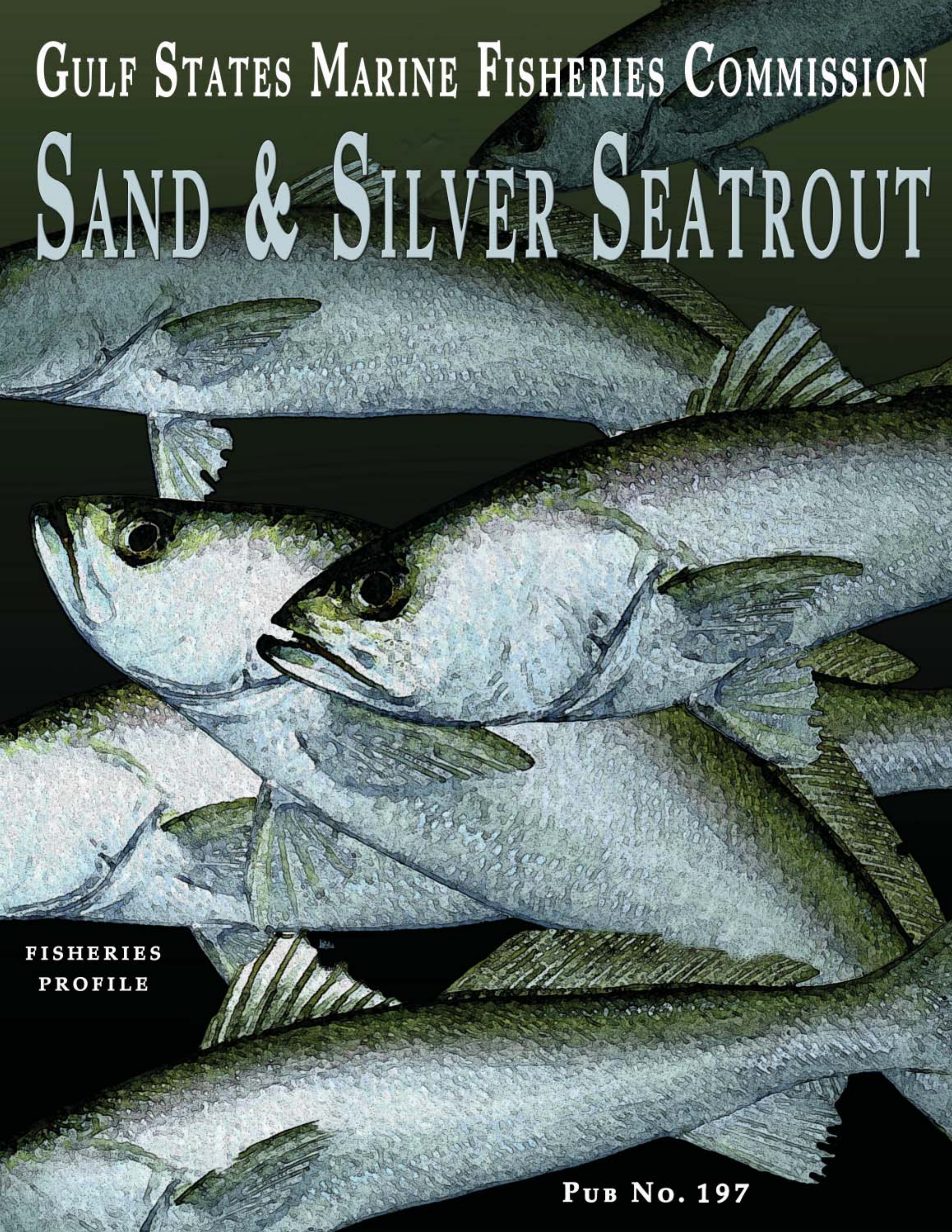
Gulf States Marine Fisheries Commission

Sand & Silver Seatrout



FISHERIES PROFILE

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Gulf States Marine Fisheries Commission

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The Sand and Silver Seatrout Fishery of the Gulf of Mexico, United States:

A Fisheries Profile

by the

Arenarius Technical Task Force

edited by

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Preface

The Gulf States Marine Fisheries Commission (GSMFC) was established by the Gulf States Marine Fisheries Compact under Public Law 81-66 approved May 19, 1949. Its charge is to promote better management and utilization of marine resources in the Gulf of Mexico.

The GSMFC is composed of three members from each of the five Gulf States. The head of the marine resource agency of each state is an *ex officio* member. The second is a member of the legislature. The third is a governor-appointed citizen with knowledge of or interest in marine fisheries. The offices of the chairman and vice chairmen are rotated annually from state to state.

The GSMFC is empowered to recommend to the governor and legislature of the respective states action on programs helpful to the management of marine fisheries. The states, however, do not relinquish any of their rights or responsibilities to regulate their own fisheries as a result of being members of the GSMFC.

One of the most important functions of the GSMFC is to serve as a forum for the discussion of various problems and needs of marine management authorities, the commercial and recreational industries, researchers, and others. The GSMFC also plays a key role in the implementation of the Interjurisdictional Fisheries (IJF) Act. Paramount to this role is the GSMFC's activities to develop and maintain regional fishery management plans for important Gulf species.

The Sand and Silver Seatrout Profile is a cooperative planning effort of the five Gulf States under the IJF Act. Members of the task force contributed by drafting individually assigned sections. In addition, all members contributed their expertise to discussions that resulted in revisions and led to the final draft of the plan.

The GSMFC made all necessary arrangements for task force workshops. Under contract with the National Marine Fisheries Service (NMFS), the GSMFC funded travel for state agency representatives and consultants other than federal employees.

Throughout this document, metric equivalents are used wherever possible and appropriate with the exceptions of reported landings data and size limits which, by convention, are reported in English units. A glossary of fisheries terms pertinent to this profile is provided in Section 12.1. Recreational landings in this document are 'Type A + B1' and actually represent total harvest, as designated by the NMFS. Type A catch are fish that are brought back to the dock in a form that can be identified by trained interviewers. Type B1 catch are fish that are used for bait, released dead, or filleted – i.e., they are killed but identification is by individual anglers. Type B2 catch are fish that are released alive – again, identification is by individual anglers and is excluded from the values in this profile.

Abbreviations and Symbols

ADCNR	Alabama Department of Conservation Natural Resources
AMRD	Alabama Marine Resources Division
BRD	bycatch reduction device
DMS	Data Management Subcommittee
°C	degrees Celsius
DO	dissolved oxygen
EFH	essential fish habitat
EEZ	Exclusive Economic Zone
ft	feet
FMP	Fishery Management Plan
FWC/FWRI	Florida Fish and Wildlife Conservation Commission/Florida Wildlife Research Institute
GSI	gonadal somatic index
g	gram
GMFMC	Gulf of Mexico Fisheries Management Council
GSMFC	Gulf States Marine Fisheries Commission
ha	hectare
hr	hour(s)
IJF	interjurisdictional fisheries
IGFA	International Game Fish Association
kg	kilogram
km	kilometer
LDWF	Louisiana Department of Wildlife and Fisheries
MRFSS	Marine Recreational Fisheries Statistical Survey
MRIP	Marine Recreational Information Program
m	meter
mm	millimeter(s)
min	minute(s)
MDMR	Mississippi Department of Marine Resources
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Atmospheric Administration
n	number
ppm	parts per million
ppt	parts per thousand
lbs	pounds
PPI	producer price index
sec	second(s)
SPR	spawning potential ratio
SL	standard length
SFFMC	State-Federal Fisheries Management Committee
SAT	Stock Assessment Team
TCC	Technical Coordinating Committee
TTF	Technical Task Force
TPWD	Texas Parks and Wildlife Department
TTS	Texas Territorial Sea
TL	total length
TW	total weight
TED	turtle exclusion device
USEPA	United States Environmental Protection Agency
USDOC	United States Department of Commerce
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
YOY	young-of-the-year

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1.0 SUMMARY

Sand seatrout (*Cynoscion arenarius*) and silver seatrout (*C. nothus*) occur in high numbers in the Gulf of Mexico. The two species can not be easily identified from one another, and are not generally separated to species by most recreational anglers, commercial fishermen, and even some fishery samplers. Sand seatrout are commonly found in estuarine and shallow offshore waters of the Gulf of Mexico from southwest Florida to the Bay of Campeche, Mexico (Sutter and McIlwain 1987), and on the Atlantic coast of the United States at least as far north as Doboy Sound, Georgia (Cordes and Graves 2003). Silver seatrout are commonly found in offshore waters of the Gulf of Mexico and western Atlantic Ocean from Chesapeake Bay to the Bay of Campeche, Mexico (Sutter and McIlwain 1987).

The extent of sand seatrout spawning grounds has not been determined, but spawning has been reported to occur in inshore bays, inlets, passes, nearshore areas beyond barrier islands, near offshore islands, and in deeper offshore Gulf waters. Much less is known about silver seatrout spawning.

Although sand seatrout larvae (<3.0 mm TL) have been collected in all months of the year (Cowan 1985, Peebles 1987), spawning primarily occurs from March-September exhibiting two distinct spawning peaks. The spring peak occurs from March-April, and the late summer peak occurs in August/September. Silver seatrout in the northern Gulf spawn from early May through late October, with the greatest or more successful spawning occurring during the late summer. The late summer spawn shows a tendency for two sub-peaks, one in August and one in September.

Following the coastal or offshore spawn, sand seatrout pelagic eggs and larvae are transported into the shallow Gulf waters (<18m) and upper estuaries (Cowan and Shaw 1988, Ditty et al. 1991) Silver seatrout apparently use rising Gulf levels and prevailing currents to carry spawned eggs inshore to nursery grounds in much the same manner as sand seatrout.

Larval sand seatrout are carnivorous, feeding primarily on copepods and mysid shrimp (Sheridan 1979, Flores-Coto et al. 1998). Fish dominate the diets of adult sand seatrout in the Gulf of Mexico. The most frequent fish prey taxa of sand seatrout is *Anchoa* sp. Silver seatrout are similar to sand seatrout in their feeding habits, feeding primarily on shrimp and mysids early in their lives, switching to more macromobile prey as they mature (Rogers 1977).

The sand seatrout habitat overlaps both that of the spotted seatrout (*C. nebulosus*) and silver seatrout. Like the spotted seatrout, the sand seatrout can be found in bays and estuaries. Juvenile sand seatrout have a preference for unvegetated benthic habitat during the summer months, and adult sand seatrout tend to migrate to deeper waters nearshore and offshore during colder months (Simmons 1957, Swingle 1971, Ditty et al. 1991). The silver seatrout differs in habitat preference from both the spotted and sand seatrout by remaining primarily offshore and at deeper depths. Silver seatrout appear to favor a slightly cooler upper temperature range (30°C) than sand seatrout and prefer waters with higher salinities (Gunter 1945, Sutter and McIlwain 1987).

In the five Gulf states, there are no size or bag regulations on sand and silver seatrout at this time. Sand and silver seatrout are harvested commercially and recreationally, with the majority being taken incidentally throughout the Gulf of Mexico region. Most anglers and commercial fishermen do not distinguish between sand seatrout and silver seatrout and frequently lump them together under the local names ‘white trout’ or ‘sand trout.’ Sand and silver seatrout are easily accessible to most anglers and can be caught in most of the Gulf’s large coastal rivers, bays, inlets, and estuaries as well as offshore (Horst and Lane 2008). Although few recreational anglers target sand and silver seatrout, they are caught opportunistically, and it is rare to see them discarded. Sand and silver seatrout are harvested from as small as seven inches TL to as large as 30 inches TL. Almost all fish harvested recreationally are used for consumption, although smaller fish are sometimes used for live or cut bait.

The NMFS Marine Recreational Fisheries Statistics Survey (MRFSS) and the Texas Recreational Harvest Monitoring Program provide the most current Gulf-wide sources of recreational fishing information. The total number of sand and silver seatrout taken recreationally has been relatively stable with the exception of Florida back in the early 1980s. In recent years, Florida landings have decreased with the exception of 2006 and 2007, and Louisiana has had the highest landings in the Gulf in recent years.

The two species actually make up a significant portion of the finfish bycatch in the Gulf commercial shrimp fishery. Gunter (1936) surveyed commercial shrimp trawlers in Louisiana waters and found ‘white trout’ (actual species unknown) to be the most common finfish bycatch. The commercial use of sand and silver seatrout is not large as indicated by the total landings. However, the value of these two species as a fresh fish product is high. Sand and silver seatrout are frequently sold in combination with spotted seatrout filets since the quality of the meat is similar. Most of the sand and silver seatrout landings up until the 1980s and 1990s resulted from bycatch in several of the larger trawl fisheries (the Atlantic croaker food fish fishery, and the Gulf shrimp fishery, and to a lesser extent, the butterfish fishery) and most were processed for use as fishmeal. The total U.S. commercial landings of sand and silver seatrout come primarily from the Gulf of Mexico region. These overall landings peaked in the 1970s at 2.6 million pounds and then have declined to an average of 116,000 pounds since 1998. In recent years, the commercial landings have been split fairly evenly between all states except Texas, whose commercial sand and silver seatrout landings have been extremely small.

The dockside value of sand and silver seatrout landed in the Gulf of Mexico exhibited a general increasing trend from the late 1960s through the mid-1990s. Dockside value began a steady downward trend through 2004-05, when dockside value reached approximately $39,000, which was almost half that reported for 1969. In general, exvessel prices for sand and silver seatrout exhibited an increasing trend across all states over the 40-year period from 1969 to 2008. The Gulf-wide exvessel price increased from $0.06 in 1969 to $0.57 in 1988 and remained relatively stable around $0.53 until 1996. Exvessel price then increased to $0.76 in 2000, then again to $0.78 in 2008.

Information on the role that sand and silver seatrout play in regional seafood markets is scarce. Anecdotal evidence suggests that some commercially harvested sand and silver seatrout enter the commercial seafood markets. To provide some insight into the commercial market channels, a brief survey was administered to seafood buyers in the Gulf region. A total of 91 completed surveys was returned Gulf-wide. Of those that completed surveys, 31 respondents (34%) indicated that sand or silver seatrout had been handled during 2009. Sand and silver seatrout that enter the commercial seafood market channels are predominantly sold as fresh, whole product. On average, approximately 88.7% of the sand and silver seatrout (by volume) was sold in whole form, while 11.3% was sold as fillets with the majority of the sales to in-state retailers (38.2%).

Sand and silver seatrout are a relatively minor commercially harvested species in the Gulf of Mexico relative to shrimp, crabs, and other finfish. Considering the incidental nature of the fishery, it is very difficult to identify exactly who is participating in the sand and silver seatrout fishery commercially. Despite the historical characterizations of the various fisheries, the major catastrophic events of the last decade (hurricanes and the economy overall) have likely resulted in major changes in the demographics of these fishermen and anglers that have yet to be studied. Therefore, there is very little reliable data on the social and culture framework that comprise the commercial sand and silver seatrout fishery at this time.

While many of the sand and silver seatrout landed in the Gulf are caught by people fishing for other species such as spotted seatrout and red drum, there are a number of anglers who specifically target sand and silver seatrout throughout the year. The demographics for these recreational anglers are routinely identified even though they may be ‘targeting’ other species.

As demonstrated throughout this profile, there is a need for a regional approach to the management and research of these two species, especially considering the lack of clearly speciated landings data and very little understanding of fishing effort, commercial or recreational. There are a number of fishery-dependent and independent issues which must be resolved before a formal assessment for these species could be conducted. This includes the detailed reporting of the two species at the state and federal level.

2.0 INTRODUCTION

On March 13, 2007, the State-Federal Fisheries Management Committee (SFFMC) agreed that sand seatrout (Cynoscion arenarius) would be the next species (fishery) designated for IJF Profile/FMP development. Because of the popularity of this species, the lack of consolidated information regarding these fish and the fisheries, and the level of concern for the well-being of stocks, the SFFMC concluded that a Gulf-wide species profile or FMP that includes the best available data was needed. Because there were so many local names for this species, it was agreed that the technical task force (TTF) would refer to it by its accepted common name ‘sand seatrout’ and the working group would be called the Arenarius TTF. The task force was subsequently formed, and an organizational meeting was held September 25, 2007 in New Orleans, Louisiana. However, during the literature and data gathering process, it became clear that what most recreational anglers and commercial fishermen around the Gulf were calling ‘sand seatrout’ were actually two species. Therefore, this profile now covers both C. arenarius (sand seatrout) and C. nothus (silver seatrout), since the commercial landings data cannot be separated between the species.

2.1 IJF Program and Management Process

The Interjurisdictional Fisheries Act of 1986 (Title III, Public Law 99-659) was approved by Congress to: (1) promote and encourage state activities in support of the management of interjurisdictional fishery resources and (2) promote and encourage management of interjurisdictional fishery resources throughout their range. Congress also authorized federal funding to support state research and management projects that were consistent with these purposes. Additional funds were authorized to support the development of interstate FMPs by the GSMFC and other marine fishery commissions. The GSMFC decided to pattern its plans after those of the Gulf of Mexico Fishery Management Council (GMFMC) under the Magnuson Fishery Conservation and Management Act of 1976. This decision ensured compatibility in format and approach to management among states, federal agencies, and the GMFMC.

After passage of the act, the GSMFC initiated the development of a planning and approval process for the profiles and FMPs. The process has evolved to its current form outlined below:

DMS						
↕						
TTF	↔	**TCC**	↔	**SFFMC**	↔	**GSMFC**
↕				↕		
SAT				**Outside Review**		

DMS = Data Management Subcommittee
SAT = Stock Assessment Team
TTF = Technical Task Force
TCC = Technical Coordinating Committee
SFFMC = State-Federal Fisheries Management Committee
GSMFC = Gulf States Marine Fisheries Commission
Outside Review = standing committees, trade associations, general public

The TTF is composed of a core group of scientists from each Gulf state and is appointed by the respective state directors that serve on the SFFMC. Also, a TTF member from each of the GSMFC standing committees (Law Enforcement, Habitat Advisory, Commercial Fisheries Advisory, and Recreational Fisheries Advisory) is appointed by the respective committee. In addition, the TTF may include other experts in economics, socio-anthropology, population dynamics, and other specialty areas when needed. The TTF is responsible for development of the Profile/FMP and receives input in the form of data and other information from the DMS and the SAT.

Once the TTF completes the document, it may be approved or modified by the Technical Coordinating Committee (TCC) before being sent to the SFFMC for review. The SFFMC may also approve or modify the document before releasing it for public review and comment. After public review and final approval by the SFFMC, the document is submitted to the GSMFC where it may be accepted or rejected. If rejected, the document is returned to the SFFMC for further review.

Once approved by the GSMFC, Profile/FMPs are submitted to the Gulf States for their consideration for adoption and implementation of management recommendations.

2.2 Arenarius Technical Task Force

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Section 6.0	McCawley/Porche/All
Section 7.0	Adams
Section 8.0	Isaacs
Section 9.0	All
Section 10.0	Staff
Section 11.0	All
Section 12.0	All

2.5 Profile Objectives

The objectives of the Sand and Silver Seatrout Profile are:

1. To summarize, reference, and discuss relevant scientific information and studies regarding the management of sand and silver seatrout in order to provide an understanding of past, present, and future efforts.

2. To describe the biological, social, and economic aspects of the sand and silver seatrout fishery.

3. To review state and federal management authorities and their jurisdictions, laws, regulations, and policies affecting sand and silver seatrout.

4. To ascertain optimum benefits of the sand and silver seatrout fishery to the U.S. Gulf of Mexico region while perpetuating these benefits for future generations.

3.0 DESCRIPTION OF THE STOCK

Sand seatrout (*Cynoscion arenarius*) and silver seatrout (*C. nothus*) occur in high numbers in the Gulf of Mexico. The two species can be easily identified from one another, but are not generally separated to species by most recreational anglers, commercial fishermen, and even some samplers. Likewise, there are identification problems along the south Atlantic between sand seatrout and the weakfish, *C. regalis* (Tringali et al. 2004).

3.1 Geographic Distribution

Sand seatrout are commonly found in estuarine and shallow offshore waters of the Gulf of Mexico from southwest Florida to the Bay of Campeche, Mexico (Sutter and McIlwain 1987), and on the Atlantic coast of the United States at least as far north as Doboy Sound, Georgia (Cordes and Graves 2003) (Figure 3.1). Specimens have also been reported from Charleston Harbor, South Carolina (three individuals from a 4.9 m trawl, Anon 2008a), Guyana (by-catch in shrimp trawls, Furnell 1981), Belize (five individuals, 4.6 km east of Dangriga, Anon 2008c), Boca del Rio, Veracruz, Mexico (four individuals from a seine, Anon 2008a) and Nicaragua and Honduras (Sánchez 1997). Reports from Trinidad and Tobago (Anon 2008b) are probably misidentifications considering the specimen(s) were reportedly caught at 165-219 m depths.

Silver seatrout are commonly found in offshore waters of the Gulf of Mexico and western Atlantic Ocean from Chesapeake Bay to the Bay of Campeche, Mexico (Sutter and McIlwain 1987) (Figure 3.1). Specimens have also been reported from the New York Bight, Long Island, (five individuals, Anon 2009a), Trinidad and Tobago (six individuals, Anon 2009b) and off Surinam (five individuals, Anon 2008b).

3.2 Biological Description

3.2.1 Classification and Morphology

3.2.1.1 Classification

The following classification is for sand seatrout:

Phylum: Chordata
- Subphylum: Vertebrata
  - Superclass: Osteichthyes
    - Class: Actinopterygii
      - Subclass: Neopterygii
        - Infraclass: Teleostei
          - Superorder: Acanthopterygii
            - Order: Perciformes
              - Suborder: Percoidei
                - Family: Sciaenidae
                  - Genus: *Cynoscion*
                    - Species: *arenarius*

Figure 3.1 Distribution of sand and silver seatrout (*Cynoscion arenarius* and *C. nothus*) as reported in the literature for the Western Atlantic Ocean, the Gulf of Mexico, and the Caribbean Sea.

The valid scientific name for the sand seatrout is *Cynoscion arenarius* (Ginsburg 1930). There are no other synonyms for this species. The accepted common name, according to Nelson et al. (2004), is sand seatrout. Other common names include the following:

沙犬牙石首魚 "Sand canine croaker" (Mandarin Chinese - China)
沙犬牙石首鱼 "Sand canine croaker" (Mandarin Chinese - China)
Acoupa de sable (French - France)
Adlerfisch (German - Germany)
Corbina (Spanish - Spain)
Corvina de arena (Spanish - Mexico)
Corvinata (Portuguese - Portugal)
Corvinata de arena (Spanish - Spain, Nicaragua)
Curvina (Spanish - Mexico)
Havsgös (Swedish - Sweden)

Sand squeteague (North American Indian)
Sand trout (English - UK)
Sand weakfish (English - UK)
Sandskørfish (Danish - Denmark)
Seatrout (English - USA)
Trucha de arena (Spanish - Mexico)
White seatrout (English - UK)
White trout (English - UK)
White weakfish (English - UK)

The following classification is for silver seatrout:

Phylum: Chordata
Subphylum: Vertebrata
Superclass: Osteichthyes
Class: Actinopterygii
Subclass: Neopterygii
Infraclass: Teleostei
Superorder: Acanthopterygii
Order: Perciformes
Suborder: Percoidei
Family: Sciaenidae
Genus: *Cynoscion*
Species: *nothus*

The valid scientific name for the silver seatrout is *Cynoscion nothus* (Holbrook 1848). Synonyms for this species are *Cynoscion nothus* (Holbrook 1855), *Otolithus nothus* (Holbrook 1848) and *Otolithus nothus* (Holbrook 1855). The accepted common name, according to Nelson et al. (2004), is silver seatrout. Other common names include the following:

銀色犬牙石首魚 “Sand canine croaker” (Mandarin Chinese - China)
银色犬牙石首鱼 “Sand canine croaker” (Mandarin Chinese - China)
Acoupa argenté (French - France)
Bastard trout (English – U.S.)
Corvina plateada (Spanish - Mexico)
Corvinata plateada (Spanish – Spain)
Curvina (Spanish – Mexico)
Seatrout (English – USA)
Silver weakfish (English – UK)
Silver squeteague (North American Indian)
Sølvskørfisk (Danish – Denmark)
Trucha plateada (Spanish – Mexico)

3.2.1.2 Morphology

3.2.1.2.1 Eggs

According to Holt et al. (1988), sciaenid eggs (including sand and silver seatrout) have similar morphologies and characteristics. In general, sciaenid eggs are buoyant and semitransparent, containing one oil globule in the later stages of egg development. Both the oil globule and embryo are profusely covered with yellow chromatophores. Silver seatrout eggs are undescribed (Fahay 2007). In Holt et al. (1988), minimum and maximum sizes of sand seatrout eggs observed were 0.67-0.90 mm. Since these egg characteristics are shared by several fish species and families, the only true way to distinguish species is from observing the hatched larvae.

3.2.1.2.2 Larvae

Lippson and Moran (1974) reported the length at hatching for weakfish (*C. regalis*) is 1.5-1.75 mm SL, and Fable et al. (1978) reported that yolk-sac absorption is complete by 64 hours posthatching in *C. nebulosus* (spotted seatrout). Peebles (1987) and Daniels (1977) observed sand seatrout larvae as small as 1.7 mm SL and 1.88 mm SL, respectively, with complete yolk-sac absorption at an estimated age of 40-60 hours posthatching.

Sand seatrout larvae < 2 mm SL have well-developed pigmented eyes, oblique mouths with undeveloped jaws, blunt snouts and large heads (Figure 3.2). The body is narrow and tapers to a point. As larvae develop, the body thickens in relation to the head and generally reaches the adult shape by 7 mm SL. Teeth first appear in the jaws around 3-4 mm SL. Vertebrae begin to appear at 3 mm SL, and formation is complete between 6-7 mm SL (Daniels 1977).

Fins begin to form at about 4.5 mm SL. Caudal fin begins development first, followed by dorsal and anal fins. The full complement of adult caudal rays is formed at >9 mm. Dorsal and ventral rays begin to develop around 3.5-4.0 mm SL, and dorsal spines begin development around 5 mm SL. By 8 mm SL, the full adult complement of dorsal rays and spines has formed. Anal ray development is usually complete by 7-8 mm SL. Pectoral rays first appear around 6 mm SL and reach full complement at >10 mm SL. Pelvic rays reach full complement at 10-11 mm SL (Daniels 1977).

Day-old larvae of sand seatrout have two bands of yellow chromatophores, one above the anus and a more prominent one midway between the anus and the tip of the notochord. There are also aggregations of yellow chromatophores on top of the head and behind the eye, with none between the posterior band and the notochord tip. The position of the pigmentation on the head and anus help distinguish sand seatrout larvae from other similar sciaenid larvae. An oil globule is located in the posterior section to the yolk sac (Holt et al. 1988).

Larvae <3 mm SL have pigment on the throat between lower jaw rami with very little pigment on the rest of the body. A row of 15-18 chromatophores lies on the ventral midline with largest chromatophore on myomere 16-17. Anal base chromatophores decrease in number as larvae increase in size up to about 3.5 mm SL. At this point, there are four to six chromatophores extending from the anus-anal fin gap to the anal fin base and caudal peduncle (Ditty 1989).

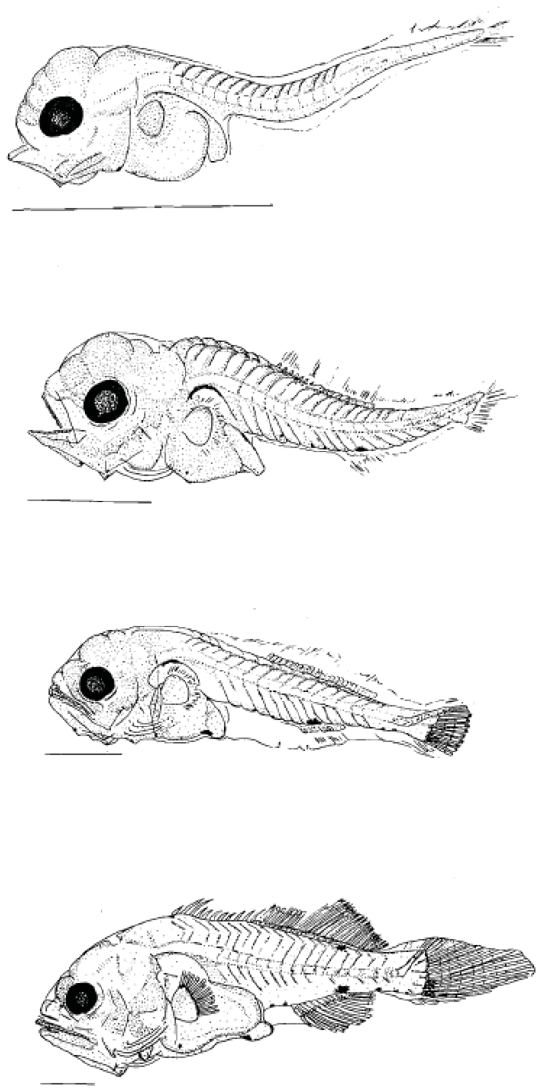

Figure 3.2 Sand seatrout (*Cynoscion arenarius*) larvae at 1.88 mm, 3.63 mm, 5.38 mm, and 7.80 mm SL. Solid line represents 1 mm (*from* Daniels 1977).

Cowan et al. (1989) found two morphological larvae types of sand seatrout off Louisiana (Figure 3.3). Morphs B have a chromatophore on the posterior third of the dorsal midline opposite a large chromatophore on the anal fin base (may not be visible on larvae <3.5 mm TL). Larvae >5 mm TL have two to three chromatophores on the pre-anal fanfold. Development of lateral pigmentation begins at approximately 8 mm TL. Morphs A do not have the dorsal chromatophore and have only one chromatophore on the pre-anal fanfold. Development of lateral pigmentation begins at approximately 12 mm TL.

Ditty (1989) also recognized two morphs of sand seatrout larvae in Louisiana. He noted that the anal chromatophore in morphs B is more dendritic than in morphs A and sometimes has a branch of pigment extending to the dorsal midline.

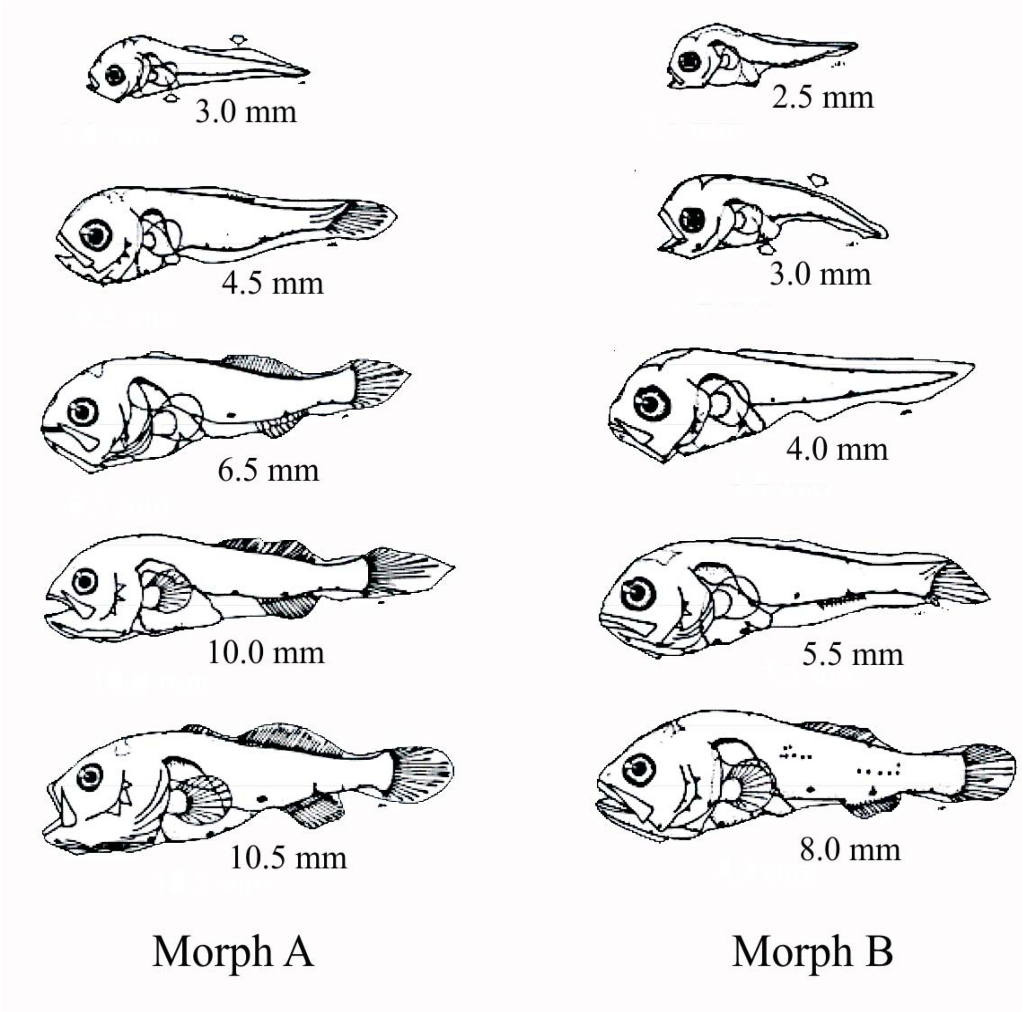

Figure 3.3 Composite illustrations of two morphological forms of sand seatrout (*Cynoscion arenarius*) larvae (*from* Cowan 1985).

Distinction between the two sand seatrout morphs at size >5 mm TL can be determined by body depth, growth rate and size at which lateral pigmentation develops (Holt et al. 1988).

Information on silver seatrout larvae is sparse. Flexion of the notochord starts at 3.5-5 mm SL (Richards 2006, Fahay 2007). Similar to sand seatrout, pigmentation occurs on the throat between the lower jaw rami and on the dorsal surface of the gut. No pigmentation occurs dorsally except for a melanophore on top of the head, and no lateral pigmentation occurs posterior to the anus (Ditty 1989, Fahay 2007). The placement of melanophores on the postanal ventral midline distinguishes silver seatrout from other members of the genus *Cynoscion*. At <3 mm SL, a row of melanophores occurs on the postanal ventral surface, the largest being midway between the anus and the tip of the notochord. As the anal base elongates, a melanophore develops internally at the anus-anal fin gap, externally at the base and termination of the anal fin, and several posterior to the anal fin (Ditty 1989) (Figure 3.4).

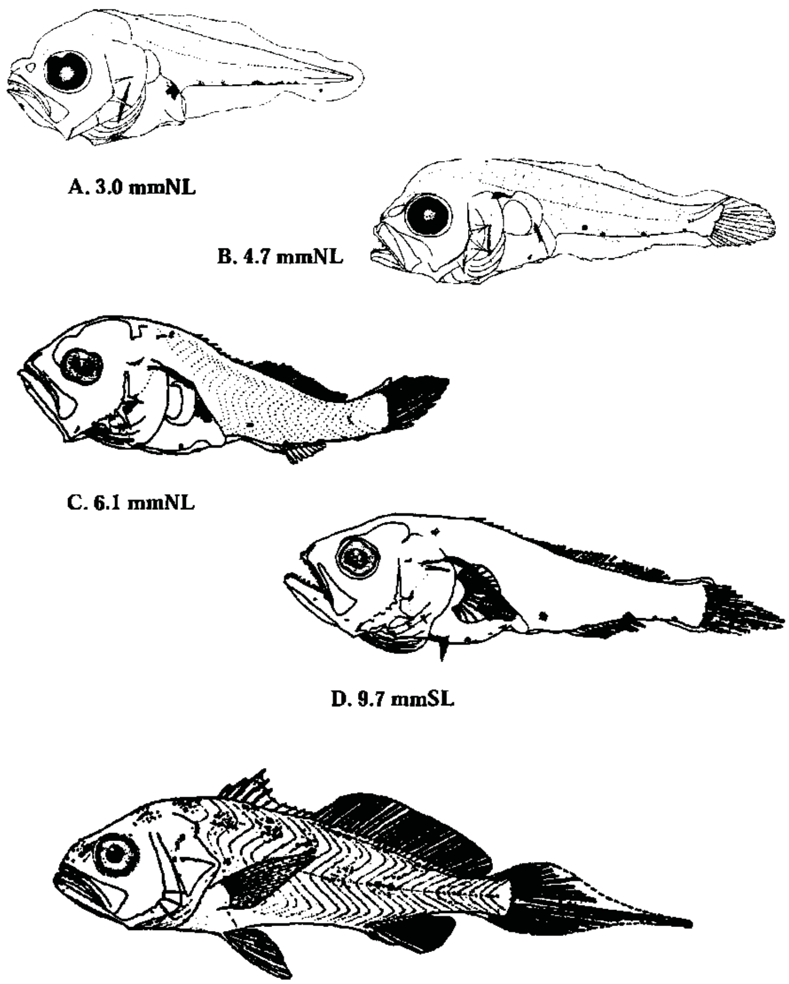

Figure 3.4 Silver seatrout (*Cynoscion nothus*) larvae and juvenile (*from* Fahay 2007).

Silver seatrout larvae differ meristically from sand seatrout larvae by having 27 myomeres (25 in other sciaenids), longer preanal length (50% SL), larger eyes (10-12% SL), and deeper bodies (>32% SL) (Ditty 1989, Richards 2006, Fahay 2007).

3.2.1.2.3 Juveniles

Descriptions of sand seatrout juveniles are lacking. Hildebrand and Cable (1934) describe silver seatrout development in great detail from early juvenile to adult (Table 3.1). The two species' development likely do not mirror each other because sand seatrout grow larger than silver seatrout and have different tail shapes, markings and scale patterns on the fins.

Bowling (unpublished data) described juvenile sand seatrout (35-41 mm TL):

Table 3.1 Description of silver seatrout (*Cynoscion nothus*) development from juvenile to adult stages (compiled from Hildebrand and Cable 1934).

Size	Body Depth	Head and Eye	Snout	Mouth	Scales	Fins	Markings
9.5-11 mm SL	deep, compressed; 3.0-3.25 of SL	head short, deep, 2.85-3.0 of SL; eye 3.7-4.4 of head	short, blunt, about as long as eye, 3.7-4.4 of head	large, strongly oblique, reaches nearly posterior margin of eye, 1.65-1.85 of head; lower jaw projects slightly	none apparent	full complement of fins; caudal long, pointed; ventrals short, scarcely as long as eye	ventral outline of the caudal peduncle, spot at base of anterior and posterior ends of anal ray, spot anterior to spiny dorsal, spot under base of spinous dorsal, spot under anterior rays of soft dorsal, spot near the end of base of soft dorsal, jaws anteriorly slightly dusky
24-26 mm SL	less deep; 3.2-3.6 of SL	head longer than deep; 2.5-2.7 of SL; eye 3.7-4.4 of head	sharper, about as long as eye, 3.7-4.3 of head	moderately oblique, maxillary reaches to or beyond posterior margin eye; 2.0-2.2 of head; lower jaw projects slightly	evident but not completely covering sides	caudal sharply pointed, middle rays much longer than head; ventrals longer, twice as long as eye	more numerous, chromatophores small and scattered. present along sides, head, back, ventral outline, lateral line, some with saddle-like blotches on back; cross line at base of caudal fin, few spots on spinous dorsal
40-46 mm SL	deeper posterior to ventral fins, 3.2-3.6 of SL	head 2.5-2.75 of SL; eye 3.7-4.4 of head	sharper; about as long as eye; 3.7-4.3 of head	quite oblique, maxillary reaches slightly past posterior margin of pupil, 1.9-2.2 of head; two canines in upper jaw slightly evident at 45 mm	body fully covered with scales, scales evident on base of soft dorsal and anal fins	caudal long and pointed, middle rays nearly an eye's diameter longer than head	blotches along lateral line and back; blotches mostly separate, sometimes anterior back and lateral blotches unite to form cross bands; small dots on dorsals, caudal and sometimes anal fins
75-90 mm SL	body more compressed, greatest width slightly less than maxillary length, 3.4-4.0 of SL	head 2.9-3.0 of SL	same	same, two canines in upper jaw prominent	small scales present on basal portion of soft fins;	caudal pointed, proportionally shorter, longest rays about equal to head length	blotches less distinct; cross lines at base of caudal gone; dark dots on dorsal and caudal fins increase
adult fish	robustness increases, at 150 mm width about equal to length of maxillary, as adult width greater than maxillary length; 3.4-4.0 of SL	head proportionally shorter, 3.2-3.4 of SL	same	same, two canines in upper jaw prominent	scales extend over most of fins	at 200 mm caudal upper lobe slightly concave, lower lobe sharply rounded	no blotches, grayish above, silvery below; at 200+ mm have faint oblique lines above on dorsum; dorsal and caudal fins densely dotted and become dusky in color; spinous dorsal with black margin

> "Sand seatrout body elongate and flattened laterally. Distinct chromatophores along anal fin base and along posterior ventral surface to caudal fin. Chromatophores line base of caudal fin with a group of chromatophores on caudal peduncle. Some chromatophores along last half of lateral line. 5-6 distinct groups of chromatophores (saddles) along dorsal fin, another group on dorsal of caudal peduncle. Snout to dorsal fin and above anterior lateral line dusky with numerous chromatophores. Chromatophores line anterior tips of premaxillary and lower jaw. Conical teeth in lower jaw to near posterior edge of jaw, decreasing in size posteriorly. 2 long and hinged canine teeth on tip of upper jaw, smaller conical teeth forming mid to about ¾ length of posterior edge of jaw. Full complement of dorsal and anal spines and soft rays. Caudal fin pointed, middle rays much produced."

Soft anal ray counts are usually used to distinguish between juvenile seatrouts. Sand seatrout have 11 rays, sometimes 10 or 12. Silver seatrout have nine rays, occasionally eight or infrequently 10 (on the Atlantic coast) (Sutter and McIlwain 1987). They can also be distinguished internally by vertebral count, 25 in sand seatrout, and 27 in silver seatrout.

3.2.1.2.4 Adults

Sand seatrout mature at 140-180 mm TL (Shlossman and Chittenden 1981). The following description is for sand seatrout and is from Fischer (1978):

> "Body elongate and moderately compressed. Mouth large, oblique, lower jaw slightly projecting; maxillary extending to below hind margin of eye. A pair of large canine teeth at tip of upper jaw; remaining teeth in upper jaw small and conical, set in narrow bands with outer row slightly enlarged; lower jaw teeth larger, closely set in a single row except at the tip and gradually increasing in size posteriorly. Chin without barbels or pores, snout with only 2 marginal pores. Gill rakers long and slender, 12 to 14 on first gill arch. Preopercular margin smooth. Anterior portion of dorsal fin with 9 or 10 spines, posterior portion with 1 spine and 25 to 29 soft rays; anal fin with 2 spines and 10 to 12 (usually 11) soft rays, second spine rather slender; caudal fin double emarginated in adults. Swim bladder with a pair of medium-sized, nearly straight, horn-like anterior appendages. Sagitta (larger earstone) thin and elongate, lapillus (small earstone) rudimentary. Scales large, ctenoid (comb-like) on body, cycloid (smooth) on head; soft portion of dorsal fin covered with small scales up to basal third of fin; lateral line extending to hind margin of caudal fin.
>
> Color: uniform yellowish gray above, without conspicuous spots, silvery below; fins pale to yellowish; a faint dark area at bases of pectoral fins."

The largest reported size for sand seatrout in the literature is 590 mm from Florida (Vick 1964) although few reach > 300 mm TL (Shlossman and Chittenden 1981). The official world record is 2.78 kg (IGFA 2010) which is estimated (based on length/weight conversions) to be from 625-635 mm. Females usually grow larger than males (Shlossman and Chittenden 1981).

Silver seatrout mature at 140 to 170 mm SL (DeVries and Chittenden 1982). The following description is for silver seatrout and is from Fischer (1978):

> "A medium-sized fish, elongate and rather compressed. Mouth large, oblique, lower jaw projecting; maxilla not extending to below hind margin of eye. A pair of large canine-like teeth at tip of upper jaw; remaining teeth in upper jaw small and conical, set in narrow bands with the outer row slightly enlarged in upper jaw; lower jaw teeth larger, in a single row except at the tip and widely spaced. Chin without barbels or pores; snout with only 2 marginal pores. Gill rakers long and slender, 11 to 14 on first gill arch. Preopercular margin nearly smooth. Anterior portion of dorsal fin with 10 spines, posterior portion with 1 spine and 26 to 31 (usually 28 or 29) soft rays; anal fin with 2 spines and 8 to 10 soft rays, second spine slender; caudal fin rhomboidal to truncate in adults. Swim bladder with a pair of medium-sized, nearly straight, horn-like anterior appendages. Sagitta (large earstone) moderately thin and broad, lapillus (small earstone) rudimentary. Scales large, ctenoid (comb-like) on body, cycloid (smooth) on most of head; soft portion of dorsal fin covered with small scales beyond basal half of fin; lateral line extending to hind margin of caudal fin.
>
> Color: Grayish above changing abruptly to silvery below; back and upper sides sometimes with very faint irregular rows of spots; dorsal fin dusky, other fins pale."

Maximum length reported in the literature for silver seatrout is 400 mm TL (Carpenter 2002). However, very few probably reach over 230 mm TL (DeVries and Chittenden 1982).

Adult seatrout are generally distinguished by the number of soft anal ray counts. Sand seatrout have 11 rays, sometimes 10 or 12. Silver seatrout have nine rays, occasionally eight or infrequently 10 (on the Atlantic coast) (Sutter and McIlwain 1987). Sand seatrout also have scales covering the basal third of the soft dorsal fin, whereas in silver seatrout, the scales cover beyond half the fin (Fischer 1978). In fresh specimens, sand seatrout may have yellowish pigmentation on its back and fins. The silver seatrout sometimes have small faint darker spots arranged in rearward sloping rows on its upper sides (Sutter and McIlwain 1987). Internally they can be distinguished by vertebral counts.

3.2.2 Age and Growth

Age and growth information for sand and silver seatrout is limited. Laroche and Richardson (1980) determined that sand seatrout otoliths do exhibit daily rings and these counts could be used to calculate larval growth rates. Daily rings were observed of otoliths from fish 2.7 mm SL and greater. Cowan et al. (1989) estimated daily growth rates for two morphological types of sand seatrout (Section 3.2.1.2.2). The two types had significantly different growth rates of 0.20 mm d^{-1} and 0.14 mm d^{-1}. Growth of juvenile sand seatrout recruiting to the estuaries of the northern Gulf of Mexico can be greatly influenced by the characteristics of the habitat being utilized. Rakocinski et al. (2000) examined the growth rates of sand seatrout related to water depth, temperature, salinity, turbidity, pH, and dissolved oxygen. Water temperature was determined to have a direct relationship to sand seatrout growth. Seasonal variation in water temperature was also determined to have effects on the differences in the growth rates of the spring and fall pulses of juvenile sand seatrout, with the greater growth occurring in the fall months of the season. Salinity also had effects, with growth rates low at both of the extremes of salinity (0.4-11.2 ppt), but highest at a relatively low salinity.

Peebles (1987) used otolith increments and lengths to determine a growth rate and age at length curve for sand seatrout larvae (1.7-5.5 mm SL). Citing previous studies of other sciaenids, increment development was assumed to be daily and increment initiation was assumed to be at hatching. Results yielded a growth rate of 0.313 mm SL/day (Figure 3.5). This rate may be slightly underestimated due to shrinkage during preservation of specimens.

Barger and Williams (1980) reported that length frequency analysis was the most successful method used for ageing the seatrout. This report indicated one to three age classes for the sand and no more than two for the silver. Shlossman and Chittenden (1981) reported length at age, based on length frequency analysis, for sand seatrout to be 250 mm TL at age-1, 425 mm TL at age-2 and 574 mm TL at age-3. They also reported that scales could be used to age sand seatrout, but the length-frequency analysis was simpler and as accurate except for much older fish. Barger and Johnson (1980) were able to age sand and silver seatrout by counting the bands on otoliths from

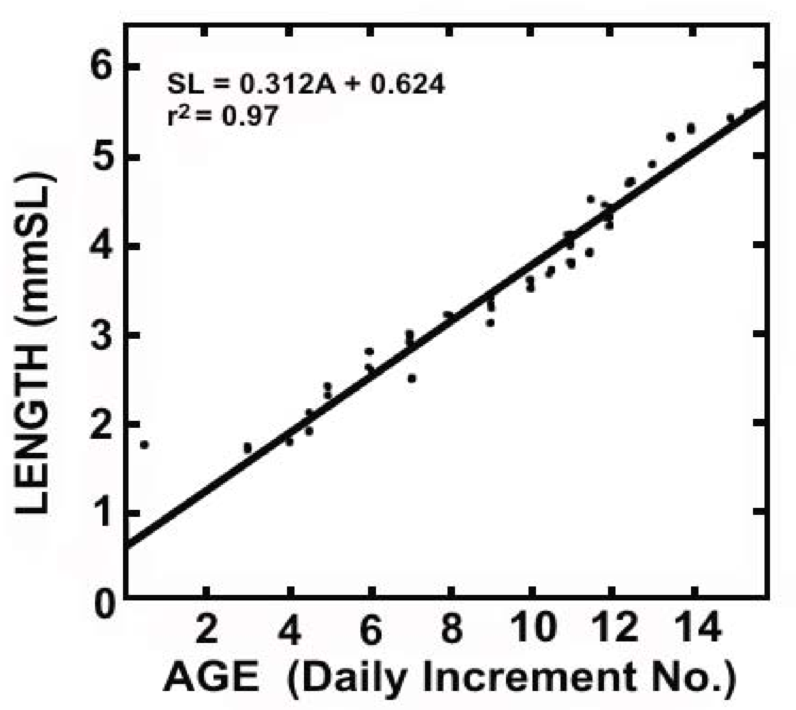

Figure 3.5 Growth curve for sand seatrout larvae (*Cynoscion arenarius*) between 1.7 and 5.5 mm SL, indicating a growth rate of 0.313 mm/day (*from* Peebles 1987).

fishes collected from the north central Gulf of Mexico. Sand seatrout had a positive correlation between total length and otolith radius. However, silver seatrout had a poor correlation, but was most likely due to a small sample size and limited range in lengths obtained.

