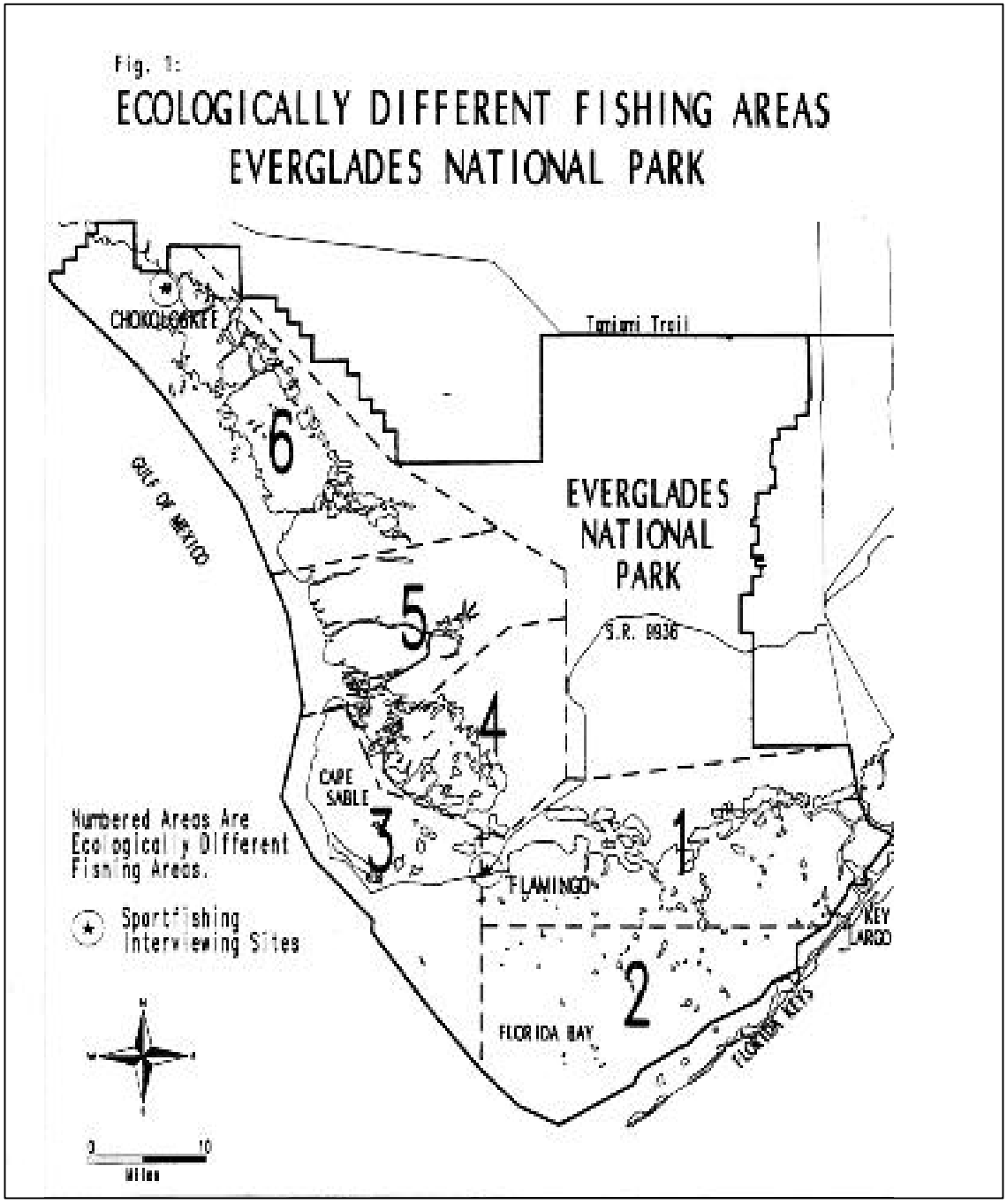
(1) Smalltooth sawfish recreational sport (non-guided) fishing CPUE data

Year	Number of Sawfish Caught	Fishing Hours on Successful Trips	CPUE of successful fishermen	Total Annual Fishing Hours	CPUE with total effort
89	2	12	0.16667	50649	0.000039487
90	13	126	0.10317	82323	0.000157915
91	0	---	---	66547	0.000000000
92	2	24	0.08333	76422	0.000026170
93	2	38	0.05263	79080	0.000025291
94	7	93	0.07527	101703	0.000068828
95	6	124	0.04839	72321	0.000082963
96	14	163	0.08589	99367	0.000140892
97	18	194	0.09278	112006	0.000160706
98	5	52	0.09615	86390	0.000057877
99	7	112	0.06250	78577	0.000089085

(2) Number of smalltooth sawfish caught by year and area

Year	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Total
89			2				2
90	1	1	6		3	2	13
91							
92			1		1		2
93					1	1	2
94			2		2	3	7
95			2		3	1	6
96	1		3	3	5	2	14
97	1			5	9	3	18
98				1		4	5
99			1	1	3	2	7
Total	3	1	17	10	27	18	76

Fig. 1:


ECOLOGICALLY DIFFERENT FISHING AREAS
EVERGLADES NATIONAL PARK
CHOKOLOSKEE
Tamiami Trail
GULF OF MEXICO
EVERGLADES NATIONAL PARK
S.R. 9336
CAPE SABLE
FLAMINGO
KEY LARGO
FLORIDA BAY
FLORIDA KEYS
6
5
4
3
2
1
Numbered Areas Are Ecologically Different Fishing Areas.
Sportfishing Interviewing Sites
N
0
10
Miles

Appendix C: Smalltooth sawfish commercial landings (NMFS data)

Year	State	Gear	Metric Tons	Pounds	$
1950	Florida, West Coast	Lines Hand, Other	0.4	800	30
1950	Louisiana	Trawls, unspecified	9	19800	764
1951	Louisiana	Trawls, unspecified	4.9	10,8000	540
1952	Louisiana	Trawls, unspecified	5.4	12000	840
1953	Louisiana	Trawls, unspecified	4.1	9100	728
1953	Texas	Trawls, unspecified	0.1	300	30
1954	Louisiana	Trawls, unspecified	5.4	12000	842
1955	Louisiana	Trawls, unspecified	5.5	12200	610
1955	Texas	Trawls, unspecified	0.1	200	20
1956	Louisiana	Trawls, unspecified	6.6	14600	800
1957	Louisiana	Trawls, unspecified	3.4	7600	439
1958	Louisiana	Haul Seines, Beach	0.2	500	25
1958	Louisiana	Trawls, unspecified	4.9	10800	512
1958	Louisiana	Trammel nets	0.4	900	45
1959	Louisiana	Haul Seines, Beach	0.2	400	20
1959	Louisiana	Trawls, unspecified	3.9	8700	435
1959	Louisiana	Trammel nets	0.5	1100	55
1960	Louisiana	Haul Seines, Beach	0.5	1000	80
1960	Louisiana	Trawls, unspecified	3.8	8400	420
1960	Louisiana	Trammel nets	0.6	1400	91
1961	Louisiana	Haul Seines, Beach	0.6	1400	68
1961	Louisiana	Trawls, unspecified	1.3	2800	140
1961	Louisiana	Trammel nets	0.8	1700	87
1962	Louisiana	Otter trawl, bottom, fish	2.4	5200	226
1963	Louisiana	Haul Seines, Beach	0.2	500	25
1963	Louisiana	Otter trawl, bottom, fish	1.7	3800	162
1964	Louisiana	Otter trawl, bottom, shrimp	1.4	3100	155
1964	Louisiana	Trammel nets	0.2	500	25
1965	Louisiana	Haul Seines, Beach	0.2	400	20
1965	Louisiana	Otter trawl, bottom, shrimp	1.5	3200	184
1966	Louisiana	Haul Seines, Beach	0.3	700	67
1966	Louisiana	Otter trawl, bottom, fish	0	100	9
1966	Louisiana	Otter trawl, bottom, shrimp	1.4	3100	282
1966	Louisiana	Trammel nets	0.4	800	87
1967	Louisiana	Haul Seines, Beach	0.4	800	65
1967	Louisiana	Otter trawl, bottom, shrimp	2	4500	361
1967	Louisiana	Trammel nets	0.6	1400	112
1968	Louisiana	Haul Seines, Beach	0.1	300	18
1968	Louisiana	Otter trawl, bottom, shrimp	0.7	1500	102
1968	Louisiana	Trammel nets	0.3	600	37
1969	Louisiana	Haul Seines, Beach	0.1	300	19
1969	Louisiana	Otter trawl, bottom, shrimp	0.8	1800	111
1969	Louisiana	Trammel nets	0.4	800	46
1970	Louisiana	Otter trawl, bottom, shrimp	0.7	1500	149
1971	Louisiana	Otter trawl, bottom, shrimp	0.1	200	8
1972	Louisiana	Otter trawl, bottom, shrimp	0.6	1300	67
1973	Louisiana	Otter trawl, bottom, shrimp	0	100	7
1974	Louisiana	Otter trawl, bottom, shrimp	0.6	1300	64
1975	Louisiana	Otter trawl, bottom, shrimp	0	100	10

Year	State	Gear	Metric Tons	Pounds	$
1976	Louisiana	Otter trawl, bottom, shrimp	0	100	10
1977	Louisiana	Otter trawl, bottom, shrimp	4.1	9000	450
1978	Louisiana	Otter trawl, bottom, shrimp	0.2	523	42
		TOTALS:	84.4	186023	10541

Totals per gear type:

Gear Type	Metric tons	Pounds	$
Trawls, unspecified	58.7	129300	7120
Otter trawl, bottom, shrimp	14.2	31323	2002
Otter trawl, bottom, fish	4.1	9100	397
Trammel nets	4.2	9200	585
Haul Seines, Beach	2.8	6300	407
Lines Hand, Other	0.4	800	30

Totals per state:

State	Metric tons	Pounds	$
Florida	0.4	800	30
Louisiana	83.8	184723	10461
Texas	0.2	500	50