Mean back calculated total lengths at age for sand seatrout were 200 mm and 248 mm for age-1 and age-2, respectively. Silver seatrout mean back calculated total lengths were 160 mm, 207 mm and 216 mm for ages 1-3, respectively. Sample sizes were small for both sand (48) and silver (21); therefore differences between sexes were not determined.

Nemeth et al. (2006) estimated a June 1 hatch date for sand seatrout from Florida bays in the Gulf of Mexico. Nemeth et al. (2006) and Shlossman and Chittenden (1981) reported sexual dimorphism for sand seatrout with the females being longer than males (Table 3.2). Otolith age data in the tables below (Tables 3.2, 3.3, and 3.4) indicate that regional differences in growth rates may exist. Nemeth et al. (2006) calculated Von Bertalanffy growth functions for male and female sand seatrout. Lengths ranged between 100-400 mm TL which helps explain the low asymptotic length in the equation below; the observed asymptotic length is 600+ mm for this species.

$$\text{Females: } TL = 360.1\{1-\exp[-0.31(age + 1.74)]\}$$
$$\text{Males: } TL = 313.6\{1-\exp[-0.34(age + 1.75)]\}$$

Observations of length-weight data also support regional differences for sand seatrout. Sand seatrout are heavier for a given length when moving east to west around the Gulf of Mexico. These differences may be due to slight variations in spawning periods, habitat differences, available resources or a combination of any of these. When comparing length at age data, sand seatrout are smaller at age (moving east to west) around the Gulf of Mexico.

Table 3.2 Mean total length in mm (sample size) at age for sand seatrout (*Cynoscion arenarius*) from western Florida estuaries October 2001-September 2003 (Nemeth et al. 2006).

Estuary	Sex	Age-1	Age-2	Age-3	Age-4	Age-5
Cedar Key	F	212 (193)	268 (109)	307 (38)	302 (11)	325 (5)
	M	190 (40)	247 (18)	291 (2)	284 (4)	291 (1)
Tampa Bay	F	230 (52)	260 (36)	271 (23)	300 (19)	
	M	219 (23)	249 (18)	272 (6)	268 (11)	
Charlotte Harbor	F	221 (44)	268 (38)	293 (21)	272 (4)	324 (1)
	M	206 (36)	251 (7)	255 (19)	266 (9)	277 (2)

3.2.3 Reproduction

3.2.3.1 Gonadal Development

Gonadal maturity in sand and silver seatrout is similar to that of spotted seatrout with peak gonadal development during spring and summer months (Benefield 1971, DeVries and Chittenden

Table 3.3 Mean total length in mm (sample size) at age for sand seatrout (*Cynoscion arenarius*) from Mobile Bay estuary 2000-2008 (AMRD unpublished data).

Estuary	Sex	Age-1	Age-2	Age-3	Age-4
Mobile Bay	F	260 (322)	303 (172)	318 (5)	307 (2)
	M	240 (117)	267 (77)	268 (14)	362 (1)

Table 3.4 Length weight relationships [$\text{Log}_{10}(W_{(g)}) = a + b(\text{Log}_{10}(TL_{(mm)}))$] of sand seatrout (*Cynoscion arenarius*) by selected estuaries in the Gulf of Mexico.

Location	Sex	n	Range	*a*	*b*	R^2	Reference
Texas coast	M	851	-	-5.661	3.257	0.978	Shlossman and Chittenden 1981
	F	653	-	-5.633	3.242	0.984	Shlossman and Chittenden 1981
Mobile Bay	M	366	70-397	-5.233	3.089	0.982	AMRD unpublished
	F	711	70-460	-5.341	3.135	0.961	AMRD unpublished
Cedar Key	ALL	544	111-358	-5.262	3.096	0.982	Nemeth et al. 2006
Tampa Bay	ALL	202	147-375	-4.978	2.975	0.962	Nemeth et al. 2006
Charlotte Harbor	M	86	170-302	-4.122	2.622	0.968	Nemeth et al. 2006
	F	188	121-368	-4.85	2.937	0.978	Nemeth et al. 2006

1982). Sand seatrout approaching age-1 reach sexual maturity on average between 140-180 mm TL and first spawn at 12 months of age (Shlossman and Chittenden 1981, Ditty et al. 1991). The smallest mature fish recorded were 129 mm TL and 140 mm TL for males and females, respectively (Sheridan et al. 1984). Silver seatrout mature on average between 140-170 mm SL as they approach age-1. Silver seatrout also mature to first spawn at 12 months, similar to sand seatrout (DeVries and Chittenden 1982).

3.2.3.2 Spawning

Although sand seatrout larvae (<3.0 mm TL) have been collected in all months of the year (Cowan 1985, Peebles 1987), spawning primarily occurs from March-September exhibiting two distinct spawning peaks. The spring peak occurs from March-April and the late summer peak occurs in August/September. Little spawning occurs during June and July and essentially none from October-December based on gonad maturity data and larval sand seatrout data (Benefield 1971, Christmas and Waller 1973, Gallaway and Strawn 1974, Daniels 1977, Pitre and Landry 1981, Shlossman and Chittenden 1981, Sheridan et al. 1984, Rogers and Herke 1985, Ditty et al. 1988). Exceptions have been noted however. Janke (1971) found a February-October spawn in Everglades National Park, Florida, which was attributed to higher winter water temperatures. Peebles (1987) also captured larval sand seatrout in December and January suggesting a year-round spawn in waters off southwest Florida.

Silver seatrout in the northern Gulf spawn from early May through late October, with the greatest or more successful spawning occurring during the late summer. The late summer spawn shows a tendency for two sub-peaks, one in August and one in September. Collection of fish 45-55 mm SL late June and 50-60 mm SL late July indicates spawning begins in early May. Gonad maturity data also suggest silver seatrout spawns May-September in agreement with spawning season indicated by length frequencies (DeVries and Chittenden 1982).

The extent of sand seatrout spawning grounds has not been determined, but spawning has been reported to occur in inshore bays, inlets, passes, nearshore areas beyond barrier islands, near offshore islands, and in deeper offshore Gulf waters (Gunter 1938, Gunter 1945, Copeland 1965, Hoese 1965, Pitre and Landry 1981, Shlossman and Chittenden 1981, Sheridan et al. 1984, and Cowan 1985). Presence of larvae in mid-shelf to offshore waters (15-80m) in early spring suggests spawning initially takes place offshore moving shoreward as the season progresses with most spawning activity occurring in the lower estuary and shallower waters of the Gulf of Mexico (Cowan and Shaw 1988, Franks et al. 1972, Shlossman 1980). Various studies have found differing spawning depths. Shlossman and Chittenden (1981) determined spawning depths to be 7-22 m from Cedar Bayou to Galveston Bay, Texas, whereas Sheridan et al. (1984) found higher numbers of mature trout in 56-73 m of water than in any other depth strata. Franks et al. (1972) also found ripe females off Mississippi in water depths of 73-91 m. This spawning depth variation may be due to difference in depths of habitats off Texas and Mississippi deltas (Sheridan et al. 1984).

Spawning location is probably determined by salinity and intensity of spawning by water temperature, with water temperature being the primary factor controlling sand seatrout movements (Benefield 1971, Peebles 1987). Pitre and Landry (1981) found males to exhibit an extended time of spawning, coinciding with temperatures between 23°-30°C. Although spawning salinity is probably less variable than salinities tolerated by non-spawning adults (Peebles and Tolley 1988), studies with spotted seatrout suggest they are able to spawn successfully in a wide range of salinities and produce large numbers of fertilized eggs with high rates of hatching and survival. Spawning and short term survival does not appear to be sensitive to ambient salinity (Thomas and Boyd 1989). A study by Banks et al. (1991) further suggests that the salinity tolerance of larvae is influenced by the habitat (salinity) in which eggs were incubated.

Much less is known about silver seatrout spawning. It is not considered to be an estuarine species (Ginsburg 1931, Hildebrand and Cable 1934, DeVries and Chittenden 1982), and its spawning grounds have not yet been determined. A study by McDonald et al. (2009) found silver seatrout abundance to be higher off the coast of Texas, where salinities are higher than off the coast of Louisiana or Mississippi, where salinities are reduced by the Mississippi and Atchafalaya rivers.

Time of spawning is believed to be at dusk. Sciaenids primarily use sound (drumming of air bladder) for courtship, and the final stages of spawning are therefore independent of light. Sand seatrout are believed to follow this reproductive strategy model. A study by Holt et al. (1985) indicated a correlation between overnight egg dispersals and reductions in egg predation. All eggs from sciaenids examined during their study were spawned near sunset with sand seatrout having an estimated spawn time one to two hr after sunset.

Lengths at capture of spawning sand seatrout adults have ranged from 350-370 mm TL with males being smaller than females. Studies have also shown no consistent male to female ratio pattern (Moffet et al. 1979, Shlossman and Chittenden 1981, Sheridan et al. 1984).

3.2.3.3 Fecundity

Fecundity is defined as the potential number of eggs that could be spawned throughout a reproductive season, assuming all counted eggs would be released. Information relative to fecundity of sand and silver seatrout is very limited (Etzold and Christmas 1979, Sheridan et al. 1984). Sheridan et al. (1984) found mean fecundity of silver seatrout to be 73,900 eggs, and sand seatrout to be 100,990 eggs; both are less fecund than weakfish of similar size (190-268 mm SL) which averaged 285,700 eggs.

Fecundities of sand seatrout (N=131) from the Mississippi delta region increase with length and range from 28,200 eggs for a 210 mm SL (142.8g TW) female to 324,900 eggs for a 224 mm SL (223.7g TW) female (Sheridan et al. 1984). Fecundity is only moderately related to fish lengths (SL), weight (W), and ovary weight (OW) as follows:

$$F = -198{,}665 + 1{,}480\ SL, \text{ where } r^2 = 0.36$$
$$F = -8{,}917 + 759\ W, \text{ where } r^2 = 0.51$$
$$F = 32{,}557 + 7{,}893\ OW, \text{ where } r^2 = 0.53$$

Fecundities of silver seatrout (N=18) also increase with standard length and range from 16,800 eggs for a 140 mm SL (40.1g TW) female to 389,500 eggs for a 256 mm SL (291.5g TW) female (Sheridan et al. 1984). Fecundity is strongly related to fish lengths (SL), weight (W), and ovary weight (OW) as follows:

$$F = -362{,}882 + 2{,}570\ SL, \text{ where } r^2 = 0.76$$
$$F = -52{,}623 + 1{,}309\ W, \text{ where } r^2 = 0.84$$
$$F = 32{,}539 + 5{,}662\ OW, \text{ where } r^2 = 0.94$$

3.2.3.4 Incubation

Spawning of sand seatrout in the laboratory occurs after lab-simulated dusk and hatching usually occurs between 18-36 hr following the spawn depending on water temperature (Holt et al. 1988). A study with spotted seatrout found eggs to incubate for 18 hr at 26°C (Arnold et al. 1976). Fable et al. (1978) noted this incubation period was reduced to 15 hr at 27°C and increased to 21 hr at 23°C.

3.2.3.5 Larval Transport

Following the coastal or offshore spawn, pelagic eggs and larvae are transported into the shallow Gulf waters (<18m) and upper estuaries (Cowan and Shaw 1988, Ditty et al. 1991). These estuaries are the target habitat for larval sand seatrout and are used as nursery grounds (Shlossman and Chittenden 1981, Perret et al. 1971, Conner and Truesdale 1972, Ditty et al. 1991). New recruits (10-17 mm postlarval sand seatrout) remain in estuaries until at least 50-60 mm SL and emigrate back into deeper waters with the onset of cool weather in the fall/winter (Conner and Truesdale 1972, Moffet et al. 1979, Benefield 1971, Gunter 1945). Chittenden and McEachran (1976) noted a summer to late fall emigration after a residency of four to eight months. A study at Sabine Wildlife Refuge in Louisiana found a time range of larval movement from April to November/December with maximum movement (in and out) in July (Rogers and Herke 1985).

Sand seatrout recruits first appear in estuarine nursery areas in March and April and again in October and November, and have been collected irregularly throughout the summer and fall (Hoese 1965, Dunham 1972, Gallaway and Strawn 1974, Shlossman and Chittenden 1981, Rogers and Herke 1985, Felley 1987), with the exception again being southern Florida in which recruitment begins earlier and lasts longer (Purtlebaugh and Rogers 2007). Larval sand seatrout are primarily collected in water depths <25 m. More are collected at night than during the day and are somewhat surface-oriented (Peebles 1987, Cowan and Shaw 1988, Shaw et al. 1988, Ditty et al. 1991).

A study by Cowan and Shaw (1988) indicated sand seatrout larval densities to be highest in April with a mean of 46.1 larvae/100 m^3. In contrast, the mean larvae density was 0.3 larvae/100 m^3 and 2.9 larvae/100 m^3 for February and March, respectively. Ditty et al. (1991) reported another peak in August and September. Some evidence suggests that increased larval densities are associated with elevated zooplankton biomass (Norcross and Shaw 1984). Purtlebaugh and Rogers (2007) found juveniles almost exclusively within and adjacent to rivers and other freshwater influences. Areas near freshwater input often support increased densities of phytoplankton, zooplankton, larval fishes, and nekton.

Migration of sand seatrout larvae into nursery grounds is a complex system in which larvae do not necessarily recruit to the nearest estuary. Recruitment mechanisms include water stratification; west-northwest advective transport currents; coastal advective currents; and short term forces such as wind, rainfall, and tidal levels (Herke 1971, Cowan and Shaw 1988).

Northern Gulf of Mexico, spring-spawned sand seatrout larvae are exposed to a west-northwest advection that allows larvae to cross the continental shelf and enter estuarine areas with an estimated transit time of 30-94 days (Shaw et al. 1988). Alongshore advective transport currents, within and just outside the coastal boundary layer, have also been shown to transport larvae. Cowan (1985) stated this to be the “primary mechanism supplying sciaenid larvae to estuaries in Louisiana”. Cowan further proposed the transport hypothesis presented by Shaw et al. (1985) for gulf menhaden (*Brevoortia patronus*) could be applied to larval sciaenids and suggested the transport model might explain how larvae arrive in the estuaries of western Louisiana.

Herke (1971) also presented data that generally supports the ‘westward drift’ hypothesis. In Louisiana, on the Biloxi Wildlife Management Area near Lake Borgne east of the Mississippi River, 208 specimens of sand seatrout were captured. West of the Mississippi River on Marsh Island, a total of 516 sand seatrout was collected. Fish caught in the westerly samples were about twice as heavy, possibly indicating a longer transport time.

Silver seatrout apparently use rising Gulf levels and prevailing currents to carry spawned eggs inshore to nursery grounds in much the same manner as sand seatrout.

Another transport mechanism believed to aid sciaenid larvae migration is water stratification. A study in Naples, Florida, hypothesized a two-layered circulation to be the mechanism of transport toward and of retention in nursery areas (Peebles 1987). A similar study of spotted seatrout, also in Naples, Florida, found a significant correlation between larval length and position in the water column. The water at the Naples site exhibited greater salinity stratification (Peebles and Tolley 1988). Purtlebaugh and Rogers (2007) found juvenile sand seatrout follow size specific movements with respect to salinity. Juveniles 30-70 mm sought an optimal reduced salinity range, but moved into higher salinities as they grew to 100 mm.

Weather processes involving winds and tidal levels that cause inner-shelf/estuarine exchange of water mass, particularly during and immediately after cold front passages, also play a role in controlling concentrations of larvae in estuaries (Shaw et al. 1985, Sutter and McIlwain 1987). Shlossman and Chittenden (1981) noted inshore movement coincided with periods of rising sea level due to surface currents and prevailing inshore winds. Simmons and Hoese (1959) similarly noted postlarvae sand seatrout entering Aransas Bay, Texas on incoming tides. According to long-term tide records at Eugene Island, Louisiana, and Galveston, Texas, mean sea level rise from January through May produces a net filling effect of the estuaries (Marmer 1954).

3.2.4 Genetics

Distinguishing *C. arenarius* (Ginsburg 1930) as a unique species is generally accepted, although recurrent questioning of the phylogenetic and taxonomic status of sand seatrout still arises (Shlossman and Chittenden 1981, Paschall 1986, Ditty 1989, Ditty et al. 1991). Some researchers have proposed that sand seatrout is actually a subspecies of weakfish (*C. regalis*). It was also thought that sand seatrout were endemic to the Gulf of Mexico (Ditty 1989), until Tringali et al. (2004) presented genetic evidence that they also commonly occur in the inshore waters of Florida's Atlantic coast.

Sand seatrout genetics research is sparse in the Gulf of Mexico. To date, population genetics studies for *C. arenarius* have been conducted only in Texas and Florida waters. Florida's genetics data on sand seatrout resulted from only one study by FWRI, which examined the hybridization between sand seatrout and weakfish along the Atlantic coast in Florida waters (Tringali et al. 2004). In this study, a broad zone of introgressive hybridization between the taxa was documented where their geographic and reproductive ranges overlap, centered around the St. Johns River area. The hybrid dynamics observed in the zone were consistent with Ginsburg's (1930) elevation of sand seatrout and weakfish as separate species. Although there have been anecdotal reports, no weakfish or weakfish alleles have been documented in the Gulf of Mexico among more than 900 genotyped Gulf specimens (Tringali unpublished report).

The most extensive genetic analysis in the Gulf has been conducted on fish captured in Texas inshore and offshore waters. The TPWD examined the genetic variability of sand seatrout along the Texas coast using allozyme and mitochondrial DNA analysis (Karel 2002). Data were collected from Galveston and Matagorda bays, and offshore stations at Sabine Lake, Galveston, Port O'Connor, Rockport, and Brownsville, to examine genetic variation both within and among populations of sand seatrout. Results suggested some degree of population differentiation between inshore and offshore populations and an upper coast and lower coast division among inshore populations. Both techniques showed that sand seatrout exhibit significant genetic variation within and between sampling localities. Mitochondrial analysis indicated that greater than 95% of the total molecular variation occurred within sampling localities, but also indicated that significant variation occurred among localities as well.

The TPWD also examined the possibility of hybridization between sand seatrout and silver seatrout in Galveston Bay (Anderson et al. 2009). They used both morphological and molecular techniques (nuclear microsatellites and mitochondrial restriction fragments) to characterize the populations. Their data indicate that hybrid formation is either rare or nonexistent in the offshore Galveston Bay area.

3.2.5 Migration and Movements

Sand seatrout are commonly found in estuarine and shallow offshore waters in the Gulf of Mexico (Sutter and McIlwain 1987). It is generally thought that, during the cooler months of the year, adults emigrate from these shallower and protected waters into the Gulf of Mexico (Guest and Gunter 1958). Declining catches in trawl samples in Cedar Bayou, Texas (Guest and Gunter 1958) and Vermilion Bay, Louisiana (Perret and Caillouet 1974) suggest that this offshore migration begins as early as May and June, respectively, and is greatest during October. In contrast, it is suggested that there is an immigration of recently spring-spawned offspring, as well as spent adults, back into the bays and protected waters beginning in June, staying inshore throughout the summer months (Guest and Gunter 1958, Perret and Caillouet 1974, McDonald et al. 2009).

Although silver seatrout are most common in the offshore waters of the Gulf of Mexico, they are occasionally found in the inshore waters of the Gulf of Mexico, most often during the cooler winter months, suggesting an inshore movement where the waters are deep and still warm enough (Guest and Gunter 1958, McDonald et al. 2009).

3.2.6 Parasites and Diseases

There are two strains of lymphosystis causing viruses that infect some sciaenid fishes in Mississippi estuaries. One strain, *Cystivirus sp*. (Blaylock and Overstreet 2003) in particular, primarily infects Atlantic croaker and sand seatrout (Overstreet and Howse 1977), occurring at least from Texas to Georgia (Blaylock and Overstreet 2003). Infections in sand seatrout result in "greatly hypertrophied host fibroblasts, surrounded by a thick hyaline capsule that involves the fins and integument" (Overstreet and Howse 1977).

Silver seatrout were identified in an acute to chronic fish kill in Alabama and Florida attributed to a nonhemolytic, group B, type $\mathrm{I}_{b,}$ *Streptococcus* bacterium (Plumb et al. 1974).

Overstreet (1978) mentions that several microsporidans are known to infect sciaenids in the Gulf of Mexico, However, the only microsporidian recovered from sand and spotted seatrout was a species of *Pleistophora* encysted in the liver.

The dinoflagellate, *Amyloodinium ocellatum*, was found infecting sand seatrout (three specimens) killed in a mass mortality of primarily spot (*Leiostomus xanthurus*) at Orange Beach Marina in 1984 (Overstreet 1993). *A. ocellatum* has also caused mortalities in tank-held sand seatrout due to heavy infestations (Blaylock and Overstreet 2003).

Blaylock and Overstreet (2003) reports two species of myxosporeans belonging to two different genera infecting sand seatrout. *Kudoa* sp. is typically found infecting somatic muscle, and *Henneguya sp*. infects the skin.

Ciliates of the genus *Trichodina* have been reported from the gills and skin of sand seatrout in Mississippi and Louisiana. As the individual species of *Trichodina* are difficult to identify, several species may be involved in infection. These are commensal organisms in the wild, using the fish only as a means to anchor or as a source to accumulate detritus or bacteria on which to feed. No mortality due to trichodiniasis has been reported in wild fishes, however, they can cause disease under stressful conditions, accumulating and irritating the skin at their attachment sites and by grazing (Blaylock and Overstreet 2003).

The cestode, *Poecilancistrium caryophyllum*, is also found in many sciaenids, including the sand seatrout, using them as an intermediate host (Overstreet 1977). This intermediate stage consists of a blastocyst harboring the entwined fleshy larva (plerocercoid) at the swollen end (Overstreet 1978). Seatrouts infected with *P. caryophyllum* are commonly known as 'wormy trout'. The final host is a carcharhinid shark, most likely the bull shark (*Carcharhinus leucas*), and are not considered a public health problem (Overstreet 1977). Other cestodes belong to a group collectively termed 'Scolex polymorphus' (Blaylock and Overstreet 2003). 'Scolex polymorphus' is comprised of several species, as it is difficult to identify individuals, since the scolex differs in the juvenile and adult stages, changing considerably as the worm develops (Blaylock and Overstreet 2003). Also, *Kotorella pronosoma* have been found inhabiting the stomach walls of sand seatrout and *Otobothrium crenacolle* have been found in the stomach submucosa and mesentery. Both of these tapeworms are relatively widespread in fishes and apparently cause little harm (Blaylock and Overstreet 2003). *Rhinebothrium* sp. has also been indentified from the intestine of sand seatrout (Overstreet 1983).

Small monogeneans (polyopisthocotylids) commonly occur on the gills of seatrouts, feeding on blood, rather than the tissue and mucus like others (monopisthocotylids) (Overstreet 1978). More specifically, *Neoheterobothrium cynoscioni* has been observed infecting the gills of both sand and silver seatrouts (Blaylock and Overstreet 2003). Another monogenean, *Udonella caligorum*, is often found infecting caligid copepods that are often observed on the skin and gills of seatrouts, hardhead catfish and striped mullet (Overstreet 1978).

Eleven different digenean flukes have been catalogued by Blaylock and Overstreet (2003) as infecting sand seatrout. *Stephanostomum interruptum* can be found infecting the intestine and rectum. *Cardicola laruei* is found in the heart. *Bucephalus cynoscion, Prosorhynchoides caecorum* and *Pleorchis americanus* can all be found in the intestine and the pyloric ceca. *Metadena spectanda* infect the fins and flesh, *Phyllodistomum* sp. infect the urinary bladder, *Postodiplostomum minimum* and *Lecithochirium sp*. infect the stomach, and *Hirudinella ventricosa* can be found throughout the body cavity. *Stomachicola magnus*, encysts in the flesh of sand seatrout (Overstreet 1978), and can also be found in the stomach, air bladder, ovarian membrane, muscles, body cavity, and the stomach wall (Blaylock and Overstreet 2003).

Two different nematode species belonging to the Hysterothylacium genus have been found to infect sand seatrout. *Hysterothylacium reliquens*, and *Hysterothylacium* type MB have been found in the mesentery of sand seatrout (Deardorff and Overstreet 1981). *Hysterothylacium* type MB has been described as a potential public health hazard. After being administered to white mice, they rapidly penetrated the alimentary tract (Norris and Overstreet 1975). That study was expanded to using Rhesus monkeys (*Macaca mulatta*) as a host. *Hysterothylacium* type MB larvae penetrated the stomach wall causing hemorrhaging and attracting eosinophils (Overstreet and Meyer 1981). *Spirocamallanus cricotus* has also been found infecting the intestine of sand seatrout, and *Agamonema* sp. have been found infecting the mouth (Blaylock and Overstreet 2003).

Overstreet (1983) found the leech *Malmiana philotherma* inhabiting the gills of silver seatrout.

Lernaeenicus radiates, a copepod, during most years, can be found infecting seatrout as well as Atlantic croaker, killifish, gobies, and other fish. The anterior end extends into the host's flesh so that antler-like appendages protruding from the head can cling around a vertebra or some other structure adjacent to a rich blood supply. The head structure varies according to where and how it attaches to the host. Externally, the neck, body and egg strings protrude from the host. The egg strings change in color from transparent to reddish-brown as the larvae develop. Red blood from the host can also be observed flowing within the external portion of the copepod (Overstreet 1978). Blaylock and Overstreet (2003) also lists *Caligus rapax* as parasitizing the gills of sand seatrout. The isopod, *Lironeca ovalis,* can be found on the gills of silver seatrout as well as spotted seatrout in the Gulf of Mexico and weakfish on the Atlantic Coast (Blaylock and Overstreet 2003).

3.2.7 Prey-Predator Relationships

3.2.7.1 Feeding

Larval sand seatrout are carnivorous, feeding primarily on copepods and mysid shrimp (Sheridan 1979, Flores-Coto et al. 1998). Flores-Coto et al. (1998) also found Cladocera and Chaetognatha in gut analysis of fish 3-7 mm in the southern Gulf of Mexico. Rogers (1977) reports shrimp and mysids make up 78% of the diet of sand seatrout 26-50 mm, with fish making up 20%. As the fish grow, they become more piscivorous (Reid 1955, Sheridan 1979), with fish remains identified from sand seatrout as small as 34 mm (Reid 1955). Moffett et al. (1979) found that there appeared to be a shift in food preference from crustaceans to fish at about 160 mm SL. Rogers (1977) places this shift a little earlier in the life cycle, with fish making up only 73% of their diet from the 51-75 mm size class, while shrimp and mysids made up 14%. In the 76-100 mm SL size class, fishes and squid made up 88% of the overall diet.

Shrimp (including Penaeidae), although utilized to some extent by sand seatrout of all sizes (Moffett et al. 1979, Sheridan et al. 1984), appear to be an important element in intermediate sized sand seatrout diets (Darnell 1958). Sheridan et al. (1984) reports shrimp being the second most abundant food type of age-0 sand seatrout (2-37%). The caridean *Alpheus floridanus*, as well as the penaeid, roughneck shrimp (*Trachypenaeus constrictus*) have been reported by Rogers (1977). Squid, stomatopods, mysids, and crab larvae comprised up to 11% of their diets while fish composed the rest of the volume.

Fish dominate the diets of adult sand seatrout in the Gulf of Mexico (Reid 1955, Darnell 1958, Springer and Woodburn 1960, Moffett et al. 1979, Sheridan 1979, Byers 1981, Kasprzak and Guillory 1984, Sheridan 1984). The most frequent fish prey taxa is *Anchoa* sp., although Darnell (1958) and Kasprzak and Guillory (1984) found gulf menhaden to be the most utilized species identified in Lake Pontchartrain and Barataria Bay, Louisiana, respectively. Reid (1955) also reports high utilization of gulf menhaden in East Bay, Texas. Gulf menhaden and bay anchovy (*Anchoa mitchelli*) were identified from stomach analysis by Moffett et al. (1979) as well as Atlantic croaker, *Micropogonias undulatus*, striped mullet (*Mugil cephalus*), and spotted seatrout from Galveston Bay, Texas. Kasprzak and Guillory (1984) also indentified Atlantic bumper (*Chloroscombrus chysurus*), gulf menhaden, striped mullet, and sand seatrout in Barataria Bay, Louisiana. Cannibalism by sand seatrout has also been reported in Lake Pontchartrain, Louisiana (Darnell 1958) and Galveston Bay, Texas (Moffett et al. 1979). Byers (1981) was able to also identify striped anchovy (*Anchoa hepsetus*), bay anchovy, anchoviella (*Anchoviella perfasciata*), bullseye grenadier (*Bathygadus macrops*), Atlantic threadfin (*Polydactylus octonemus*), blackear bass (*Serranus atrobranchus*), and seabass (*Centropristis* sp.). Other sciaenids and clupeids have been found in adult diets by Reid (1955) and Darnell (1958).

Silver seatrout are similar to sand seatrout in their feeding habits, feeding primarily on shrimp and mysids early in their lives, switching to more macromobile prey as they mature (Rogers 1977). Larval silver seatrout feed almost exclusively on copepods although Cladocera were also found by Flores-Coto et al. (1998) in analysis of stomach contents. Rogers (1977) found polychaetes, stomatopods, copepods, amphipods, mysids, shrimp, squid, and fish in silver seatrout from 26-50 mm in length. Mysids and shrimp comprised 58% of the diet in this size class. In the 51-75 mm size class, shrimp and mysids accounted for only 25% of silver seatrout diet, and only 8% in the 76-175 mm size class. Over half of the overall diet of this size class was fish, primarily anchovies, with striped anchovy, inshore lizardfish (*Synodus foetens*), and *Cynoscion* sp. being observed. Roughneck shrimp and sergestid shrimp (*Acetes americanus*) were also commonly observed, as well as a number of small carideans. Overstreet and Heard (1982) also found fish to be the primary food source for silver seatrout (197-324 mm SL) in the Mississippi Sound, with a continuing dependence on penaeids. Fish were also the primary prey beyond the Mississippi Sound, into the Mississippi Delta for both age-0 (32-149 mm SL) and age-1 (150-280 mm SL), with the exception being age-0 fish feeding during the day in the East Delta primarily on shrimp (Sheridan et al. 1984). Sheridan et al. (1984) found nine fish taxa including *Bregmaceros*, *Anchoa*, and *Centropristis*, and eight shrimp taxa including *Trachypenaeus* and alpheids, as well as *Sicyonia* and *Solenocera*.

Sheridan and Trimm (1983) found that not only age but depth of capture influences the diet of silver seatrout. Age-1 silver seatrout in waters from 7-17 m fed primarily on shrimp. Silver seatrout in waters from 18-44 m were found to feed primarily on squid and stomatopods. *Anchoa* and caridean shrimp were most often noted in silver seatrout stomachs, regardless of water depth or age class (age-0 or -1).

3.2.7.2 Predation

Little is known about predation on sand and silver seatrout by other fish species. Sand seatrout have been identified in feeding studies of spotted seatrout by Overstreet and Heard (1982). Sand seatrout are also known to be cannibalistic as noted by Darnell (1958). Mareska (personal communication) noted that in Alabama, recreational anglers are catching sand seatrout on hook-and-line for use as live bait in the red snapper/grouper fishery. It is likely that fish consuming sciaenids generally would be predators of sand and silver seatrout given the opportunity. Likewise, other animal groups such as piscivorous birds, marine mammals, and even terrestrial mammals might consume seatrout when encountered.

The common bottlenose dolphin (*Tursiops truncatus*) is an active predator in the nearshore estuaries where sand seatrout occur. Berens McCabe et al. (2010) found that while soniferous fish (including the sciaenids) comprised only 6.3% of the total available prey in Sarasota Bay, Florida, they accounted for 51.9% of the total prey consumed by resident dolphins. Even though gulf toadfish (*Opsanus beta*), pinfish (*Lagodon rhomboids*), ladyfish (*Elops saurus*), and spotted seatrout were the most abundant species found in the dolphin stomach contents, *C. arenarius* were also reported but in smaller numbers.

A lack of studies focused in the Gulf for fish consumption by large shore and wading birds suggests that the role of sand and silver seatrout may be under-represented in the estuarine food web. A number of bird species have been associated with preying on fish species including Sciaenidae from the estuarine environment in other areas of the country, although specific identification of sand or silver seatrout is not common in the literature.

In Chesapeake Bay, osprey (*Pandion haliaetus*) have been found to consume spotted seatrout (McLean and Byrd 1991). More recently, Glass and Waters (2009) found seatrout (*Cynoscion* sp.), Atlantic menhaden (*Brevoortia tyrannus*), spot (*Leiostomus xanthurus*), and Atlantic croaker (*Micropogonias undulatus*) composed the major percentage (74%) of the diet of osprey in the lower-estuarine sites of Chesapeake Bay. Although they are not the primary species targeted, sand seatrout have been recovered from the stomachs of olivaceous cormorants (*Phalacrocorax olivaceus*) (King 1989) in Galveston Bay, Texas, and unidentified sciaenids have been found in the stomachs of double-crested cormorants (*P. auritus*) in Lavaca Bay, Texas (Withers and Brooks 2004).

4.0 DESCRIPTION OF THE HABITAT OF THE STOCK(S) COMPRISING THE MANAGEMENT UNIT

4.1 Description of Essential Habitat

The GSMFC has endorsed the definition of essential fish habitat (EFH) as found in the NMFS guidelines for all federally-managed species under the revised Magnuson-Stevens Act of 1996. The NMFS guidelines define EFH as:

> "those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of essential fish habitat: 'Waters' include aquatic areas and their associated physical, chemical, and biological properties that are widely used by fish, and may include aquatic areas historically used by fish where appropriate; 'substrate' includes sediment, hard bottom, structures underlying the waters, and associated biological communities; 'necessary' means the habitat required to support a sustainable fishery and the 'managed species' contribution to a healthy ecosystem; and 'spawning, breeding, feeding, or growth to maturity' covers a species' full life cycle."
>
> *Federal Register* 67(12):2343-2383. Final Rule.

For the purposes of describing those habitats that are critical to sand and silver seatrout in this fishery profile, this definition was utilized; however, these areas are referred to as "essential habitat" to avoid confusion with EFH mandates in the Magnuson-Stevens Act since the species in the Gulf is not federally managed. These mandates include the identification and designation of EFH for all federally-managed species, development of conservation and enhancement measures including those which address fishing gear impacts, and require federal agency consultation regarding proposed adverse impacts to those habitats.

4.2 Gulf of Mexico

Sand and silver seatrout are non-migratory with habitat shifts of onshore to offshore movements that are related to several factors including spawning, salinity and water temperature changes (Section 4.4). An overview of the prevailing Gulf circulation, water temperatures, salinities, and inshore nursery characteristics is key to understanding how young sciaenids, in general, are passively and actively transported through critical habitats toward maturity.

Galstoff (1954) summarized the geology, marine meteorology, oceanography, and biotic community structure of the Gulf of Mexico. Later summaries include those of Jones et al. (1973), Beckert and Brashier (1981), Holt et al. (1983), and the Gulf of Mexico Fishery Management Council (GMFMC 1998). In general, the Gulf is a semi-enclosed basin connected to the Atlantic Ocean and Caribbean Sea by the Straits of Florida and the Yucatan Channel, respectively. The Gulf has a surface water area of approximately 1,600,000 km^2 (GMFMC 1998), a coastline measuring 2,609 km, one of the most extensive barrier island systems in the United States, and is the outlet for 33 rivers and 207 estuaries (Buff and Turner 1987). The Loop Current and major episodic freshwater discharge events from the Mississippi/Atchafalaya Rivers influence oceanographic conditions throughout the Gulf. The Loop Current directly affects species dispersal throughout the Gulf while discharge from the Mississippi/Atchafalaya Rivers creates areas of high productivity that are occupied by many commercially and recreationally important marine species.

The Gulf coast wetlands and estuaries provide the habitat for an estimated 95% of the finfish and shellfish species landed commercially and 85% of the recreational catch of finfish (Thayer and Ustach 1981). Four of the top ten commercial fishery ports in the United States are located in the Gulf and account for an estimated 1.19 billion lbs of fish and shellfish harvested annually from the Gulf (USDOC 2003). The Gulf fishery accounts for 18% of the nation's total commercial landings by volume (Adams et al. 2004) and supports the most valuable shrimp fishery in the United States (USDOC 2003). Additionally, the Gulf of Mexico's wetlands, coastal estuaries, and barrier islands also support large populations of wildlife (e.g., waterfowl, shorebirds); play a significant role in flood control and water purification; and buffer the coastal mainland from hurricanes and lesser storm events. It has been estimated that the mean annual storm protection value for one hectare of coastal wetlands is $8,240. The coastal wetlands ecosystem services value excluding storm protection provides an additional $11,700 per year (Costanza et al. 2008).

4.2.1 Circulation Patterns and Tides

Hydrographic studies depicting general circulation patterns of the Gulf of Mexico include those of Parr (1935), Drummond and Austin (1958), Ichiye (1962), Nowlin (1971), and Jones et al. (1973). Circulation patterns in the Gulf are dominated by the influence of the upper-layer transport system of the western North Atlantic. Driven by the northeast trade winds, the Caribbean Current flows westward from the junction of the Equatorial and Guiana Current, crosses the Caribbean Sea, and continues into the Gulf through the Yucatan Channel, eventually becoming the eastern Gulf Loop Current. Upon entering the Gulf through the Yucatan Channel, the Loop Current transports 700-840 thousand m^3/sec (Cochrane 1965).

Moving clockwise, the Loop Current dominates surface circulation in the eastern Gulf and generates permanent eddies over the western Gulf. During late summer and fall, the progressive expansion and intrusion of the loop reaches as far north as the continental shelf off the Mississippi River Delta. Nearshore currents are driven by the impingement of regional Gulf currents across the shelf, passage of tides, and local and regional wind systems. The orientation of the shoreline and bottom topography may also place constraints on speed and direction of shelf currents.

When the Loop Current is north of 27°N latitude, a large anticyclonic eddy about 300 km in diameter usually separates. These warm core eddies originate as pinched off northward penetrations of Loop Current meanders. In the following months, the eddy migrates westward at about 4 km/day until it reaches the western Gulf shelf where it slowly disintegrates over a span of months. The boundary of the Loop Current and its associated eddies is a dynamic zone with meanders and strong convergences and divergences, which can concentrate planktonic organisms including fish eggs and larvae.

Gulf tides are small and noticeably less developed than those along the Atlantic or Pacific coasts. Normal tidal ranges are seldom more than 0.5 m. Despite the small tidal range, tidal current velocities are occasionally high, especially near the constricted outlets that characterize many of the bays and lagoons. Tide type varies widely throughout the Gulf with diurnal tides (one high tide and one low tide each lunar day of 24.8 hrs) existing from St. Andrew's Bay, Florida, to western Louisiana. The tide is semi-diurnal in the Apalachicola Bay area of Florida and mixed in west Louisiana and Texas.

4.2.2 Sediments

Two major sediment provinces exist in the Gulf of Mexico: carbonate sediments found predominantly east of Desoto Canyon and along the Florida west coast, and terrigenous sediments commonly found west of Desoto Canyon and into Texas coastal waters (GMFMC 1998). Quartz sand sediments are found relatively nearshore from Mississippi eastward across Alabama and the Panhandle and west coast of Florida. Due to the influence of the Mississippi and Rio Grande rivers, fine sediments (i.e., silt and mud) are common in the western Gulf and south of the Rio Grande, and are also found in deeper shelf waters (>80 m) (Darnell et al. 1983).

West of Mobile Bay, fine-grained organic-rich silts and clays of terrestrial origin are brought to the shelf by distributaries of the Mississippi, Pearl, and other rivers (Darnell and Kleypas 1987). These fine sediments spread eastward from the Louisiana marshes to Mobile Bay, but off the Mississippi barrier islands a band of coarser quartz sand interrupts them. Fine sediments are also found southwestward of the Everglades extending the full length of the Florida Keys. Another area of fine sediments lies along the eastern flank of DeSoto Canyon.

Quartz sand predominates in the nearshore environment from the Everglades northward along the coast of Florida. However, from below Apalachicola Bay to Mobile Bay, it covers the entire shelf, except the immediate flank of DeSoto Canyon. The outer half to two-thirds of the Florida shelf is covered with a veneer of carbonate sand of detrital origin. Between the offshore carbonate and nearshore quartz, there lies a band of mixed quartz/carbonate sand.

4.2.3 Estuaries

Gulf estuaries provide essential habitat for a variety of commercially and recreationally important species, serving primarily as nursery grounds for juveniles but also as habitat for adults during certain seasons. The Gulf of Mexico is bordered by 207 estuaries (Buff and Turner 1987), extending from Florida Bay to the Lower Laguna Madre. The Cooperative Gulf of Mexico Estuarine Inventory (GMEI) reported 5.62 million ha of estuarine habitats in the Gulf States including 3.2 million ha of open water and 2.43 million ha of emergent tidal vegetation (Lindall and Saloman 1977). Emergent tidal vegetation includes 174,000 ha of mangrove and one million ha of salt marsh; submerged vegetation covers 324,000 ha of estuarine bottom throughout the Gulf (GMFMC 1998). Most of the Gulf's salt marshes are located in Louisiana (63%) while the largest expanses of mangroves (162,000 ha) are located along the southern Florida coast (GMFMC 1998).

4.2.4 Submerged Aquatic Vegetation

Seagrass resources are estimated to encompass an estimated 1,500,000 ha of the Gulf coast bottoms (Fonseca 1994). Six distinct species of seagrass can be found in the marine and estuarine waters of the Gulf of Mexico. Turtle grass (*Thalassia testudinum*), shoal grass (*Halodule wrightii*), manatee grass (*Syringodium filiforme*), star grass (*Halophila engelmanni*), paddle grass (*Halophila deciepiens*) and widgeon grass (*Ruppia maritima*) are the dominant seagrass species (Handley et al. 2007). Eel grass (*Vallisneria americana*) and widgeon grass are two species that are common in freshwater systems and also tolerant of varying degrees of salinity. Widgeon grass can be found in salinities greater than 30 ppt while eel grass can tolerate salinities upward of 20 ppt for short durations (Korschgen and Green 1988). Distribution of seagrasses in the Gulf throughout the mid-1980s was predominant (98.5%) along the Florida and Texas coasts (MMS 1983) with 910,000 ha of seagrass located on the west Florida continental shelf, contiguous estuaries, and embayments (Iverson and Bittaker 1985). Macro algae species including *Caulerpa*, *Udotea*, *Sargassum*, and *Penicillus* are found throughout the Gulf but are most common on the west Florida shelf and in Florida Bay.

Unfortunately, loss of seagrass beds due to human activities has occurred Gulf-wide over the last century, and the extent of recovery and restoration efforts varies by region. For example, Mississippi has seen an approximate 50% loss of submerged vegetation from 1969 to 1992. Since 1992, submerged vegetation has increased primarily due to increased abundance of shoal grass (Moncreiff et al. 1998). Pulich and White (1990) reported a loss of 90% in Galveston Bay, Texas and, in Florida, more than 50% of the historical seagrass coverage has been lost in Tampa Bay, followed by 29% of seagrass coverage lost in Charlotte Harbor, Florida (Fonseca 1994). The loss of seagrasses results in the loss of important biological functions to the marine and estuarine ecosystems. In addition to being a significant food source for marine turtles, manatees, migratory ducks, wading birds and many other organisms, seagrasses provide a refuge and nursery for numerous wildlife species including commercially and recreationally valuable fish and invertebrates. Seagrasses also stabilize sediments with their rhizomes, provide enhanced water quality by prohibiting resuspension of sediments, and actively recycle important nutrients (Zieman 1982, Phillips and Menez 1988, Fonseca 1994).

4.2.5 Emergent Vegetation

Emergent vegetation is not evenly distributed along the Gulf coast. Marshes in the Gulf of Mexico consist of several species of marsh grasses, succulents, mangroves, and other assorted marsh complements. In Texas, emergents include shore grass (*Monanthochloe littoralis*), saltwort (*Batis maritima*), smooth cordgrass (*Spartina alterniflora*), saltmeadow cordgrass (*Spartina patens*), saltgrass (*Distichlis spicata*), black needlerush (*Juncus roemerianus*), coastal dropseed (*Sporobolus virginicus*), saltmarsh bulrush (*Scirpus robustus*), annual glasswort (*Salicornia bigelovii*), seacoast bluestem (*Schizachyrium scoparium*), sea blite (*Suaeda linearis*), sea oat (*Uniola paniculata*), and gulfdune paspalum (*Paspalum monostachyum*) (Diener 1975, GMFMC 1998). The southernmost reaches of Texas also have a few isolated stands of black mangrove (*Avicennia germinans*). Over 247,670 ha of fresh, brackish, and salt marshes occur along the Texas coastline.

Louisiana marshes comprise more than 1.5 million ha or more than 60% of the entire marsh habitat in the Gulf (GMFMC 1998). They include a diverse number of species including black mangrove, saltgrass, wiregrass, saltwort, threecorner grass (*Scirpus olneyi*), hairypod cowpea (*Vigna luteola*), arrowhead (*Sagittaria* sp.), wild millet (*Echinochloa walteri*), bullwhip (*Scirpus californicus*), sawgrass (*Cladium jamaicense*), maiden-cane *(Panicum hemitomon*), pennywort (*Hydrocotyl*e sp.), pickerelweed (*Pontederia cordata*), alligator-weed (*Alternanthera philoxeroides*), and water hyacinth (*Eichhornia crassipes*) (Perret et al. 1971, Chabreck et al. 2001).

Mississippi and Alabama have a combined 40,246 ha of mainland marsh habitat (26,237 and 14,009 ha, respectively). Mississippi marshes were dominated by black needlerush, smooth cordgrass, saltmeadow cordgrass, and threecorner grass (Eleuterius 1973, Wieland 1994). Other common species of saltmarsh vegetation include saltgrass, torpedo grass (*Panicum repens*), sawgrass, saltmarsh bulrush, sea myrtle (*Baccharis halimifolia*), sea ox-eye (*Borrichia frutescens*), pennywort, and marsh pink (*Sabatia stellaris*) (C. Moncreiff personal communication). Alabama marshes contain the same complement of species as Mississippi with the addition of big cordgrass (*Spartina cynosuroides*), common reed (*Phragmites communis*), and bullwhip. In addition, the Mississippi Sound barrier islands contain about 860 ha of saltmarsh habitat (GMFMC 1998).

Florida's west coast and panhandle include 213,895 ha of tidal marsh (GMFMC 1998). Emergent vegetation is dominated by black needlerush but also includes saltmarsh cordgrass, saltmeadow cordgrass, saltgrass, perennial glasswort (*Salicornia perennis*), sea ox-eye, saltwort, and sea lavender (*Limonium carolinianum*). An additional 159,112 ha of Florida's west coast is covered in red mangrove (*Rhizophora mangle*), black mangrove, and buttonwood (*Conocarpus erectus*). A fourth species, white mangrove (*Laguncularia racemosa*), occurs on the west coast but is much less abundant.

4.3 Regional Area Description

4.3.1 Eastern Gulf

The eastern Gulf of Mexico extends from Florida Bay northward to Mobile Bay on the Florida/Alabama boundary and includes 40 estuarine systems covering 1.2 million ha of open water, tidal marsh, and mangroves (McNulty et al. 1972). Considerable changes occur in the type and acreage of submergent and emergent vegetation from south to north. Mangrove tidal flats are found from the Florida Keys to Naples. Sandy beaches and barrier islands occur from Naples to Anclote Key and from Apalachicola Bay to Perdido Bay (McNulty et al. 1972). Tidal marshes are found from Escambia Bay to Florida Bay and cover 213,895 ha with greatest acreage occurring in the Suwanee Sound and Waccasassa Bay. Wide, sand beaches situated either on barrier islands or on the mainland itself characterize the coast from Apalachee Bay to the Alabama border. Beds of mixed seagrasses and/or algae occur throughout the eastern Gulf with the largest areas of submerged vegetation found from Apalachee Bay south to the tip of the Florida peninsula. Approximately 9,150 ha of estuarine area, principally in the Tampa Bay area, have been filled for commercial or residential development.

Coastal waters in the eastern Gulf may be characterized as clear, nutrient-poor, and highly saline. Rivers that empty into the eastern Gulf carry little sediment load. Primary production is generally low except in the immediate vicinity of estuaries or on the outer shelf when the nutrient-rich Loop Current penetrates into the area. Presumably, high primary production in frontal waters is due to the mixing of nutrient-rich, but turbid, plume water (where photosynthesis is light-limited) with clear, but nutrient-poor, Gulf of Mexico water (where photosynthesis is nutrient-limited), creating good phytoplankton growth conditions (GMFMC 1998).

4.3.2 Northern Central Gulf

The northern central Gulf includes Alabama, Mississippi, and Louisiana. Sand barrier islands and associated bays and marshes dominate the eastern and central Louisiana coasts. The most extensive coastal salt marshes in the United States are associated with the Mississippi/Atchafalaya River deltas. Annual wetlands loss along the Louisiana Coastal Zone for the period of 1978-2000 is estimated to be 7,744 ha/yr (Barras et al. 2004) and accounts for 90% of the total coastal marsh loss occurring in the nation (USACOE 2004). The shoreline of the western third of Louisiana is made up of sand beaches with extensive inland marshes. A complex geography of sounds and bays protected by barrier islands and tidal marshes acts to delay mixing, resulting in extensive areas of brackish conditions. The Alabama and Mississippi coasts are bound offshore by a series of barrier islands that are characterized by high-energy sand beaches, grading to saltwater marshes with interior freshwater marshes. The mainland shoreline is made up of saltwater marsh, beach, seawall, and brackish-freshwater marsh in the coastal rivers. In 1968, approximately 26,000 ha of mainland marsh existed in southern Mississippi and salt marsh on the barrier islands covered 860 ha (GMFMC 1981).

About 2,928 ha of submerged vegetation, including attached algae, have been identified in Mississippi Sound and in the ponds and lagoons on Horn and Petit Bois Islands (C. Moncreiff personal communication). Approximately 4,000 ha of mainland marsh along the Mississippi coastal zone have been filled for industrial and residential use since the 1930s (Eleuterius 1973). Seagrasses in Mississippi Sound declined 40%-50% since 1969 (Moncreiff et al. 1998). The Alabama coastal zone contains five estuarine systems covering 160,809 ha of surface water and 14,008 ha of tidal marsh (Crance 1971). Vittor and Associates (2004) mapped coastal Alabama's submerged aquatic vegetation (SAV). Sixteen species of SAV were identified covering 2,718.2 ha. Wild celery (*Vallisneria neotropicalis*) had the greatest acreage (686.4 ha) and dominated the delta of upper Mobile Bay. Shoal grass (*Halodule wrightii*) was the dominant marine species. Continuous beds were located in Mississippi Sound and patches noted along the north shore of the western tip of Dauphin Island, bays along the Intracoastal Waterway in Baldwin County, and Little Lagoon. Consensus from this and previous studies was that species diversity, species composition, and spatial coverage has declined because of coastal development and commercial activities.

In general, estuaries and nearshore Gulf waters of Louisiana and eastern Mississippi are low saline, nutrient-rich, and turbid due to the high rainfall and subsequent discharges of the Mississippi, Atchafalaya, and other coastal rivers. Average discharges (2002-2006) for the Mississippi and Atchafalaya Rivers were 13,610 m^3/sec and 5,830 m^3/sec (Battaglin et al. 2010).

The Mississippi River deposits approximately 150 million metric tons of sediment annually near its mouth while the lower Atchafalaya River deposits about half this amount annually (Walker

1994). As a consequence of the large fluvial nutrient input, the Louisiana nearshore shelf is considered one of the most productive areas in the Gulf of Mexico.

4.3.3 Western Gulf

The shoreline of the western Gulf includes approximately 612 km of open Gulf shoreline and contains 3,528 km of bay-estuary-lagoon shoreline along the Texas coast. The estuaries are characterized by extremely variable salinities and reduced tidal action. Eight major estuarine systems are located in the western Gulf and include the entire Texas coast. These systems contain 620,634 ha of open water and 462,267 ha of tidal flats and marshlands (GMFMC 1998). Submerged seagrass coverage is approximately 92,000 ha. Riverine influence is highest in Sabine Lake and Galveston Bay. Estuarine wetlands along the western Gulf decreased 10% between the mid-1950s and early 1960s with an estimated loss of 24,840 ha (Moulton et al. 1997).

Climate along the Texas coast ranges from humid on the upper coast where average rainfall is 55 inches, to semi-arid on the lower coast where rainfall averages about 25 inches. This wide range of annual rainfall results in a salinity gradient along the coast. For instance in Sabine Lake, salinity ranges from 4-14 ppt, but in the Laguna Madre salinity ranges from 26 ppt to well over 50 ppt.

Upper coast bay systems are heavily influenced by the rivers that empty into them. They are typified by turbid water; silt, mud, and clay bottoms; abundant oyster reefs; and are bordered by extensive intermediate marshes with large stands of emergent vegetation. South of Corpus Christi, the hypersaline Laguna Madre with its clear water, sandy bottom, and extensive seagrass beds represents the other end of the spectrum. Along the central Texas coast lie the San Antonio, Aransas, and Corpus Christi bay systems that represent a transition between the extremes of the upper and lower Texas coast.

4.4 General Distribution

Sand seatrout (*Cynoscion arenarius*) range from southwest Florida (Roessler 1970) to the Bay of Campeche, Mexico. The range of silver seatrout (*C. nothus*) overlaps that of *C. arenarius* in the Gulf and its range also extends along the Atlantic coast from Florida to Chesapeake Bay (Hildebrand 1955) (see Figure 3.1). The sand and silver seatrout are both considered common fishes of the Gulf of Mexico (DeVries and Chittenden 1982, Sutter and McIlwain 1987, Purtlebaugh and Rogers 2007). The sand seatrout habitat overlaps both that of the spotted seatrout (*C. nebulosus*) and silver seatrout. Like the spotted seatrout, the sand seatrout can be found in bays and estuaries. However, the spotted seatrout is a non-migratory species inhabiting seagrass systems during the summer months while juvenile sand seatrout have a preference for unvegetated benthic habitat during the same time frame. During the winter months, spotted seatrout utilize deep sites within the estuary, which contrasts the sand seatrout tendency to migrate to deeper waters nearshore and offshore during colder months (Simmons 1957, Swingle 1971, Ditty et al. 1991). The silver seatrout differs in habitat preference from both the spotted and sand seatrout by remaining primarily offshore and at deeper depths. Silver and sand seatrout habitats overlap in the offshore waters but the spatial and temporal dynamics of these two species are not well understood (Chittenden and

McEachran 1976, McDonald et al. 2009).

Although they are common fish of the Gulf of Mexico, information pertaining to sand and silver seatrout life histories is relatively limited, and sometimes conflicting (Shlossman and Chittenden 1981, Ditty et al. 1991). This includes information regarding the essential habitat of juvenile sand and silver seatrout (Purtlebaugh and Rogers 2007). Typically, larger adult sand seatrout and juvenile and adult silver seatrout are more common in offshore waters of intermediate depth (<80 m). Larval and juvenile sand seatrout may be found in bays, estuaries, and shallow nearshore waters while larval and post-larval silver seatrout are also believed to use estuarine and nearshore habitats (DeVries and Chittenden 1982, Hein et al. 1999). All life stages of sand seatrout are associated most commonly with mud bottoms although seine and trawl captures have occurred to a lesser extent over sand and hard substrate. Seine captures in estuarine waters showed increased abundance associated with emergent saltmarsh vegetation compared to unvegetated shorelines (Purtlebaugh and Rogers 2007).

Moffett et al. (1979) found that the distribution of sand seatrout appears to be restricted to a greater extent by water temperature than by salinity. Along the Gulf coast, sand seatrout have been collected at temperatures ranging from 6-37ºC, but they are found in greatest abundance at temperatures of 20-24ºC or higher (Copeland and Bechtel 1974, Gallaway and Strawn 1974). This species tolerates salinities of 0-45 ppt (Simmons 1957, Roessler 1970) and there are indications that young sand seatrout are found at lower salinities than older fish (Gunter 1945). Silver seatrout appear to favor a slightly cooler upper temperature range (30°C) than sand seatrout and prefer waters with higher salinities (Gunter 1945, Sutter and McIlwain 1987).

4.5 Spawning Habitat

Sand seatrout spawning in the Gulf of Mexico occurs between March and September with a bimodal peak periodicity during March-April and August-September (Shlossman and Chittenden 1981, Peebles 1987, Ditty et al. 1991). However, Peebles (1987) did note that, in southwest Florida, some spawning may occur year-round. Four occurrences of larval sand seatrout were found in both December and January sampling events during his study.

Most evidence suggests a bimodal peak spawning pattern that takes place in offshore and nearshore Gulf waters close to suitable nursery sites, although the extent of the spawning habitat is not clear and could vary seasonally (Shlossman and Chittenden 1981). Initial spawning in most Gulf waters begins offshore in the spring (Sutter and McIlwain 1987, Ditty et al. 1991) and moves progressively shoreward during the season (Cowan and Shaw 1988, Ditty et al. 1991) with most intense spawning occurring in the lower estuary and shallow Gulf (Ditty et al. 1991). This is further supported by Simmons (1951) and Simmons and Hoese (1959) who found that adult sand seatrout from Aransas Bay migrated into the Gulf between May and August and that post-larval specimens and spent adults entered Aransas Bay on incoming tides.

Although spawning has been documented to occur in offshore waters close to nursery areas, spawning depths vary throughout the Gulf of Mexico. Shlossman and Chittenden (1981) identified spawning events taking place at depths of 7-22 m from Cedar Bayou to Galveston Bay in Texas. Sheridan et al. (1984) collected a greater percentage of ripe mature fish in Texas from the 56-73 m isobath, but also found ripe fish in depths from 9-91 m. Franks et al. (1972) found ripe sand seatrout in similar depth (73-91 m) off the Mississippi coast. This variation in the depth of spawning habitat may be attributed to differences in the depth of habitat off Texas and the Mississippi Delta (Sheridan et al. 1984), but also shows a large range for the species in terms of demonstrated spawning habitat depth (7-91 m).

Spawning in southwest Florida may differ from other areas of the Gulf due to the variability of local salinity regimes. Most spawning in this region takes place in depths < 20 m as opposed to significantly deeper depths that have been documented in other regions of the Gulf. Salinity has been documented to be an important factor in sand seatrout spawning in southwest Florida, where spawning areas were described as typically stable with high salinity and optimally near coastal embayments and other nursery areas (Peebles 1987).

Silver seatrout follow a similar temporal pattern as sand seatrout by spawning between May and October in offshore waters with a peak in spawning occurring in late summer (DeVries and Chittenden 1982, Sutter and McIlwain 1987). Evidence off the coast of Georgia also indicates a similar pattern in spawning including that the late summer spawning of silver seatrout occurs closer to shore like that of sand seatrout in the Gulf region (Mahood 1974).

4.6 Eggs and Larval Habitat

Shlossman and Chittenden (1981) found that the inshore movement of young sand seatrout coincided with periods of rising sea level in the northern Gulf that were due to surface currents and prevailing inshore winds. The spawning strategy employed by the sand seatrout in the inshore waters of the Gulf of Mexico seems to take advantage of the periodicity of onshore winds and surface currents, which transport fertilized eggs or newly hatched larvae to estuarine and inshore Gulf nursery areas (Shlossman and Chittenden 1981). This strategy may be generally true for sand seatrout in southwest Florida, although optimal environmental conditions for survival of eggs and small larvae may exist at various proximities to coastal embayments or other nursery areas utilized by the more euryhaline post-larval and juvenile stages. The apparent positioning of spawning farther away from the coast in the Everglades is probably related to a preference for stable, higher salinity spawning locations, such as those found by Peebles (1987).

The main sand seatrout nursery region is located in the northwestern Gulf and lies in water < 25 m in depth (Ditty et al. 1988). Within this depth contour, the occupied Gulf nursery area probably expands or contracts depending on spawned cohort strength and factors that determine dispersal of the young (Shlossman and Chittenden 1981). Larvae migrate into shallow areas of the upper estuaries in most areas of the Gulf (Benson 1982) and apparently prefer small bayous, shallow marshes, and channels during their early life stages (Conner and Truesdale 1972, Moffett et al. 1979, Ditty et al. 1991). Use of this estuarine nursery habitat has been further documented by Moffett (1979) who noted that soft-bottom lakes and blind bayous in the Trinity River Delta of Galveston Bay, Texas, are important sand seatrout nursery areas (Conner and Truesdale 1972). Moffett (1975) further documented that sand seatrout also utilize salt marshes as nursery grounds for a short period and then apparently move into open bay waters, where he found fish as small as

18 mm SL in the open water of Chocolate Bay.

Due to seasonal bimodal spawning, in which early spawning begins further from the coast, larvae and early juvenile sand seatrout < 30 mm SL usually begin to immigrate to estuaries during April with a peak in May (Ditty et al. 1991). During the immigration to the estuary, it has been documented that more young sand seatrout are collected at night rather than during the day and they are somewhat surface-oriented at this life stage (Peebles 1987, Cowan and Shaw 1988, Leffler 1989, Lyczkowski-Shultz et al. 1990), but become increasingly demersal with size (Rogers and Herke 1985, Peebles 1987). Upon reaching the estuary, larval sand seatrout move into shallow areas of the estuary where they remain until at least 50-60 mm TL, after which they move to deeper water. Shlossman and Chittenden (1981) also documented the immigration and emigration patterns of sand seatrout during their studies, noting that estuarine nurseries may be most important to late summer spawned groups. Both spawned groups leave estuarine nurseries in the fall to overwinter in the Gulf.

Very little information is available on silver seatrout at this life stage. DeVries and Chittenden (1982) suspected that silver seatrout were taking advantage of the same current transport conditions as sand seatrout to move their eggs and larvae into the bays and nearshore waters.

4.7 Juvenile Habitat

Juvenile sand seatrout use estuarine and nearshore waters as nursery grounds (Gunter 1945, Christmas and Waller 1973, Shlossman and Chittenden 1981). In Texas, Mississippi, and Alabama, use by juveniles appears on the nursery grounds in April or May depending on latitudinal variation. Gallaway and Strawn (1974) first observed YOY fish in Galveston Bay during April and continued to collect them until September. Immigration of juvenile sand seatrout (30 mm SL) into Mississippi nursery areas was observed to begin in April or May, and recruitment continued through the summer and fall (Warren and Sutter 1981). Swingle (1971) noted that young sand seatrout appeared in Alabama Gulf waters in May and were most abundant in June.

In Louisiana waters, juvenile use of estuarine and nearshore nurseries increased concomitantly with a rapid decline in both minimum and mean TL of sand seatrout collected at offshore stations (30m station depth) during May and June. This coincided with a rapid increase in both minimum and mean TL of fish collected at nearshore stations (10m station depth) during June and July. These movements suggest immigration and emigration of juvenile sand seatrout to and from the nursery area. It was also noted that both minimum and mean TL of sand seatrout in nearshore waters decrease as larger fish move further offshore and immature fish move out of the estuary into deeper waters during the early fall (Ditty et al. 1991).

Purtlebaugh and Rogers (2007) also found that juvenile sand seatrout primarily recruited into the estuaries from May-October in four Florida systems. Unlike larval sand seatrout that are found in euryhaline environments, juveniles were found to be most abundant over unvegetated mud bottoms in mesohaline conditions, and near salt marsh vegetation. Highest abundances also occurred in small rivers, tidal creeks and areas adjacent to the mouths of large rivers. Juveniles 30-70 mm SL primarily occupied mesohaline conditions before shifting toward higher salinities as they approached 100 mm SL.

Purtlebaugh and Rogers (2007) suggested that the importance of estuarine areas may include several factors, not the least of which being that areas near freshwater input often support increased densities of phytoplankton, zooplankton, larval fishes, and nekton because of the high level of associated nutrients (Grimes and Kingsford 1996). The observed increased abundance of sand seatrout in these areas in Florida Gulf estuaries may be a function of feeding and prey abundance. During early life stages, sand seatrout prey heavily upon mysid shrimp, copepods, and larval fish (Reid 1954, Darnell 1958, Springer and Woodburn 1960, Sheridan 1979, Byers 1981). In addition, Purtlebaugh and Rogers (2007) noted that it is well known that estuarine species often select a particular range, along with an environmental gradient, particularly salinity gradients, that minimizes metabolic costs, optimizes growth, and facilitates survival (Wohlschlag and Wakeman 1978, Moser and Gerry 1989, Cyrus and Blaber 1992, Whitfield 1999, Nelson and Leffler 2001).

Juvenile silver seatrout were taken in the same general vicinity as adults in Texas during the months of June - August (McDonald et al. 2009). Mississippi Sound had the main recruitment of juveniles in September (20-80 mm SL), and by the following June, the length of fish caught in this same region had increased to 110-160 mm SL (Sutter and McIlwain 1987).

4.7.1 Juvenile Temperature and Salinity

Christmas and Waller (1973) noted that sand seatrout have been collected in temperatures of 5-35°C, with most taken above 10°C. Warren and Sutter (1981) found similar results in Mississippi where small fish <20 mm SL were most often taken in water temperatures of 25-30ºC, but fish were found in water temperatures as low as 15ºC. Copeland and Bechtel (1974) examined catch records of sand seatrout from the Gulf coast and found that fish were taken in temperatures between 5-30ºC, but optimum catches were made between 20-30ºC. Seine and trawl captures made in Galveston Bay were similar with the largest catches being made by seines in 29-32ºC and trawls at 25-32ºC.

Juvenile sand seatrout were found in a more extensive temperature range than adults and show a similar plasticity for salinity. Larval and juvenile sand seatrout occur in almost the complete range of salinities that have been documented by the information that has been collected to date. Due to nearshore spawning by sand seatrout, it is not surprising that in Naples Bay, Florida, the smaller larvae were predominantly found in salinities of 28-36 ppt (Peebles 1987). Small sand seatrout (<20 mm SL) were collected in Mississippi waters at salinities of 0-30 ppt, which was similar to Warren and Sutter (1981). Christmas and Waller (1973) found larval and juvenile sand seatrout in salinities ranging from 0-26 ppt.

Although larval and early juvenile sand seatrout showed a distinct ability to inhabit a euryhaline environment, it appears that as the juveniles mature, more stable and eventually increasing salinities are preferred. Warren and Sutter (1981) found increased catches of larger YOY 20-90 mm SL in Mississippi were at salinities <15 ppt, with most in <10 ppt. Juveniles 30-35 mm SL from three estuaries in Florida settled into a consistent mesohaline gradient and in all estuaries examined. As 70 mm SL fish increased in length, they moved toward higher salinities

(Purtlebaugh and Rogers 2007).

The temperature and salinities where juvenile silver seatrout >20 mm SL have been caught are the same as that of the adult silver seatrout, between 10 and 30°C. No information on temperature or salinity preferences has been found for specimens <20 mm SL.

4.8 Adult Habitat

Adult sand seatrout are described as nearshore and offshore inhabitants that move between these areas (nearshore to offshore) with decreasing winter temperatures (Gunter 1938). In Tampa Bay, Florida, Knapp and Purtlebaugh (2008) found that adult sand seatrout were present in the bay year-round but followed a similar pattern of moving to deeper waters within Tampa Bay with decreasing temperatures. Although there are similarities in the preferred benthic substrate between juvenile and adult sand seatrout, which is soft mud bottoms, there appears to be more habitat flexibility in adults (Conner and Truesdale 1972, Hein et al. 1999). Adults have also been located over a variety of other substrates including wrecks, man-made structures, and oyster reefs (Gallaway and Strawn 1974, Benson 1982).

Salinities also appear to be a factor in differentiating habitat use in juvenile and adult sand seatrout. Gunter (1945) and Benson (1982) noted that adults were less tolerant of low salinities than either juveniles or larvae, with adults favoring salinities >15 ppt and juveniles and larvae preferring waters <15 ppt. In all four estuaries studied by Purtlebaugh and Rogers (2007), sand seatrout 10-70 mm SL were found in upper mesohaline and lower polyhaline waters and individuals >70 mm SL moved toward higher salinities. This shift away from mesohaline waters by sand seatrout of increasing size was further documented by Knapp and Purtlebaugh (2008) in Tampa Bay and Charlotte Harbor, Florida. Sand seatrout >155 mm SL declined in both estuaries as freshwater discharge into the estuary increased. The movement by adult sand seatrout away from lower salinity waters may be a result of one or more factors that include feeding preferences, seeking out spawning habitat, and the reduction of osmoregulatory stress.

Silver seatrout are a relatively short-lived species, typically reaching an age of 1.0-1.5 years. Adult silver seatrout are almost exclusively offshore residents with only occasional exceptions found in inshore waters (Gunter 1945, McDonald et al. 2009). Silver seatrout are much more abundant in Texas offshore waters in all seasons but the summer. This exception is believed to be due to silver seatrout moving further offshore (DeVries and Chittenden 1982). However, this lower abundance during the summer has also been speculated to be due to the cyclic spawning of silver seatrout followed by a die-off of the spawning adults. Adult silver seatrout are found in higher salinities than sand seatrout and are more abundant off the Texas coast where offshore salinities tend to be higher, as opposed to the northern Gulf where sand seatrout are in greater abundance. The difference in salinities between these two regions is due to the inflow of freshwater from the Atchafalaya and Mississippi Rivers which results in lower salinities and a reduction in higher salinity habitat for silver seatrout (McDonald et al. 2009).

Adult silver seatrout appear to move farther from shore and into deeper waters during the winter months (January-April) (Sutter and McIlwain 1987). This is likely due to these fish seeking more moderate temperatures. Adult silver seatrout were most commonly found in temperatures ranging from 10-30°C. Juveniles were taken over a slightly larger range of 5-30°C (Sutter and McIlwain 1987). Gunter (1945) found a similar temperature range (13.7-29.9°C) for silver seatrout caught during his study.

Salinities where silver seatrout were captured ranged from 18.2-36.7 ppt. Gunter (1945) noted that silver seatrout are primarily an offshore species, but they are known to enter bays in Texas during cooler months when salinities are at their lowest. Silver seatrout typically prefer higher salinity areas. Adults were found between 7.5-38.6 ppt but were most commonly found above 25 ppt.

Recent analysis of Southeast Area Monitoring and Assessment Program (SEAMAP) data for the Gulf of Mexico was conducted by Rester (2010) to determine if an inshore/offshore distribution pattern existed. The distribution pattern was investigated by means of geostatistics using catch data from the Summer Shrimp/Groundfish Survey. The survey is a standardized fishery-independent data collection survey that has taken place annually since 1982. A total of 3,765 trawl stations from 1997-2007 were sorted from the SEAMAP database with water depth and bottom temperature as covariates. The results show that sand seatrout are the predominate species in areas with lower salinities such as around the mouth of the Mississippi River, off the Atchafalaya River in central Louisiana, off the mouth of the Calcasieu River in western Louisiana, and off Galveston Bay (Figure 4.1). Silver seatrout seem to predominate off south and central Texas and off southwestern Louisiana which usually have higher salinities due to less freshwater

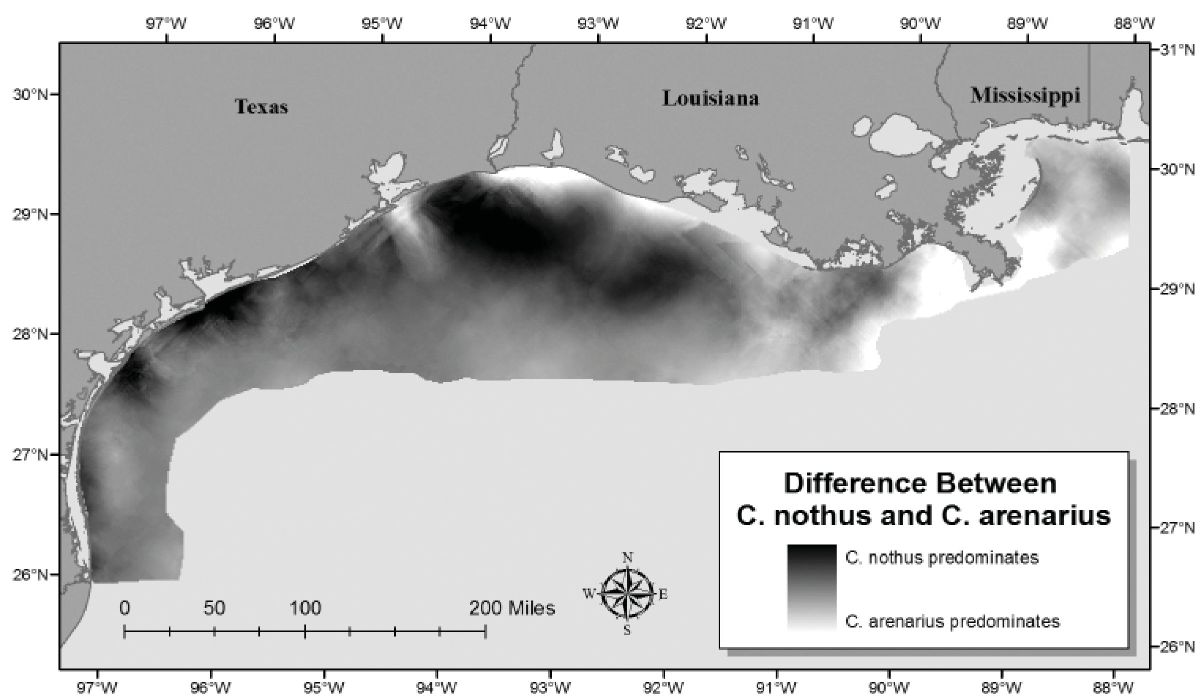

Figure 4.1 Prediction map of sand and silver seatrout (*Cynoscion arenarius* and *C. nothus*) in the northern and western Gulf of Mexico using the 1997-2007 SEAMAP summer shrimp/groundfish survey data (*from* Rester 2010).

inflow. However, sand seatrout, which were thought to be more common in estuarine and shallow offshore waters than silver seatrout, are found in higher numbers offshore (70-100 m water depth) than silver seatrout.

4.9 Habitat Quality, Quantity, Gain, Loss, and Degradation

The general knowledge of the importance of habitat and nursery areas to the survival of many nearshore and offshore fish species, such as sand and silver seatrout, is well known, although the specific interactions of various biotic and abiotic factors are less understood. Approximately 75% of the nation's commercial fish and shellfish are dependent on estuarine habitat during part of their life cycle. In the Gulf of Mexico, approximately 98% of commercial fish and shellfish harvested are dependent on estuaries and wetlands (Stedmand and Dahl 2008). Allen and Baltz (1997) pointed out that a better understanding of estuarine-dependent species is necessary to assess the relative importance of abiotic factors, food resources, predation, and habitat quality.

Physical alterations to vegetated and unvegetated estuarine habitats that either remove or modify such a habitat will have a negative impact on most life stages of animals that utilize the habitat for feeding, growth, predator avoidance, and/or reproduction (Hoss and Thayer 1993). The remainder of this section addresses several critical habitat concerns and their potential impact on sand and silver seatrout.

4.9.1 Hypoxia

Anoxic bottom conditions have not been reported for most of the eastern Gulf with the exceptions of local hypoxic events in Mobile Bay and several bay systems in Florida (Tampa, Sarasota, and Florida Bays). However, extensive areas (1,820,000 ha) of low DO (<2 ppm) occur in offshore waters of Louisiana and Texas during February through early October. This phenomenon is most prevalent during the warmer summer months (Rabalais et al. 1997, Rabalais et al. 1999). The large Gulf hypoxic zone, commonly known as the 'dead zone', is created by low dissolved oxygen due primarily to nitrogen and phosphorus runoff from upstream agricultural activity along the Mississippi and Atchafalaya Rivers. These two rivers account for 80% of the freshwater input into the northern Gulf region that encompasses the area of this large recurring hypoxic zone. Although first documented in 1972, this hypoxic zone has been monitored since 1985 and averages 14,644 km^2 annually. A Mississippi River/Gulf of Mexico Watershed Nutrient Task Force (WNTF) made up of representatives from ten states and six federal agencies has written an action plan to address the excessive freshwater nutrient input from the Mississippi River. The WNTF (2008) has set a goal of reducing the annual average size of the Gulf hypoxic zone to 5,000 km^2.

The close association that larval and juvenile sand and silver seatrout have with estuaries during the hot summer months tends to decrease the effects these offshore hypoxic areas have on these populations. Conversely, the adult population and breeding efforts by sand seatrout may be affected to a greater extent, since breeding is known to occur during the summer months in waters encompassed by the hypoxic zone. The low dissolved oxygen levels of the hypoxic zone can affect both sand and silver seatrout through direct mortality, but it is more likely that alterations in migration, disruptions in their life cycle through a reduction of available habitat, an increase in susceptibility to predation, and changes in the availability of food sources would likely adversely affect these species.

Minor inshore hypoxic events have been documented frequently in the Gulf of Mexico (Rabalais et al. 1991) and its estuaries. However, the impact of these events apparently did not lead to significant sand seatrout mortality as few sand seatrout mass fish kills have been documented.

4.9.2 Harmful Algal Blooms (HABs)

Harmful algal blooms (HABs) are caused by naturally occurring organisms (dinoflagellates). Over 60 species of dinoflagellates that can cause harmful algal blooms are found in the Gulf with the most common being *Karenia brevis*. HABs in the Gulf of Mexico occur most commonly in Florida waters with over 60% of the documented events occurring between 1957 and 2005. Louisiana, Mississippi and Alabama have each experienced at least one red tide event, but Texas has documented the most red tide events after Florida. Texas has documented 13 since 1935, with one of these events in 1997 killing a minimum of 22 million finfish (Heil personal communication, McEachron et al. 1998). Clupeids and other schooling fishes were the main species impacted, although about 100 total species were identified, including recreationally and commercially important fish such as spotted seatrout, red drum (*Sciaenops ocellatus*), flounder (*Paralichthys* sp.), black drum (*Pogonias cromis*), and Atlantic croaker (*Micropogonias undulatus*). Brevitoxin, the toxic compound produced and released by red tide cells, also affects top predators through bioaccumulation of toxin in planktivorous prey fish that ingest the cells or are otherwise exposed to a bloom. Finfish are not the only casualties of harmful algal blooms. In addition, bottlenose dolphins (*Tursiops truncatus*), marine turtles, and the Florida manatee (*Trichechus manatus latirostrus*) have all died as a result of toxins associated with HABs.

In 1996, 149 Florida manatees, an endangered species, died and, in 2005, 138 marine turtles died due to HABs in Florida Gulf waters. The contribution of HABs to natural mortality is difficult to quantify and perhaps impossible to predict. Algal blooms occur under particular physio-chemical conditions and over broad regions with focal concentration-related impacts; thus great variability exists in the frequency of the occurrence, distribution, and potential impact that these blooms may have on the fishery in any given year. It should also be noted, HABs can contribute to other adverse sand and silver seatrout population effects. Research related to sand seatrout and spotted seatrout spawning was being conducted in Tampa Bay, Florida, during 2004 and 2005. A harmful algal bloom occurred during 2005 and significant differences in the amounts of sand seatrout spawning were noted in the portions of the bay affected by the bloom. Upper Tampa Bay was not affected by the bloom because of salinities below the requirements of the harmful algae in the bloom. No difference in sand seatrout spawning was noted between sampling years (Walters et al. 2005).

4.9.3 Tropical Weather Impacts

El Niño [also referred to as El Niño Southern Oscillation (ENSO)] is a change in the eastern Pacific's surface water temperatures that contributes to major changes in global weather. It is a periodic phenomenon that is caused by changes in surface trade wind patterns. The tropical trade winds normally blow east to west, piling up water in the western Pacific and causing upwelling of cooler water along the South American coast. El Niño occurs when this 'normal' wind pattern is disrupted. El Niño generally produces cooler and wetter weather in the southern United States and warmer than normal weather in the northern part of the country. In addition, there seems to be reduced, though no less severe, tropical activity during El Niño years (NAS 2000). The resulting increased summer rainfall can significantly increase river discharge, flow rates, water clarity, and other physical-chemical parameters which may affect sand and silver seatrout behavior or habitat choice.

The effects of La Niña are nearly opposite that of El Niño. La Niña is characterized by unusually cold ocean temperatures in the eastern equatorial Pacific Ocean. La Niña periods are characterized by wetter than normal conditions across the Pacific Northwest and very dry and hot conditions in the Southeast. Also, a greater than average number of tropical storms, and possibly hurricanes, are likely in the Gulf from June-October.

Tropical storm and hurricane damage to coastal property is a recognized physical and monetary threat to the states located along the Gulf coast. Economic losses have steadily increased during the past 50 years (NSB 2007). Between 1949 and 1989, an estimated $1.3 billion in storm damage occurred. That number increased to $10.1 billion from 1990-1995, and to $35.8 billion from 1996-2000. For the first time since records have been kept, over $100 billion were lost in a single year (2005) when Hurricanes Cindy, Katrina, Wilma, Rita, Dennis and Tropical Storm Arlene made landfall in the Gulf of Mexico. These increasing economic losses over time can be correlated to the loss of protective coastal wetlands. Costanza et al. (2008) estimated that the coastal wetlands of the United States provide $23.2 billion per year in storm protection services. Each hectare of coastal wetland lost corresponds to an average of $33,000 of increased damage from specific storms. Louisiana alone lost $816 million per year of wetland services prior to Hurricane Katrina and an additional $34 million were lost due to Katrina. These values emphasize the need to protect and restore coastal wetlands. Due to the importance of low salinity habitat found in emergent marsh systems, the continued loss of this habitat could also have negative consequences on both sand and silver seatrout populations that require these areas as juvenile developmental habitat.

4.9.4 Anthropogenic Habitat Impacts

Many of the factors that affect sand and silver seatrout populations in the Gulf of Mexico overlap and, at times, are almost impossible to separate. In an effort to provide a broad description of the sources of present, potential, and perceived threats to habitat, many of the issues presented here could be placed in multiple categories. This section attempts to offer a general overview of these human related impacts that include negative, positive, and benign habitat issues.

4.9.4.1 Habitat Alteration

The high degree of natural variation and proximity to human activities makes estuarine areas the weakest habitat link for the life cycle of estuarine-dependent organisms. Human population growth in southeastern coastal regions, accompanied by industrial growth, is responsible for the alteration or destruction of approximately 1% of estuarine habitats required for commercial and recreational species (Klima 1988). Human activities in inshore and offshore habitats of sand and silver seatrout that may affect recruitment and survival of stocks include: 1) ports, marinas, and maintenance dredging for navigation; 2) discharges from wastewater plants and industries; 3) dredge and fill for land development; 4) agricultural runoff; 5) ditching, draining, or impounding wetlands; 6) oil spills; 7) thermal discharges; 8) mining, particularly for phosphates and petroleum; 9) entrainment and impingement from cooling operations associated with industrial activities; 10) dams; 11) alteration of freshwater inflows to estuaries; 12) saltwater intrusion; and, 13) nonpoint source discharges of contaminants (Lindall et al. 1979).

4.9.4.2 Dredge and Fill

Navigational dredging and shallow water dredging for sand, gravel, and oyster shell directly alters the bottom and may change sediment characteristics and local current patterns. Those changes could lead to erosion or siltation of productive habitats. Destruction of wetlands, through dredging and filling for the purpose of developing waterfront properties, results in loss of productive habitat acreage and reduction of detrital production (Taylor and Saloman 1968). Channeling or obstruction of watercourses emptying into estuaries can result in loss of wetland acreage and changes in the salinity profile. Lowered flow rates of drainage systems can reduce nutrients washed into estuaries and permanently alter the composition of shoreline communities. These activities in estuarine water bodies may have multiple adverse effects on sand and silver seatrout habitat including reduced light penetration into the water column due to increased turbidity; altered tidal exchange, mixing, and circulation; reduced nutrient outflow from marshes and swamps; increased saltwater intrusion; siltation; and creation of an environment highly susceptible to recurrent low dissolved oxygen levels (Johnston 1981). These negative effects on the estuarine system could result in loss of habitat, increased predation, and changes to the spawning environment and reduced food availability for sand and silver seatrout.

Early degradation of Gulf coast estuarine habitat can be traced to the early 1900s, when exploration for and exploitation of oil and gas, with its concomitant development of refineries and chemical companies, began in the northern Gulf (Texas and Louisiana), along major rivers and bays. Canal construction results in wetland degradation far beyond the direct loss of habitat seen at dredge sites. Additional marsh loss is produced through secondary hydrologic effects: increased erosive energy, salinity intrusion, and disruption of natural flow effects. Some affected areas experience excessive sediment drying, while others undergo extended flood periods (Turner and Cahoon 1988); both effects produce loss of vegetative cover and increased conversion to open water.

Texas, Louisiana and Florida have had the greatest amount of submerged lands that have been filled by dredge spoil (Lindell and Saloman 1977). Maintenance dredging has been documented to increase turbidity and reduce light availability for seagrasses, causing their decline in Laguna Madre, Texas (Onuf 1994, Handley et al. 2007). Taylor and Saloman (1968) found that in Tampa Bay, canals created in filled wetlands had much less diversity and their fishery production value was significantly less than other areas of the bay. However, it should also be noted that a habitat assessment of 11 dredge holes in Tampa Bay found that sand seatrout utilized all 11 holes and were a dominant species in five. These dredge holes were not directly compared to natural habitat areas of the bay and it should not be interpreted that dredge holes were superior habitat areas (TBEP 2005).

4.9.4.3 Wetland Impoundment and Water Management

More than 50% of the population of the U.S. lives within 50 miles of a coast and development to support this population (dams, levees, and navigation projects) was a major factor in the loss of coastal wetlands along the Mississippi River and its major tributaries. These activities have resulted in a 67% decrease in the amount of sediment delivered to these Gulf coastlines (USEPA 2005). Other factors contributed as well, including sea level rise, coastal subsidence, and erosion. Most of the coastal wetland loss occurred in the Gulf of Mexico from 1998-2004 (25,010 ha/year). Most of this loss was due to the shifting of emergent wetlands to open saltwater bays. The most dramatic coastal wetland losses in the United States are in the northern Gulf of Mexico. This area contains 41% of the national inventory of coastal wetlands and has suffered 80% of the nation's total wetlands loss (Dahl 1990, Turner 1990). These wetlands support 28% of the national fisheries harvest, the largest fur harvest in the United States, the largest concentration of overwintering waterfowl in the United States, and provide the majority of the recreational fishing landings (Turner 1990). Coastal wetlands encompass many habitats that provide areas for spawning, nursery and shelter and food for finfish, shellfish, birds and other wildlife (NRC 1997, Stedman and Dahl 2008).

Marsh loss, wetland impoundments, and saltwater intrusion are critical topics in regard to management of estuarine-dependent species such as sand and silver seatrout. Subsidence, eustatic sea-level rise, and erosion due to storms and wave/wind action are naturally occurring factors, but these can be exacerbated by human activities. Such activities include levee construction along the lower Mississippi River (which eliminated the major source of sediment introduction to marshes), canal construction, dredge and fill activities, and land reclamation. In addition, damming tributaries to the Mississippi River led to a decrease in sediment load, further reducing accretion. Salinity levels may have increased in portions of coastal Louisiana in association with marsh loss and canal construction.

Changes in the amount and timing of freshwater inflow may have a major effect on the early life history of sand and silver seatrout that use the estuary. These habitats rely on freshwater inflow to transport nutrients critical for increased production. Activities affecting freshwater inflow include leveeing of rivers (eliminating overflow into surrounding marshes), damming of rivers, channelization, and water withdrawal.

4.9.4.4 Point and Nonpoint Source Pollution

An additional concern related to water management is the discharge of pesticides and other toxic substances into rivers flowing into the Gulf of Mexico. Such contaminant loading is increasing as anthropogenic activity increases. Point sources for the introduction of these contaminants include discharge from industrial facilities, municipal wastewater treatment plants, and accidental spills. Nonpoint sources include urban storm water runoff, air pollutants, and agricultural activities. Approximately 5.9 million kg of toxic substances are discharged annually into the Gulf's watersheds, and approximately 2.3 million kg of pesticides were applied to agricultural fields bordering Gulf coastal counties in 1990 (USEPA 1994). The effects of these substances on aquatic organisms include: 1) interruption of biochemical and cellular activities, 2) alterations in populations dynamics, and 3) sublethal effects on ecosystem functions (Capuzzo et al. 1988). Lethal effects on ecosystems and individual organisms may occur with high levels of certain contaminants.

4.9.4.5 Methylmercury

Mercury is found naturally in the environment, being released into the atmosphere from rock soils through volcanic activity. Mercury is also introduced to the environment through human activities, including incineration of solid waste, combustion of fossil fuels, and other industrial activities. Bacteria in the water convert elemental mercury into methylmercury (CH_3Hg^+) that is then absorbed by fish as a result of feeding activities. Older fish and those higher on the food chain, are more susceptible to high levels of mercury contamination.

In the late 1970s, the FDA established an action level of 1.0 ppm for methylmercury contamination. This level was based on data, partly contributed by the NMFS, that indicated that exposure would not increase significantly by consumption of seafood at the 1.0 ppm level. The FDA issued a fish consumption advisory for mercury in 1995, which was revised in 2004. The revised advisory states that pregnant women and women who may become pregnant should not eat shark, swordfish, king mackerel, or tilefish. Also, the advisory states that the consumption of all other fish should average no more than about 340 g (12oz.) per week as high, prolonged exposure can cause neurological damage (USEPA 2009).

Mercury levels in a variety of fish species were documented between 1989 and 2001 by the FWC (Adams et al. 2003). Included in the survey were 104 sand seatrout collected from three areas on the Gulf coast of Florida. Total mercury levels ranged from 0.11-1.20 ppm, with a mean of 0.44. However, 62% of all sand seatrout analyzed in this study contained levels above or equal to 0.5 ppm (Adams et al. 2003). Mercury levels above 0.5 ppm have resulted in the sand seatrout being added to the Florida Department of Health list recommending that women of childbearing age and young children not eat more than one meal a month, and all others not more than one meal a week. A small number of silver seatrout (N=17), almost all taken from the Atlantic coast were also tested for mercury and were found to have a mean mercury level of 0.24 ppm. Lowery and Garrett (2005) also conducted a synoptic survey for mercury levels in Gulf fish and found that spotted seatrout and sand seatrout in Tampa Bay appeared to have elevated total mercury concentrations (relative total length relationship) compared to Mobile Bay, Matagorda Bay, and Galveston Bay.

Conversely, recent scientific studies have demonstrated the importance of selenium (Se) in human health and the dietary role of selenium in ameliorating the potentially toxic effects of mercury in the body (Perry personal communication). Selenium has a high molecular binding affinity for mercury and thus helps to prevent possible mercury toxicity when found in combination. Although selenium has been known to counteract mercury toxicity since the 1960s (Parizek and Ostadalova 1967), consumption advisories for mercury in fishes generally do not consider selenium and, thus, may not accurately predict risks. Ralston et al. (2008) noted that exposure to methylmercury was not sufficient to provide accurate information regarding potential risks unless selenium intakes were part of the evaluation process.

4.9.4.6 Introductions of Nonnative Flora and Fauna

According to ISFT (2000), the terms ‘nonnative’ and ‘introduced’ are synonyms for ‘nonindigenous’. That reference defines nonindigenous species to include:

> “any individual, group, or population of a species, or other viable biological material, that is intentionally or unintentionally moved by human activities, beyond its natural range or natural zone of potential dispersal, including moves from one continent or country into another and moves within a country or region; includes all domesticated and feral species, and all hybrids except for naturally occurring crosses between indigenous species.”

Nonindigenous aquatic species are further defined as those that must live in a water body for part or all of their lives.

Introduced species in marine and estuarine systems arrive in new regions by a variety of vectors including ships (attachment to hull, ballast water, and cargo), public aquaria, aquarium pet industry, floating marine debris, fisheries and marine aquaculture. Introduced species that occur in Gulf of Mexico freshwater, estuarine and marine environments include 483 aquatic microbes, invertebrates and aquatic vertebrates, and 221 aquatic plants (Battelle 2000). These introduced species have the potential to affect native populations and their habitat. The Pacific spotted jellyfish (*Phyllorhiza puncata*) were reported covering 150 km^2 in the northern Gulf of Mexico in the summer of 2000. An estimated six million of these jellyfish consumed vast amounts of plankton, potentially affecting species such as the sand and silver seatrout. The green mussel (*Perna viridis*) found in Tampa Bay, Florida, is well established on hard surfaces in the bay. This species is now being reported attaching to unconsolidated sediments and creating new shellfish communities. The ability to establish on unconsolidated sediments could affect habitat for larval and juvenile sand and silver seatrout by consuming them while filter feeding or providing an attraction for an increase in predators to their supporting habitat. Nutria (*Myocastor coypus*) is a well known introduced species that has had a significant adverse impact on Louisiana marshes, which could affect the nursery habitat for many species including sand and silver seatrout as they undermine and convert tidal emergent marsh habitat to open water.

4.9.4.7 Polycyclic Aromatic Hydrocarbons (PAHs)

PAHs, the toxic components of oil and petroleum products, enter the Gulf of Mexico in two ways, oil spills through human activities and from natural oil seeps that leak crude oil and form tar balls. Of the total amount of oil entering the world’s oceans, approximately 6-47% originates from natural oil seeps. Remote sensing surveys indicate that there are about 350 seeps in the Gulf of Mexico (Kvenvolden and Cooper 2003).

The initial effects of PAHs to marine organisms often result in increased mortality rates or, in the case of mobile wildlife, it can result in their avoidance of affected habitats (Rozas et al. 2000). The consequences of an oil spill in marine and estuarine habitats depend on several factors related to the spill, 1) the amount of oil spilled, 2) the duration of the spill and 3) the weight of the oil that comes in contact with these habitats (Mendelssohn et al. 1993, USDOC 2010). The intensity of the negative impacts will also be affected by several meteorological components (wind-wave energy, rain and storm events). The residual time that the oil remains available to these meteorological variables will expose these habitats to adverse effects (NOAA 2000).

Remediation techniques used during oil spill events have shown that the cleanup of oil products should focus first and foremost on preventing oil from reaching marine and estuarine habitats, simply because it is easier and more effective to prevent the oiling of these habitats than cleaning them after the fact (NOAA 2000, USDOC 2010). Additionally, cleanup efforts that take place within marine and estuarine habitats have often resulted in additional damage to those habitats (Hoff 1995, Baker 1999, NOAA 2000). As toxic as petroleum products can be to the environment, marine and estuarine habitats have been documented to recover in one-three years, depending on the volume and type of crude oil spilled (Hoff 1995, Baker 1999). However, when marine and estuarine habitats have been exposed to large volumes of oil, the effects to marine and estuarine habitats, due to the entrainment of the oil in the sediments, has been measured in decades (Hoff 1995, Bergen et al. 2000).

Provided below is a short synopsis of the potential effects to marine and estuarine habitats that are used by sand and silver seatrout, as well as a myriad of other organisms which may be predators on, or prey for, the two species.

4.9.4.7.1 Saltmarsh

The negative effects to salt marshes have varied due to the types of oils spilled and also due to the remedial clean-up actions taken in response to those spills (Hoff 1995, NOAA 2000). The expected adverse effects to the saltmarsh community would include reduced productivity, short and long term loss of marsh plants, and persistent levels of hydrocarbons in the sediments.

Recovery of saltmarsh from the effects of oil has ranged from as little as one growing season for the recolonization of smooth cordgrass to longer than 30 years for partial recovery of the entire marsh community due to the retention of oil in the sediments (Hoff 1995, Bergen et al. 2000). When saltmarsh habitat has been lightly oiled, it is recommended to allow the area affected to heal naturally, which reduces restoration costs and ancillary damage to the marsh vegetation. This recommendation is further supported by evidence that some of the cleaning methods can cause greater damage to this community than the spill itself (Hoff 1995, NOAA 2000).

4.9.4.7.2 Seagrasses

Studies of oil spill impacts on seagrasses are largely confined to observations of spill events or physiological studies. Oil in the water column has a primarily phototoxic effect on seagrasses, which is caused by the plant tissue absorption of the water soluble fraction of the oil (Fonseca in prep.). Impaired photosynthesis is a major resultant symptom of oil toxicity (Runcie et al. 2005). The type of oil to which seagrass plants are exposed determines the effects on different species of seagrass. The combined effects of dispersants and oil are poorly understood. The use of dispersants during a spill encourages the oil to spread and increase the bioavailable fraction of oil by increasing the concentration and variety of petroleum-derived hydrocarbons in the water column (Yamada et al. 2003) and altering the interaction of these compounds with biological membranes (Wolfe et al. 2001). Adverse impacts which have been noted included short-term sloughing and die-off of seagrass blades, as well as mortality or displacement of encrusting biota (USDOC 2010). The loss of seagrasses may also adversely affect forage areas for many sciaenids and habitat for their forage species as well.

4.9.4.7.3 Oysters

The impacts of oil on oyster habitats depend, in large part, on the type and amount of oil to which oysters are exposed; however, oyster preferential settling behavior and foraging strategies increase their risk of exposure. Oyster habitats typically occupy shallow subtidal, intertidal or estuarine regions susceptible to direct contact with oil. Oil exposure can substantially reduce feeding rates, decrease respiration, increase energy expenditure, and reduce byssal thread production resulting in weakened substrate attachment strength (Suchanek 1993). Impacts of oil exposure during the spring months, when oysters begin their spawning season, could be magnified because oil can reduce egg production and hatching rates, cause abnormal larval development or survival, and decrease survival and settlement of spat. In addition, because oysters filter large volumes of water for food and oxygen (ATSDR 1995, Law and Hellou 1999), they are particularly sensitive to contamination from the accumulation of toxic PAHs.

4.9.4.7.4 Mangroves

In southwest Florida, the mangrove community replaces saltmarsh as the predominant estuarine shoreline vegetation. Hoff et al. (2002) identified effects of oil on the mangrove community, which depend on the type of oil or fuel spilled and also on the geomorphology and hydrology of the site. However, given the complex structure and biodiversity of mangrove communities, they tend to be highly susceptible to oiling by petroleum products of all types. Apparent effects include mangrove mortality within weeks/months/years due to acute and chronic consequences of oil in direct contact with the plants and within surrounding sediments. Oil primarily acts as a physical barrier over lenticels on mangrove roots and pneumatophores, thereby disrupting gas, nutrient, and salt exchange. Mangrove leaf yellowing over weeks/months/years is common. Other effects include long-term decreases in mangrove survivorship, leaf production, reproduction, seedling recruitment, and peat deposition (leading to erosion/subsidence of sediment and organic layers).

5.0 FISHERY MANAGEMENT JURISDICTIONS, LAWS, AND POLICIES AFFECTING THE STOCK(S)

Since *Cynoscion arenarius* (sand seatrout) and *C. nothus* (silver seatrout) are distributed over most of the habitats occurring in the northern Gulf of Mexico including brackish estuaries, bayous, canals, saltwater bays, sounds, lagoons, and offshore waters, numerous state and federal management institutions, both directly and indirectly, affect them. Sand seatrout can be found in bays and estuaries and tend to migrate to deeper waters nearshore and offshore during colder months (Simmons 1957, Swingle 1971, Ditty et al. 1991). Silver seatrout remain primarily offshore and at deeper depths. Both the silver and sand seatrout habitats overlap in offshore waters, but the spatial and temporal dynamics of these two species are not well understood (Chittenden and McEachran 1976, McDonald et al. 2009).

The following is a partial list of some of the more important agencies and a brief description of the laws and regulations that could potentially affect sand and silver seatrout and their habitat. Individual Gulf States and federal agencies should be contacted for specific and up-to-date state laws and regulations, which are subject to change on a state-by-state basis.

5.1 Federal

5.1.1 Management Institutions

Sand and silver seatrout can be found in both the exclusive economic zone (EEZ) and state waters, but the majority of the landings result in state management jurisdictions. Consequently, laws and regulations of federal agencies primarily affect sand and silver seatrout populations by maintaining and enhancing habitat, preserving water quality and food supplies, and abating pollution. Federal laws may also be adopted to protect consumers through the development of regulations to maintain the quality of sand and silver seatrout as seafood.

5.1.1.1 Regional Fishery Management Councils

With the passage of the Magnuson Fishery Conservation and Management Act (MFCMA), the federal government assumed responsibility for fishery management within the EEZ, a zone contiguous to the territorial sea and whose inner boundary is the outer boundary of each coastal state. The outer boundary of the EEZ is a line 200 nautical miles from the (inner) baseline of the territorial sea. Management of fisheries in the EEZ is based on Fishery Management Plans (FMPs) developed by regional fishery management councils. Each council prepares plans for each fishery requiring management within its geographical area of authority and amends such plans as necessary. Plans are implemented as federal regulation through the U.S. Department of Commerce (USDOC).

The councils must operate under a set of standards and guidelines, and to the extent practicable, an individual stock of fish shall be managed as a unit throughout its range. Management shall, where practicable, promote efficiency, minimize costs, and avoid unnecessary duplication (MFCMA Section 301a). The Gulf of Mexico Fishery Management Council (GMFMC) has not developed a management plan for sand or silver seatrout in federal waters.

5.1.1.2 National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Commerce (USDOC)

The Secretary of Commerce, acting through the NMFS, has the ultimate authority to approve or disapprove all FMPs prepared by regional fishery management councils. Where a council fails to develop a plan, or to correct an unacceptable plan, the Secretary may do so. The NMFS also collects data and statistics on fisheries and fishermen. It performs research and conducts management authorized by international treaties. The NMFS has the authority to enforce the MFCMA and Lacey Act and is the federal trustee for living and nonliving natural resources in coastal and marine areas.

The NMFS exercises no management jurisdiction, other than enforcement, with regard to sand and silver seatrout in the Gulf of Mexico. It conducts some research and data collection programs and comments on all projects that affect marine fishery habitat.

The USDOC, in conjunction with coastal states, administers the National Estuarine Research Reserve and National Marine Sanctuaries Programs as authorized under Section 315 of the Coastal Management Act of 1972. Those protected areas serve to provide suitable habitat for a multitude of estuarine and marine species and serve as sites for research and education activities relating to coastal management issues.

5.1.1.3 Office of Ocean and Coastal Resource Management (OCRM, NOAA)

The OCRM asserts management authority over marine fisheries through the National Marine Sanctuaries Program. Under this program, marine sanctuaries are established with specific management plans that may include restrictions on harvest and use of various marine and estuarine species. Harvest of sand seatrout could be directly affected by such plans.

The OCRM may influence fishery management for sand and silver seatrout indirectly through administration of the Coastal Zone Management Program and by setting standards and approving funding for state coastal zone management programs. These programs often affect estuarine habitat on which both species depend.

5.1.1.4 National Park Service (NPS), U.S. Department of the Interior (USDOI)

The NPS under the USDOI may regulate fishing activities within park boundaries. Such regulations could affect the harvest of sand and silver seatrout if implemented within a given park area. The NPS has regulations preventing commercial fishing within one mile of the barrier islands in the Gulf Islands National Seashore off Mississippi, Padre Island National Seashore in Texas, and regulates various fishing activities in Everglades National Park in Florida. At Padre Island, fishing guides must obtain a special permit to run charters in Park waters.

5.1.1.5 United States Fish and Wildlife Service (USFWS), USDOI

The USFWS has no direct management authority over sand or silver seatrout. The USFWS may affect their management through the Fish and Wildlife Coordination Act, under which the USFWS and the NMFS review and comment on proposals to alter habitat. Dredging, filling, and marine construction are examples of projects that could affect sand and silver seatrout and their respective habitats.

In certain refuge areas, the USFWS may directly regulate fishery harvest. This harvest is usually restricted to recreational limits developed by the respective state. Special use permits may be required if commercial harvest is to be allowed in refuges.

5.1.1.6 United States Environmental Protection Agency (USEPA)

The USEPA, through its administration of the Clean Water Act and the National Pollutant Discharge Elimination System (NPDES), may provide protection for sand and silver seatrout and their habitats. Applications for permits to discharge pollutants into estuarine waters may be disapproved or conditioned to protect these marine resources.

The National Estuary Program is administered jointly by the USEPA and a local sponsor. This program evaluates estuarine resources and local protection and development of policies, and seeks to develop future management plans. Input is provided to these plans by a multitude of user groups including industry, environmentalists, recreational and commercial interests, and policy makers. National Estuary Programs in the Gulf include Sarasota, Tampa, Mobile, Barataria/ Terrebonne, Galveston, and Corpus Christi Bays.

5.1.1.7 United States Army Corps of Engineers (USACOE)

Sand and silver seatrout populations may be influenced by the USACOE's responsibilities pursuant to the Clean Water Act and Section 10 of the Rivers and Harbors Act. Under these laws, the USACOE issues or denies permits to individuals and other organizations for proposals to dredge, fill, and construct in wetland areas and navigable waters. The USACOE is also responsible for planning, construction, and maintenance of navigation channels and other projects in aquatic areas. These projects could affect both species, their habitats, and food sources.

5.1.1.8 United States Coast Guard

The United States Coast Guard is responsible for enforcing fishery management regulations adopted by the USDOC pursuant to management plans developed by the fishery management councils. The Coast Guard also enforces laws regarding marine pollution and marine safety, and they assist commercial and recreational fishing vessels in times of need.

Although no regulations have been promulgated for sand and silver seatrout in the EEZ, enforcement of laws affecting marine pollution and fishing vessels could influence both species populations.

5.1.1.9 United States Food and Drug Administration (FDA)

The FDA may directly regulate the harvest and processing of fish through its administration of the Food, Drug, and Cosmetic Act and other regulations that prohibit the sale and transfer of contaminated, putrid, or otherwise potentially dangerous foods.

5.1.2 Treaties and Other International Agreements

There are no treaties or other international agreements that affect the harvesting or processing of sand or silver seatrout. No foreign fishing applications to harvest either species have been submitted to the United States.

5.1.3 Federal Laws, Regulations, and Policies

The following federal laws, regulations, and policies may directly and indirectly influence the quality, abundance, and ultimately the management of sand and silver seatrout.

5.1.3.1 Magnuson Fishery Conservation and Management Act of 1976 (MFCMA); Magnuson-Stevens Conservation and Management Act of 1996 (Mag-Stevens) and Sustainable Fisheries Act; Magnuson-Stevens Fishery Conservation and Management Reauthorization Act of 2006.

The MFCMA mandates the preparation of FMPs for important fishery resources within the EEZ. It sets national standards to be met by such plans. Each plan attempts to define, establish, and maintain the optimum yield for a given fishery. The 1996 reauthorization of the MFCMA included three additional national standards to the original seven for fishery conservation and management, included a rewording of standard number five, and added a requirement for the description of essential fish habitat and definitions of overfishing.

The 2006 reauthorization builds on the country's progress to implement the 2004 Ocean Action Plan which established a date to end over-fishing in America by 2011, use market-based incentives to replenish America's fish stocks, strengthen enforcement of America's fishing laws, and improve information and decisions about the state of ocean ecosystems.

5.1.3.2 Interjurisdictional Fisheries (IJF) Act of 1986 (P.L. 99-659, Title III)

The IJF Act established a program to promote and encourage state activities in the support of management plans and to promote and encourage management of IJF resources throughout their range. The enactment of this legislation repealed the Commercial Fisheries Research and Development Act (P.L. 88-309).

5.1.3.3 Federal Aid in Sport Fish Restoration Act (SFRA); the Wallop-Breaux Amendment of 1984 (P.L. 98-369)

The SFRA provides funds to states, the USFWS, and the regional marine fisheries councils to conduct research, planning, and other programs geared at enhancing and restoring marine sportfish populations.

5.1.3.4 Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA), Titles I and III; and the Shore Protection Act of 1988 (SPA)

The MPRSA provides protection of fish habitat through the establishment and maintenance of marine sanctuaries. The MPRSA and the SPA regulate ocean transportation and dumping of dredged materials, sewage sludge, and other materials. Criteria for issuing such permits include consideration of effects of dumping on the marine environment, ecological systems, and fisheries resources.

5.1.3.5 Federal Food, Drug, and Cosmetic Act of 1938 (FDCA)

The FDCA prohibits the sale, transfer, or importation of 'adulterated' or 'misbranded' products. Adulterated products may be defective, unsafe, filthy, or produced under unsanitary conditions. Misbranded products may have false, misleading, or inadequate information on their labels. In many instances, the FDCA also requires FDA approval for distribution of certain products.

5.1.3.6 Clean Water Act of 1981 (CWA)

The CWA requires that an USEPA approved NPDES permit be obtained before any pollutant is discharged from a point source into waters of the United States including waters of the contiguous zone and the adjoining ocean. Discharges of toxic materials into rivers and estuaries that empty into the Gulf of Mexico can cause mortality to marine fishery resources and may alter habitats.

Under Section 404 of the CWA, the USACOE is responsible for administration of a permit and enforcement program regulating alterations of wetlands as defined by the act. Dredging, filling, bulk-heading, and other construction projects are examples of activities that require a permit and have potential to affect marine populations. The NMFS is the federal trustee for living and nonliving natural resources in coastal and marine areas under United States jurisdiction pursuant to the CWA.

5.1.3.7 Federal Water Pollution Control Act of 1972 (FWPCA) and MARPOL Annexes I and II

Discharge of oil and oily mixtures is governed by the FWPCA and 40 Code of Federal Regulations (CFR), Part 110, in the navigable waters of the United States. Discharge of oil and oily substances by foreign or domestic ships operating or capable of operating beyond the United States territorial sea is governed by MARPOL Annex I.

MARPOL Annex II governs the discharge at sea of noxious liquid substances primarily derived from tank cleaning and deballasting. Most categorized substances are prohibited from being discharged within 22 km of land and at depths of <25 m.

5.1.3.8 Coastal Zone Management Act of 1972 (CZMA), as amended

Under the CZMA, states receive federal assistance grants to maintain federally-approved planning programs for enhancing, protecting, and utilizing coastal resources. These are state programs, but the act requires that federal activities must be consistent with the respective states' CZM programs. Depending upon the individual state's program, the act provides the opportunity for considerable protection and enhancement of fishery resources by regulation of activities and by planning for future development in the least environmentally damaging manner.

5.1.3.9 Endangered Species Act of 1973, as amended (P.L. 93-205)

The Endangered Species Act provides for the listing of plant and animal species that are threatened or endangered. Once listed as threatened or endangered, a species may not be taken, possessed, harassed, or otherwise molested. It also provides for a review process to ensure that projects authorized, funded, or carried out by federal agencies do not jeopardize the existence of these species or result in destruction or modification of habitats that are determined by the Secretary of the USDOI to be critical.

5.1.3.10 National Environmental Policy Act of 1970 (NEPA)

The NEPA requires that all federal agencies recognize and give appropriate consideration to environmental amenities and values in the course of their decision-making. In an effort to create and maintain conditions under which man and nature can exist in productive harmony, the NEPA requires that federal agencies prepare an environmental impact statement (EIS) prior to undertaking major federal actions that significantly affect the quality of the human environment. Within these statements, alternatives to the proposed action that may better safeguard environmental values are to be carefully assessed.

5.1.3.11 Fish and Wildlife Coordination Act of 1958

Under the Fish and Wildlife Coordination Act, the USFWS and NMFS review and comment on fish and wildlife aspects of proposals for work and activities sanctioned, permitted, assisted, or conducted by federal agencies that take place in or affect navigable waters, wetlands, or other critical fish and wildlife habitat. The review focuses on potential damage to fish, wildlife, and their habitat; therefore, it serves to provide some protection to fishery resources from activities that may alter critical habitat in nearshore waters. The act is important because federal agencies must give due consideration to the recommendations of the USFWS and NMFS.

5.1.3.12 Fish Restoration and Management Projects Act of 1950 (P.L. 81-681)

Under this act, the USDOI is authorized to provide funds to state fish and game agencies for fish restoration and management projects. Funds for protection of threatened fish communities that are located within state waters could be made available under the act.

5.1.3.13 Lacey Act of 1981, as amended

The Lacey Act prohibits import, export, and interstate transport of illegally taken fish and wildlife. As such, the act provides for federal prosecution for violations of state fish and wildlife laws. The potential for federal convictions under this act with its more stringent penalties has probably reduced interstate transport of illegally possessed fish and fish products.

5.1.3.14 Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA or "Superfund")

The CERCLA names the NMFS as the federal trustee for living and nonliving natural resources in coastal and marine areas under United States jurisdiction. It could provide funds for 'clean-up' of fishery habitat in the event of an oil spill or other polluting event.

5.1.3.15 MARPOL Annex V and United States Marine Plastic Research and Control Act of 1987 (MPRCA)

MARPOL Annex V is a product of the International Convention for the Prevention of Pollution from Ships, 1973/1978. Regulations under this act prohibit ocean discharge of plastics from ships; restrict discharge of other types of floating ship's garbage (packaging and dunnage) for up to 46 km from any land; restrict discharge of victual and other recomposable waste up to 22 km from land; and require ports and terminals to provide garbage reception facilities. The MPRCA of 1987 and 33 CFR, Part 151, Subpart A, implement MARPOL V in the United States.

5.1.3.16 Fish and Wildlife Act of 1956

This act provides assistance to states in the form of law enforcement training and cooperative law enforcement agreements. It also allows for disposal of abandoned or forfeited property with some equipment being returned to states. The act prohibits airborne hunting and fishing activities.

5.2 State

Table 5.1 outlines the various state management institutions and authorities.

5.2.1 Florida

5.2.1.1 Florida Fish and Wildlife Conservation Commission

Florida Fish and Wildlife Conservation Commission
620 South Meridian Street
Tallahassee, Florida 32399
Telephone: (850) 410-0656
www.myfwc.com

Table 5.1 State management institutions for the Gulf of Mexico.

State	Administrative Body and Responsibilities	Administrative Policy-making Body and Decision Rule	Legislative Involvement in Management Regulations
FL	*Florida Fish and Wildlife Conservation Commission* • administers management programs • enforcement • conducts research	• creates rules in conjunction with management plans • seven-member commission	• responsible for setting fees, licensing, and penalties
AL	*Alabama Department of Conservation and Natural Resources* • administers management programs • enforcement • conducts research	• Commissioner of department has authority to establish management regulation • Conservation Advisory Board–13-member board which advises the Commissioner • has authority to amend and promulgate regulations • authority for detailed management regulations delegated to Commissioner • statutes concerned primarily with licensing	
MS	*Mississippi Department of Marine Resources* • administers management programs • enforcement • conducts research	*Mississippi Commission on Marine Resources* • five-member board • establishes ordinances on recommendation of the MDMR Executive Director	• authority for detailed management regulations delegated to Commission • statutes concern licenses, taxes, and specific fisheries laws
LA	*Louisiana Department of Wildlife and Fisheries* • administers management programs • enforcement • conducts research makes recommendations to legislature	*Louisiana Wildlife and Fisheries Commission* seven-member board establishes policies and regulations based on majority vote of a quorum (four members constitute a quorum) consistent with statutes	• detailed regulations contained in statutes • authority for detailed management regulations delegated to Commission
TX	*Texas Parks and Wildlife Department* • administers management programs • enforcement • conducts research • makes recommendations to the Texas Parks and Wildlife Commission	*Texas Parks and Wildlife Commission* • nine-member body • establishes regulations based on majority vote of quorum (five members constitute a quorum) • granted authority to regulate means and methods for taking, seasons, bag limits, size limits and possession	• licensing requirements & penalties are set by legislation

The agency charged with the administration, supervision, development, and conservation of natural resources is the Florida Fish and Wildlife Conservation Commission (FWC). This Commission is not subordinate to any other agency or authority of the executive branch. The administrative head of the FWC is the executive director. Within the FWC, the Division of Marine Fisheries Management is empowered to manage marine and anadromous fisheries in the interest of all people of Florida. The Division of Law Enforcement is responsible for enforcement of all marine resource-related laws, rules, and regulations of the state.

The FWC, a seven-member board appointed by the governor and confirmed by the senate, was created by constitutional amendment in November 1998, effective July 1, 1999. This Commission was delegated rule-making authority over marine life in the following areas of concern: gear specification, prohibited gear, bag limits, size limits, quotas and trip limits, species that may not be sold, protected species, closed areas, seasons, and quality control codes. Florida has habitat protection and permitting programs and a federally-approved CZM program.

5.2.1.2 Legislative Authorization

Prior to 1983, the Florida Legislature was the primary body that enacted laws regarding management of sand and silver seatrout in state waters. Chapter 370 of the Florida Statutes did not contain specific laws directly related to harvesting or processing of sand and silver seatrout. In 1983, the Florida Legislature established the Florida Marine Fisheries Commission and provided the Commission with various duties, powers, and authorities to promulgate regulations affecting marine fisheries. On July 1, 1999, the Florida Marine Fisheries Commission (including the Florida Marine Patrol) and the Florida Game and Freshwater Fisheries Commission were merged into one Commission. Marine fisheries rules of the new Florida Fish and Wildlife Conservation Commission are now codified under Chapter 68B, Florida Administrative Code, which does not directly address any regulation for the harvest or possession of sand and silver seatrout. Florida recently merged the old 370 (marine fisheries) and 372 (game related) statutes into the new 379 statute.

5.2.1.3 Reciprocal Agreements and Limited Entry Provisions

5.2.1.3.1 Reciprocal Agreements

Florida statutory authority provides for reciprocal agreements related to fishery access and licenses. Florida has no statutory authority to enter into reciprocal management agreements.

5.2.1.3.2 Limited Entry

Florida has no statutory provisions for limited entry in the sand and silver seatrout fishery being that neither are restricted species.

5.2.1.4 Commercial Landings Data Reporting Requirements

Florida requires wholesale dealers to maintain records of each purchase of saltwater products by filling out a Marine Fisheries Trip Ticket (Chapter 379.2521, Florida Statutes, grants rule making authority and Chapter 68E-5.002 of the Administrative Code specifies the requirements). Information to be supplied for each trip includes Saltwater Products License number; vessel identification; wholesale dealer number; date; time fished; area fished; county landed; depth fished; gear fished; number of sets; whether a head boat, guide, or charter boat; number of traps; whether aquaculture or lease number; species code; species size; amount of catch; unit price; and total dollar value which is optional. The wholesale dealer is required to submit trip tickets weekly if the tickets contain quota-managed species such as Spanish mackerel; otherwise, trip tickets must be submitted every month.

5.2.1.5 Penalties for Violations

Penalties for violations of Florida laws and regulations are established in Florida Statutes, Section 379.407. Additionally, upon the arrest and conviction of any license holder for violation of such laws or regulations, the license holder is required to show just cause why his saltwater license should not be suspended or revoked.

5.2.1.6 Annual License Fees

Resident wholesale seafood dealer	
· county	$400.00
· state	$550.00
Nonresident wholesale seafood dealer	
· county	$600.00
· state	$1,100.00
Alien wholesale seafood dealer	
· county	$1,100.00
· state	$1,600.00
Resident retail seafood dealer	$75.00
Nonresident retail seafood dealer	$250.00
Alien retail seafood dealer	$300.00
Saltwater products license	
· resident-individual	$50.00
· resident-vessel	$100.00
· resident-individual/vessel	$150.00
· nonresident-individual	$200.00
· nonresident-vessel	$400.00
· nonresident-individual/vessel	$600.00
· alien-individual	$300.00
· alien- vessel	$600.00
· alien-individual/vessel	$900.00
Recreational saltwater fishing license	
· resident	
annual	$15.50
annual shoreline resident	$0.00
· nonresident	
three day	$15.50
seven day	$28.50
annual	$45.50

Annual commercial vessel saltwater fishing license (recreational for hire)	
· 11 or more customers	$800.00
· ten or fewer customers	$400.00
· four or fewer customers	$200.00
Optional pier saltwater fishing license (recreational users exempt from other licenses)	$500.00
Optional recreational vessel license (recreational users exempt from other licenses)	$2,000.00

5.2.1.7 Laws and Regulations

Florida's laws and regulations regarding the harvest of sand and silver seatrout are statewide. The following discussions are general summaries of laws and regulations, and the FWC should be contacted for more specific information. *The restrictions discussed in this section are current to the date of this publication and are subject to change at any time thereafter.*

5.2.1.7.1 Size Limits

There are currently no size limit regulations for sand and silver seatrout.

5.2.1.7.2 Gear Restrictions

Sand and silver seatrout may be harvested with a beach or haul seine (under 500 ft^2), cast net (less than 14 ft in length; fishing with more than two cast nets per vessel is prohibited in state waters, hook-and-line gear, gig, and spear or lance. Gill nets, trammel nets, pound nets, and other entangling nets are prohibited throughout Florida territorial waters. Sand and silver seatrout may be harvested as an incidental bycatch by gears not specifically authorized for the harvest of either species (e.g., trawls), provided that the number of sand or silver seatrout harvested and in possession does not exceed 100 lbs without possession of a saltwater products license. Additionally, possession of sand or silver seatrout aboard any vessel carrying gill nets or other entangling nets is prohibited.

5.2.1.7.3 Closed Areas and Seasons

There are no closed areas for the harvest of sand and silver seatrout in Florida with the exception of Everglades National Park, the sanctuary preservation areas (SPA) within the Florida Keys National Marine Sanctuary, and other state and national parks and reserves.

5.2.1.7.4 Quotas and Bag/Possession Limits

There are currently no specific bag limits that relate to sand and silver seatrout. However, an individual must possess a commercial saltwater products license to possess more than 100 lbs of either species.

5.2.1.7.5 Other Restrictions

5.2.1.8 Historical Changes to Regulations in Affecting Sand and Silver Seatrout

February 12-May 13, 1991:
- Prohibited use of gill or trammel nets with a total length greater than 600 yards
- No more than two nets to be possessed aboard a boat
- No more than one net to be used from a single boat
- Required net to be tended and marked according to certain specifications in the waters of Brevard through Palm Beach counties

January 1, 1993:
- Set a maximum mesh size for seines at two inches stretched mesh, excluding wings
- Set a minimum mesh size for gill and trammel nets at three inches stretched mesh beginning January 1, 1995
- Set a maximum length of 600 yards for all gill and trammel nets and seines
- Allowed only a single net to be fished by any vessel or individual at any time
- Prohibited the use of longline gear

September 1, 1993:
- Prohibited the use of gill and trammel nets in any bayou, river, creek, or tributary of waters between Collier and Pinellas counties from November 1 - January 31 each year

July 18, 1994:
- Prohibited the use of gill and trammel nets and seines in state waters of Martin County

July 1, 1995:
- Prohibited the use of any gill or entangling net in Florida waters
- Prohibited the use of any net with a mesh area greater than 500 ft^2
- Created closed seasons for spotted seatrout

January 1, 1996:
- Created closed seasons for spotted seatrout: February, all harvest closed on the Gulf coast from the Alabama-Florida line to the Pinellas-Pasco County line and on the Atlantic coast from the Florida-Georgia border to the Flagler-Volusia County line; November and December, all harvest closed in the rest of state waters in the southern part of the state.

5.2.2 Alabama

5.2.2.1 Alabama Department of Conservation and Natural Resources

Alabama Department of Conservation and Natural Resources
Marine Resources Division
P.O. Box 189
Dauphin Island, Alabama 36528
(251) 861-2882
www.outdooralabama.com

The Commissioner of the Alabama Department of Conservation and Natural Resources (ADCNR) holds management authority of fishery resources in Alabama. The Commissioner may promulgate rules or regulations designed for the protection, propagation, and conservation of all seafood. He may prescribe the manner of taking, times when fishing may occur, and designate areas where fish may or may not be caught.

Most regulations are promulgated through the Administrative Procedures Act approved by the Alabama Legislature in 1983; however, bag limits and seasons are not subject to this act. The Administrative Procedures Act outlines a series of events that must precede the enactment of any regulations other than those of an emergency nature. Among this series of events are: (a) the advertisement of the intent of the regulation; (b) a public hearing for the regulation; (c) a 35-day waiting period following the public hearing to address comments from the hearing; and (d) a final review of the regulation by a Joint House and Senate Review Committee.

Alabama also has the Alabama Conservation Advisory Board (ACAB) that is endowed with the responsibility to provide advice on policies and regulations of the ADCNR. The board consists of the Governor, the ADCNR commissioner, the Director of the Auburn University Agriculture and Extension Service, and ten board members.

The Alabama Marine Resources Division (AMRD) has responsibility for enforcing state laws and regulations, for conducting marine biological research, and for serving as the administrative arm of the commissioner with respect to marine resources. The division recommends regulations to the commissioner.

Alabama has a habitat protection and permitting program and a federally-approved CZM program.

5.2.2.2 Legislative Authorization

Chapters 2 and 12 of Title 9, Code of Alabama, contain statutes that affect marine fisheries.

5.2.2.3 Reciprocal Agreements and Limited Entry Provisions

5.2.2.3.1 Reciprocal Agreements

Alabama statutory authority provides for reciprocal agreements with regard to access and licenses. Alabama has no statutory authority to enter into reciprocal management agreements.

5.2.2.3.2 Limited Entry

Alabama law provides that commercial net and seine permits shall only be issued to applicants who purchased such licenses in two of five years from 1989 through 1993 and who show proof (in the form of an unamended Alabama state income tax return) that they derived at least 50% of their gross income from the capture and sale of seafood species in two of the five years. Alabama law also provides that commercial net and seine permits can be issued to applicants who purchased such licenses in all five years and in subsequent years for annual renewal, and who show proof of filing an Alabama income tax return in all five years (unless exempt from filing Alabama income tax). Persons who possessed a resident gill net license on June 1, 2008 may purchase a gill net license in subsequent years for the remainder of that person's life, subject to the requirements above. Any person who fails to purchase a license for any year shall not be eligible to purchase a gill net license thereafter. Effective October 1, 2008, a nonresident may not purchase a commercial gill net license. Other restrictions are applicable, and the ADCNR/AMRD should be contacted for details.

5.2.2.4 Commercial Landings Data Reporting Requirements

Alabama law requires that wholesale seafood dealers file monthly trip ticket reports by the tenth of each month for the preceding month. Under a cooperative agreement, NMFS and ADCNR port agents now collect records of sales of seafood products jointly.

5.2.2.5 Penalties for Violations

Violations of the provisions of any statute or regulation are considered Class A, Class B, or Class C misdemeanors and are punishable by fines up to $2,000 and up to one year in jail.

5.2.2.6 Annual License Fees

The following is a list of license fees current to the date of publication; however, they are subject to change at any time. Nonresident fees for commercial hook-and-line licenses, recreational licenses, and seafood dealers licenses may vary based on the charge for similar fishing activities in the applicant's resident state.

Commercial hook-and-line	
· resident	$101.00
· nonresident	$201.00
Commercial gill nets, trammel nets, seines* (up to 2,400ft)	
· resident	$301.00
· nonresident	Not Available
Recreational gill net	
· resident	$51.00
· nonresident	Not Available
Roe mullet/Spanish mackerel endorsement**	
· resident	$501.00
· nonresident	Not Available
Seafood dealer	
· resident	$201.00
· nonresident	variable
Seafood dealer vehicle	
· resident	$101.00
· nonresident	$101.00

Recreational saltwater fishing license	
· resident	$29.00
· nonresident	variable
Spearfishing	
· resident	$6.00
· nonresident	$8.50
· nonresident seven day	$3.50

*Seines 25 ft or less in length are exempt from licensing
**Required in addition to gill net license

5.2.2.7 Laws and Regulations

Alabama laws and regulations regarding the harvest of sand and silver seatrout primarily address the type of gear used and seasons for the commercial fishery. The following is a general summary of these laws and regulations which are current to the date of this publication and are subject to change at any time thereafter. *The ADCNR/AMRD should be contacted for specific and up-to-date information.*

5.2.2.7.1 Size Limits

Alabama has no minimum size limit for sand and silver seatrout in either the commercial or recreational fishery.

5.2.2.7.2 Gear Restrictions

Commercial gill nets must be marked every 100 ft with a color-contrasting float and every 300 ft with the fisherman's permit number. Recreational nets may not exceed 300 ft in length and must be marked with the licensee's name and license number. Commercial gill nets, trammel nets, and other entangling nets may not exceed 2,400 ft in length; however, depth may vary by area.

Gill nets, trammel nets, and other entangling nets used to catch any fish in Alabama coastal waters under the jurisdiction of the AMRD must have a minimum mesh size of 1.5 inch bar (knot to knot). A minimum mesh size of two-inch bar is required for such nets used to take mullet from October 24-December 31 of each year for all Alabama coastal waters under the jurisdiction of the AMRD as provided in Rule 220-2-42 and defined in Rule 220-3-04(1), and any person using a two-inch or larger bar net from October 24-December 31 of each year shall be considered a roe mullet fisherman and must possess a roe mullet permit. Only strike nets may be used in certain waters of Bon Secour Bay during this period.

The use of purse seines to catch sand seatrout is prohibited. Commercial and recreational gill net fishermen may use only one net at any time; however, commercial fishermen may possess more than one such net. No hook-and-line device may contain more than five hooks when used in Alabama coastal waters under the jurisdiction of the AMRD except from January 1-April 30, trotlines may be used to take legal species other than saltwater gamefish east of Mobile Ship

Channel and north of a line from MSC#78 to Blakely River Ch#2 and due east to shoreline. These trotlines cannot exceed 300 ft and 50 hooks.

5.2.2.7.3 Closed Areas and Seasons

Gill nets, trammel nets, seines, purse seines, and other entangling nets are prohibited in any marked navigational channel, Theodore Industrial Canal, Little Lagoon Pass, or any man-made canal; within 300 ft of the mouth of certain rivers and bayous; and within 300 ft of any pier, marina, dock, boat launching ramp, or certain ‘relic’ piers. Recreational gill nets may not be used beyond 300 ft of any shoreline or in the waters of the Gulf of Mexico.

Year-round gill nets, trammel nets, seines, haul seines, and other entangling nets are prohibited within 0.25 miles of the Gulf shoreline. However, subject to other provisions, waters east of longitude 87°47.826’ will be open from 6:00 p.m. to 6:00 a.m. each day from March 15-May 7. From October 2-December 31, the waters east of Old Little Lagoon Pass to the Florida line are open 24 hours a day. From the day after Labor Day through March 14, Gulf of Mexico waters will be open to netting west of Old Little Lagoon Pass in Mobile and Baldwin Counties. From March 15 through the Friday before Labor Day, waters west of Old Little Lagoon Pass in Mobile and Baldwin counties shall be open from 6:00 p.m. to 6:00 a.m. each day. From March 15 through the Friday before Labor Day, waters west of longitude 88°11.500’ are open 24 hours a day. From May 8 through Labor Day, all waters in the Gulf of Mexico east of Old Little Lagoon Pass to the Florida line are closed to gill nets, trammel nets, seines, haul seines and other entangling nets. All waters of the Gulf of Mexico are closed during the following holidays: Memorial Day, Independence Day, and Labor Day.

In addition, it is unlawful to use or possess a gill net, trammel net or other entangling net in Alabama waters of the Gulf of Mexico from March 15 through the day after Labor Day each year, from 12 noon each Friday through 7 PM each Sunday.

From January 1 through the day after Labor Day of each year, entangling nets are prohibited in certain waters in and around Dauphin Island.

5.2.2.7.4 Quotas and Bag/Possession Limits

There are no quotas or bag/possession limits for the recreational or commercial sand and silver seatrout.

5.2.2.7.5 Other Restrictions

The licensee must constantly attend all nets and no dead fish or other dead seafood may be discarded within three miles of Gulf beaches; within 500 ft of any shoreline; or into any river, stream, bayou, or creek.

5.2.2.8 Historical Changes to the Regulations Affecting Sand and Silver Seatrout

1983 –MR-12

- Spotted seatrout and red drum were prohibited from being harvested with the intent to sell

1985–MR–2

- Spotted seatrout and red drum were declared game fish and could not be harvested except by means of hook-and-line.

2007–MR–5

- Increased the minimum mesh size of recreational and commercial gill nets during January through September from 2.75-3 inches stretch mesh.
- Increased the minimum mesh size of recreational and commercial gill nets during October through December from 3.5-4 inches stretch mesh.

5.2.3 Mississippi

5.2.3.1 Mississippi Department of Marine Resources

Mississippi Department of Marine Resources
1141 Bayview Avenue, Suite 101
Biloxi, Mississippi 39530
(228) 374-5000
www.dmr.state.ms.us

The Mississippi Department of Marine Resources (MDMR) administers coastal fisheries and habitat protection programs. Authority to promulgate regulations and policies is vested in the Mississippi Commission on Marine Resources (MCMR), the controlling body of the MDMR. The commission consists of five members appointed by the Governor. The MCMR has full power to "manage, control, supervise and direct any matters pertaining to all saltwater aquatic life not otherwise delegated to another agency" (Mississippi Code Annotated 49-15-11).

Mississippi has a habitat protection and permitting program and a federally-approved CZM program. The MCMR is charged with administration of the Mississippi Coastal Program (MCP), which requires authorization for all activities that impact coastal wetlands. Furthermore, the state has an established Coastal Zone Management Program (CZMP) approved by NOAA. The CZMP reviews activities that would potentially and cumulatively impact coastal wetlands located above tidal areas. The Executive Director of the MDMR is charged with administration of the CZMP.

5.2.3.2 Legislative Authorization

Title 49, Chapter 15 of the Mississippi Code of 1972, annotated, contains the legislative regulations related to harvest of marine species in Mississippi. Chapter 15 also describes regulatory duties of the MCMR and the MDMR regarding the management of marine fisheries. Title 49, Chapter 27 involves the utilization of wetlands through the Wetlands Protection Act and is also administered by the MDMR.

Title 49, Chapter 15 of the Mississippi Code of 1972 §49-15-2 “Standards for fishery conservation and management; fishery management plans,” was implemented by the Mississippi Legislature on July 1, 1997 and sets standards for fishery management as related to the Magnuson-Stevens Act (1996).

5.2.3.3 Reciprocal Agreements and Limited Entry Provisions

5.2.3.3.1 Reciprocal Agreements

Section §49-15-15(h) provides statutory authority to the MDMR to enter into or continue any existing interstate and intrastate agreements, in order to protect, propagate, and conserve seafood in the state of Mississippi.

Section §49-15-30(1) gives the MCMR the statutory authority to regulate nonresident licenses in order to promote reciprocal agreements with other states.

5.2.3.3.2 Limited Entry

Section §49-15-16 gives the MCMR authority to develop a limited entry fisheries management program for all resource groups.

Section §49-15-29(3) states that, when applying for a license of any kind, the MCMR will determine whether the vessel or its owner is in compliance with all applicable federal and/or state regulations. If it is determined that a vessel or its owner is not in compliance with applicable federal and/or state regulations, no license will be issued for a period of one year.

Section §49-15-80(1B) states that no nonresident will be issued a commercial fishing license for the taking of fish using any type of net, if the nonresident state of domicile prohibits the sale of the same commercial net license to a Mississippi resident.

5.2.3.4 Commercial Landings Data Reporting Requirements

Ordinance Number 9.004 of the MDMR establishes data reporting requirements for marine fisheries’ operations, including confidentiality of data and penalties for falsifying or refusing to make the information available to the MDMR.

5.2.3.5 Penalties for Violations

Section §49-15-63 provides penalties for violations of Mississippi laws and regulations regarding sand and silver seatrout in Mississippi.

5.2.3.6 Annual License Fees

The license fees required for the resident commercial harvest and sale of sand and silver seatrout in Mississippi marine waters are listed below. Also included are the fees for the recreational harvest of sand and silver seatrout. Nonresident fees may vary based on the charge for similar fishing activities in the applicant's state of residence. All license fees listed below are subject to change at any time. *The MDMR should be contacted for current license fees.*

Resident Commercial Shrimp	
· vessel (<30 ft)	$60.00
· vessel (30-45 ft)	$85.00
· vessel (> 45 ft)	$110.00
Nonresident Commercial Shrimp	
· vessel (< 30 ft)	$110.00
· vessel (30-45 ft)	$160.00
· vessel (> 45 ft)	$210.00
· Louisiana resident vessel (1 trawl)	$570.00
· Louisiana resident vessel (2 trawls)	$670.00
· Texas commercial vessel	$1125.00
· Alabama resident vessel (<30ft)	$60.00
· Alabama resident vessel (30-45ft)	$85.00
· Alabama resident vessel (>45ft)	$110.00
Commercial hook and line	
· resident vessel	$100.00
· resident fisherman	$100.00
· nonresident fisherman	$400.00
Charter boats and party boats	
· resident	$200.00
· nonresident	$200.00
· Alabama charter boat (7-25 people)	$300.00
Commercial Fishing Boat (includes use of gill nets, trammel nets and seines*)	
· resident	$100.00
· nonresident	$300.00
· Florida resident fishing boat	$635.00
Seafood dealer	
· resident	$100.00
· nonresident	$200.00
· Louisiana resident	$1150.00
· Alabama resident	$250.00
· Florida resident	$1000.00
Seafood processor (resident)	$200.00
Recreational saltwater hook and line	
· resident annual	$10.00
· nonresident annual	$34.29
· nonresident 3-day	$18.29

*Small mesh beach seines (less than a ¼ inch bar, ½ inch stretched mesh) that do not exceed 100 ft in length are exempt from licensing.

A Mississippi saltwater fishing license is required for all recreational methods of finfish harvest in the coastal and marine waters of this state with the following exceptions:

- Any person under the age of 16
- Residents 65 years of age or older
- Residents who are adjudged totally service-connected disabled by the Veteran's Administration or 100% disabled though the Social Security Administration

5.2.3.7 Laws and Regulations

Mississippi laws which regulate the harvest of sand and silver seatrout are primarily limited to gear restrictions for the use of nets.

Ordinance 5.013 regulates the methods of harvest as related to the sand and silver seatrout fishery in Mississippi marine waters. The following is a general summary of regulations that apply to the harvest of sand and silver seatrout; however, the MDMR should be contacted for the most current regulations.

Title 49, Chapter 15 of the Mississippi Code of 1972 section §49-15-96 allows licensed shrimpers to retain (for personal consumption only), no more than 25 lbs of sand or silver seatrout that are caught in shrimp trawls.

5.2.3.7.1 Size Limits

Currently there are no commercial or recreational size limits for sand and silver seatrout in Mississippi.

5.2.3.7.2 Closed Areas and Seasons

All commercial saltwater fishing is prohibited north of the CSX railroad track in coastal Mississippi. Gill nets, trammel nets, purse seines, and other commercial nets may not be used within 1,200 ft of any public pier or hotel/motel pier, and they are prohibited within 300 ft of any private piers that are at least 75 ft in length. These nets are also prohibited within 1,200 ft of the shoreline of Deer Island and within 1,500 ft of the shoreline between the U.S. Highway 90 bridge and the north shore of Bayou Caddy in Hancock County. These aforementioned nets are prohibited within 100 ft of the mouth of rivers, bays, bayous, streams, lakes, and other tributaries to Mississippi marine waters, i.e., Point Aux Chenes Bay, Middle Bay, Jose Bay, L'Isle Chaude, Heron Bay, Pascagoula Bay (south of the CSX railroad bridge), and Biloxi Bay (south of a line between Marsh point and Grand Bayou). The nets must not be used in a manner to block any of these bays, bayous, rivers, streams, or other tributaries.

No gill or trammel nets, seines, or like contrivance may be used within an area formed by a line running one mile from the shoreline of the national park islands of Ship, Horn, and Petit Bois. In addition, no gill or trammel nets, seines, or like contrivance may be used within one mile of Cat and Round islands, or from the shoals of Telegraph Keys and Telegraph Reef (Merrill Coquille) from May 15-September 15 of each year.

There are no closed seasons for the harvest of sand seatrout. Section 49-15-78 states gill or trammel nets cannot be set within one-half mile of shoreline in the state of Mississippi.

It is illegal to use a gill or trammel net in the marine waters of Mississippi or to possess fish in, or in contact with, a gill or trammel net in a boat in the marine waters of Mississippi between 6:00 a.m. on Saturday mornings and 6:00 p.m. on Sunday evenings, or on any legal holidays established by the Mississippi Legislature and as set forth in Mississippi Code Annotated §3-3-7. No gill or trammel net shall be set within one-fourth mile of another gill or trammel net. Gill and trammel nets must be attended at all times from a distance of no greater than the length of the boat in use. All gill and trammel nets must be constructed of an approved degradable material. An approved degradable materials list will be on file with the Executive Director of the MDMR or his designee.

5.2.3.7.3 Quota and Bag/Possession Limits

There are no quotas, bag limits, or possession limits for the commercial or recreational sand and silver seatrout fisheries in the state of Mississippi.

5.2.3.8 Historical Changes to the Regulations Affecting Sand and Silver Seatrout

Sand and silver seatrout are not regulated in Mississippi either commercially or recreationally.

5.2.4 Louisiana

5.2.4.1 Louisiana Department of Wildlife and Fisheries

Louisiana Department of Wildlife and Fisheries
P.O. Box 98000
Baton Rouge, Louisiana 70898-9000
Marine Fisheries: (225) 765-2384
Law Enforcement: (225) 765-2989
www.wlf.state.la.us

The Louisiana Department of Wildlife and Fisheries (LDWF) is one of 21 major administrative units of the Louisiana government. The Governor appoints a seven-member board, the Louisiana Wildlife and Fisheries Commission (LWFC). Six of the members serve overlapping terms of six years, and one serves a term concurrent with the Governor. The commission is a policy-making and budgetary-control board with no administrative functions. The legislature has authority to establish management programs and policies; however, the legislature has delegated certain authority and responsibility to the LWFC and the LDWF. The LWFC may set possession limits, quotas, places, seasons, size limits, and daily take limits based on biological and technical data. The Secretary of the LDWF is the executive head and chief administrative officer of the department and is responsible for the administration, control, and operation of the functions, programs, and affairs of the department. The Governor, with consent of the Senate, appoints the Secretary.

Within the administrative system, an Assistant Secretary is in charge of the Office of Fisheries. This office performs:

> "the functions of the state relating to the administration and operation of programs, including research relating to oysters, water bottoms and seafood including, but not limited to, the regulation of oyster, shrimp, and marine fishing industries."

The Enforcement Division, in the Office of the Secretary, is responsible for enforcing all marine fishery statutes and regulations.

Louisiana has habitat protection and permitting programs and a federally-approved CZM program. The Department of Natural Resources is the state agency that monitors compliance of the state Coastal Zone Management Plan and reviews federal regulations for consistency with that plan.

5.2.4.2 Legislative Authorization

Title 56, Louisiana Revised Statutes (L.R.S.) contains statutes adopted by the Legislature that govern marine fisheries in the state that empower the LWFC to promulgate rules and regulations regarding fish and wildlife resources of the state. Title 36, L.R.S. creates the LDWF and designates the powers and duties of the department. Title 76 of the Louisiana Administrative Code contains the rules and regulations adopted by the LWFC and the LDWF that govern marine fisheries.

Section 320 of Title 56 (L.R.S.) establishes methods of taking freshwater and saltwater fish. Additionally, Sections 325.1 and 326.3 of Title 56 (L.R.S.) give the LWFC the legislative authority to set possession limits, quotas, places, season, size limits, and daily take limits for all freshwater and saltwater finfish based upon biological and technical data.

5.2.4.3 Reciprocal Agreements and Limited Entry Provisions

5.2.4.3.1 Reciprocal Agreements

The LWFC is authorized to enter into reciprocal management agreements with the states of Arkansas, Mississippi, and Texas on matters pertaining to aquatic life in bodies of water that form a common boundary. The LWFC is also authorized to enter into reciprocal licensing agreements.

Louisiana seniors, 65 years of age and older, are not required to purchase a nonresident license to fish in all public waters in Texas. These anglers will be allowed to fish Texas water bodies with a Louisiana Senior fishing license but shall comply with Texas law. Senior anglers are advised that anglers turning 60 before June 1, 2000 are also required to possess a Louisiana Senior fishing license when fishing in Texas, except in border waters. Louisiana residents from 17-64 years of age will still be required to purchase a nonresident fishing license when fishing in Texas, except when fishing in border waters.

In all border waters, except the Gulf of Mexico, Texas and Louisiana anglers possessing the necessary resident licenses, or those exempted from resident licenses for their state, are allowed to fish the border waters of Louisiana and Texas without purchasing nonresident licenses. Border waters include Caddo Lake, Toledo Bend Reservoir, the Sabine River and Sabine Lake.

Louisiana is also allowing Texas senior residents 65 years of age and older, to fish throughout Louisiana's public waters if they possess any type valid Special Texas Resident licenses for seniors as issued by Texas Parks and Wildlife, any type of water, saltwater or freshwater. Even Texas residents born before September 1, 1930 must possess the Texas Special Resident Fishing license when fishing in Louisiana, except in border waters.

5.2.4.3.2 Limited Entry

No limited entry exists to commercially take sand and silver seatrout with legal commercial gear other than with a commercial rod and reel. Louisiana has adopted limited access restriction for the issuance of a commercial rod and reel license. Sections 325.4 and 305B(14) of Title 56 (L.R.S.), as amended in 1995, provide that rod and reel licenses may only be issued to a person who has derived 50% or more of his income from the capture and sale of seafood species in at least two of the years 1993, 1994, and 1995 and has not applied for economic assistance for training under 56:13.1(C). Additionally, any person previously convicted of a Class 3 or greater violation cannot be issued a commercial rod and reel license.

5.2.4.4 Commercial Landings Data Reporting Requirements

Wholesale/retail seafood dealers who purchase sand and silver seatrout from fishermen are required to report those purchases by the tenth of the following month on trip tickets supplied by the Department for that purpose. Commercial fishermen who sell sand and silver seatrout directly to consumers must be licensed as a wholesale/retail seafood dealer or Fresh Products Licensee and comply with the same reporting requirements.

5.2.4.5 Penalties for Violations

Violations of Louisiana laws or regulations concerning the commercial or recreational taking of sand and silver seatrout by legal commercial gear shall constitute a Class 3 violation which is punishable by a fine from $250 to $500 or imprisonment for not more than 90 days, or both. Second offenses carry fines of not less than $500 or more than $800 and imprisonment of not less than 60 days or more than 90 days and forfeiture to the LWFC of any equipment seized in connection with the violation. Third and subsequent offenses have fines of not less than $750 or more than $1,000 and imprisonment for not less than 90 days or more than 120 days and forfeiture of all equipment involved with the violation. Civil penalties may also be imposed.

In addition to any other penalty, for a second or subsequent violation of the same provision of law, the penalty imposed may include revocation of the permit or license under which the violation occurred for the period for which it was issued, and barring the issuance of another permit or license for that same period.

5.2.4.6 Annual License Fees

The following list of licenses fees is current to the date of this publication. They are subject to change any time thereafter. *The LDWF should be contacted for current license fees.*

5.2.4.6.1 Commercial

Commercial fisherman's license	
· resident	$55.00
· nonresident	$460.00
Commercial wholesale/retail license (business)	
· resident	$250.00
· nonresident	$1,105.00
Fresh Products license (Commercial Fisherman's License required)	
· resident	$20.00
· nonresident	$120.00
Vessel license	
· resident	$15.00
· nonresident	$60.00
Gear licenses (trawls, hoop nets, cast nets, set lines, flounder gigs, spear guns)	
· resident	$25.00
· nonresident	$100.00
Gear licenses (commercial rod and reel)	
· resident	$250.00
· nonresident	$1000.00
Charter boat fishing guide (up to six passengers)	
· resident	$250.00
· nonresident	$1,000.00
Charter boat fishing guide (more than six passengers)	
· resident	$500.00
· nonresident	$2,000.00

5.2.4.6.2 Recreational

Hook-&-Line (cane pole)	
· resident	$2.50
Basic recreational fishing license	
· resident	$9.50
· nonresident	$60.00
Saltwater angling license	
· resident	$5.50
· nonresident	$30.00

Temporary basic recreational fishing license

- nonresident - per day $5.00

Temporary saltwater recreational license

- nonresident - per day $17.50

Charter Passenger (3-day)

- resident $5.00
- nonresident $5.00

Nonresident Active Military Fishing $9.50

Nonresident Active Military Saltwater $5.50

Senior LA Fish / Hunt $5.00

LA Sportsman's Paradise License

(basic and saltwater fishing; basic and big game hunting, bow, muzzle, turkey and LA waterfowl license; WMA hunting permit, and all recreational gear licenses <u>except recreational trawls greater than 16 ft in length</u>)

$100.00

Nonresidents may not purchase any gear license for Louisiana if their resident state prohibits the use of that particular gear.

5.2.4.7 Laws and Regulations

Louisiana laws and regulations regarding the harvest of sand and silver seatrout include gear restrictions and other provisions. The following is a general summary of these laws and regulations. *They are current to the date of this publication and are subject to change at any time thereafter. The LDWF should be contacted for specific and up-to-date information.*

5.2.4.7.1 Size Limits

There are no recreational or commercial size limits for sand and silver seatrout in Louisiana.

5.2.4.7.2 Gear Restrictions

Licensed commercial fishermen may take sand and silver seatrout commercially with a pole, line, yo-yo, hand line, trotline wherein hooks are not less than 24 inches apart, trawl, skimmer, butterfly net, cast net, scuba gear using standard spearing equipment, and rod and reel (if permitted). It is also legal to harvest sand and silver seatrout with hoop nets with the proper gear license.

Licensed recreational fishermen may take sand and silver seatrout recreationally with a bow and arrow, scuba gear, hook and line, and rod and reel.

5.2.4.7.3 Closed Areas and Seasons

Commercial activities including harvest of sand and silver seatrout are prohibited on designated refuges and state wildlife management areas.

5.2.4.7.4 Quotas and Bag/Possession Limits

There is no recreational bag limit or commercial quota on sand and silver seatrout.

5.2.4.7.5 Other Restrictions

The use of aircraft to assist fishing operations is prohibited. Sand and silver seatrout must be landed 'whole' with heads and tails attached; however, they may be eviscerated and/or have the gills removed. For the purpose of consumption at sea aboard the harvesting vessel, a person shall have no more than two lbs of finfish parts per person on board the vessel, provided that the vessel is equipped to cook such finfish. The provisions shall not apply to bait species.

5.2.4.8 Historical Changes in Regulations Affecting Sand and Silver Seatrout

The following regulatory changes may have notably influenced the landings during a particular year and are summarized here for interpretive purposes.

Prior to 1976:

Commercial regulations allowed a minimum bar-mesh size of 1.5 inches for saltwater gillnets, a 1.0 inch minimum for the inside wall of saltwater trammel nets, and a 0.875 inch minimum for saltwater fish seines. All nets used in the fishery were restricted to maximum lengths of 2,000 ft. No creel limits, size restrictions, or quota were placed on properly licensed fishermen. Recreational fishermen were required to possess a basic fishing license.

1977:

Monofilament webbing was banned in all saltwater nets except those on properly permitted vessels engaged in the pompano and black drum underutilized species program. Maximum net lengths were reduced to 1,200 ft, and new minimum bar-mesh sizes of 2.0 inches for saltwater gillnets, 1.0 inch for the inside wall of trammel nets, and 1.0 inch for saltwater fish seines were enacted.

1980:

Established a minimum mesh size of 3.0-inch bar in the outer wall of saltwater trammel nets.

1983:

Required all saltwater trammel nets to consist of three walls. A Saltwater Seller's License at a cost of $105 was established for the sale of commercial finfish.

1984:

Required minimum bar-mesh sizes of 1.75 inches for saltwater gillnets and 1.625 inches for the inside wall of saltwater trammel nets and a maximum mesh size of 12-

inch bar for the outer wall of trammel nets. Mandated a mesh size of 1.0-inch bar for saltwater fish seines, discontinued Commercial Angler's License, and gear license fees were increased. Required saltwater fishing license for all anglers fishing south of the officially established 'saltwater line' for saltwater species.

1986:

Saltwater Seller's License discontinued.

1987:

Established minimum bar-mesh sizes of 1.75 inches for saltwater gillnets, saltwater fish seines and the inside wall of saltwater trammel nets.

1988:

Prohibited the use of unattended gill and trammel nets in saltwater areas.

1995:

Use of 'set' gill nets or trammel nets prohibited in saltwater areas. Use of 'strike' gill nets to harvest specified fishes (which did not include sand seatrout) limited to the period between the third Monday in October and March 1 of the following year. All harvest of sand seatrout by gill or trammel nets banned, and legal commercial gear to harvest sand seatrout is limited to trawls, commercial cast nets, trotlines and commercial rod and reel.

5.2.5 Texas

5.2.5.1 Texas Parks and Wildlife Department

Texas Parks and Wildlife Department
Coastal Fisheries Division
4200 Smith School Road
Austin, Texas 78744
(512) 389-4863
www.tpwd.state.tx.us

The Texas Parks and Wildlife Department (TPWD) is the administrative unit of the state charged with management of the coastal fishery resources and enforcement of legislative and regulatory procedures under the policy direction of the Texas Parks and Wildlife Commission (TPWC). The commission consists of nine members appointed by the Governor for six-year terms. The commission selects an Executive Director who serves as the administrative officer of the department. Directors of Coastal Fisheries, Inland Fisheries, Wildlife, and Law Enforcement are named by the Executive Director. The Coastal Fisheries Division, headed by a Division Director, is under the supervision of the Deputy Executive Director of Natural Resources.

Texas has habitat protection and permitting programs and a federally-approved CZM program. The Texas General Land Office (TGLO) is the lead agency for the Texas Coastal Zone

Management Program (TCZMP). The Coastal Coordination Council monitors compliance of the TCZMP and reviews federal regulations for consistency with that plan. The Coastal Coordination Council is an 11-member group whose members consist of a chairman (the head of TGLO) and representatives from Texas Commission on Environmental Quality, TPWC, the Railroad Commission, Texas Water Development Board, Texas Transportation Commission, and the Texas Soil and Water Conservation Board. The remaining four places on the council are appointed by the governor and are comprised of an elected city or county official, a business owner, someone involved in agriculture, and a citizen. All must live in the coastal zone.

5.2.5.2 Legislative Authorization

Chapter 11, Texas Parks and Wildlife Code, establishes the TPWC and provides for its make-up and appointment. Chapter 12, Texas Parks and Wildlife Code, establishes the powers and duties of the TPWC concerning wildlife, and Chapter 61, Texas Parks and Wildlife Code, provides the TPWC with responsibility for marine fishery management and authority to promulgate regulations. Chapter 47, Texas Parks and Wildlife Code, provides for the authority to create commercial licenses required to catch, sell, and transport finfish commercially, and Chapter 68, Texas Parks and Wildlife Code, provides for the sale, purchase, and transportation of protected fish in Texas. All regulations pertaining to size limits, bag and possession limits, and means and methods pertaining to finfish are adopted by the TPWC and included in the annual Texas Statewide Hunting and Fishing Proclamations. Additionally, the Texas Department of State Health Services (TDSHS), under Chapter 436 of the Texas Health and Safety Code, has the authority to regulate the fish processing industry and to close areas to fishing based upon contaminant sampling to protect human health.

5.2.5.3 Reciprocal Agreements and Limited Entry Provisions

5.2.5.3.1 Reciprocal Agreements

Texas statutory authority allows the TPWC to enter into reciprocal licensing agreements in waters that form a common boundary, i.e., the Sabine River area between Texas and Louisiana. TPWD has statutory authority to enter into reciprocal management agreements under Chapter 11 of the Texas Parks and Wildlife Code Section 11.0171.

5.2.5.3.2 Limited Entry

On June 18, 1999, Governor George W. Bush signed Senate Bill 1303 into law, creating Texas' third commercial fishing limited entry program – The Finfish License Management Program. This program, which went into effect on September 1, 2000, seeks to complement traditional management measures through restricting access into the fishery to offset increased effort and to ultimately create long-term social, economic, and biological stability in the fishery. Key elements of Senate Bill 1303 included establishing 1) eligibility requirements (based on historical participation in the finfish fishery between September 1, 1997 and April 20, 1999) to receive a license in the program, 2) a voluntary buyback program, 3) a review board of finfish license holders to review hardship and appeal cases and to advise TPWD on various aspects of the program administration, and 4) a report to the Legislature and Governor for review of the program. Other key features of the bill include restrictions on the number of licenses held, license transfers, and license suspensions for flagrant violations. Senate Bill 1303 is embodied in Chapter 47, Texas Parks and Wildlife Code. TPWC proclamations regarding the program are contained in Chapter 31 Texas Administrative Code, Section 58.301.

5.2.5.4 Commercial Landings Data Reporting Requirements

Chapter 66, Section 66.019, Texas Parks and Wildlife Code, provides:

a) The department shall gather statistical information on the harvest of aquatic products of this state.
b) The department shall prescribe the method or methods used to gather information and shall produce and distribute any applicable report forms.
c) Unless otherwise required by the department, no dealer who purchases or receives aquatic products directly from any person other than a licensed dealer may fail to file the report with the department each month on or before the tenth day of the month following the month in which the reportable activity occurred. The report must be filed even if no reportable activity occurs in the month covered by the report. No dealer required to report may file an incorrect or false report. A culpable mental state is not required to establish an offense under this section.
d) Unless otherwise required by the department, no dealer who purchases, receives, or handles aquatic products (other than oysters) from any person except another dealer may fail to:
   1) maintain cash sale tickets in the form required by this section as records of cash sale transactions; or
   2) make the cash sale tickets available for examination by authorized employees of the department for statistical purposes or as a part of an ongoing investigation of a criminal violation during reasonable business hours of the dealer.
e) All cash sale tickets must be maintained at the place of business for at least one year from the date of the sale.
f) A cash sale ticket must include:
   1) name of the seller;
   2) general commercial fisherman's license number, the commercial finfish fisherman's license number, the commercial shrimp boat captain's license number, the commercial shrimp boat license number, or the commercial fishing boat license number of the seller or of the vessel used to take the aquatic product, as applicable;
   3) pounds sold by species;
   4) date of sale;
   5) water body or bay system from which the aquatic products were taken; and
   6) price paid per pound per species.

5.2.5.5 Penalties for Violations

Penalties for violations of Texas' proclamations regarding sand and silver seatrout are provided in Chapter 66 and 47 of Texas Parks and Wildlife Code. Most are Class C misdemeanors punishable by fines ranging from $25 to $500. Under certain circumstances, a violation can be enhanced to a Class B misdemeanor ($200 to $2000 fine), Class A misdemeanor ($500 to $4,000 fine), or a State Jail Felony ($1,500-$10,000 fine). Punishment may also include jail time (Class B or higher), suspension or revocation of license for up to five years, and forfeiture of gear used to commit a violation. Under Chapter 47, Section 47.080, flagrant violations by holders of a commercial finfish license may result in revocation of the license. In addition to criminal penalties, a civil restitution value for the resource can be assessed, based on the current value of the resource.

5.2.5.6 Annual License Fees

The following is a list of licenses and fees that are applicable to sand and silver seatrout harvest in Texas as of September 1, 2009. Licenses and fees are subject to change at any time thereafter. *The TPWD should be contacted for current license fees.*

5.2.5.6.1 Recreational

Resident Saltwater Fishing Package	$35.00
Resident All Water Fishing Package	$40.00
Senior Resident Saltwater Fishing Package	$17.00
Senior Resident All Water Fishing Package	$22.00
Special Resident All Water License (for legally blind)	$ 7.00
Resident Year-From-Purchase All Water Package	$47.00
Resident One Day All Water License	$11.00
Nonresident Saltwater Fishing Package	$63.00
Nonresident All Water Fishing Package	$68.00
Nonresident One Day All Water License	$16.00
Resident Fishing Guide License	$210.00
Nonresident Fishing Guide License	$1050.00
Resident Super Combo Package	$68.00
Senior Resident Super Combo Package	$32.00
Resident Combination Hunting/Saltwater Fishing Package	$55.00
Resident Combination Hunting/All Water Fishing Package	$60.00
Senior Resident Combination Hunting/Saltwater Fishing Package	$21.00
Senior Resident Combination Hunting/All Water Fishing Package	$26.00
Lifetime Resident Fishing License	$1000.00
Lifetime Resident Combination Hunting and Fishing License	$1800.00
Resident Disabled Veteran Super Combo Package	Free

5.2.5.6.2 Commercial

General Commercial Fisherman's License	
· Resident	$26.00
· Nonresident	$189.00
Commercial Finfish Fisherman's License	

· Resident	$360.00
· Nonresident	$1,440.00
Commercial Fishing Boat License	
· Resident	$27.00
· Nonresident	$100.00

5.2.5.7 Laws and Regulations

Very few provisions of the Statewide Hunting and Fishing Proclamation adopted by the TPWC affect the harvest of sand and silver seatrout in Texas. The following is a general summary of these laws and regulations. They are current to the date of this publication and are subject to change at any time thereafter. *The TPWD should be contacted for specific and up-to-date information.*

5.2.5.7.1 Size Limits

There are no size limits for sand seatrout.

5.2.5.7.2 Gear Restrictions

Gill nets and trammel nets are prohibited in the coastal waters of Texas. Sand and silver seatrout may be legally taken by pole and line, trotlines, sail lines, bow and arrow, spears, gigs, cast nets, dip nets, perch traps, minnow traps, umbrella nets, seines, and trawls. Sand seatrout taken incidentally during legal shrimp trawling operations may be retained provided the total weight of aquatic products retained, in any combination, does not exceed 50% by weight of shrimp on a shrimping vessel.

5.2.5.7.3 Closed Areas and Seasons

Possession of all species of fish and crabs is prohibited in portions of upper Lavaca Bay in Calhoun County. There are no other closed areas or seasons for the taking of sand or silver seatrout in Texas. The TDSHS publishes an annual report of fish consumption advisories and bans in Texas' waters.

5.2.5.7.4 Quotas and Bag/Possession Limits

5.2.5.7.4.1 Recreational

There are no recreational quotas or bag and possession limits for sand seatrout.

5.2.5.7.4.2 Commercial

There are no daily bag and possession limits for sand seatrout for the holder of a valid Commercial Finfish Fisherman's License. Non-game fish and other aquatic products taken incidental to legal shrimp trawling operations may be retained provided the total weight of aquatic products retained, in any combination, does not exceed 50% by weight of shrimp on a shrimping vessel.

5.2.5.7.5 Other Restrictions

Sand seatrout must be kept in a 'whole' condition with heads and tails attached until landed on a barrier island or the mainland; however, viscera and gills may be removed.

5.2.5.8 Historical Changes to Regulations Affecting Sand and Silver Seatrout

The following regulatory changes may have notably influenced the landings during a particular year and are summarized here for interpretive purposes.

1977: TPWC adopts prohibition of weekend use of nets and trotlines in coastal regulatory county waters.

1979: Texas becomes the first state to prohibit the use of single strand monofilament gill nets in some situations.

1981: House Bill 1000 (Redfish Bill) passed which designated red drum and spotted seatrout as game fish, and prohibited their sale. An attempt by commercial finfish fishermen to overturn the law in federal court was unsuccessful. Commercial finfish fishermen subsequently redirected their fishing effort to black drum, southern flounder, and other species.

1983: The Wildlife Conservation Act was passed giving the TPWC authority to manage fish and wildlife. Prior to the passage of this act, all hunting and fishing laws in 13 Texas counties, and certain laws in 72 counties were set by the Legislature, while regulations set by TPWC in 30 other counties were subject to review by local county commissioners' courts.

1984: The minimum mesh size for commercial trammel nets was set at 6-inch stretched, and mainlines on trotlines were required to be fished on the bottom.

1985: The Saltwater Stamp Bill created a $5.00 stamp for saltwater anglers. This provided an estimate of the number of anglers fishing in saltwater and provided revenue for improved coastal fisheries management and law enforcement. Funding allowed for expansion of the TPWD Coastal Fisheries Division's monitoring programs and an increase in staff to support them.

1988: The TPWC voted to close Texas' waters to all gill nets, trammel nets, and drag seines. Commercial fishermen were also required to comply with the size limits.

1989: Senate Bill 609 was passed prohibiting possession of illegal fishing devices on or near Texas' waters. House Bill 1417 passed creating a new mechanism for civil restitution cases designed to strengthen fishing laws and their enforcement. Regulations were modified to prohibit the use of top-water trotlines and to establish circle hooks as the only style of hook that can legally be used on saltwater trotlines.

1992: An exemption was provided for removing trotlines during weekend periods when small craft warnings are in effect.

1995: Senate Bill 750 was passed which granted authority to TPWC to create a limited entry fishery for bay and bait shrimpers. This may have resulted in some redirection of fishing effort and possibly a reduction in bycatch.

1997: House Bill 2542 was passed which granted authority to TPWC to create a limited entry fishery for crabbers. This may have resulted in some redirection of fishing effort and possibly a reduction in bycatch.

1999: On June 18, 1999, Governor George Bush signed into law Senate Bill 1303 authorizing the TPWC under Parks and Wildlife Code 47, to establish a license limitation plan for the Texas commercial finfish fishery with the goal of improving the economic stability of the commercial finfish fishery while providing long-term sustainability of finfish stocks. The Finfish License Management Program became effective September 1, 2000.

2000: By TPWD proclamation, all shrimp boats fishing in Texas waters were required to have a bycatch reduction device (BRD) installed in each trawl rigged for fishing.

2001: The Texas Legislature granted authority to TPWC to create an abandoned crab trap removal program. This program is intended to remove derelict traps from state waters to reduce navigational hazards and mortality to aquatic organisms due to "ghost fishing."

2001: By TPWC proclamation, all species landed in Texas must meet Texas' length and bag, and possession limits regardless of where they were caught.

2002: By TPWC proclamation, a special "boat limit" was created for guided fishing trips. The "boat limit" consists of the aggregate limit of the paying customers only.

5.3 Regional/Interstate

5.3.1 Gulf States Marine Fisheries Compact (P.L. 81-66)

The Gulf States Marine Fisheries Commission (GSMFC) was established by an act of Congress (P.L. 81-66) in 1949 as a compact of the five Gulf States. Its charge is:

> "to promote better utilization of the fisheries, marine, shell and anadromous, of the seaboard of the Gulf of Mexico, by the development of a joint program for the

> promotion and protection of such fisheries and the prevention of the physical waste of the fisheries from any cause."

The GSMFC is composed of three members from each of the five Gulf States. The head of the marine resource agency of each state is an ex-officio member, the second is a member of the legislature, and the governor appoints the third, a citizen who shall have knowledge of and interest in marine fisheries. The chairman, vice chairman, and second vice chairman of the GSMFC are rotated annually among the states.

The GSMFC is empowered to make recommendations to the governors and legislatures of the five Gulf States on action regarding programs helpful to the management of the fisheries. The states do not relinquish any of their rights or responsibilities in regulating their own fisheries by being members of the GSMFC.

Recommendations to the states are based on scientific studies made by experts employed by state and federal resource agencies and advice from law enforcement officials and the commercial and recreational fishing industries. The GSMFC is also authorized to consult with and advise the proper administrative agencies of the member states regarding fishery conservation problems. In addition, the GSMFC advises the U.S. Congress and may testify on legislation and marine policies that affect the Gulf States. One of the most important functions of the GSMFC is to serve as a forum for the discussion of various problems, issues, and programs concerning marine management.

5.3.2 Interjurisdictional Fisheries Act of 1986 (P.L. 99-659, Title III)

The Interjurisdictional Fisheries (IJF) Act of 1986 established a program to promote and encourage state activities in the support of management plans and to promote and encourage management of IJF resources throughout their range. The enactment of this legislation repealed the Commercial Fisheries Research and Development Act (P.L. 88-309).

5.3.2.1 Development of Management Plans (Title III, Section 308(c))

Through P.L. 99-659, Congress authorized the Department of Commerce to appropriate funding in support of state research and management projects that were consistent with the intent of the IJF Act. Additional funds were authorized to support the development of interstate FMPs by the Gulf, Atlantic, and Pacific States Marine Fisheries commissions.

6.0 DESCRIPTION OF FISHING ACTIVITIES AFFECTING THE STOCK(S) IN THE UNITED STATES GULF OF MEXICO

Sand and silver seatrout are harvested commercially and recreationally, with the majority being taken incidentally throughout the Gulf of Mexico region. Although these seatrout are often caught incidentally while fishing for other sciaenids, their popularity will likely increase as regulations for more exploited species, such as snappers and groupers, become increasingly more stringent (Ditty et al. 1991). As noted in Section 3, most anglers and commercial fishermen do not distinguish between sand seatrout and silver seatrout and frequently lump them together under the local name ‘white trout’ or ‘sand seatrout’.

The two species actually make up a significant portion of the finfish bycatch in the Gulf commercial shrimp fishery as well. Gunter (1936) surveyed commercial shrimp trawlers in Louisiana waters and found ‘white trout’ (actual species unknown) to be the most common finfish bycatch. More recently, Fuls (1996) indicated that *C. arenarius* was in the top five most common finfish bycatch species in the Texas shrimp fleet. Until the 1980s and early 1990s, a large number of sand and silver seatrout were harvested incidentally in the industrial groundfish fishery which primarily targeted Atlantic croaker which is both ground for the pet food industry and kept whole for human consumption (Haskell 1961, Gutherz et al. 1975, Vecchione 1987, Gledhill 1991).

6.1 Recreational Fishery

6.1.1 History

The NMFS Marine Recreational Fisheries Statistics Survey (MRFSS) and the Texas Recreational Harvest Monitoring Program provide the most current Gulf-wide sources of recreational fishing information. The Texas program has been in place since 1974 and the MRFSS since 1979. Together they provide the best estimates of landings and effort by recreational anglers in the five Gulf states. Since the late 1990s, the MRFSS and Texas programs have increased sampling efforts leading to more reliable estimates of the recreational contribution to the sand and silver seatrout fishery.

The MRFSS randomly collects catch and effort information from anglers fishing from shore, from for-hire vessels and from private and rental boats. Catch and effort data currently are obtained through a dockside sampling survey and a phone survey of randomly selected coastal residents. Operators of for-hire vessels also participate in a more directed volunteer phone survey. These data are the primary source of catch and effort estimates of sand and silver seatrout for the Gulf states excluding Texas.

Unlike commercial landings information, the reported recreational landings in the MRFSS include both kept (type A and B1 that are observed and reported catches) and released fish (type B2). These data are less affected by regulations than are commercial landings data. The recreational landings presented in these figures and tables are type A+B1 and actually represents total harvest, as designated by the NMFS. Gulf-wide recreational landings from 1981-2008 are summarized in Table 6.1 for sand seatrout and Table 6.2 for silver seatrout by total number.

Table 6.1 Total annual sand seatrout (*Cynoscion arenarius*) recreational landings (number) by state from 1981-2008 (NMFS unpublished data, TPWD unpublished data). ***Note*:** Texas numbers do not include any 'shore' mode landings which would likely increase the Texas and overall totals. Texas data shown here are for the fishing season May 15-May 14.

Year	WFL	AL	MS	LA	TX	Total
1981	4,375,710	42,572	1,020,288	865,405	NA	6,303,975
1982	404,272	104,229	363,436	849,066	305,400	2,026,403
1983	627,705	563,446	879,116	2,459,400	471,200	5,000,867
1984	4,662,782	177,263	627,986	897,720	314,290	6,680,041
1985	3,583,551	235,118	1,269,979	1,170,945	308,309	6,567,902
1986	1,925,766	620,072	1,149,852	1,279,906	401,094	5,376,690
1987	624,785	178,425	494,854	1,640,802	296,000	3,234,866
1988	790,583	484,761	639,577	325,704	329,203	2,569,828
1989	818,954	327,432	1,201,557	166,965	259,885	2,774,793
1990	682,266	260,620	424,655	1,417,579	220,360	3,005,480
1991	2,098,901	376,970	389,314	1,142,679	261,566	4,269,430
1992	1,279,614	353,122	467,950	1,088,053	412,475	3,601,214
1993	666,207	901,951	236,337	1,342,606	492,993	3,640,094
1994	1,665,807	742,222	641,946	1,777,224	168,807	4,996,006
1995	1,240,362	1,078,925	642,357	856,107	316,720	4,134,471
1996	908,116	954,087	865,754	924,177	232,992	3,885,126
1997	398,927	675,152	478,141	830,639	445,041	2,827,900
1998	529,511	868,257	559,003	850,784	157,004	2,964,559
1999	1,723,265	892,128	1,379,571	998,989	191,217	5,185,170
2000	1,640,788	556,964	1,052,993	1,256,875	331,333	4,838,953
2001	996,917	711,908	1,150,349	448,550	199,437	3,507,161
2002	1,172,581	427,665	865,855	599,353	118,388	3,183,842
2003	703,843	708,936	665,577	983,350	122,715	3,184,421
2004	566,569	716,394	403,631	601,195	152,693	2,440,482
2005	299,590	409,672	267,019	773,383	122,353	1,872,017
2006	367,430	725,302	421,862	1,161,396	125,021	2,801,011
2007	819,099	687,917	279,641	1,121,899	71,787	2,980,343
2008	757,882	1,256,864	370,234	1,177,162	100,204	3,662,346

Currently, the MRFSS is undergoing a national redesign intended to improve the timeliness and accuracy of angler survey efforts. The new program, the Marine Recreational Information Program (MRIP) was being phased in beginning January 2009. In-person field sampling and telephone interviews are expected to continue with the MRIP, but many specific survey elements related to both data collection and analysis are being refined to address issues such as data gaps, bias, consistency, accuracy, and timeliness. The Magnuson-Stevens Act was reauthorized in 2006 with numerous significant changes that included a redesign of the national recreational survey program and establishment of a national registry of saltwater anglers. The registry will serve to identify the recreational saltwater anglers and improve fishing effort estimates.

Table 6.2 Total annual silver seatrout (*Cynoscion nothus*) recreational landings (number) by state from 1981-2008 (NMFS unpublished data, TPWD unpublished data; NA indicates data not reported). ***Note*:** Texas numbers do not include any 'shore' mode landings which would likely increase the Texas and overall totals. Texas data shown here are for the fishing season May 15-May 14.

Year	WFL	AL	MS	LA	TX
1981	380,850	92,436	38,741	21,611	NA
1982	208,665	NA	10,173	159,363	NA
1983	855,518	NA	NA	574,651	5,073
1984	2,117,345	NA	426	8,238	11,260
1985	1,194,728	NA	NA	72,907	18,537
1986	685,443	2,265	24,196	31,276	1,662
1987	504,632	545	4,495	233,591	387
1988	1,368,178	6,373	9,190	79,599	4,169
1989	446,039	NA	NA	62,312	2,755
1990	624,563	38,833	5,643	27,547	2,995
1991	41,329	163,160	124,099	16,043	3,964
1992	183,739	63,020	3,944	49,600	676
1993	86,503	NA	NA	75,635	712
1994	94,521	NA	NA	17,587	968
1995	19,396	3,791	NA	99,118	908
1996	20,763	NA	NA	7,102	5,243
1997	168,874	NA	10,276	24,477	215
1998	109,339	9,622	NA	689	1,944
1999	237,330	21,488	795	18,249	2,531
2000	199,999	1,454	NA	3,273	1,727
2001	49,981	7,810	NA	690	2,245
2002	181,525	874	NA	866	1,678
2003	47,416	NA	NA	1,291	216
2004	4,327	NA	NA	NA	456
2005	72,106	NA	NA	3,050	395
2006	44,363	5,421	NA	676	1,025
2007	48,373	35,497	NA	5,389	897
2008	16,095	0	81	21,604	5,073

The Texas monitoring program presents data on a cycle lasting from May 15-May 14 each year. These data break the year into high and low seasons, with May 15-November 20 being the high season. Boat ramps and marinas are sampled to capture private boat and charter boat data. Texas recreational data do not include shore anglers, which likely causes an underestimation for some species that can be caught easily from shore, such as sand seatrout.

The inability to identify sand and silver seatrout correctly by recreational anglers may cause reporting errors for both in the recreational data. Sand seatrout have many common names and are often confused with silver seatrout on the Gulf coast and weakfish (*C. regalis*) on the Atlantic coast (see Section 3.0). Thus, due to possible angler and port sampler misidentifications, there are likely data inaccuracies for both sand and silver seatrout.

Sand and silver seatrout are easily accessible to most anglers and can be caught in most of the Gulf's large coastal rivers, bays, inlets, and estuaries as well as offshore (Horst and Lane 2008). Concentrations can also be found around offshore rigs (Shipp 1994). They are primarily caught recreationally using hook-and-line, baited with either live or cut baits, and are caught equally well with artificial jigs and flies. The preferred baits by most anglers include crabs, shrimp (live or dead), minnows, and strips of fish or squid (Dunaway 2000). Spring is thought to be the best time to catch sand seatrout in inshore waters. While sand and silver seatrout are plentiful and excellent table fare, the soft texture of their meat can make them less desirable after freezing, so they are usually cooked and eaten fresh (Shipp 1994, Horst and Lane 2008).

The state records for the Gulf region are listed in Table 6.3. Florida does not currently have a record category for sand seatrout and Alabama has a sand seatrout/silver seatrout combined category. The current world record for sand seatrout was caught off Dauphin Island, Alabama, in 1997 and weighed 6 lbs 2 oz; however, a larger specimen at 6 lbs 11 oz was caught in Alabama that same year, but it was not submitted to the International Game Fish Association (IGFA).

The total number of sand seatrout taken recreationally has been relatively stable with the exception of Florida back in the early 1980s (Figure 6.1a). In recent years, Florida landings have decreased with the exception of 2006 and 2007, and Louisiana has had the highest landings in the Gulf in recent years. The total number of Gulf recreational silver seatrout landings has been minimal compared to sand seatrout, with the greatest number reported in Florida throughout the 1980s (Figure 6.1b).

Table 6.3 Regional and world recreational angling records by weight for sand/silver seatrout.

State	Category	Date	Weight
Florida	N/A		
Alabama	Seatrout Sand/Silver	07/12/1997	6 lb 11 oz
Mississippi	Seatrout, Sand	03/12/2009	6 lb 9.6 oz
Louisiana	Sand Trout[1]	Aug. 1973	11 lb
Texas	Seatrout, Sand	02/26/1972	6 lb 4 oz
	Seatrout, Silver[2]	02/28/1992	6 lb 14.5 oz
World (IGFA 2010)	Seatrout, Sand	05/24/1997	6 lb 2 oz
	Seatrout, Silver	08/6/2005	1 lb 2 oz

[1]The Louisiana record is not verifiable.
[2]The Texas silver seatrout record has no documentation that can be verified.

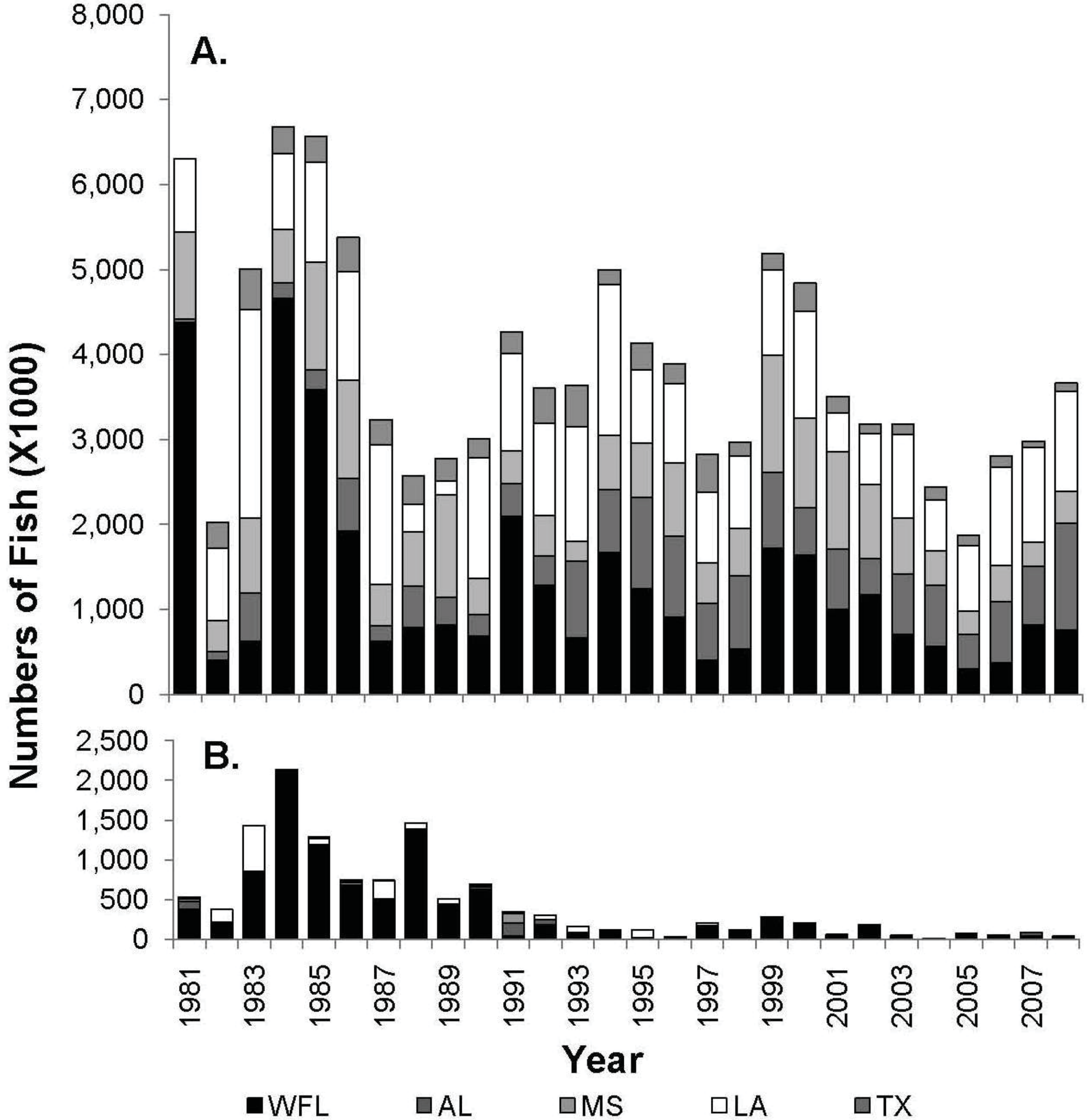

Figure 6.1 Total numbers of recreationally harvested **A.** sand seatrout (*Cynoscion arenarius*) and **B.** silver seatrout (*C. nothus*) by state from 1981-2008 (NMFS unpublished data, TPWD unpublished data). Note: Texas numbers do not include any 'shore' mode landings which would likely increase the Texas and overall totals. Texas data shown here are for the fishing season May 15-May 14.

Figure 6.2 shows the distribution of saltwater anglers licensed in the Gulf of Mexico in 2004, with Texas having the most resident anglers and Florida, the most nonresident anglers. However, most states have exemptions (e.g., under 16, over 65, etc.) that would make the actual number of recreational anglers greater than the license sales would indicate.

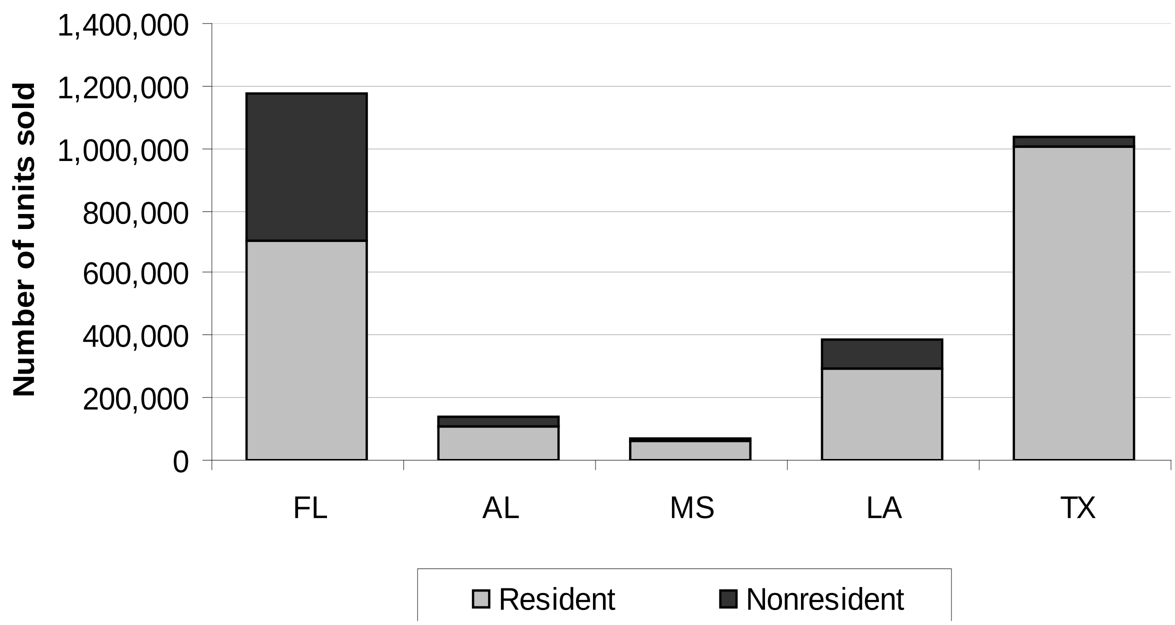

Figure 6.2 Number of recreational saltwater licenses sold in the Gulf of Mexico (including combination licenses) for 2004. Florida sales represent all residents, not a west coast or Gulf component.

According to NMFS (unpublished data) the total U.S. recreational landings for *C. arenarius* and the total Gulf landings are essentially identical, indicating that sand seatrout is primarily a Gulf fishery (Figure 6.3). However, these data could be misleading as some sand seatrout are also caught off the east coast of Florida, but are often misreported as weakfish since they are morphologically indistinguishable and produce hybrids (Tringali et al. 2004) (see Section 3.2.4). Landings have been generally decreasing Gulf-wide and averaged 3.1 million in the past nine years (2000-2008). While the NMFS provides *C. arenarius* landings in the MRFSS database, silver seatrout are intercepted by samplers but not in high enough numbers to be reported online. The data for *C. nothus* is available by request from the NMFS Fisheries Statistics Division in Silver Spring, MD.

According to NMFS and TPWD recreational landings data, the majority of the *C. arenarius* taken by recreational anglers in the Gulf are between 10 and 12 inches FL (Figure 6.4), even though they do achieve considerably larger sizes. Also, Gulf-wide in the 1980s and 1990s, most sand seatrout were taken recreationally in July-October (Figure 6.5). However, since 2000, they reportedly are taken year-round with a slight peak in midsummer.

6.1.2 State Fisheries

Gear, vessels, fishing methods and other aspects of the recreational fishery vary from state to state. These variations are due, at least in part, to geographical and sociological diversity. Individual state landings are described below.

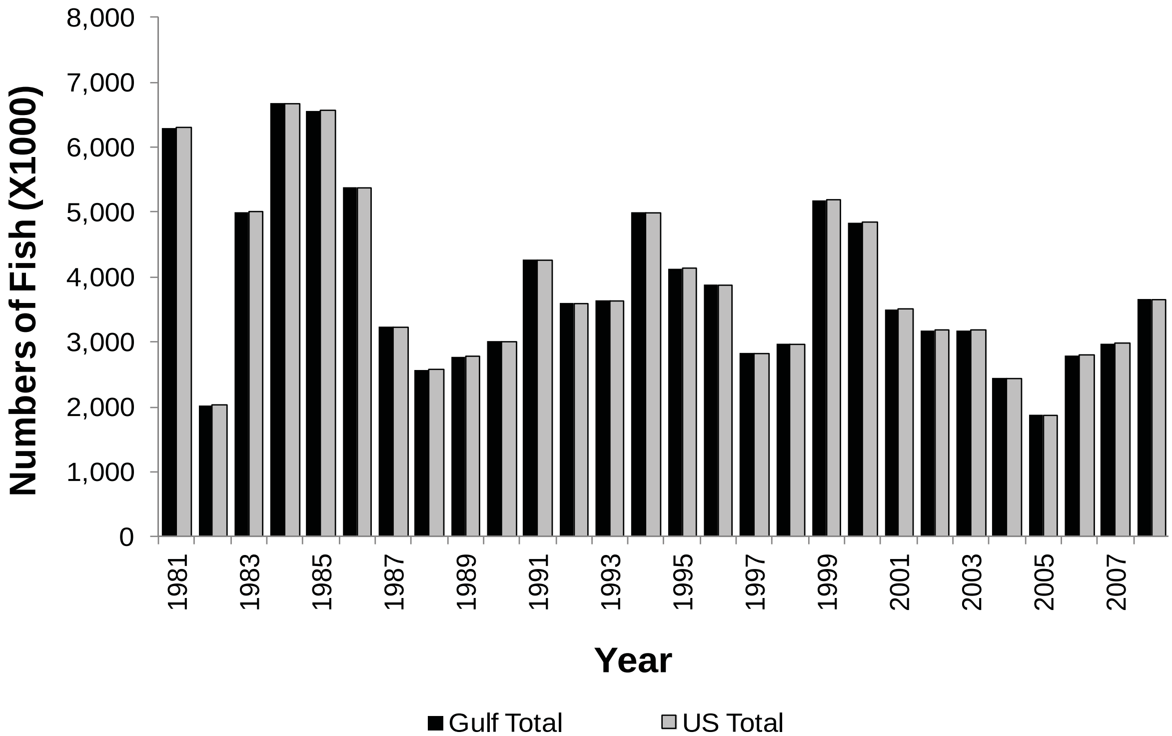

Figure 6.3 Total Gulf of Mexico and total U.S. recreational harvest of sand seatrout (*Cynoscion arenarius*) from 1981-2008 (NMFS unpublished data, TPWD unpublished data).

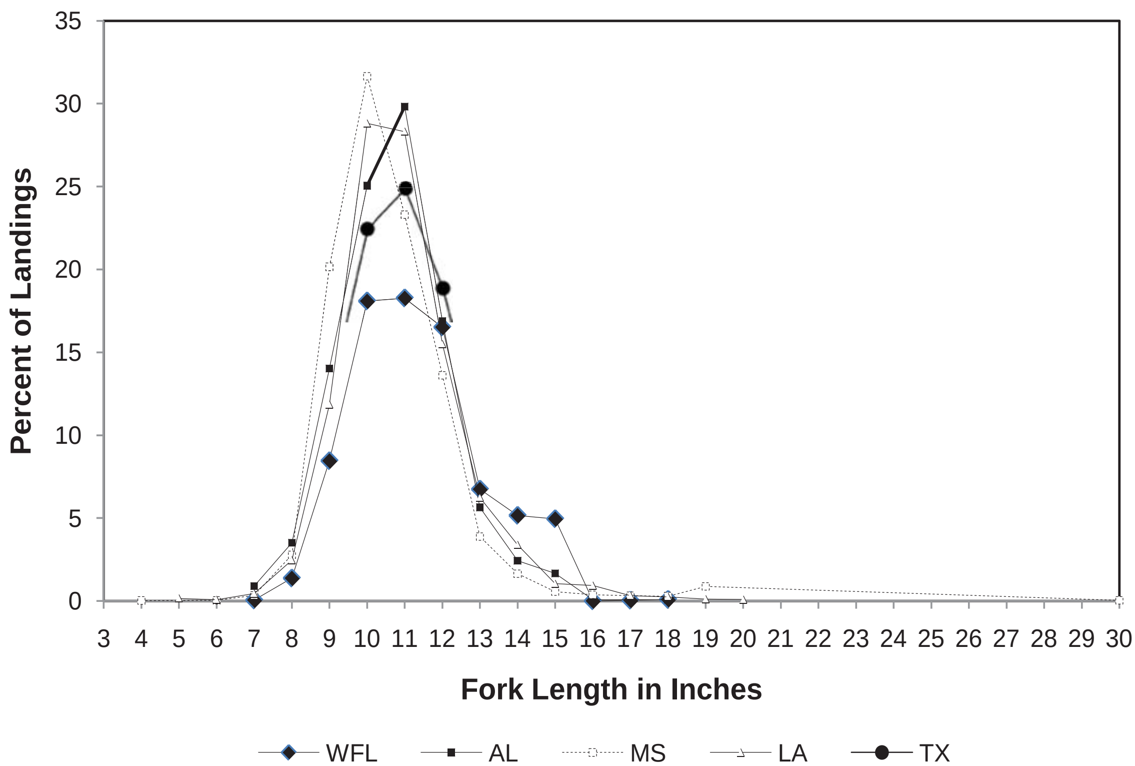

Figure 6.4 Fork length frequency distribution in inches of sand seatrout (*Cynoscion arenarius*) harvested by recreational anglers in the Gulf of Mexico region (2004-2008). (NMFS unpublished data, TPWD unpublished data). **Note:** Texas data are total length; West Florida data are for 2005-2008.

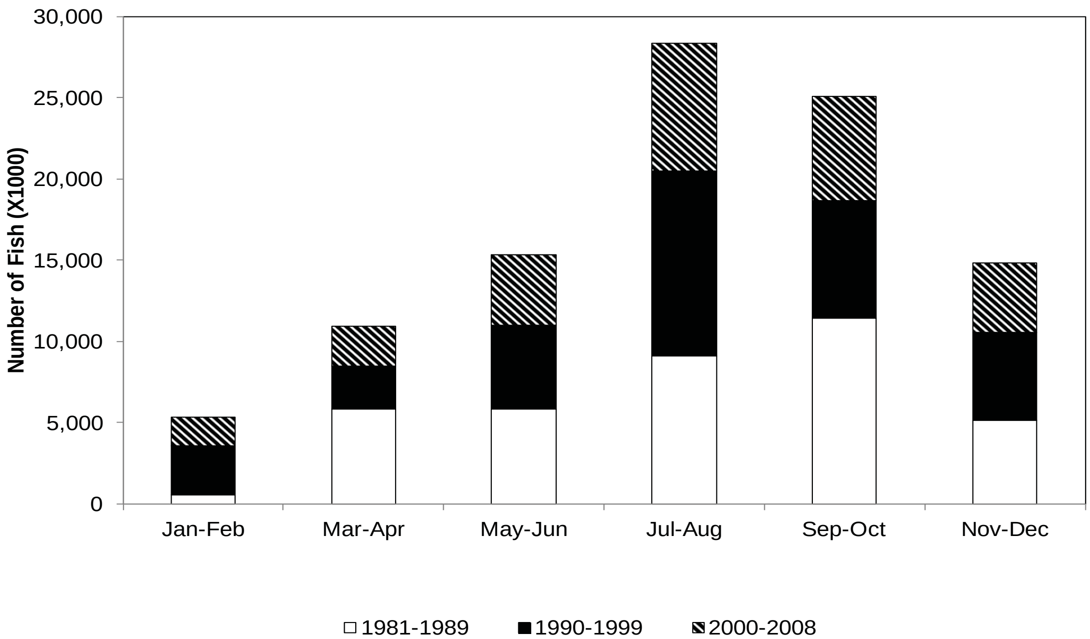

Figure 6.5 Cumulative bimonthly recreational sand seatrout (*Cynoscion arenarius*) landings for west Florida, Alabama, Mississippi, and Louisiana combined from 1981-2008 (NMFS unpublished data).

6.1.2.1 Florida

In 2008, participation in Florida's Gulf coast saltwater recreational fishery, including non-coastal residents and out-of-state anglers, was estimated at 3.85 million anglers. The total number of recreational anglers in Florida has increased steadily since the early 1990s, and nonresidents make up a large component of all licensed anglers (Figure 6.6A). The number of sand seatrout landed has varied since the 1980s, with a notable increase in 1984 (Figure 6.7A). The total number caught annually has fluctuated widely, ranging from 0.3 million to 4.6 million, with an average of 1.3 million fish harvested annually since 1981. The majority of sand seatrout landed in Florida measure between 8 and 13 inches and most are landed during July and August. The sand seatrout landed in Florida account for an average of 30% of the sand seatrout harvested from the Gulf of Mexico.

In Florida, sand seatrout are sometimes targeted in place of spotted seatrout, especially during the months when spotted seatrout fishing is closed. The first closed seasons for spotted seatrout went into effect on January 1, 1996, and it is possible that anglers shifted effort to catching sand seatrout during the closed season of spotted seatrout. Current closed months for spotted seatrout include November and December in the southern part of the state and February in the northern part of the state (Figure 6.8A). Also, the minimum slot limit and bag limit for spotted seatrout could have caused some anglers to shift their effort to sand seatrout. Although sand seatrout may be taken while targeting other species, anecdotal information indicates that inshore fishing guides in the Cedar Key area are targeting sand seatrout for their customers. A possible increase in effort due to the spotted seatrout season closures established in the late 1990s is not shown in the data (Figure 6.7A). This could be a result of the inability of the MRFSS system to intercept enough anglers targeting sand or silver seatrout.

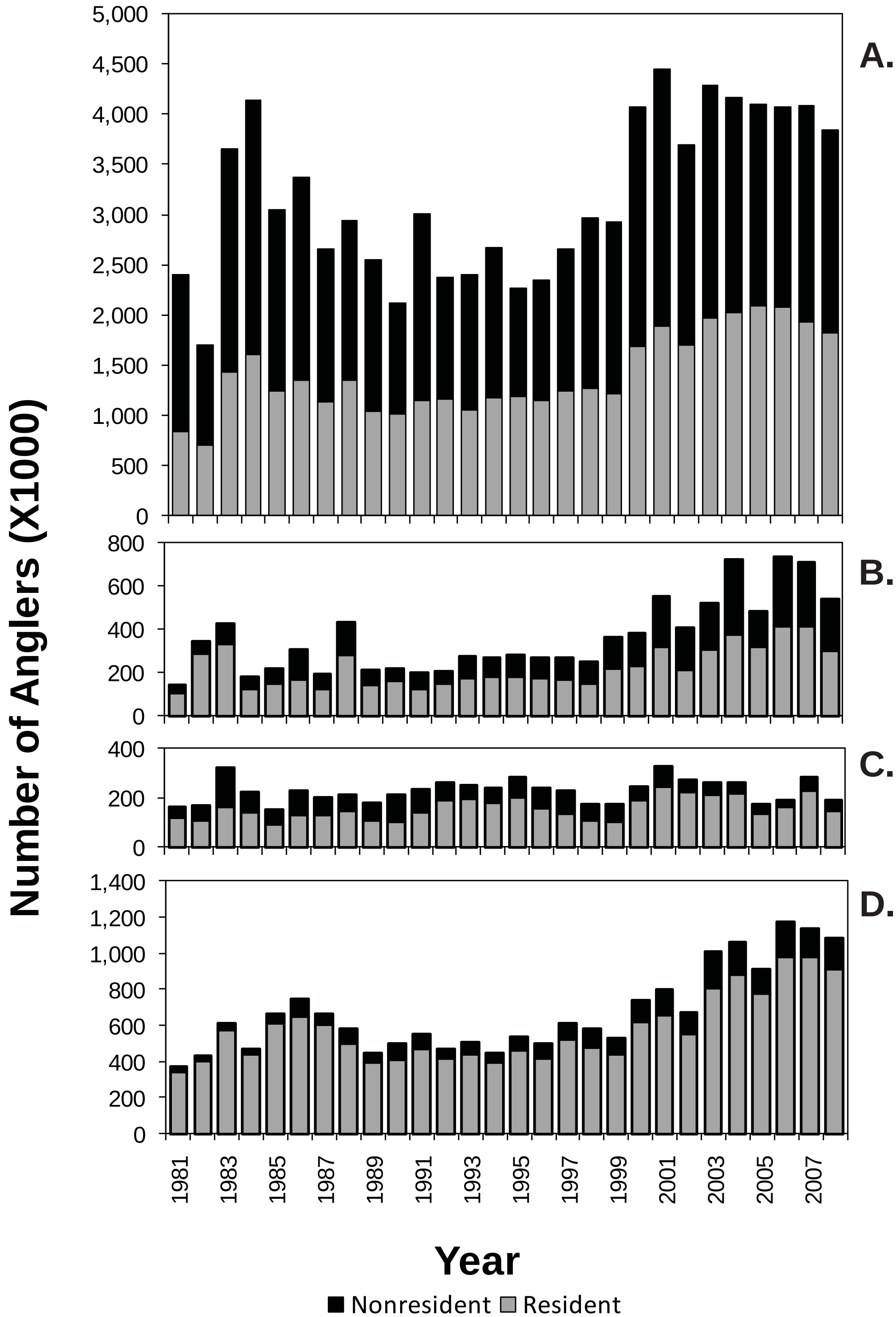

Figure 6.6 Number of resident and nonresident saltwater anglers in **A.** West Florida, **B.** Alabama, **C.** Mississippi, **D.** Louisiana from 1981-2008 (NMFS unpublished data).

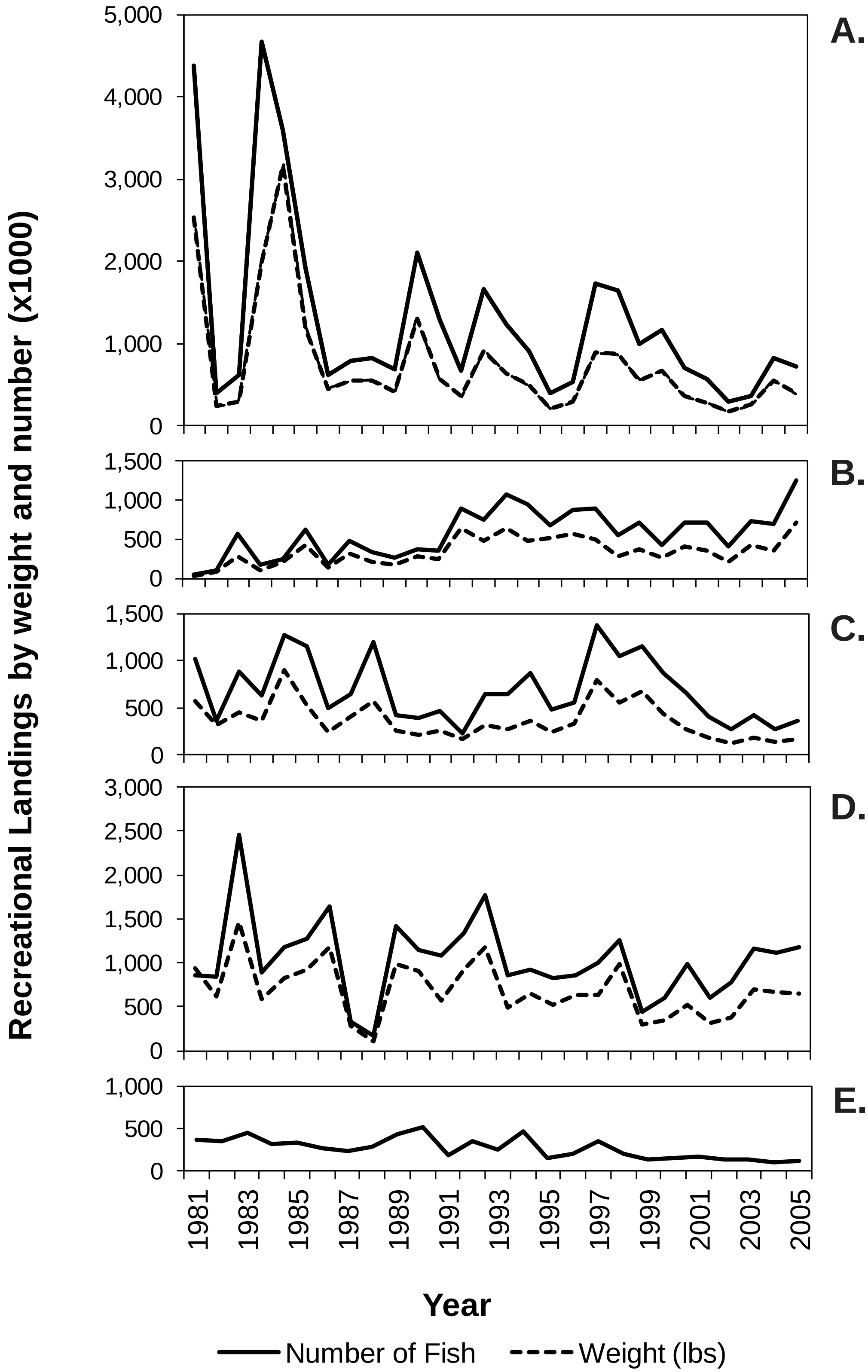

Figure 6.7 Recreational harvest of sand seatrout (*Cynoscion arenarius*) by number and weight from 1981-2008 for **A.** West Florida, **B.** Alabama, **C.** Mississippi, **D.** Louisiana, and **E.** Texas (no weight data) by total number and weight (lbs) (NMFS unpublished data; TPWD unpublished data).

The majority of sand seatrout taken recreationally on Florida's West coast are landed in the panhandle, making up 50% of the harvest from 1998-2008. Few sand or silver seatrout are caught from the Florida Keys or the southwestern part of the state.

6.1.2.2 Alabama

Recreationally, sand seatrout has been the second most sought after species behind spotted seatrout but compose the majority of the seatrout pounds that are harvested. Recreational harvest of *C. arenarius* continues to increase (Figure 6.7B) along with coastal license sales (Figure 6.6B). Estimated average pounds of harvested sand seatrout from 1981-1989 were 300,736 pounds. Average pounds harvested for the following decade more than doubled to 653,874. The most recent decade, 1999-2008, has seen a small increase to 709,375 pounds. In comparison, silver seatrout landings in Alabama have remained sporadic with the greatest number reported in 2007 and the least in 2002 (35,497 and 874 respectively). During that same period (1999-2008), there were three years in a row with no reported landings (Table 6.2). The majority of the harvest occurs in Mobile County on inside waters and less frequently on the nearshore waters. Southern kingfish (*Menticirrhus americanus*) are frequently harvested in conjunction with sand and silver seatrout.

Sand seatrout (and likely silver seatrout) are targeted by anglers fishing cut baits on sand substrate and oyster reefs mainly from May-October (Figure 6.8B). Gear is a typical medium-action spinning reel with 10-12 lb test line, exceptions being that anglers fishing double or triple hooks will use heavier rods and line. Silver seatrout are caught infrequently in mixed catches with sand seatrout in deep holes and within the ship channels. Most anglers do not recognize a difference between the two species of seatrout, and they are collectively referred to as 'white trout' in Alabama. 'White trout' have been noted in live wells of offshore vessels prior to a fishing trip, with the intent of using sand and silver seatrout as live bait for snapper and grouper. Average length at harvest for sand seatrout is 11 inches FL (Figure 6.4).

6.1.2.3 Mississippi

In 2008, 145,754 anglers (in-state and out of-state anglers combined) participated in Mississippi's saltwater recreational fishery (Figure 6.6C), taking 968,800 saltwater angling trips. The majority of these anglers (119,398) reside in the three coastal counties, Hancock, Harrison, and Jackson. Participation numbers have remained steady since the early 1990s, with dips in 1998-1999, possibly due to Hurricane George and, in 2005-2006, probably due to Hurricane Katrina. Participation has been increasing to the current level, which other than 2007, has not returned to pre-Katrina numbers. There have been wide fluctuations in the annual harvest of *C. arenarius* since 1981, ranging from 0.24 million in 1993 to 1.4 million fish in 1999, with an average of 0.68 million fish (Figure 6.7C) (NMFS unpublished data).

Through the MRFSS survey, most Mississippi anglers list "No Particular Species" when asked if they are targeting any specific species of fish. However, among anglers that do target particular fish species, 'sand seatrout' is very popular, consistently ranking in the top five species targeted for both boat and shore anglers. During the winter months, they are often targeted by inshore charter and guide boats as well. Southern kingfish (*M. americanus*) are often targeted and

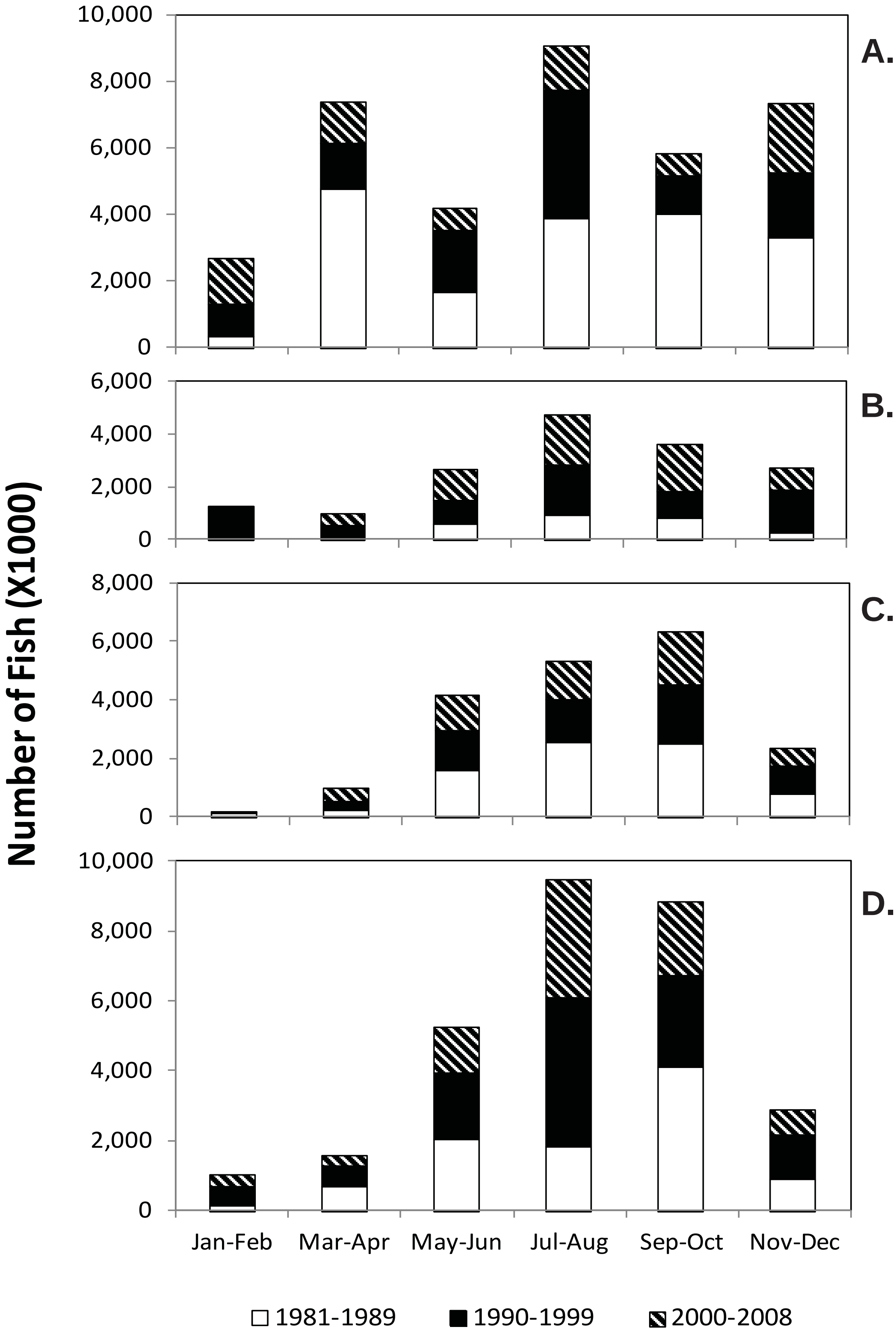

Figure 6.8 Cumulative bimonthly recreational sand seatrout (*Cynoscion arenarius*) landings for **A.** West Florida, **B.** Alabama, **C.** Mississippi, and **D.** Louisiana for 1981-2008 (NMFS unpublished data).

harvested in conjunction with sand seatrout. Sand seatrout are primarily caught inshore using dead shrimp or cut bait over sand substrate and oyster reefs, although they can also be found offshore around oil rigs and other artificial reefs. The majority of sand seatrout in Mississippi are harvested between May and October, although a large number are still harvested during the colder months of November and December (Figure 6.8C). Sand seatrout in Mississippi have been harvested from 4-30 inches, with the majority of those fish ranging between 8 and 14 inches (Figure 6.4) (NMFS unpublished data).

Silver seatrout harvest is rare in Mississippi, although it is thought that they are perhaps misidentified and 'lumped in' collectively with sand seatrout as 'white trout'. They can, however, be found on offshore reefs, deep holes, and ship channels.

6.1.2.4 Louisiana

The total number of recreational anglers in Louisiana has increased steadily since the early 1990s. Participation in Louisiana's saltwater recreational fishery, including non-coastal residents and out-of-state anglers, was estimated at an average of 1.1 million fish harvested annually since 1981 (Figure 6.6D). The number of sand seatrout landed has varied since the 1980s, with a notable increase in 1983 (Figure 6.7D). The total number caught annually has fluctuated widely, ranging from 0.1 million to 2.4 million. Silver seatrout have been reported infrequently in the MRFSS database. The number of silver seatrout reported has ranged from 574,651 in 1983 to 676 fish in 2006 with no discernable pattern (Table 6.2).

The sand seatrout landed in Louisiana averaged 26% of all the sand seatrout recreationally harvested from the Gulf of Mexico, the majority of which were landed in Jefferson (Grand Isle), Lafourche, and Orleans Parishes. These three parishes account for 53% of the state harvest from 1998-2008 (Bray Personal Communication).

Despite the significant landings, sand and silver seatrout are rarely targeted by recreational anglers in Louisiana and occur more as incidental catch by anglers targeting other species. The 2008 MRFSS survey indicated that 0.5% of surveyed anglers reported 'miscellaneous seatrouts' as their target species. Sand and silver seatrout make up a significant portion of the catch by anglers targeting red drum and spotted seatrout. While sand and silver seatrout may not be the targeted species, they are still considered a desirable catch and contribute to the enjoyment of the fishing experience.

Much of the directed recreational fishery for sand and silver seatrout may be attributed to the lack of creel limits and overlap of habitat with spotted seatrout under certain conditions. Anglers targeting spotted seatrout will also target sand and silver seatrout concurrently due to similar bait and tackle. The majority of the annual catch of sand (and silver) seatrout occurs in the late summer/early fall (Figure 6.8D). According to 1981-2007 Louisiana wave landings, on average, 63% of the annual catch is landed in the months of July-October.

6.1.2.5 Texas

Sand seatrout (*C. arenarius*) are the one of the most abundant recreationally caught fishes in Texas (Green and Campbell 2005) with around 300,000 fish reported annually in the 1980s and around 100,000 in recent years (Figure 6.7E). Silver seatrout are nearly absent in the recreational catch in Texas waters and, therefore, will not be reported in this discussion. For the 10-year period May 1993-May2003, sand seatrout were the second most abundant fish (12%) landed by private boat anglers, behind spotted seatrout, from bays and passes. Most (65%) were landed in Galveston Bay. During the same period, sand seatrout were the fourth most abundant fish (9%) landed from Texas Territorial Seas (TTS), behind spotted seatrout, red snapper (*Lutjanus campechanus*), and king mackerel (*Scomberomorus cavalla*).

The TPWD has been conducting recreational angler surveys since mid-1974. Beginning May 15, 1991, one member of each angling party was randomly selected and asked what species of fish they were targeting for that trip. For the statistics described below, the anglers that answered the 'species sought' question are treated as a representative sub-sample of the angling population with the assumption that the purpose of the angling trip was to catch that particular set of preferred species.

From 1991-2008, only 0.23% of recreational anglers in Texas targeted sand seatrout exclusively (TPWD unpublished data). Approximately 71% of angling trips that targeted only sand seatrout were successful at landing sand seatrout and 41.1% landed only sand seatrout. Of those successful trips, the angling parties landed an average of 31.6 sand seatrout per trip. The most abundant species landed with sand seatrout were Atlantic croaker (*Micropogonias undulatus*) and southern kingfish (*Menticirrhus americanus*). The baits used most often to catch sand seatrout were dead shrimp, live shrimp, and worm jigs.

Approximately 84% of sand seatrout landed in Texas were caught by anglers targeting other species, combination of sand seatrout and other species, or that had no preference in catch. Only 3.8% of angling parties that did not specifically target sand seatrout actually landed sand seatrout. Of those that landed sand seatrout, the average number landed per trip was 6.5 fish.

Since 1992, a significant decline in preference for sand seatrout has occurred from around 0.4% of all the recreational saltwater anglers in the early 1990s to >0.05% in 2008. Consequently, recreational landings of sand seatrout have declined over the years (Figure 6.9). However, trends in abundance of adult sand seatrout in Texas' waters have shown a slight increase in population (TPWD unpublished data) indicating that the declines in preferences and landings do not have a biological cause. Most likely, the declines represent a shift in preferred species as spotted seatrout, red drum, and sheepshead experienced a significant increase in angler preferences over the same time period.

6.2 Commercial Fishery

6.2.1 History

The commercial use of sand and silver seatrout is not large as indicated by the total landings (Table 6.4). However, the value of these two species as a fresh fish product is high. Sand and

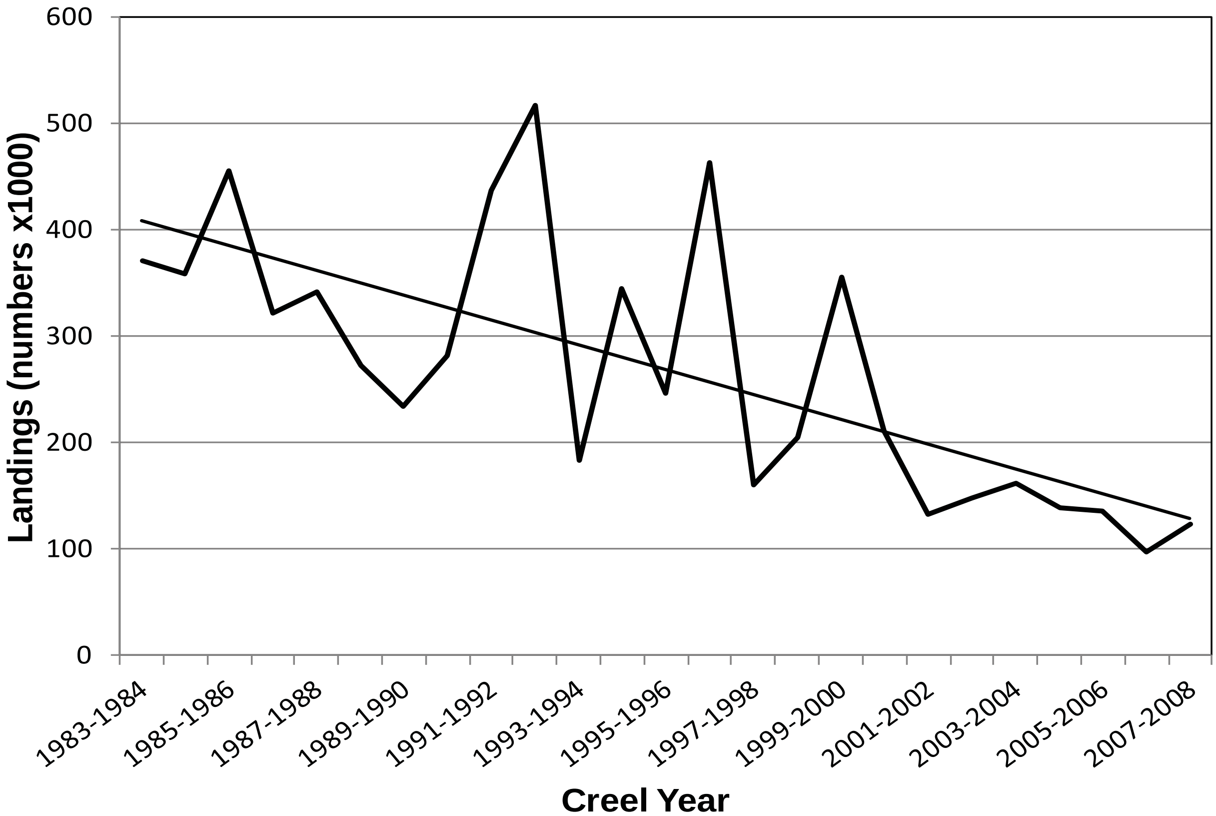

Figure 6.9 Texas recreational landings for sand and silver seatrout (*Cynoscion arenarius* and *C. nothus*). ***Note:*** Creel year is from May 15-May 14; silver seatrout make up <2% of landings; TPWD unpublished data.

silver seatrout are frequently sold in combination with spotted seatrout filets since the quality of the meat is similar. As a long-term or frozen product, sand and silver seatrout is less desirable. Most of the sand and silver seatrout landings up until the 1980s and 1990s resulted from bycatch in several of the larger trawl fisheries (the Atlantic croaker food fish fishery, and the Gulf shrimp fishery, and to a lesser extent, the butterfish fishery) and most were processed for use as fishmeal.

The Gulf industrial groundfish fishery (dominated by sciaenids) began in 1952 when canneries started to process small groundfish caught as bycatch in shrimp trawls for pet food. In the late 1960s, these fish were targeted by special trawlers for human finfish consumption (Roithmayr 1965). Gutherz et al. (1975) provided a good review of the industrial groundfish fishery in the northern Gulf of Mexico from 1952-1973. While Atlantic croaker was the targeted species in both of these fisheries, a combination of Atlantic croaker, spot (Leiostomus xanthurus), and trout (sand and silver) often made up as much as 98% of the total catch. Gutherz et al. (1975) pointed out that both fisheries sorted and saved all edible finfish and shrimp for separate onshore sale. In 1972, the combined landings from these two fisheries exceeded 100 million pounds. The primary fishing grounds for both fisheries were from Mobile Bay to Ship Shoals in western Louisiana (Haskell 1961). The pet food plants in Pascagoula and Biloxi, Mississippi, and Golden Meadow, Louisiana, closed by the late 1970s when the market for fish meal as pet food declined and the Atlantic croaker stocks appeared to decline as well (Franks personal communication).

Table 6.4 Total annual sand and silver seatrout (*Cynoscion arenarius* and *C. nothus*) commercial landings (lbs) by state from 1950-2008 (NMFS unpublished data; NA indicates data not reported).

YEAR	WFL	AL	MS	LA	TX	Gulf
1950	181,600	24,100	53,800	208,500	2,300	470,300
1951	397,200	35,300	40,200	59,000	23,200	554,900
1952	205,500	43,700	294,300	30,400	NA	573,900
1953	127,900	34,900	697,100	34,800	NA	894,700
1954	74,100	48,200	1,339,800	30,900	32,000	1,525,000
1955	40,500	75,400	1,855,100	19,900	NA	1,990,900
1956	35,500	44,000	1,226,900	39,200	NA	1,345,600
1957	44,900	10,600	62,900	69,100	1,100	188,600
1958	82,300	18,500	53,400	56,400	400	211,000
1959	53,900	41,600	67,500	63,500	9,700	236,200
1960	78,200	24,600	26,300	50,100	6,000	185,200
1961	251,500	33,400	69,100	81,700	NA	435,700
1962	55,000	62,000	63,600	115,200	NA	295,800
1963	68,500	77,900	68,200	79,600	NA	294,200
1964	42,900	65,100	26,100	66,100	NA	200,200
1965	169,200	108,000	27,100	60,500	NA	364,800
1966	197,400	101,600	173,800	70,200	NA	543,000
1967	183,100	149,300	174,100	73,600	43,600	623,700
1968	110,600	325,700	310,900	112,900	20,000	880,100
1969	107,000	816,000	131,600	100,600	18,300	1,173,500
1970	256,500	750,600	105,300	139,600	1,000	1,253,000
1971	278,300	980,000	163,200	131,700	1,900	1,555,100
1972	243,600	936,200	157,300	148,800	20,000	1,505,900
1973	225,500	1,522,500	118,800	152,100	6,400	2,025,300
1974	234,300	1,590,800	266,800	146,800	1,000	2,239,700
1975	175,900	1,971,200	264,600	166,300	15,000	2,593,000
1976	143,500	1,336,600	169,300	75,300	45,000	1,769,700
1977	168,400	448,600	40,400	89,200	6,500	753,100
1978	216,869	779,498	82,550	100,789	6,381	1,186,087
1979	415,197	796,296	32,290	98,595	9,803	1,352,181
1980	244,451	775,150	39,600	109,317	3,411	1,171,929
1981	386,544	662,851	39,850	94,207	16,044	1,199,496
1982	221,373	713,698	69,050	30,538	3,484	1,038,143
1983	136,777	363,017	73,240	94,087	1,162	668,283
1984	130,558	219,468	41,380	281,486	4,500	677,392
1985	129,660	202,249	47,444	243,082	4,927	627,362
1986	184,519	164,974	60,555	234,422	5,296	649,766
1987	131,581	132,532	60,537	227,721	6,451	558,822
1988	111,068	54,754	50,956	186,260	463	403,501
1989	89,986	49,630	80,195	87,298	4,394*	311,503

YEAR	WFL	AL	MS	LA	TX	Gulf
1990	99,863	56,246	45,789	114,022	1,017*	316,937
1991	105,405	68,008	21,843	141,595	3,190	340,041
1992	107,521	120,472	12,274	144,507	660*	385,434
1993	64,116	142,857	30,765	138,947	57	376,742
1994	103,070	141,381	109,823	235,847	573	590,694
1995	63,967	73,320	72,224	98,474	423	308,408
1996	21,187	77,746	49,431	42,825	108	191,297
1997	20,239	84,420	29,855	29,273	330	164,117
1998	20,854	47,682	26,261	30,750	281	125,828
1999	25,894	45,995	110,967	26,953	548	210,357
2000	25,058	41,209	41,804	56,001	376	164,448
2001	18,860	39,219	43,073	23,956	NA	125,108
2002	17,102	51,088	46,548	29,092	50	143,880
2003	15,693	33,801	39,210	22,863	417	111,984
2004	6,474	13,312	34,805	16,108	202	70,901
2005	7,350	14,759	39,238	10,335	705	72,387
2006	14,958	17,659	12,486	17,213	218	62,739
2007	20,755	43,468	13,606	12,721	453	91003
2008	21375	34335	17433	8412	192	81747

* Data supplied by TPWD not NMFS for these years

The Gulf's shrimp fishery may have contributed significantly to overall mortality of juvenile and adult sand and silver seatrout, along with many of the sciaenids (Gunter 1936, Juhl and Drummond 1976, Fuls et al. 2002). Bottom trawling for shrimp in the Gulf of Mexico has been ongoing since the early 1900s; however, estimates of bycatch and discards were not available from NMFS in detail prior to 1972. Diamond et al. (1999) suggest that shrimp trawl bycatch could have been considerable prior to 1972 because of the rapid growth of the fishery. They noted that in 1940, there were an estimated 2,500 otter trawls actively fishing in the Gulf and over 5,400 trawls fished by 1948 (NMFS various years). See Section 6.3 for more discussion of the commercial fleet's bycatch contributions to sand and silver seatrout mortality.

Gledhill (1991) reported on the butterfish (Peprilus burti) fishery in the Northern Gulf of Mexico by converting traditional shrimping vessels and gear starting around 1986. The fishery was initiated when freezer trawlers that normally fished the New England butterfish and squid fisheries came to the Gulf. The boats fished until 1989 and then returned to New England; however, a few Gulf vessels continued to fish until the early 1990s. Annual estimates of butterfish bycatch range from 4,931 metric tons in 1972 to 23,462 metric tons in 1987. While most of the butterfish harvest occurred in the 129-185 m (70-100 fathoms) depth range along the edge of the continental shelf, a number of non-target species occurred in the catch, at times making up as much as one-third of the total finfish landed (Vecchione 1987). Vecchione (1987) includes silver seatrout as a commonly caught species although it is not part of the six species making up the majority of bycatch.

The total U.S. commercial landings of sand and silver seatrout come primarily from the Gulf of Mexico region. These overall landings peaked in the 1970s at 2.6 million lbs and then have declined since to an average of 116,000 pounds since 1998. During the peaks in the 1970s, the bulk of these commercial Gulf landings came from Alabama (Figure 6.10). However, in the 1980s and early 1990s the majority of the commercial landings came from Louisiana, averaging 185,000 pounds between 1984 and 1994 (Figure 6.11). In recent years, the commercial landings have been split fairly evenly between all states except Texas, whose commercial sand and silver seatrout landings have been extremely small.

Between 1981 and 2008 the primary commercial gears used to harvest sand and silver seatrout in the Gulf were trawls and 'other gears' (Figure 6.12). NOAA's category 'other gears' excludes vertical lines and gillnets. Sand and silver seatrout are taken commercially year-round in all Gulf states, with a greater percentage of the landings occurring in Alabama in October (Figure 6.13).

6.2.2 State Fisheries

6.2.2.1 Florida

Historically, entangling nets (gill nets and trammel nets) accounted for the majority of gear being used in Florida's commercial fishery (Figure 6.14A). Since the net limitation amendment of July, 1995, cast nets and hook-and-line have been the primary gears for commercial sand seatrout

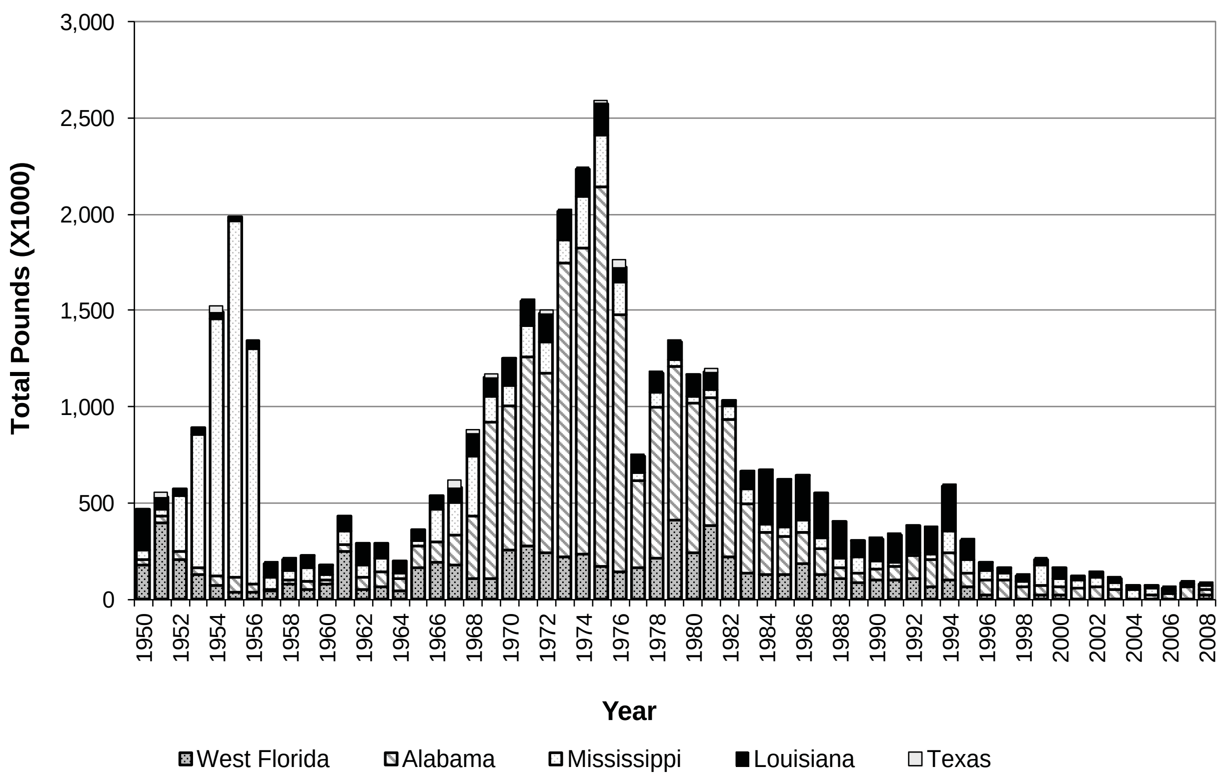

Figure 6.10 Gulf-wide commercial landings of sand and silver seatrout (*Cynoscion arenarius* and *C. nothus*) by state in the Gulf of Mexico from 1950-2008 (NMFS unpublished data).

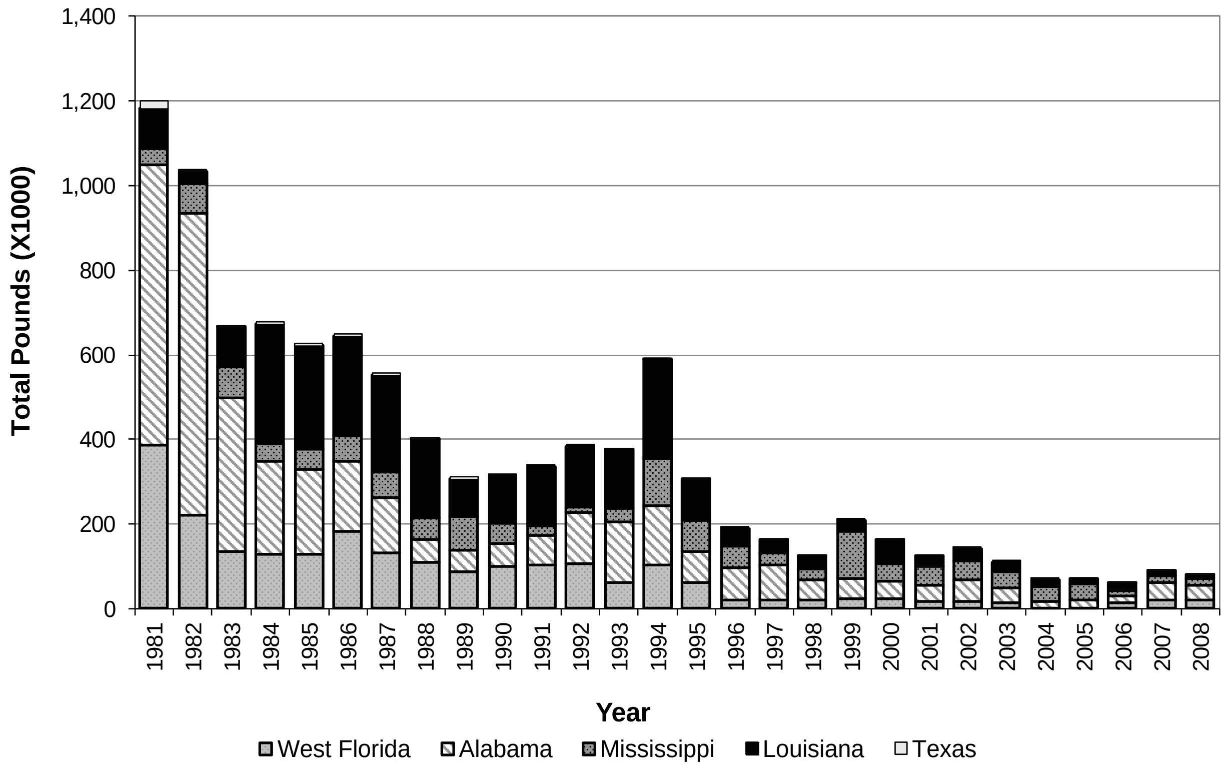

Figure 6.11 Gulf-wide commercial landings of sand and silver seatrout (*Cynoscion arenarius* and *C. nothus*) by state in the Gulf of Mexico from 1981-2008 (NMFS unpublished data).

(C. arenarius) harvest. The net limitation amendment greatly decreased the amount of sand seatrout landed commercially in Florida (Figure 6.15A). Prior to the limitation, an average of 137,000 lbs of sand seatrout were harvested commercially in Florida. From 1996 to the present, that average dropped to about 18,000 lbs of sand seatrout per year. In 2008, Florida ranked second (in pounds) for sand seatrout caught in the Gulf of Mexico, with 26% of the catch.

Like the recreational fishery, the majority of the commercially harvested sand seatrout in Florida come from the Panhandle area, specifically Pensacola (Escambia county) representing about 70% of the landings since the net limitation amendment (Figure 6.16 and Figure 6.17). The next largest area for commercial landings since the net limitation amendment is the Big Bend, specifically Apalachee Bay, representing about 8% of the landings. Few sand seatrout are taken commercially in the Keys or the southwest region of the state.

The majority of the commercial landings prior to 1995 were reportedly taken in March, but since then, have been taken fairly consistently in all months of the year, with landings in February and July being slightly larger than the other months (Figure 6.18).

6.2.2.2 Alabama

The importance of sand and silver seatrout to the present day commercial fisheries is small compared to the historical landings (Figure 6.15B). Estimated landings of sand and silver seatrout

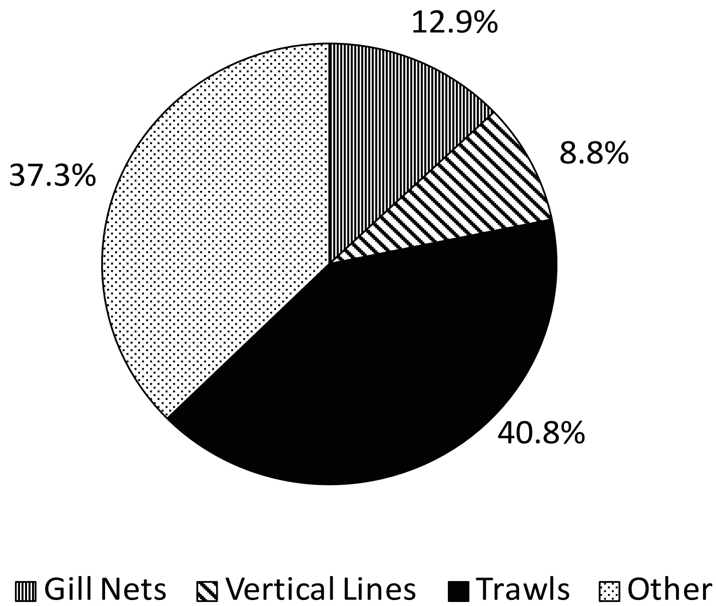

Figure 6.12 Percent of total commercial landings of sand and silver seatrout (*Cynoscion arenarius* and *C. nothus*) by major gear type from 1981-2008 for west Florida, Alabama, Mississippi, and Louisiana (NMFS unpublished data; vertical includes hook-and-line as well as bandit gear, etc.).

from 1981 to 1989 averaged 314,193 lbs annually. Average annual landings for the following decade were decreased by 73% to 86,176 lbs. Declines in landings were due to regulations imposed in 1983, which made the harvest of spotted seatrout illegal with the intent to sell. Fishermen could retain the fish, but only for personal consumption. In 1985, spotted seatrout and red drum were declared game fish, which made possession by commercial fishermen illegal. The most recent decade, 1999-2008, landings of sand and silver seatrout have been relatively stable averaging 33,485 lbs annually. Gill nets currently are the principle gear for harvesting sand and silver seatrout in the estuarine waters, but a smaller portion are landed by hook-and-line (Figure 6.14B). The catches in gill nets are principally bycatch. Average size in the commercial harvest is 11 inches FL (Figure 6.19), but the commercial hook-and-line average is 12 inches FL.

6.2.2.3 Mississippi

Historically, trawl nets accounted for the majority of commercial landings of sand and silver seatrout in Mississippi. From 1950 to 1990, the majority of sand and silver seatrout were taken by trawls. In 1993, there was a shift in gear type from trawls to entanglement nets and vertical lines, with vertical lines becoming the sole gear type from 2006-2008 (Figure 6.14C). In 1955, over 1.85 million lbs of sand and silver seatrout were landed in the state of Mississippi, as part of the industrial groundfish fishery. Landings fell off in 1957, and have not reached over 310,000 lbs since 1968. In the early 1970s, there was a slight rebound in sand and silver seatrout landings, peaking in 1974 and 1975 at approximately 260,000 lbs annually, but landings declined again sharply in 1977. The commercial landings for all gear types from 1981-2008 have fluctuated annually but have averaged around 49,000 lbs per year (Figure 6.15C).

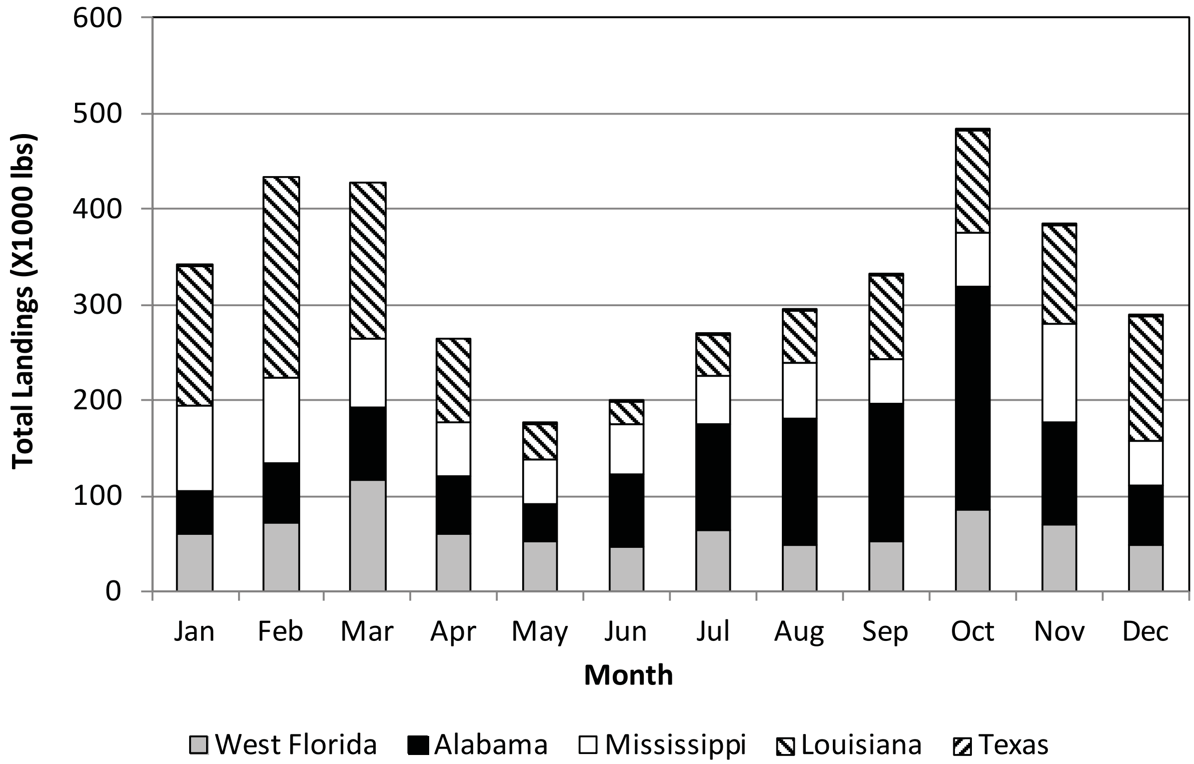

Figure 6.13 Cumulative monthly commercial landings of sand and silver seatrout (*Cynoscion arenarius* and *C. nothus*) reported from 1990-2008 combined (NMFS unpublished data).

6.2.2.4 Louisiana

Currently, the importance of sand and silver seatrout to the commercial fisheries of Louisiana is insignificant compared to the historical landings. Sand and silver seatrout were harvested in relatively large quantities during the 1980s and early 1990s, but landings declined dramatically by 1996 (Figure 6.14D). This decline is most likely a direct reflection of a state law passed in 1995 that removed entanglement nets from state waters.

Hook-and-line is currently the principle gear for harvesting sand and silver seatrout in the estuarine waters (Figure 6.15D). Similar to the recreational fishery, the commercial sand and silver seatrout fishery functions mainly as a byproduct of other commercial fisheries. Louisiana trip ticket data shows for 2007, the total landings for 'white trout' (sand and silver combined) were 12,269 lbs which has a market value of $9,986 (Figure 6.20).

6.2.2.5 Texas

Commercial sand seatrout (C. arenarius) landings in Texas represent <1% of sand seatrout landings from the Gulf of Mexico. Most sand seatrout sold commercially in Texas are landed as bycatch in commercial shrimp trawls. There is no directed hook-and-line fishery although some sand seatrout may be caught incidentally in bandit rig fisheries.

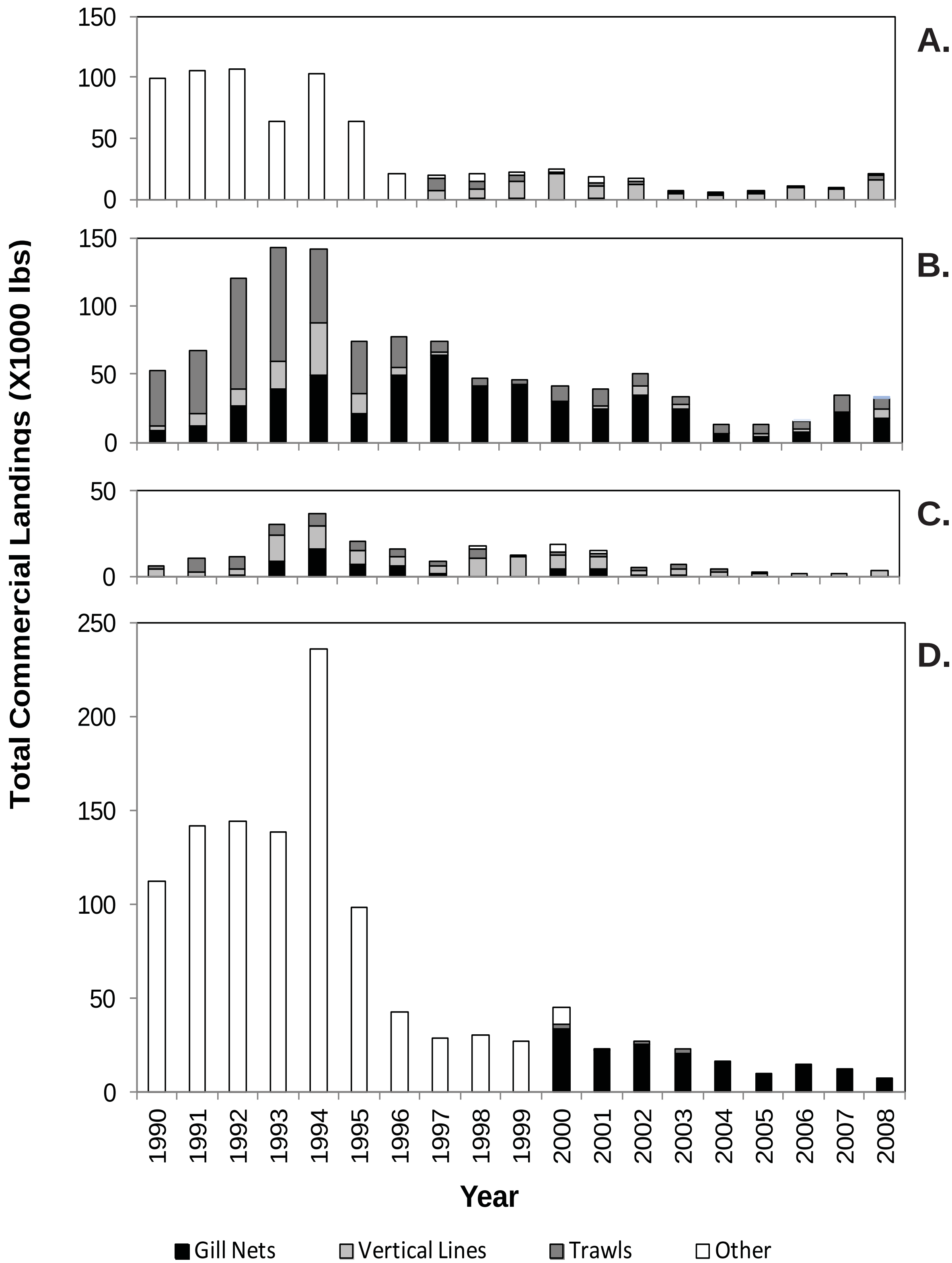

Figure 6.14 Annual commercial landings by gear type for **A.** West Florida, **B.** Alabama, **C.** Mississippi, and **D.** Louisiana; "other" includes not coded, combined gear, and everything else for all states (NMFS unpublished data).

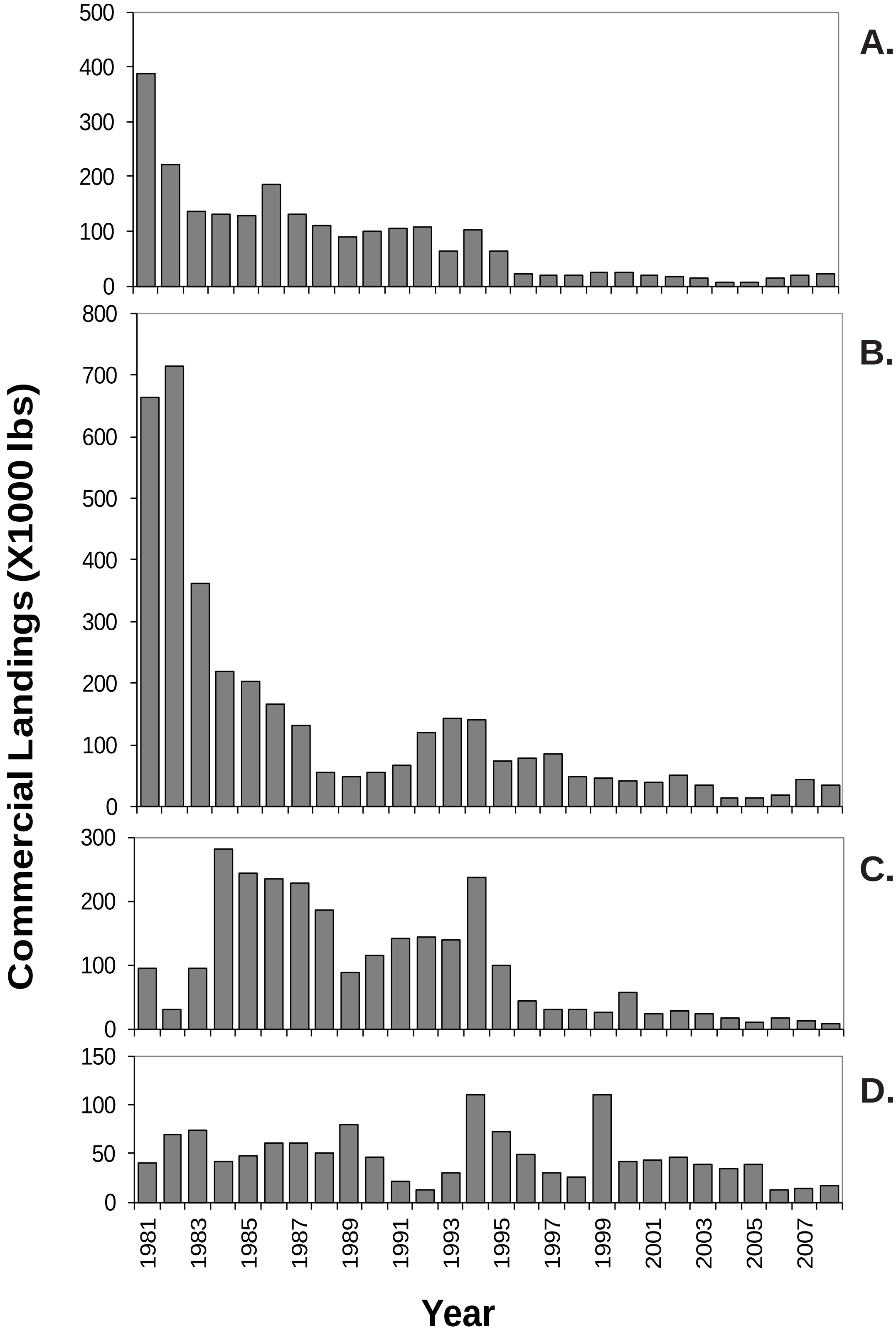

Figure 6.15 Total commercial landings of sand and silver seatrout (*Cynoscion arenarius* and *C. nothus*) for **A.** West Florida, **B.** Alabama, **C.** Mississippi, and **D.** Louisiana from 1981-2008 (NMFS unpublished data).

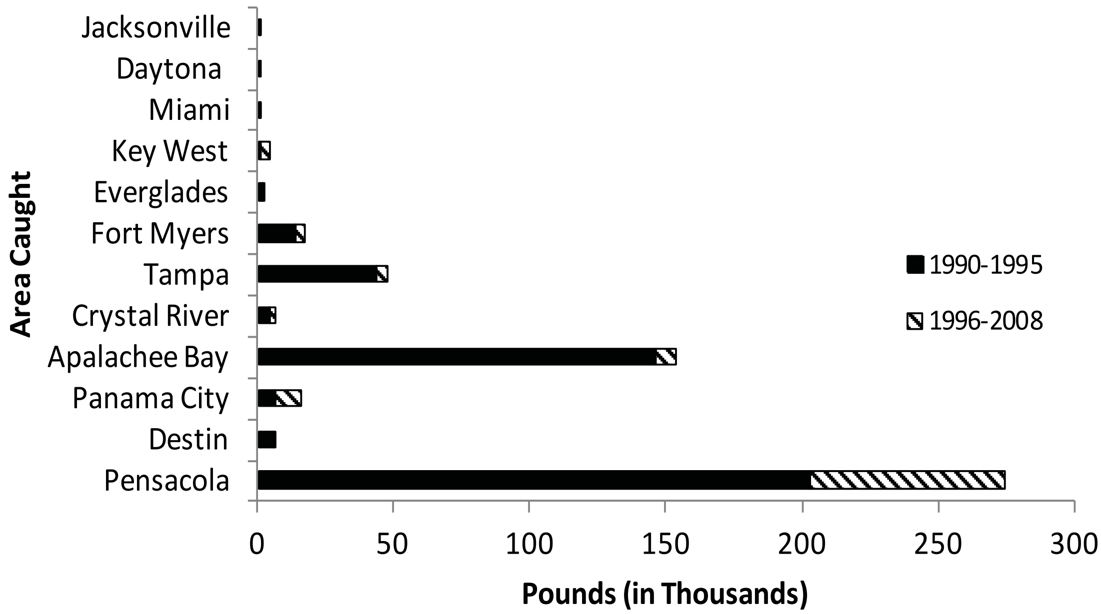

Figure 6.16 Florida landings of sand seatrout (*Cynoscion arenarius*) from Florida's trip tickets using area code from where fish were caught (area code wasn't required until 1996; FWC trip ticket data).

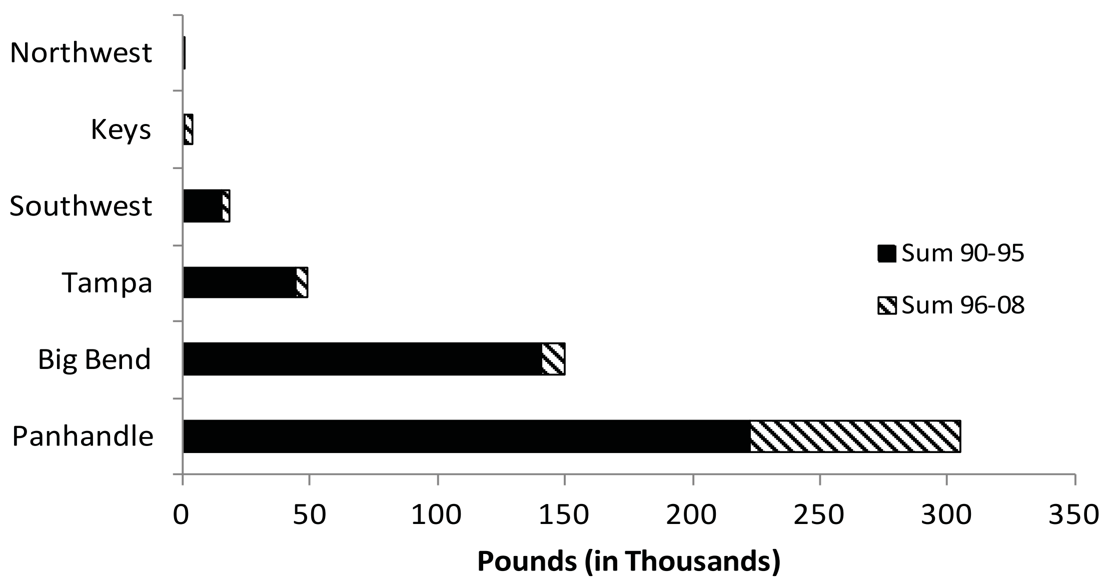

Figure 6.17 Florida regional landings of sand seatrout (*Cynoscion arenarius*) by combining county landings based on trip tickets (county where fish actually landed and sold; FWC trip ticket data).

Commercial landings of sand seatrout in Texas have declined over the years from a high of 45,053 lbs in 1976 to a low of 50 lbs in 2002 (Figure 6.21). Since 1992, landings have consistently remained under 1,000 lbs per year. Landings are lowest in the summer months (May-August) and highest in spring (February-April) and fall (September-November), peaking in March.

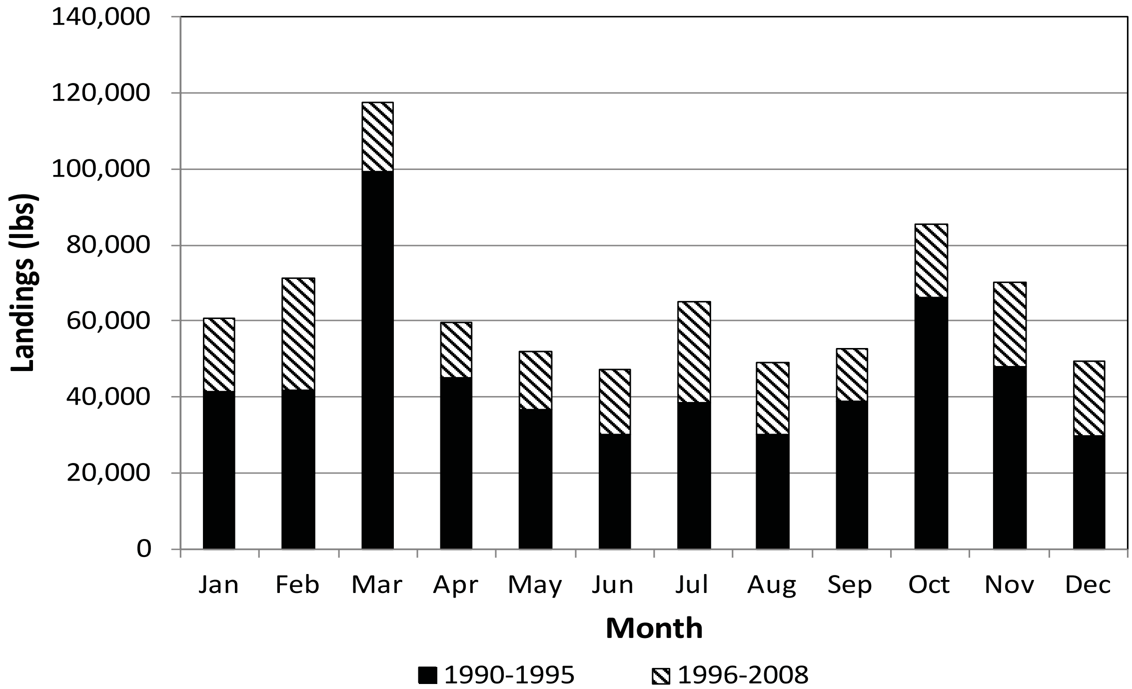

Figure 6.18 Cumulative landings of sand seatrout (*Cynoscion arenarius*) in Florida by month using trip ticket data for 1990-1995 and 1996-2008 (FWC trip ticket data).

The highest amount of landings come from Galveston Bay (34.5% of total landings since 1972), followed by Lower Laguna Madre and Corpus Christi Bay (19.9% and 13.4%, respectively, of total landings since 1972).

6.3 Incidental Catch

Although few recreational anglers target sand and silver seatrout, they are caught opportunistically, and it is rare to see them discarded. Sand and silver seatrout are harvested from as small as seven inches TL to as large as 30 inches TL. Almost all fish harvested are used for consumption, although smaller fish are sometimes used for live or cut bait.

Unwanted fish caught in commercial harvests, or bycatch, is not a new problem to the United States fishing industry. In 1907, the U.S. Bureau of Fisheries published a report in an effort to find a solution for bycatch suggesting that the only practical solution was to develop the utilization of those species having no market (Field 1907). In 1952, the fishing industry along the Gulf coast attempted to solve the problem with marketing small bottomfish, weighing less than one pound each and caught incidentally in shrimp trawls, by constructing a pet food plant in Pascagoula, Mississippi (Roithmayr 1965). The effects of the industrial bottom fish industry, as a solution to trawl bycatch, has been studied and found to have little effect upon the harvesting of commercial and sport fish species (Gunter 1956). Most sand seatrout sold commercially in Texas are landed as bycatch in commercial shrimp trawls. There is no directed hook-and-line fishery in the Gulf of Mexico.

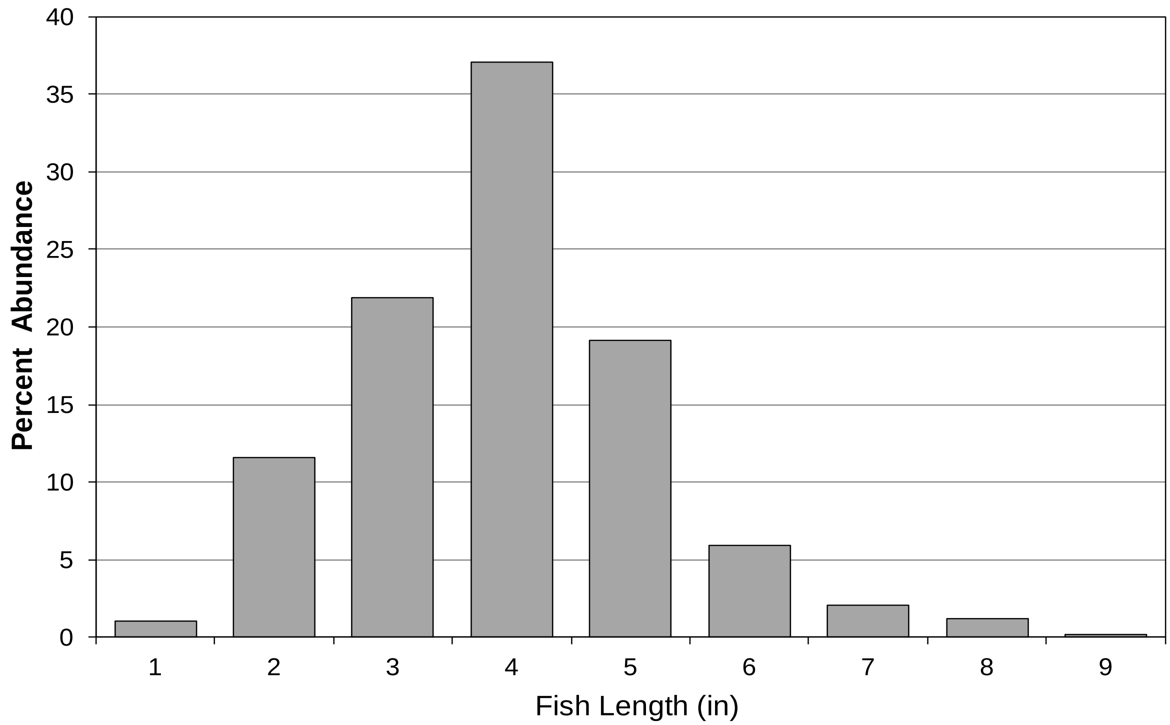

Figure 6.19 Sand seatrout (*Cynoscion arenarius*) length-frequency data from Alabama commercial catch (AMRD Trip Interview data).

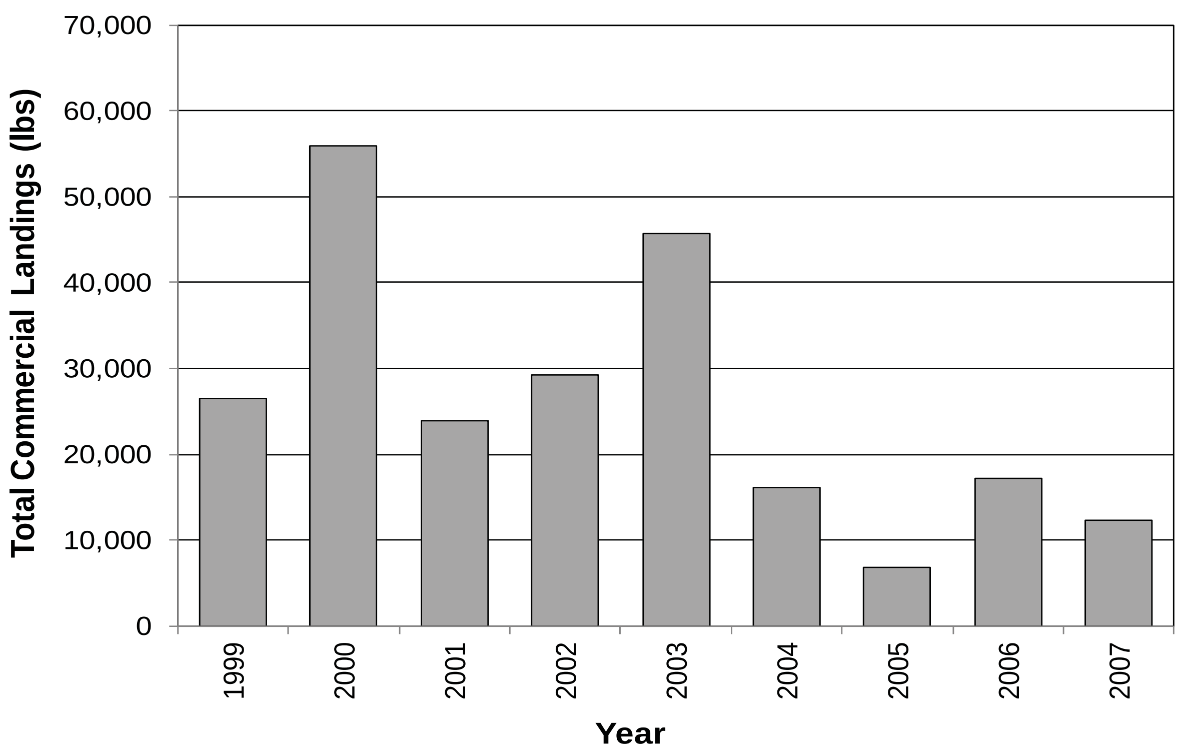

Figure 6.20 Louisiana's 'white trout' (sand and silver seatrout [*Cynoscian arenarius* and *C. nothus*] combined) landings from 1999-2007 (LDWF trip ticket data).

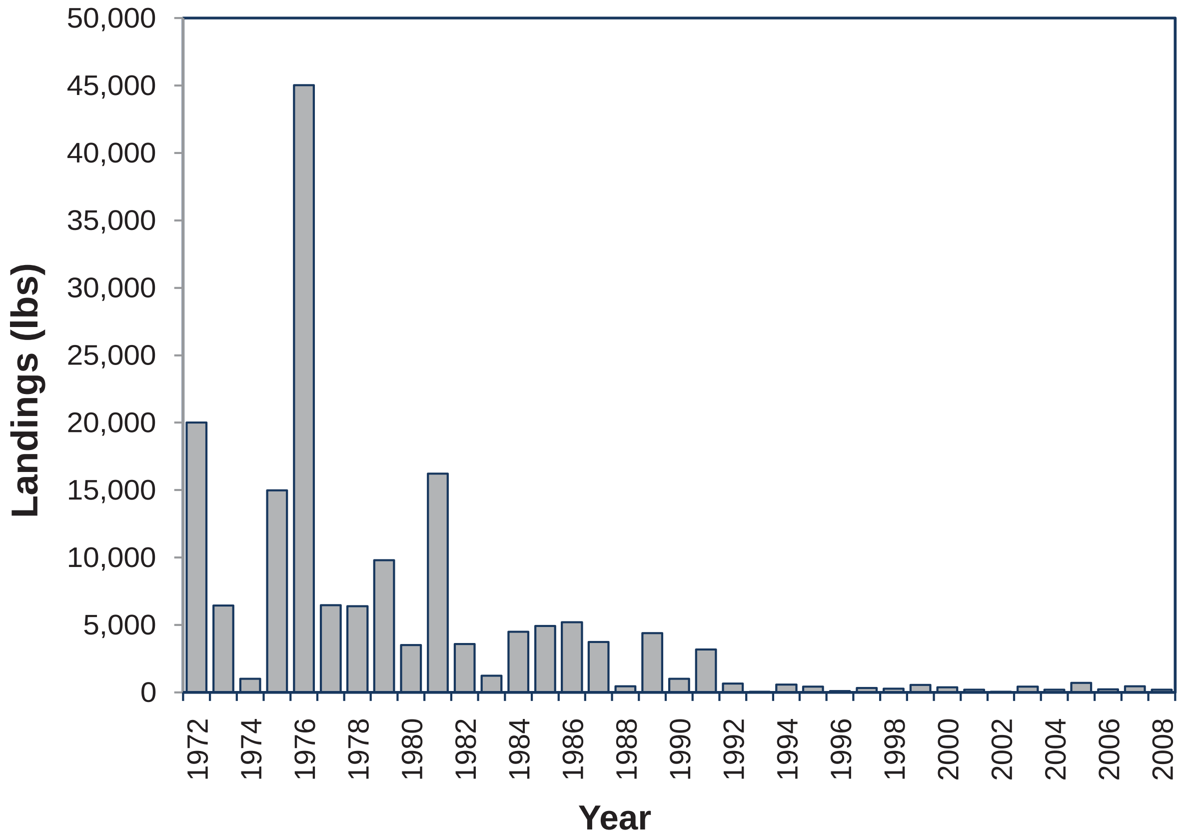

Figure 6.21 Annual commercial landings of sand and silver seatrout (*Cynoscion arenarius* and *C. nothus*) landed from Texas waters (TPWD unpublished data).

Shrimp trawl bycatch studies across the Gulf region indicate that sand seatrout is one of the most common species of fish caught as bycatch in inshore waters. Gunter (1936) found sand seatrout in similar abundance both in the inshore waters of Barataria Bay as well as the Gulf of Mexico south of Grand Isle, Louisiana, ranking second only to Atlantic croaker. Silver seatrout were also found in trawl samples, both in the bay as well as in the Gulf of Mexico, but in much fewer numbers than sand seatrout. Roithmayr (1965) also studied shrimp trawl bycatch from Ship Shoal and Golden Meadow, Louisiana, Gulfport and Pascagoula, Mississippi, and the southeast coast of Alabama from 1959-1962. Roithmayr, like Gunter (1936), found an abundance of sand and silver seatrout (in aggregate), ranking behind only Atlantic croaker and spot in numbers, and accounting for nearly 10% of the total composition for the entire study. Perret and Caillouet (1974) also reported sand seatrout third in frequency of occurrence and in numerical abundance in Vermillion Bay, Louisiana.

Dunham (1972) found similar results in a trawl study from 1970-1972 in Barataria Bay in Louisiana. Sand seatrout ranked third and silver seatrout ranked seventh in catch frequency for the entire study. The percentage of Atlantic croaker (the most frequent species in the study) fluctuated between 42-94%, except for June of 1971, when a low of 15% made up the catch. Silver seatrout made up the largest percentage (40.7%) at that time.

Shrimp trawl bycatch studies off Texas indicate that sand seatrout is one of the most common species of fish caught as bycatch in inshore waters. Lamkin (1984) and Bessette (1985) sampled catches from bait shrimpers in Galveston Bay. In the Lamkin (1984) study, sand seatrout was the second most abundant bycatch species by number and third most abundant by weight. Bessette (1985) found that sand seatrout was the fourth most abundant bycatch species by number and weight. Martinez et al. (1993) sampled both bay and bait shrimpers in Galveston Bay. In all, sand seatrout was the fifth most abundant bycatch species by number and fourth by weight.

A coastwide bycatch study was conducted by the TPWD from 1993-1995 in all Texas' major bay systems (Fuls et al. 2002). As in previous studies, sand seatrout composed a major component of the trawl bycatch, being the second most abundant bycatch species by number and the fourth by weight in the study. Sand seatrout were commonly among the top four most abundant bycatch species in all bay systems, along with Brevoortia patronus (gulf menhaden), Atlantic croaker, Anchoa mitchilli (bay anchovy), and Leiostomus xanthurus (spot). Sand seatrout were highly abundant both spring and fall seasons and showed very little spatial variation among bays.

A bycatch composition and abundance study was done in 1991 and 1992 by Coleman et al. (1992) for otter trawls in the panhandle of Florida, St. John's River, Tampa Bay, and Charlotte Harbor. Roller frame rigs in the Big Bend region off Ingles, Bayport, Keaton Beach, and Biscayne Bay were also sampled. Sand seatrout ranked in the top five most abundant species on each trip in the summer 1991 in Apalachicola Bay, Charlotte Harbor, January 1992 and April 1992; Dickerson Bay in April and May 1992; St. John's River June 1991; Pensacola Bay, June and July 1991; Tampa Bay, April 1991 and November 1991. Sand seatrout were also identified in samples from St. Andrews Bay and Choctawhatchee Bay, although not in significant numbers.

The Florida Finfish Excluder Device (FFED) was tested during trips to Choctawhatchee Bay in April-June, 1992. Numbers of sand seatrout were actually higher in the first trial of the FFED than in the control net without the device. During the second trial, numbers of sand seatrout were not significantly reduced by the FFED.

The menhaden purse seine fishery was surveyed in 1980 and 1981 by Guillory and Hutton (1982) for incidental catch. Forty-two samples were taken from three processing plants in Empire, Dulac, and Cameron, Louisiana. At Cameron and Dulac, approximately 86% and 77% of the samples contained <2% bycatch by number and weight, respectively. At Empire, 60% of the samples contained <2%. Of the incidental species taken, sand and silver seatrout (combined) were second in abundance, accounting for 19.7% of the bycatch. The modal size group for sand and silver seatrout was 170-179 mm SL. The maximum length group was 280-289 mm SL. Dunham (1972) also surveyed the menhaden purse seine fishery in 1971 and 1972, finding 0.05% and 1.59% bycatch, respectively. Sand and silver seatrout (combined) were taken in both years, ranking fifth in abundance of incidental species taken for both years. Between 2009 and 2010, the MDMR conducted 28 different onboard samplings of menhaden purse seines. Less than 2% of the total catch (by weight) was bycatch, and sand and silver seatrout (combined) composed 0.15% of the total weight landed (MDMR unpublished data).

7.0 ECONOMIC CHARACTERISTICS OF THE COMMERCIAL AND RECREATIONAL FISHERIES

Sand and silver seatrout (*Cynoscion arenarius* and *C. nothus*) are a component of the species mix which comprises the economically important nearshore commercial and recreational finfish fisheries in the Gulf of Mexico. The economic value associated with sand seatrout is derived from both commercial and recreational uses. Commercial economic value is partly derived from the economic activity associated with the commercial harvesting and sale of sand and silver seatrout. Recreational economic value would be partly generated by the economic activities associated with sand and silver seatrout anglers. In addition, a component of the general public may simply value the existence of sand seatrout stocks, without ever engaging in extractive uses, such as commercial harvest, purchasing sand seatrout products, or engaging in sand and silver seatrout angling.

For the purposes of the following discussion, the commercial economic value includes only the total amount paid by the first handler to the harvester during the initial off-loading of the fish. This is often referred to as the exvessel or dockside value. Markups that might occur in the subsequent market levels, from the first handler to the consumer, are not included. In addition, the recreational values discussed herein only include those associated with angler expenditures generated while targeting sand and silver seatrout. For both commercial and recreational sectors, the nonmarket-related values are not available.

Annual and monthly nominal (not adjusted for inflationary changes) dockside values will be discussed for each state and the Gulf in general. Annual and monthly nominal exvessel prices (i.e., the price per lb received by the harvester for the whole fish) will be discussed for the Gulf region, by state, and harvest gear type. Information on exvessel prices and dockside value provides basic insight into the economic importance of the commercial sand and silver seatrout harvest sector. Information on trends in Gulf commercial landings (lbs) is found in Section 6.2, Table 6.4, and Figure 6.19.

The following discussions are based on the NMFS reporting of commercial landings and values through the NMFS Office of Economics and Statistics and the data provided by the NMFS Fisheries Statistics Division website (www.st.nmfs.noaa.gov/st1/commercial/index.html).

7.1 Commercial Sector

7.1.1 Annual Dockside Value

7.1.1.1 Gulf-wide Annual Dockside Value

The dockside value of sand and silver seatrout landed in the Gulf of Mexico exhibited a general increasing trend from the late 1960s through the mid-1990s (Table 7.1). Nominal dockside value increased from $72,969 in 1969 to $225,919 in 1976, then decreased by 47% the following year. Dockside value increased to $291,702 by 1979, and remained about steady through 1988. During 1989, dockside fell by 41%, not recovering to previous levels until 1994, when dockside value reached an all-time record of $343,345. Dockside value then fell by 55% the following year

Table 7.1 Annual sand and silver seatrout (*Cynoscion arenarius* and *C. nothus*) dockside value in dollars (nominal, not adjusted for inflation) for the Gulf states, 1969-2008 (NMFS unpublished data, TPWD unpublished data).

Year	State					Gulf
	WFL	AL	MS	LA	TX	
1969	11,455	41,301	8,132	10,264	1,817	72,969
1970	23,621	43,279	8,214	10,077	104	85,295
1971	22,355	59,446	10,189	15,480	207	107,677
1972	19,581	56,764	12,688	16,482	2,859	108,374
1973	21,720	103,823	10,820	17,834	831	155,068
1974	37,892	121,564	27,361	17,025	146	203,988
1975	24,194	183,236	31,072	25,695	3,742	267,939
1976	22,909	152,035	20,225	12,053	18,697	225,919
1977	36,107	56,826	6,544	16,658	3,552	119,687
1978	51,620	126,207	14,139	23,191	3,876	219,033
1979	116,324	145,589	5,627	17,555	6,607	291,702
1980	61,197	153,204	7,835	23,292	1,358	246,886
1981	106,267	142,322	11,624	29,608	2,469	292,290
1982	75,408	180,690	22,723	11,031	1,129	290,981
1983	46,126	93,116	22,448	45,181	554	207,425
1984	52,906	57,831	12,642	122,914	2,756	249,049
1985	59,340	57,207	16,977	147,339	3,044	283,907
1986	84,562	48,415	21,549	140,434	1,943	296,903
1987	60,932	45,880	16,176	116,028	3,724	242,740
1988	46,665	19,413	19,515	145,240	185	231,018
1989	35,309	21,526	22,483	55,450	1,534	136,302
1990	44,245	27,761	14,589	85,111	599	172,305
1991	48,346	32,514	6,860	86,450	2,709	176,879
1992	55,397	55,627	5,486	89,829	264	206,603
1993	30,128	67,145	16,054	86,514	21	199,862
1994	54,765	73,786	59,979	154,488	327	343,345
1995	35,035	36,578	14,744	67,654	197	154,208
1996	14,221	42,489	23,020	29,082	39	108,851
1997	12,071	49,293	14,178	20,903	149	96,594
1998	15,940	26,077	14,777	25,287	113	82,194
1999	18,200	26,036	43,820	22,356	158	110,570
2000	21,427	21,572	23,188	58,968	285	125,440
2001	16,727	19,660	17,620	24,774	NA	778,781
2002	12,102	27,952	13,994	31,232	42	85,322

Year	State					Gulf
	WFL	AL	MS	LA	TX	
2003	9,956	19,304	13,655	25,454	193	68,562
2004	5,112	8,059	11,389	15,034	109	39,703
2005	6,436	9,575	12,676	9,777	647	39,111
2006	11,713	10,229	4,467	16,023	168	42,600
2007	15,150	28,429	4,421	10,344	311	58,655
2008	21,375	25,053	17,433	6,504	131	63,980

and began a steady downward trend through 2004-05, when dockside value reached approximately $39,000, which was almost half that reported for 1969. The dockside value increased slightly to $63,980 during 2008.

7.1.1.2 Annual Dockside Values by State

The dockside value for sand and silver seatrout on the Florida Gulf coast increased from $11,455 during 1969 to $51,620 during 1978. Dockside value then increased by 127% to $116,324, one of only two years in which the dockside value exceeded $100,000. The dockside value then decreased to $75,408 during 1982, and remained somewhat stable during the following 13-year period, when the value averaged approximately $50,300. Dockside value then began a steady decline beginning in 1996, with the lowest value for the 40-year period recorded during 2004 ($5,112). The dockside value increased somewhat to $15,064 during 2008.

The dockside value of sand and silver seatrout in Alabama increased from $41,301 in 1969 to $56,764 in 1972, then increased by 83% the next year to $103,823. With the exception of 1997, dockside value remained relatively high during the 10-year period. Dockside value then declined by approximately 50% during 1983, and began a steady decline through the next 25-year period. The lowest value was reached during 2004 ($8,059), with dockside values increasing to $25,053 during 2008, which was 39% lower that than recorded in 1969.

The commercial sand and silver seatrout dockside value in Mississippi was somewhat volatile during the 1969-2008 period, during which the average annual dockside value was $21,886 (Table 7.1). Dockside value was $8,132 in 1969, then increased for the next six years to $31,072 in 1975. Dockside value then fluctuated considerably during the next five years, never falling below $5,000, and only rarely exceeding $23,000. Notable exceptions include 1994 ($59,979) and 1999 ($43,820). Following 1999, dockside value began a steady decline until 2007 ($4,421), the year in which the lowest dockside value of the 40-year period was recorded. Dockside value increased to $12,688 in 2008.

The annual dockside value for sand and silver seatrout in Louisiana increased only slightly between 1969 and 1983, during which the average annual value was $19,428 (Table 7.1). However, dockside value increased dramatically during the 1984-1988 period, during which annual dockside value averaged $134,391. Dockside value fell by 62% to $55,240 in 1989, increasing to $154,488 in 1994. Dockside value then began declining steadily over the following 12 years, reaching $6,504 in 2008.

Among all states in the Gulf region, the dockside values for sand and silver seatrout were lowest for Texas over the last 40 years. The annual dockside value for sand seatrout harvested in Texas was $1,817 in 1969, and increased to a 40-year high of $18,697 in 1976 (Table 7.1). Dockside value then declined dramatically the following year, initiating a downward trend with some slight increases as seen during 1979, 1987, and 1991. The annual dockside value for sand seatrout in Texas declined to $131 in 2008.

7.1.2 Average Monthly Dockside Value

Average monthly, nominal dockside value for sand and silver seatrout in the Gulf region was computed for the five-year period including 2004-2008 (Table 7.2). The cumulative landings for 1990-2008 indicate that dockside value peaks during November-February on the Florida Gulf coast, with an additional peak occurring in July. Peak dockside values occur earlier in Alabama, with the highest values occurring during August-October. Average monthly dockside values for Mississippi and Louisiana typically peak in the winter and early spring and reach the lowest levels in the summer months. The reported average monthly dockside values for sand seatrout landings in Texas were minimal, with reported dockside values being the greatest in the winter and spring months.

Table 7.2 Average monthly sand and silver seatrout (*Cynoscion arenarius* and *C. nothus*) dockside value in dollars (nominal, not adjusted for inflation) by state, 2004-2008 (NMFS unpublished data, TPWD unpublished data).

Month	State				
	WFL	AL	MS	LA	TX
January	1,585	594	2,721	824	10
February	2,074	1,064	891	1,595	4
March	890	833	1,388	1,712	65
April	616	1,417	1,065	692	21
May	554	637	853	573	6
June	498	806	698	217	6
July	1,891	1,580	756	274	2
August	724	2,528	477	341	4
September	340	2,212	617	609	81
October	842	2,783	576	654	29
November	1,330	1,446	878	1,225	29
December	1,387	571	1,167	3,131	16

7.1.3 Annual Exvessel Prices

7.1.3.1 Gulf-wide Exvessel Prices

The nominal exvessel price (per pound, whole weight) for sand and silver seatrout has shown a steady increase over the 40-year period from 1969-2008 (Table 7.3). The Gulf-wide exvessel price increased from $0.06 in 1969 to $0.57 in 1988. Exvessel price then fluctuated around a mean of $0.53 during the 1989-96 period. Exvessel price then increased to $0.76 in 2000, then again to $0.78 in 2008. Over the 40-year period, exvessel price increased at an average annual rate of 4.6%.

7.1.3.2 Exvessel Prices by State

In general, exvessel prices for sand and silver seatrout exhibited an increasing trend across all states over the 40-year period from 1969 to 2008. However, some dissimilarities exist. For example, steady exvessel sand and silver seatrout price increases over the 40-year period were reported for the Florida Gulf coast and Alabama. Prices increased from $0.05 in 1969 to $0.73 in 2008 for Alabama, while prices increased from $0.11 in 1969 to $0.92 in 2008 for the Florida Gulf Coast. Prices for Mississippi were somewhat more erratic, with prices increasing steadily from $0.06 in 1969 to $0.55 in 1994, then decreasing to $0.32 in 2007. Prices increased again to $0.73 in 2008. Overall, exvessel prices for sand and silver seatrout in Louisiana only exceeded $1.00 for the four-year period of 2000-2003. Exvessel prices for Louisiana exhibited a nearly steady increase during the 1969-2003 period, increasing from $0.10 to $1.11 (respectively). Prices then declined steadily to $0.77 during 2008. The exvessel prices for sand seatrout in Texas increased

Table 7.3 Annual sand and silver seatrout (*Cynoscion arenarius* and *C. nothus*) exvessel price in dollars/lb (nominal, not adjusted for inflation) for the Gulf states, 1969-2008 (NMFS unpublished data, TPWD unpublished data; NA indicates data not reported).

Year	State					Gulf
	WFL	AL	MS	LA	TX	
1969	0.11	0.05	0.06	0.10	0.10	0.06
1970	0.09	0.06	0.08	0.07	0.10	0.07
1971	0.08	0.06	0.06	0.12	0.11	0.07
1972	0.08	0.06	0.08	0.11	0.14	0.07
1973	0.10	0.07	0.09	0.12	0.13	0.08
1974	0.16	0.08	0.10	0.12	0.15	0.09
1975	0.14	0.09	0.12	0.15	0.25	0.10
1976	0.16	0.11	0.12	0.16	0.42	0.13
1977	0.21	0.13	0.16	0.19	0.55	0.16
1978	0.24	0.16	0.17	0.23	0.61	0.18
1979	0.28	0.18	0.17	0.18	0.67	0.22

Year	State					Gulf
	WFL	AL	MS	LA	TX	
1980	0.25	0.20	0.20	0.21	0.40	0.21
1981	0.27	0.21	0.29	0.31	0.15	0.24
1982	0.34	0.25	0.33	0.36	0.32	0.28
1983	0.34	0.26	0.31	0.48	0.48	0.31
1984	0.41	0.26	0.31	0.44	0.61	0.37
1985	0.46	0.28	0.36	0.61	0.62	0.45
1986	0.46	0.29	0.36	0.60	0.37	0.46
1987	0.46	0.35	0.27	0.51	0.58	0.43
1988	0.42	0.35	0.38	0.78	0.40	0.57
1989	0.39	0.43	0.28	0.64	0.35	0.44
1990	0.44	0.49	0.32	0.75	0.59	0.54
1991	0.46	0.48	0.31	0.61	0.85	0.52
1992	0.52	0.46	0.45	0.62	0.40	0.54
1993	0.47	0.47	0.52	0.62	0.37	0.53
1994	0.53	0.52	0.55	0.66	0.57	0.58
1995	0.55	0.50	0.20	0.69	0.47	0.50
1996	0.67	0.55	0.47	0.68	0.36	0.57
1997	0.60	0.58	0.47	0.71	0.45	0.59
1998	0.76	0.55	0.56	0.82	0.40	0.65
1999	0.70	0.57	0.39	0.83	0.29	0.53
2000	0.86	0.52	0.55	1.05	0.76	0.76
2001	0.89	0.50	0.41	1.03	NA	0.63
2002	0.71	0.55	0.30	1.07	0.84	0.59
2003	0.63	0.57	0.35	1.11	0.46	0.61
2004	0.79	0.61	0.33	0.93	0.54	0.56
2005	0.88	0.56	0.32	0.95	0.92	0.54
2006	0.78	0.58	0.36	0.93	0.77	0.68
2007	0.73	0.65	0.32	0.81	0.69	0.64
2008	0.92	0.73	0.73	0.77	0.68	0.78

steadily from $0.10 in 1969 to $0.67 in 1979 (Table 7.3). Prices then became erratic over the next 24 years, exhibiting a cyclical trend that reached a low price every three-four years. During this time, low prices of $0.15 (1981) and $0.29 (1999) were reported, as were relatively high prices of $0.85 (1991) and $0.84 (2002). Prices reached a 40-year high of $0.92 in 2005, only to decline again to $0.68 during 2008.

7.1.4 Average Monthly Exvessel Prices

Average monthly, nominal exvessel prices for sand and silver seatrout in the Gulf region were computed for the five-year period including 2004-2008 (Table 7.4). Total commercial landings by state can be found in Table 6.4 and Figure 6.16. Monthly prices for the Florida Gulf coast were erratic, with a peak price being reported in the winter, and the lowest price being reported in late summer. Monthly prices were somewhat consistent across seasons for Alabama, with the highest prices being reported in the late summer. Prices were relatively lowest for Mississippi, where prices peaked in the summer and early fall months, and were lowest in the winter. Average monthly prices were relatively higher for Louisiana, where prices peak in the summer months and decline in the fall. The average monthly prices just for sand seatrout in Texas were highest from August through October.

7.1.5 Exvessel Prices by Type of Harvesting Gear

Factors such as seasonal shifts in landings and demand, supply of closely substitutable species, and region of harvest may affect the per pound exvessel price for sand and silver seatrout. In addition, the harvest gear used may have some influence on the exvessel price received. For example, a gear which allows the individually harvested fish to be handled more gently (less damage through crushing, tearing, etc.) may result in a perceived higher quality product. In addition, a fish brought to shore more quickly, such as those harvested on short 'day' trips, may be less subject to thermal abuse. If buyers recognize these quality attributes and a market for those attributes exist, a higher per unit price may result. Thus, a fish caught in an entangling net (which may be bruised and missing scales), caught in a trawl and subjected to crushing in the cod-end of the trawl, and a fish kept on ice through a long duration trip may bring a lower price than a fish caught on a brief hook-and-line trip.

Table 7.4 Average monthly sand and silver seatrout (*Cynoscion arenarius* and *C. nothus*) exvessel price in dollars/lb (nominal, not adjusted for inflation) by state, 2004-2008 (NMFS unpublished data, TPWD unpublished data).

Month	State				
	WFL	AL	MS	LA	TX
January	0.82	0.67	0.26	0.91	0.70
February	1.05	0.62	0.30	0.99	0.67
March	0.82	0.64	0.31	0.97	0.69
April	0.81	0.54	0.35	0.93	0.63
May	0.69	0.69	0.56	0.96	0.56
June	0.81	0.65	0.51	1.09	0.73
July	0.81	0.65	0.46	1.00	0.50
August	0.67	0.71	0.51	0.94	0.88
September	0.78	0.75	0.75	0.64	0.89
October	0.84	0.65	0.36	0.90	0.80
November	0.76	0.64	0.43	0.89	0.73
December	0.81	0.68	0.35	0.89	0.56

Nominal exvessel prices were computed for landings of sand and silver seatrout by gear type (Table 7.5). These prices represent exvessel prices landed across all states in the Gulf of Mexico region during the 2004-2008 period. The prices were computed by dividing total nominal exvessel value for each gear type by the respective landings for each gear type. The gear types selected for comparison include those that accounted for the majority of the landings on a gear type basis. The gear types selected included trawls, various entangling nets, hand lines, electric and hydraulic reels, and cast nets, as well as a category of gear types not specifically identified ('Combined Gears'). The data reported by gear type represent only a portion of the total landings (71%) and value (84%) for the sand and silver seatrout fishery in the Gulf of Mexico during the five-year period.

The prices by gear type are shown as the average annual price across the five-year period. Note that the data suggest that the majority of the sand and silver seatrout are caught on rod/reel and hand lines, with entangling nets and electric/hydraulic reels also being important gear types. The highest exvessel prices are associated with cast nets ($0.94) and electric/hydraulic reels ($0.92), while the lowest exvessel prices are associated with landings harvested by trawls ($0.51) and entangling nets ($0.68).

7.1.6 Processing and Marketing

7.1.6.1 Market Channels

Information on the role that sand and silver seatrout play in regional seafood markets is scarce. Anecdotal evidence suggests that some commercially harvested sand and silver seatrout enter the commercial seafood markets. To provide some insight into the commercial market channels, a brief survey was administered to seafood buyers in the Gulf region. The survey instrument (see

Table 7.5 Nominal average annual sand and silver seatrout (*Cynoscion arenarius* and *C. nothus*) landings, dockside value, and exvessel price by select gear type for the Gulf of Mexico, 2004-2008 (NMFS unpublished data).

	Rod/Reel and Hand Lines	**Electric and Hydraulic Reels**	**Gill and Trammel Nets, and Haul Seines**	**Cast Nets**	**Trawls[2]**
Landings[1] (lbs)	88,860	43,849	56,898	6,863	12,604
Dockside Value ($)[1]	75,778	40,401	38,584	6,452	6,400
Exvessel Price ($/lb)[1]	0.85	0.92	0.68	0.94	0.51

[1] The data represent aggregate landings, value, and price for 2004-2008. The data reported by gear type represent only a portion of the total landings (71%) and value (84%) for the sand and silver seatrout fishery during the 5-year period.
[2] Trawls include otter trawls and skimmers.

Appendix 12.2) was designed to be completed by NMFS Port Agents as they visited fish houses in their respective areas, thereby completing the questions with brief personal interviews of the fish house managers and staff. The firms that participated in the survey do not represent a statistically relevant sample of all seafood handlers in the region, but rather an informal complement of first-buyers, wholesalers and distributors deemed likely to have handled either of the two species in 2009. Thus, the findings do not represent a rigorous description of the commercial market channels for sand and silver seatrout in the Gulf region. The survey instruments were initially distributed to the NMFS Port Agents in the Gulf region. The Port Agents were asked to complete the survey instruments as they visited each fish house during their normal visitation schedule, or contact the fish house via telephone. **Note:** *to avoid product confusion, the survey combined both species and did not differentiate between sand or silver seatrout.* The completed surveys were then returned via mail or fax to the Gulf States Marine Fisheries Commission office. A total of 91 completed surveys was returned to GSMFC by the NMFS Port Agents. Of those that completed surveys, 31 respondents (34%) indicated that sand or silver seatrout had been handled during 2009.

The survey findings indicate that about one-third of the fish houses surveyed handled sand or silver seatrout during 2009 (Table 7.6). Of those 31 respondents that did handle sand or silver seatrout, an average of 60.3% of the fish handled (by volume) during 2009 was obtained from in-state fisherman (23 respondents) and 14% was obtained from out-of-state fishermen (9 respondents). In addition, 25.7% of the sand or silver seatrout handled by the respondents during 2009 was obtained from other wholesale distributor/processors (13 respondents). Thus, local harvesters were a much more important source of supply to the firms handling sand and silver seatrout.

Sand and silver seatrout that enter the commercial seafood market channels are predominantly sold as fresh, whole product. On average, approximately 88.7% of the sand and silver seatrout (by volume) was sold in whole form (29 respondents), while 11.3% was sold as fillets (six respondents). In addition, on average about 78.1% of the sand and silver seatrout was sold as fresh product (27 respondents), while 21.9% was sold frozen (12 respondents).

A variety of buyers exhibit a demand for sand and silver seatrout. However, survey respondents indicated the majority (by volume) was sold to in-state retailers (38.2%), retail consumers (23.2%), and out-of-state wholesale buyers (17.3%). Other less important buyers include in-state restaurants (9.9%), in-state wholesale buyers (6.4%), out-of-state retailers (4.4%), and out-of-state restaurants (0.6%).

7.1.6.2 Consumption Estimates

There are no studies that indicate the importance of sand and silver seatrout for consumption to consumers. Published average, annual per-capita seafood consumption estimates do not provide estimates for most specific fresh finfish products (NMFS unpublished data). In addition, the NMFS estimates are not provided on a regional basis. A study by Degner et al. (1994) estimated weekly and annual per capita consumption (edible meat weight) by Florida residents for 34 saltwater and freshwater finfish species and 11 shellfish species. In addition, per capita consumption estimates for a number of processed products were also derived. Among all finfish species consumed in

Table 7.6 Results from the 'Sand Seatrout' Market Channel Survey. The survey did not distinguish between the two species since most processors/dealers lump them together as one. ***Note*:** In the summation of responses to each question, (N) may exceed 31 since several respondents who handled sand seatrout selected multiple options (a total of 91 surveys was returned; the percentages represent the average values across the 31 total respondents who did process sand seatrout).

	Number of responses	**Average of positive responses**
Did your processing facility handle any sand seatrout during 2009?		
Yes	N = 31	35.1%
No	N= 60	64.9%
Of the total volume of sand seatrout you handled in 2009, what percent was obtained directly from each of the following source?		
In-state fishermen	N = 23	60.3%
Out-of-state fishermen	N = 9	14.0%
Other Wholesale Distributor/Processor	N = 13	25.7%
Of the total volume of sand seatrout you processed in 2009, what percent was processed into the following product forms prior to final sale by your firm?		
Whole form	N = 29	88.7%
Fillets	N = 6	11.3%
Other	N = 0	0.0%
What percent of the sand seatrout you handled in 2009 was sold by your firm as fresh or frozen?		
Fresh	N = 27	78.1%
Frozen	N = 12	21.9%
Of the total volume of sand seatrout you sold in 2009, what percent was sold to each of the following types of buyers?		
In-state Wholesale Distributor/Processor	N = 5	6.4%
Out-of-state Wholesale Distributor/Processor	N = 9	17.3%
In-state Retailer (grocery, seafood market, etc)	N = 17	38.2%
Out-of-state Retailer	N = 4	4.4%
In-state Restaurant	N = 6	9.9%
Out-of-state Restaurant	N = 2	0.6%
Retail Consumer	N = 11	23.2%

fresh or frozen form, the annual per capita consumption estimate for seatrout was found to be minor when compared to the consumption of other species of finfish. The study found that resident adult Floridians consume, on average, approximately 0.6 lbs of seatrout each year (approximately 40% was obtained recreationally, while the remainder came from commercial sources). This represented <2% of all finfish consumed, including canned and further processed products. The consumption estimate for seatrout was not disaggregated into species of seatrout or source (i.e., domestic and imported) and may include all the 'seatrout' that occur in Florida (*C. nebulosus*, *C. regalis*, *C. arenarius*, and *C. nothus*). A recent study of seafood consumption in Louisiana found that 12.5% of that state's residents prefer to consume 'trout' but also did not provide speciated information (RSI 1996).

7.2 Recreational Sector

There is very little information in the literature or in the MRFSS/MRIP data regarding anglers specifically targeting sand and silver seatrout. Anecdotal observations suggest that the anglers who target species in the nearshore areas of the Gulf are incidentally taking a fair number of sand and silver seatrout as they encounter them. For example, even when targeting spotted seatrout and red drum, anglers may direct effort toward sand and silver (or 'white' trout) when they find large numbers of them. The resultant expenditures for bait, fuel, and other supplies, likely help support local recreational fishing-related businesses. However, no studies exist that document the magnitude of the economic activities and expenditures, as well as the non-market economic values, generated by anglers as they target sand and silver seatrout.

7.3 Civil Restitution Values and Replacement Costs

Values exist by which a state can assess damages for events in which negligence or illegal activities result in loss of fish. These values are determined in a variety of ways for both recreationally and commercially important species. Cost of replacement may be assessed based on the costs associated with hatchery production, willingness to pay by users and nonusers, and recreational user travel cost estimation. The individual states may utilize additional methods for estimating the value associated with an individual fish for the purpose of damage assessment, such as utilizing existing market prices for commercially important species and estimated recreational valuations associated with marine recreational anglers. The American Fisheries Society (AFS 1982, 1992) has estimated replacement values for certain species (primarily freshwater) and provides the methods for determining these values. State civil restitution values may be linked directly with these published estimates and methods.

Restitution values vary considerably by state and may change annually. Florida assigns a replacement value of $10.10 per fish for both 'gray' and 'silver' sea trout, regardless of size (FDEP 2011). Louisiana provides a 'monetary value' for 'white' trout on a size basis ranging from $0.42 for a 1 inch fish to $34.33 for a 31 inch fish (Table 7.7) (Louisiana Administrative Code Title 76, Ch 3, Sect 315). Texas, in 2009, had a civil restitution value for sand seatrout that increased from $0.11, for fish 1-2 inches in length, to $74.14 for fish 26 inches in length (TPWD unpublished data).

Table 7.7 Size-related civil restitution and monetary values in dollars/fish for sand and silver seatrout (*Cynoscion arenarius* and *C. nothus*) in Texas, and in dollars/inch for 'white trout' (may be either species) in Louisiana.

Length (inches)	Louisiana White trout ($/inch)	Texas Sand/Silver Seatrout ($/fish)
1	0.42	0.11
2	0.74	0.11
3	1.13	0.22
4	1.54	0.34
5	1.88	0.77
6	2.20	1.79
7	2.25	2.71
8	2.31	3.42
9	2.36	4.74
10	2.41	6.23
11	2.47	7.94
12	2.52	9.87
13	2.57	12.06
14	3.23	14.53
15	4.05	17.29
16	5.07	20.38
17	6.34	23.81
18	7.92	27.61
19	9.89	31.80
20	12.33	36.41
21	15.37	41.46
22	19.17	46.97
23	23.89	52.97
24	25.11	59.48
25	26.35	66.53
26	27.61	74.14
27	28.90	
28	30.21	
29	31.56	
30	32.93	
31	34.33	

8.0 SOCIAL AND CULTURAL FRAMEWORK OF DOMESTIC FISHERMEN AND THEIR COMMUNITIES

Since the implementation of the Magnuson-Stevens Fishery Conservation and Management Act in 1976, there has been a heightened awareness and recognition of the economic importance and impact of recreational fishing in the marine environment. In addition, a shift in the demographics of the coastal areas resulted in an increase in the number of participants in marine recreational fisheries. Both events led to a philosophical change in fisheries management throughout the late 1970s to early 1990s which included the designation of some species as 'gamefish' and the banning of entanglement nets in some states. These actions directly impacted the commercial take of sand seatrout and indirectly affected the recreational take by reducing the total commercial impact on the fishery.

8.1 Commercial Harvesting

Sand and silver seatrout are a relatively minor commercially harvested species in the Gulf of Mexico relative to shrimp, crabs, and other finfish. The two species are considered less desirable as table fare with a limited commercial market. Further, considering the incidental nature of the fishery, it is very difficult to identify exactly who is participating in the sand and silver seatrout fishery commercially. A wide variety of gears provide relatively minor contributions to the landings overall (see Section 6.2.1).

Broad trends related to economic, social, and environmental factors are altering the size and composition of commercial fishery communities throughout the Gulf. Declining commercial seafood prices and changing regulatory structures are often cited as major issues contributing to an apparent decline in commercial fisheries participation. As Deseran and Riden (2000) noted in their study of the Gulf oyster industry, fewer than 50% of commercial oystermen would encourage their children to enter the fishery, stressing education over fishing, and would advise their children to consider commercial fishing as a fallback option only. In consideration of the major demographic changes evident in the Gulf commercial fishing industry, there is very little reliable data on the social and culture framework that comprise the commercial sand and silver seatrout fishery at this time.

A series of acute destructive episodes, notably Hurricanes Katrina and Rita in 2005, Hurricanes Gustav and Ike in 2008, and the BP Oil Spill in 2010, appear to have had detrimental effects on commercial fishery participation in many Gulf communities. Damaged resources and infrastructure may contribute to decreases in commercial fishery landings in the short-term and long-term. The diversion of fishermen from harvesting activities to clean-up, repair, or containment projects may further retard commercial fishing participation, especially in the short-term. Further, the number of commercial fishermen may decline in the long-term, as many fishermen who were already struggling prior to the incidents, find it difficult to continue commercial fishing.

8.1.1 Trawl Fishery

Historically, the Gulf trawl fishery was dominated by local fishermen who had been in the fisheries for generations, passing licenses, vessels, gear, and knowledge on within families. Social and economic forces, such as the decrease in shrimp prices following an increase in imports, seem to be having some disruptive effect on the generational continuity in this commercial fishing sector.

In the past few decades, the ethnic composition of the trawl fishery in the northern Gulf underwent some changes as an unknown number of immigrants from southeast Asia entered the fishery (Starr 1981, Osburn et al. 1990, Moberg and Thomas 1993, Durrenberger 1994). As those traditional and recent immigrants expanded their families and became more integrated in the local communities, fewer and fewer children moved into the family fishing business. In more recent years, new immigrant groups from other areas, such as Central and South America, have been entering the Gulf fisheries in Texas, Louisiana, and Mississippi (VanderKooy personal communication). A report on the impacts of hurricanes Katrina and Rita in 2005 (IAI 2007) noted that following the storms,

> "Many of the new 'inhabitants' of New Orleans and coastal Mississippi are temporary residents seeking employment, and a great many are of foreign nationality."

As the aforementioned economic trends and recent acute destructive episodes have combined to exert downward pressures on commercial fishing participation, it is nearly impossible to characterize the current trawl fishery. As noted by IAI (2007):

> "Hurricane Katrina accelerated but did not introduce the current challenges to recovery. Rather, this devastating storm brought into sharp relief the struggles commercial shrimpers are having, such as rising costs and shrinking revenues, labor shortages, and loss of marine-based infrastructure and services due to coastal development and erosion. The future of the industry depends on how these economic and social concerns are addressed. While the nuances of these problems are particular to each Gulf state, the accelerated trends noted in this section are overarching and largely shared by commercial fishery participants across the Gulf."

As noted in Section 6, landings of sand and silver seatrout from 'trawl' fisheries have been declining steadily (Figure 8.1) and have been insignificant since the late 1990s. As domestic shrimp prices fell, due in part to increased imports, the effort has gone down and likewise, the bycatch of non-shrimp species including sand and silver seatrout has gone down as well.

Even with the declines in effort, 'trawl' fisheries still made up the largest component of the sand seatrout commercial fishery in Mississippi, but the demographics of the participants continue to change. Similarly, most sand and silver seatrout sold commercially in Texas are landed as bycatch in commercial shrimp trawls with the highest landings coming from Galveston Bay (34.5%), followed by Lower Laguna Madre and Corpus Christi Bay (19.9% and 13.4%, respectively). Again, the characteristics of the participants in the fishery remain in flux and would be impossible to determine at this time.

8.1.2. Gill Nets

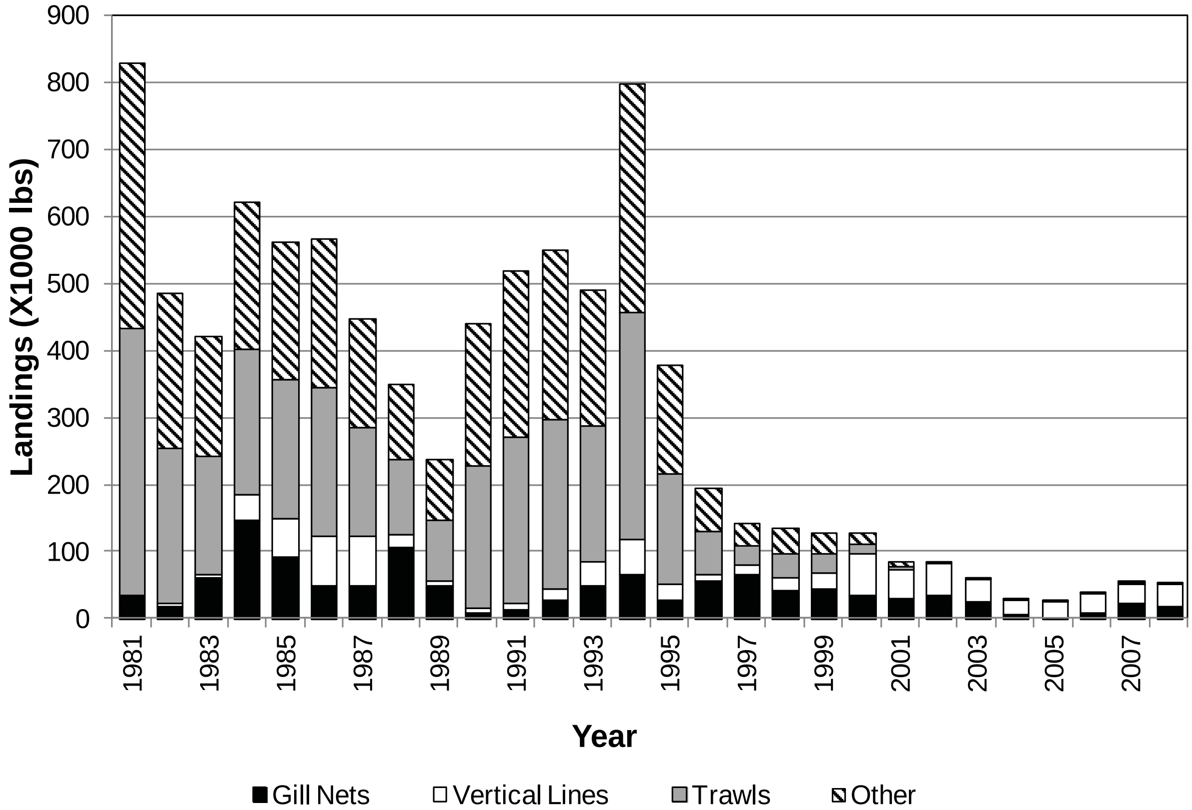

Figure 8.1 Annual commercial landings of sand and silver seatrout (*Cynoscion arenarius* and *C. nothus*) in the Gulf from 1981-2008 separated by major gear (NMFS unpublished data; vertical includes hook-and-line as well as bandit gear, etc.).

The gill net sector contributed much less to the overall landings of any species in the Gulf in the last decade and a half due to sweeping regulations on gill nets Gulf-wide. Entanglement nets are still used in Alabama and Mississippi, but gamefish status of red drum and spotted seatrout in Alabama, and material requirements in Mississippi, have further reduced their contributions to finfish landings.

A report by Wagner et al. (1990) provided insight into the Texas commercial net fishery as it existed prior to the banning of entanglement nets in all Texas waters in 1988. Their study surveyed all commercial saltwater finfish fisherman in Texas and estimated 160 of the roughly 400 license holders in 1985 and 1986 were gill net/trammel net fishermen (43% of respondents).

Historically, entangling nets (gill nets and trammel nets) accounted for the majority of gear being used in Florida's commercial fishery. Since the net limitation amendment of July 1995, cast nets and hook-and-line have been the primary gears for commercial sand and silver seatrout harvest. The majority of the sand seatrout landings in the state are derived from the Pensacola area (70%) in the Big Bend region at Apalachee Bay (8%).

The largest component to the sand and silver seatrout fisheries in Louisiana was gill nets until a state law passed in 1995 that removed entanglement nets from state waters. Prior to that, much of the commercial harvest of all finfish was from gill (strike) nets.

Although the gill net sector has been greatly reduced in the Gulf, limited net fisheries still exist in Mississippi and Alabama. The Mississippi net fishery has been greatly reduced due to 1997 restrictions on the use of monofilament nets, but gill nets made of degradable materials are still allowed. In Alabama waters, the gill net fishery is currently the principle gear for harvesting sand and silver seatrout in the estuarine waters. However, haul seines are expected to play an increasing role in the harvest of some finfish in Alabama such as sheepshead. Anecdotal reports indicate that more commercial fishermen are building haul seines constructed from nylon twine. These durable seines result in larger catches per effort of sheepshead and may be shown to be useful in harvesting of sand and silver seatrout.

8.1.3 Hook-and-Line

Little or no information exists on the makeup of the commercial hook and line/vertical line harvesters in the Gulf. Most of the work related to hook-and-line fishing lies within the recreational sector. The portion that contributes to the Gulf's overall sand and silver seatrout landings is and always has been minimal (Figure 8.1). In Florida, since the net limitation amendment of July 1995, cast nets and hook-and-line have been the primary gears for commercial sand and silver seatrout harvest. Mississippi's fishery has seen a shift in gear type since 1993 from trawls to entanglement nets and vertical lines, with vertical lines becoming the sole gear type from 2006-2008.

Hook-and-line is currently the principle gear for harvesting sand and silver seatrout in the estuarine waters. Similar to the recreational fishery, the commercial fishery functions mainly as a byproduct of other commercial fisheries. In Texas, there is no directed hook-and-line fishery, although some sand and silver seatrout may be caught incidentally in bandit rig fisheries.

8.2 Recreational Fishing

Recreational fishing is a popular activity enjoyed by millions of people throughout the Gulf of Mexico annually.

While many of the sand and silver seatrout landed in the Gulf are caught by people fishing for other species, such as spotted seatrout and red drum, there are a number of anglers who specifically target sand and silver seatrout throughout the year. In addition, the easy access to these species in most bays and estuaries make them a frequent component of the catch of boat and shore-based anglers. The demographics of recreational anglers targeting species such as spotted seatrout and red drum have been described; however, information on those anglers targeting sand and silver seatrout is limited or non-existent. Nevertheless, it is believed by some state marine agencies that there are differences between 'white/sand trout' anglers and other anglers. In Alabama, from the AMRD inshore roving creel survey 1999-2008, 18.5 % of the anglers declared 'white trout' as their target species. Of all the fish species counted during this survey, sand seatrout comprised 38.4% of the harvest and trips that declared other target species, 9.1% ended up harvesting some sand seatrout. That resulted in 24.6% of all trips harvesting sand seatrout (AMRD unpublished data).

In other states for example, Florida inshore fishing guides in the Cedar Key and Suwannee areas target sand seatrout for their clients during certain times of the year. The aggregation of sand seatrout in deeper channels and 'holes' during the cooler times of the year allows anglers to target them with considerable success (McCawley personal communication, Adams personal communication).

The following information for the anglers in the Gulf states is derived primarily from the U.S. Fish and Wildlife Service's *2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation* (USFWS 2007).

8.2.1 Florida

An estimated 1.95 million Florida residents over the age of 16 went fishing (both fresh and saltwater) in 2006, approximately 14% of the state's population over 16 years old, according to the USFWS. One-fourth (25%) lived in rural areas. Seventy-one percent were male. Ninety-percent were Caucasian and 92% non-Hispanic. Thirty-nine percent were between 25 and 44 years old. One-eighth (13%) had 11 years of education or less and 25% had four years of college or more.

In 2006, two million resident and nonresident saltwater anglers took 17.6 million saltwater angling trips over 23.1 millions days (an average of 12 days of saltwater angling per person per year) in Florida. Less than two-thirds (64%) of these saltwater anglers were state residents. State residents took an average of 15 days each fishing in saltwater in Florida.

According to USFWS estimates, 347,000 saltwater anglers in Florida took 4.759 million saltwater angling days in pursuit of seatrout in 2006. The majority of this activity was likely directed at the spotted seatrout, not necessarily sand or silver seatrout.

8.2.2 Alabama

In Alabama, 628,000 residents over the age of 16 (18% of the population over 16 years of age) fished recreationally in 2006, according to USFWS estimates. More than half (57%) resided in rural areas. Three-quarters (74%) were male, 88% were Caucasian, and 98% were non-Hispanic. Thirty-eight percent were between 25 and 44 years old. One-fifth (21%) had 11 years or less of education and 13% had four years of college or more.

In 2006, 153,000 anglers took 618,000 saltwater fishing trips over 758,000 days (an average of five days per person). Eighty-nine percent of these saltwater anglers were Alabama state residents who took an average of six saltwater fishing days in 2006.

Thirty-five thousand state resident and nonresident saltwater anglers pursued seatrout over 132,000 days, according to the USFWS. Although they did not specify a particular species in this statistic, it is likely that the majority of this activity was directed at the spotted seatrout, again, not necessarily sand or silver seatrout.

8.2.3 Mississippi

Approximately one-fifth (22%) of Mississippi residents over the age of 16 (or 479,000 people) fished recreationally in 2006, according to USFWS estimates. Three-quarters resided in rural areas. Eighty-five percent were Caucasians and 99% were non-Hispanic. Almost half (49%) were between the age of 25 and 44 years old. Approximately one-fifth (21%) had 11 years or less of education and approximately one-fifth (21%) had four years of college or more.

Sixty-six thousand resident and nonresident saltwater anglers took 593,000 saltwater fishing trips in Mississippi over 590,000 days (an average of nine days of saltwater fishing per saltwater angler per year) in 2006. Eighty-nine percent of all saltwater anglers in Mississippi were state residents. Most of these days were probably directed at spotted seatrout but were days that anglers also retained sand and silver seatrout.

8.2.4 Louisiana

In Louisiana, over one-sixth (17%) of the resident population 16 years old and older fished in 2006. Approximately one-quarter (27%) resided in rural areas and three-quarters (72%) were male. Eighty-two percent (82%) were Caucasian and 97% were non-Hispanic. Forty-two percent were between the age of 25 and 44 years old. Eighteen percent had 11 years or less of education and 19% had four years of college education or more.

In 2006, 289,000 saltwater anglers took 2.32 million saltwater angling trips in Louisiana over 2.98 million days (an average of 10 days per saltwater angler per year). Eighty-six percent of these saltwater anglers (248,000) were Louisiana residents.

One hundred thousand saltwater anglers targeted seatrout over 1.34 million days in Louisiana in 2006. Most of these days were probably directed at spotted seatrout but were days that anglers also retained sand and silver seatrout.

Louisiana resident anglers have been consistent in their identification of red drum and spotted seatrout as their favorite targeted saltwater species. In a 1990 survey of Louisiana recreational anglers by Kelso et al. (1991), 92% of the respondents who identified a first favorite species named red drum or spotted seatrout. Likewise, 84% of those who identified a second favorite saltwater fishing species specified red drum or seatrout as their second favorite. Of those who named a third favorite targeted saltwater species, 57.4% named flounder and black drum and 13.5% named red drum or spotted seatrout. In contrast, only 0.14% named ‘sand’ seatrout as a first favorite, only 0.59% identified ‘sand’ seatrout as a second favorite, and 5.4% named the species as a third favorite targeted saltwater species.

In a 1993 survey of Louisiana resident anglers (Kelso et al. 1994), 90% identified spotted seatrout or red drum as a first favorite diurnal targeted saltwater species and 81.6% as a first favorite nocturnal targeted saltwater species. None of the respondents identified sand or silver seatrout as a first favorite targeted saltwater species. Of those who named a second favorite targeted saltwater species, only 1.3% identified ‘sand’ seatrout as a second favorite for daytime species and only

2.5% as a second favorite nighttime species. Only 5.2% of those who provided a third favorite targeted species named ‘sand’ seatrout as a third favorite daytime species.

In a 1997 survey of Louisiana recreational fishing, 90.8% of the respondents who identified a first choice for saltwater recreational targeted species named red drum or spotted seatrout as their first favorite. Of those who named a second favorite targeted saltwater species, 87.95% identified these two species as a second favorite. Among those who named a third favorite targeted saltwater species, 54.9% named flounder or red snapper and 16.6% named red drum or spotted trout. Among those who named a first favorite, only 0.2% named ‘sand’ seatrout. Only 0.43% of those who identified a second favorite targeted saltwater species named the ‘sand’ seatrout in this category. Among those who named a third favorite targeted saltwater species, 2.28% named the ‘sand’ seatrout as a third favorite.

In a survey of senior anglers (60-64 years old) in 2005, the LDWF found that 81.2% of the senior anglers who named a first favorite targeted saltwater species picked red drum or spotted seatrout. Among those who named a second favorite, 80.65% identified red drum or spotted seatrout. Among those who named a third favorite, 43.9% named flounder or red snapper and 14.6% red drum or spotted seatrout. Sand seatrout (reported as white trout) were named as a first favorite by 0.46% of the senior anglers, as a second favorite by 1.0%, and 3.45% as a third favorite targeted saltwater species (Isaacs 2009).

8.2.5 Texas

Over two million (2.3 million) Texas residents over 16 years old fished in 2006, according to the USFWS. This sum represented 14% of the state’s resident population over the age of 16. Approximately one-third (35%) resided in rural areas. Roughly three-quarters (73%) were male and 32% were between 25 and 44 years old. Ninety percent were Caucasian and 77% were non-Hispanic. One-sixth (16%) had 11 years or less of education and 3% had four years of college or more.

In 2006, 1.147 million saltwater anglers took 11.965 million saltwater angling trips in Texas over 15.143 million days (an average of 13 days of saltwater angling per person per year). Texas residents accounted for 1.07 million saltwater angling days, approximately 93% of all saltwater angling days in Texas.

In 2006, according to the USFWS, 635,000 anglers (resident and nonresident) fished for seatrout over 8.955 million saltwater angling days in Texas. Most of this effort was likely directed at the spotted seatrout but were days that anglers also retained sand or silver seatrout.

8.3 Organizations Associated with the Sand and Silver Seatrout Fisheries

The following organizations have some interest in finfish-related legislation and management and therefore may have some interest in sand seatrout.

8.3.1 National

National Coalition for Marine Conservation
3 West Market Street
Leesburg, VA 22075

National Fisheries Institute
1901 North Ft. Myer Drive
Suite 700
Arlington, VA 22209

American Sportfishing Association
1033 North Fairfax Street
Suite 200
Alexandria, VA 22314

Coastal Conservation Association
4801 Woodway, Suite 220W
Houston TX 77056

8.3.2 Regional

Gulf and South Atlantic Fishery Development Foundation
Lincoln Center, Suite 997
5401 West Kennedy Boulevard
Tampa, FL 33609

Southeastern Fisheries Association
1118B Thomasville Road
Mt. Vernon Square
Tallahassee, FL 32303

8.3.3 Local (State)

The following organizations are concerned with finfish-related legislation and are, therefore, interested in the effects of sand seatrout regulations and its harvest and production (not necessarily all inclusive.)

8.3.3.1 Florida

Coastal Conservation Association
905 East Park Avenue
Tallahassee, FL 32301

Florida Department of Agriculture and Consumer Services
Bureau of Seafood and Aquaculture
2051 East Dirac
Tallahassee, FL 32310

Florida League of Anglers
534 North Yachtsman
Sanibel, FL 33957

Organized Fishermen of Florida
225 Rockledge Dr.
Rockledge, FL 32955

Florida Fishermen's Federation
11225 Old Kings Rd
Jacksonville, FL 32219

Southeastern Fisheries Association
1118-B Thomasville Rd
Tallahassee, FL 32303

8.3.3.2 Alabama

Coastal Conservation Association
P.O. Box 16987
Mobile, AL 36616

Alabama Seafood Association
P.O. Box 357
Bayou La Batre, AL 36509

Mobile County Wildlife and Conservation Association
P.O. Box 16063
Mobile, AL 36606

Alabama Wildlife Federation
3050 Lanark Rd.
Millbrook, AL 36054

8.3.3.3 Mississippi

Mississippi Charter Boat Association
3209 Magnolia Lane
Ocean Springs, MS 39564

Mississippi Gulf Coast Fishermen's Association
176 Rosetti Street
Biloxi, MS 39530

Mississippi Gulf Fishing Banks
P.O. Box 223
Biloxi, MS 39533

8.3.3.4 Louisiana

Louisiana Seafood Management Council
Rt. 6 Box 285 K
New Orleans, LA 70129

Concerned Fishermen of Louisiana
and Louisiana Fishermen for Fair Laws
P.O. Box 292
Charenton, LA 70523

Coastal Conservation Association
P.O. Box 373
Baton Rouge, LA 70821

Lake Pontchartrain Fisherman's Association
Route 6, Box 285K
New Orleans, LA 70129

United Commercial Fisherman's Association
2812 Violet Lane
Violet, LA 70092

Delta Commercial Fisherman's Association
P.O. Box 186
Venice, LA 70091

Louisiana State Seafood Industry Advisory Board
6640 Riverside Drive Suite 200
Metairie, LA 70003

Louisiana Association of Coastal Anglers
P.O. Box 80371
Baton Rouge, LA 70818

Louisiana Coastal Fishermen's Association
P.O. Box 420
Grand Isle, LA 70354

Louisiana Seafood Processors Council
P.O. Box 3916
Houma, LA 70361

Louisiana Wildlife Federation
P.O. Box 65239
Baton Rouge, LA 70896

8.3.3.5 Texas

Coastal Conservation Association-Texas
6919 Portwest Drive, Suite 100
Houston, TX 77024

Professional Involvement of Seafood Concerned Enterprises
Rt. 3, Box 789
Dickinson, TX 77539

Recreational Fishing Alliance-Texas
P.O. Box 718
Fulton, TX 78358

Saltwater Enhancement Association
711 N. Caranchua
Corpus Christi, TX 78401

Sportsmen Conservationists of Texas
807 Brazos Street
Suite 311
Austin, TX 78701

9.0 REGIONAL RESEARCH NEEDS AND DATA REQUIREMENTS

As demonstrated throughout this profile, there is a need for a regional approach to the management and research of these two species, especially considering the lack of clearly speciated landings data and very little understanding of fishing effort, commercial or recreational. Attainment of the goal and objectives as defined in this profile will require coordination and funding of interstate research programs and standardized, Gulf-wide fishery-independent and fishery-dependent data collection programs. The research and data needs identified below do not reflect any order of priority.

9.1 Biological

- Complete morphological descriptions of egg for both species
- Complete morphological descriptions of larval silver seatrout
- Complete morphological descriptions of juvenile sand seatrout
- Validate maximum lengths for each species
- Better distribute information needed for both species especially along the Atlantic coast

9.1.1 Genetic Stock Identification

- Better genetic information to address sand seatrout as a possible subspecies of weakfish
- Investigate genetics from Alabama, Mississippi, and Louisiana on both species

9.1.2 Inshore/Offshore Movement

- Determine migration patterns and distribution both regionally and by state

9.1.3 Age Composition of Commercial and Recreational Catch

- Derive comprehensive and comparable information for both species
- Improve species identification in the catch data
- Improve resolution in the NMFS data both commercially and recreationally for the two species

9.1.4 Reproduction and Fecundity

- GSIs of inshore and offshore populations
- Speciated data for spawning periodicity and duration
- Determine the extent of sand and silver seatrout spawning grounds
- Improve fecundity estimates for both species

9.1.5 Egg and Larval Development and Transport

- Larval transport mechanisms in silver seatrout

9.1.6 Feeding and Predator/Prey Relationships

- Identify predators on both species: fish, birds, mammals, etc.

9.1.7 Parasitology

- Species specific survey of parasites of both species

9.2 Habitat

- Determine habitat usage by various age classes by both species; almost no information on silver seatrout
- Identify silver seatrout adult offshore habitat and behaviors related to habitat preferences
- Identify larval and juvenile silver seatrout habitat preferences in inshore/estuarine areas
- Obtain information on environmental preferences (salinity and temperature) in larval and juvenile silver seatrout

9.3 Socioeconomic

- Species-specific landings and price data (harvest, dockside value, and exvessel price) by state
- Information on market channel and consumption by species
- Speciated recreational landings and effort by state, season, fishing mode, etc.
- State-specific sociological data on the commercial and recreational sectors
- Commercial effort data by gear to determine consequences on the fishery due to management and policy changes
- Determine collateral effects of regulations, management, and market shifts in other fisheries on sand and silver seatrout (fishermen and angler behavioral changes and preferences)
- Recreational angler expenditure data specific to trips targeting sand and silver seatrout

9.4 Resource Management

- Speciated data for all aspects of the management of these two species

9.4.1 Fishery-Independent Sampling Techniques

- Improve training of technicians and biologists to accurately identify the species composition in the catch of both sand and silver seatrout
- Species-specific age and growth estimates
- Species-specific sex and reproduction information, including fecundity estimates and GSI
- Species-specific diet analysis
- Species-specific mortality estimates
- Species-specific recruitment estimates

9.4.2 Fishery-Dependent Data Collection

- Improve training of fishermen, anglers, and port samplers to accurately identify the species composition in the catch of both sand and silver seatrout
- Species-specific fishing mortality estimates
- Estimates of directed fishing effort
- Bycatch/mortality rates from other fisheries
- Sex composition of the catch
- Discard data for both species
- Speciated landings by gear and region (inshore/offshore gear components)

10.0 REVIEW AND MONITORING OF THE PROFILE

10.1 Review

The State-Federal Fisheries Management Committee (SFFMC) of the GSMFC will review, as needed, the status of the stock, condition of the fishery and habitat, the effectiveness of management regulations, and research efforts. Results of this review will be presented to the GSMFC for approval and recommendation to the management authorities in the Gulf States. Should it be determined that a change has occurred in the fishery requiring additional management measures, the SFFMC may direct the GSMFC to expand the profile and develop a fishery management plan for this species.

10.2 Monitoring

The GSMFC, the NMFS, states, and universities should document their efforts at management measure implementation for this species and review these with the SFFMC.

11.0 REFERENCES

Adams, C., E. Hernandez, and J.C. Cato. 2004. The economic significance of the Gulf of Mexico related to population, income, employment, minerals, fisheries, and shipping. Ocean and Coastal Management 47(2004):565-580.

Adams, C. M. Personal Communication. Florida Sea Grant. University of Florida. Gainesville, Florida.

Adams, D.H., R.H. McMichael Jr., G.E. Henderson. 2003. Mercury levels in marine and estuarine fishes of Florida 1989-2001**.** Florida Marine Research Institute Technical Reports 9.

Agency for Toxic Substances and Disease Registry (ATSDR). 1995. Toxicological profile for polycyclic aromatic hydrocarbons (PAHs). U.S. Department of Health and Human Services, Atlanta, Georgia.

Alabama Marine Resources Division (AMRD). Unpublished Data. Alabama Department of Conservation and Natural Resources, Marine Resources Division. Gulf Shores, Alabama.

Allen, R.L. and D.M. Baltz. 1997. Distribution and microhabitat use by flatfishes in a Louisiana estuary. Environmental Biology of Fishes 50:85-103.

American Fisheries Society (AFS). 1982. Monetary values of freshwater fish and fish-kill counting guidelines. Special Report Number 13. Bethesda, Maryland.

American Fisheries Society (AFS). 1992. Investigation and valuation of fish kills. Special Report Number 24. Bethesda, Maryland.

Anderson, J.D., D.L. McDonald, G.R. Sutton, and W.J. Karel. 2009. Evolutionary associations between sand seatrout (*Cynoscion arenarius*) and silver seatrout (*C. nothus*) inferred from morphological characters, mitochondrial DNA, and microsatellite markers. Fishery Bulletin 107(1):13-23.

Anonymous. 2008a. Fish collection database of the Gulf Coast Research Laboratory (GCRL). The Gulf Coast Research Laboratory, Ocean Springs, Mississippi.

Anonymous. 2008b. Fish specimens database of the Royal Ontario Museum. Royal Ontario Museum, Toronto, Canada.

Anonymous. 2008c. Ichthyology collection database of the National Museum of Natural History (Smithsonian Institution). Smithsonian Institution, Washington, D.C.

Anonymous. 2009a. Fish collection database of the American Museum of Natural History. American Museum of Natural History, Central Park West, New York, New York.

Anonymous. 2009b. Ichthyology collection database of the Museum of Comparative Zoology. Harvard University, Cambridge, Massachusetts.

Arnold, C.R., J.L. Lasswell, W.H. Bailey, T.D. Williams, and W.A. Fable Jr. 1976. Methods and techniques for spawning and rearing spotted seatrout in the laboratory. Proceedings of the Annual Conference Southeastern Association of Fish and Wildlife Agencies 30:167-178.

Baker, J.M. 1999. Ecological Effectiveness of oil spill countermeasures: how clean is clean? Pure and Applied Chemistry 71(1):135-151.

Banks, M.A., G.J. Holt, and J.M. Wakeman. 1991. Age-linked changes in salinity tolerance of larval spotted seatrout (*Cynoscion nebulosus*, Cuvier). Journal of Fish Biology 39:505-514.

Barger, L.E., and A.G. Johnson. 1980. An evaluation of marks on hardparts for age determination of atlantic croaker, spot, sand seatrout, and silver seatrout. NOAA Technical Memorandum NMFS-SEFC-22. NMFS – Southeast Fisheries Center, Panama City, Florida.

Barger, L.E., and M.L. Williams. 1980. A summarization and discussion of age and growth of spot *Leiostomus xanthurus* Lacepede, sand seatrout, *Cynoscion arenarius* Ginsburg, and silver seatrout, *Cynoscion nothus* (Holbrook), based on a literature review. National Oceanic and Atmospheric Administration, Technical Memorandum NMFS-SEFC-14.

Barras, J., S. Beville, D. Britsch, S. Hartley, S. Hawes, J. Johnston, P. Kemp, Q. Kinler, A. Martucci, J. Porthouse, D. Reed, K. Roy, S. Sapkota, and J. Suhayda. 2004. Historical and projected coastal Louisiana land changes: 1978-2050: USGS Open File Report 03-334, 39 p.

Battaglin, W.A., B.T. Aulenbach, A. Vecchia, and H.T. Buxton. 2010. Changes in streamflow and the flux of nutrients in the Mississippi-Atchafalaya River Basin, USA, 1980–2007: U.S. Geological Survey Scientific Investigations Report 2009–5164, Reston, Virginia.

Battelle - Coastal Resources and Ecosystems Management. 2000. An initial survey of aquatic invasive species issues in the Gulf of Mexico region. EPA/OCPD Contract No. 68-C-00-121. Work Assignment 1-07.

Beckert, H., and J. Brashier. 1981. Final environmental impact statement, proposed OCS oil and gas sales 67 and 69. Department of the Interior, Bureau of Land Management, New Orleans, Louisiana.

Benefield, R.L. 1971. A study of sand seatrout, *Cynoscion arenarius* (Ginsburg), of the Galveston Bay area. Pages 217-225 *In*: Coastal Fisheries Project Reports 1969-1970. Texas Parks and Wildlife Department, John H. Reagan State Building, Austin, Texas.

Benson, N.G. (editor). 1982. Life history requirements of selected finfish and shellfish in Mississippi Sound and adjacent areas. U. S. Fish and Wildlife Service, Office of Biological Services, Washington, D.C. FWS/OBS-81/51.

Berens McCabe, E.J., D.P. Gannon, N.B. Barros, and R.S. Wells. 2010. Prey selection by resident common bottlenose dolphins (*Tursiops truncates*) in Sarasota Bay, Florida. Marine Biology 157:931-942.

Bergen, A., C. Alderson, R. Bergfors, C. Aquila, and M.A. Matsil. 2000. Restoration of a *Spartina alterniflora* salt marsh following a fuel oil spill, New York City, New York. Wetlands Ecology and Management 8:185-195.

Bessette, C. 1985. Growth, distribution and abundance of juvenile penaeid shrimp in Galveston Bay. M.S. Thesis submitted to University of Houston, Department of Biology. Houston, Texas.

Blaylock, R.B., and R.M. Overstreet. 2003. Chapter 12: Diseases and Parasites of Spotted Seatrout. Pages 197-225 *In*: Bortone, S.A. (editor). Biology of the Spotted Seatrout. CRC Press, Boca Raton, Florida.

Bowling, B.G. Unpublished Data. Dickinson Marine Lab, Texas Parks and Wildlife Department. Dickinson, Texas.

Bray, G. Personal Communication. Gulf States Marine Fisheries Commission. Ocean Springs, Mississippi.

Buff, V., and S. Turner. 1987. The Gulf Initiative. Pages 784-792 *In*: Magoon. O.T., H. Converse, D. Miner, L.T. Tobin, D. Clark, and G. Domurat (editors). Coastal Zone 1987, Proceedings of the Fifth Symposium on Coastal and Oceans Management. May 26-29, 1987. Volume 1.

Byers, S.M. 1981. Trophic Relationships of Two Sympatric Sciaenid Fishes, *Cynoscion arenarius* and *Cynoscion nothus*, in the North Central Gulf of Mexico. M.S. Thesis. University of Southern Mississippi, Hattiesburg, Mississippi.

Capuzzo, J.M., M.N. Moore, and J. Widdows. 1988. Effects of toxic chemicals in the marine environment: predictions of impacts from laboratory studies. Aquatic Toxicology 11:303-311.

Carpenter, K.E (editor). 2002. The living marine resources of the western central Atlantic, Volume 3: Bony fishes part 2 (Opistognathidae to Molidae), sea turtles and marine mammals. FAO Species Identification Guide for Fishery Purposes and American Society of Ichthyologists and Herpetologists Special Publication No. 5. Food and Agriculture Organization, Rome, Italy.

Chabreck, R.H., G. Linscombe, S. Hartely, J.B. Johnston, and A. Martucci. 2001. Coastal Louisiana: marsh-vegetation types: Lafayette, Louisiana, U.S. Wetlands, Planning, Protection and Restoration Act, and the Louisiana Department of Wildlife and Fisheries (CD-ROM).

Chittenden, M.E., Jr., and J.D. McEachran. 1976. Composition, ecology, and dynamics of demersal fish communities on the northwestern Gulf of Mexico continental shelf, with a similar synopsis for the entire Gulf. Texas A & M University Sea Grant Publication 76-208.

Christmas, J.Y., and R.H. Waller. 1973. Estuarine vertebrates, Mississippi. Pages 320-434 *In*: J. Y. Christmas (editor). Cooperative Gulf of Mexico Estuarine Inventory and Study, Mississippi. Gulf Coast Research Laboratory.

Cochrane, J.E. 1965. The Yucatan Current. Pages 20-27 *In*: Annual Report, Project 286, Texas A&M University, Ref. 65-17T, College Station, Texas.

Coleman, F.C., C.C. Koenig, and W.F. Herrnkind. 1992. Survey of Florida inshore shrimp trawler by-catch and preliminary tests of by-catch reduction devices.

Conner, J.C., and F.M. Truesdale. 1972. Ecological implications of a freshwater impoundment in a low salinity marsh. Pages 259-276 *In*: Proceedings of the Coastal Marsh and Estuary Management Symposium. Louisiana State University, Baton Rouge, Louisiana.

Copeland, B.J. 1965. Fauna of the Aransas Pass inlet: Texas I. Emigrations as shown by the tide trap collections. Publications of the Institute of Marine Science, University of Texas 10: 9-21.

Copeland, B.J., and T.J. Bechtel. 1974. Some environmental limits of six Gulf coast estuarine organisms. Contributions in Marine Science 18:169-204.

Cordes, J.F., and J.E. Graves. 2003. Investigation of congeneric hybridization in and stock structure of weakfish (*Cynoscion regalis*) inferred from analyses of nuclear and mitochondrial DNA loci. Fisheries Bulletin 101:443-450.

Costanza, R., O. Perez-Maqueo, M.L. Martinez, P. Sutton, S.J. Anderson, and K. Mulder. 2008. The value of coastal wetlands for hurricane protection. Ambio 37(4):241-248.

Cowan, J.H., Jr. 1985. The distribution, transport and age structure of drums (family Sciaenidae) spawned in the winter and early spring in the continental shelf waters off west Louisiana. Doctoral dissertation. Louisiana State University, Baton Rouge, Louisiana.

Cowan, J.H., Jr., and R.F. Shaw. 1988. The distribution, abundance, and transport of larval sciaenids collected during winter and early spring from the continental shelf waters off west Louisiana. Fishery Bulletin 86(1):129-142.

Cowan, J.H., Jr., R.F. Shaw, and J.G. Ditty. 1989. Occurrence, age, and growth of two morphological types of sand seatrout (*Cynoscion arenarius*) larvae in the winter and early spring coastal waters off west Louisiana. Contributions in Marine Science 31:39-50.

Crance, J.H. 1971. Description of Alabama estuarine areas-cooperative Gulf of Mexico estuarine inventory. Alabama Marine Resources Bulletin 6.

Cyrus, D.P., and S.J.M. Blaber. 1992. Turbidity and salinity in a tropical northern Australian estuary and their influence on fish distribution. Estuarine Coastal Shelf Science 35:545-563.

Dahl, T.E. 1990. Wetlands losses in the United States 1780's to 1980's. United States Department of the Interior, United States Fish and Wildlife Service, Washington, D.C.

Daniels, S.K. 1977. Description, comparison, and distribution of larvae of *Cynoscion nebulosus* and *Cynoscion arenarius* from the northern Gulf of Mexico. M.S. Thesis. Louisiana State University, Baton Rouge, Louisiana.

Darnell, R.M. 1958. Food habits of fishes and larger invertebrates of Lake Pontchartrain, Louisiana, an estuarine community. Publication of the Institute of Marine Science, University of Texas 5:353-416.

Darnell, R.M., and J.A. Kleypas. 1987. Eastern Gulf shelf bio-atlas: A study of the distribution of demersal fishes and penaeid shrimp of soft bottoms of the continental shelf from the Mississippi River Delta to the Florida Keys. OCS Study MMS86-0041. New Orleans, Louisiana.

Darnell, R.M., R.E. Defenbaugh, and D. Moore. 1983. Northwestern Gulf shelf bio-atlas, a study of the distribution of demersal fishes and penaeid shrimp of soft bottoms of the continental shelf from the Rio Grande to the Mississippi River Delta. Open File Report 82-04. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, Louisiana.

Deardorff, T.L., and R.M. Overstreet. 1981. Larval Hysterothylacium (=Thynnascaris) (Nematoda: Anisakidae) from fishes and invertebrates in the Gulf of Mexico. Proceedings of the Helminthological Society of Washington 48(2):113-126.

Degner, R.L., C.M. Adams, S.D. Moss, and S.K. Mack. 1994. Per capita fish and shellfish consumption in Florida. Industry Report 94-2. Florida Agricultural Market Research Center, Food and Resource Economics Department, University of Florida, Gainesville, Florida.

Deseran, F., and C. Riden. 2000. Louisiana Oystermen…Surviving in a Troubled Fishery. Louisiana Sea Grant College Program.

DeVries, D.A., and M.E. Chittenden, Jr. 1982. Spawning, age determination, longevity, and mortality of the silver seatrout, *Cynoscion nothus*, in the Gulf of Mexico. Fishery Bulletin 80(3):487-498.

Diamond, S.L., L.B. Crowder, and L.G. Cowell. 1999. Catch and bycatch: the qualitative effects of fisheries on population vital rates of Atlantic croaker. Transactions of the American Fisheries Society 128:1085-1105.

Diener, R.A. 1975. Cooperative Gulf of Mexico estuarine inventory and study C Texas: area description. NOAA Technical Report NMFS CIRC-393.

Ditty, J.G. 1989. Separating early larvae of sciaenids from the western North Atlantic: a review and comparison of larvae off Louisiana and Atlantic Coast of the U.S. Bulletin of Marine Science 44(3):1083-1105.

Ditty, J.G., M. Bourgeois, R. Kasprzak, and M. Konikoff. 1991. Life history and ecology of sand seatrout *Cynoscion arenarius* Ginsburg, in the northern Gulf of Mexico: a review. Northeast Gulf Science 12(1):35-47.

Ditty, J.G., G.G. Zieske, and R.F. Shaw. 1988. Seasonality and depth distribution of larval fishes in the northern Gulf of Mexico above latitude 26°00' N. Fishery Bulletin 86(4):811-823.

Drummond, K.H., and G.B. Austin, Jr. 1958. Some aspects of the physical oceanography of the Gulf of Mexico, in U.S. Fish and Wildlife Service, Gulf of Mexico physical and chemical data from Alaska cruises: U.S. Fish and Wildlife Service Special Scientific Report-Fisheries 249:5-13.

Dunaway, V. 2000. Sport Fish of Florida. 1st Edition. Florida Sportsman.

Dunham, F. 1972. A study of commercially important estuarine-dependent industrial fishes. Louisiana Wildlife and Fisheries Commission, Technical Bulletin Number 4.

Durrenberger, E.P. 1994. Shrimpers, processors, and common property in Mississippi. Human Organization 53:74-82.

Eleuterius, L.N. 1973. The marshes of Mississippi. Pages 147-190 *In*: J.Y. Christmas (editor) Cooperative Gulf of Mexico estuarine inventory and study, Mississippi. Gulf Coast Research Laboratory, Ocean Springs, Mississippi.

Etzold, D.J., and J.Y. Christmas. 1979. A Mississippi marine finfish management plan. Mississippi-Alabama Sea Grant Consortium, MASGP-78-046, September 1979, 36pp.

Fable, W.A. Jr., T.D. Williams, and C.R. Arnold. 1978. Description of reared eggs and young larvae of the spotted seatrout, *Cynoscion nebulosus*. Fishery Bulletin 76(1): 65-71.

Fahay, M.P. 2007. Early stages of fishes in the western North Atlantic Ocean (Davis Strait, Southern Greenland and Flemish Cap to Cape Hatteras). Volume Two: Scorpaeniformes through Tetraodontiformes. Northwest Atlantic Fisheries Organization, Dartmouth, Nova Scotia.

Felley, J.D. 1987. Nekton assemblages of the Calcasieu River/Lake Complex. Pages 6-1 to 6-91 *In*: L.R. DeRouen, and L.H. Stevenson (editors). Ecosystem analysis of the Calcasieu River/Lake Complex. Final Report. Volume II.

Field, I.A. 1907. Unutilized fishes and their relation to the fishing industries. Bureau of Fisheries, Document 622.

Fischer, W. (editor). 1978. FAO species identification sheets for fishery purposes. Western Central Atlantic (fishing area 31), Volume IV. Food and Agriculture Organization of the United Nations (FAO), Fishery Resources and Environment Division, Rome, Italy.

Flores-Coto, C., A. Sanchez-Iturbe, F. Zavala-Garcia, and S.M. Warlen. 1998. Age, growth, mortality and food habits of larval *Stellifer lanceolatus*, *Cynoscion arenarius* and *Cynoscion nothus* (Pisces: Sciaenidae), from the southern Gulf of Mexico. Estuarine, Coastal and Shelf Science 47:593-602.

Florida Department of Environmental Protection (FDEP). 2011. Aquatic animal damage valuation. Florida Administrative Code, Chapter 62-11.001. Tallahassee, Florida.

Fonseca, M. In prep. Demographic and photosynthetic characteristics of the eelgrass *Zostera marina* after an oil spill in San Francisco Bay, USA. Marine Pollution Bulletin.

Fonseca, M.S. 1994. A guide to planting seagrasses in the Gulf of Mexico. Texas A&M Sea Grant College Program, TAMU-SG-94-601.

Franks, J. Personal Communication. Gulf Coast Research Laboratory, University of Southern Mississippi. Ocean Springs, Mississippi.

Franks, J.S., J.Y. Christmas, W.L. Siler, R. Combs, R. Waller, and C. Burns. 1972. A study of nektonic and benthic faunas of the shallow Gulf of Mexico off the state of Mississippi as related to some physical, chemical and geological factors. Gulf Research Reports 4:1-148.

Furnell, D.J. 1981. By-catch from shrimp trawling in Guyanese waters. Pages 43-50 *In*: Fish By-Catch Bonus From the Sea. FAO, IDRC Joint Publications (1982), Ottawa, Ontario.

Fuls, B. 1996. Assessment of composition and magnitude of bycatch associated with the commercial shrimp trawling industry on the northern- and mid-Texas coast during the 1995 spring and fall Texas commercial bay-shrimp open seasons. Final Report. The Saltonstall-Kennedy Grant Program. Texas Parks and Wildlife Department, Coastal Fisheries Division, Austin, Texas.

Fuls, B.E., T. Wagner, and L.W. McEachron. 2002. Characterization of commercial shrimp trawl bycatch in Texas during spring and fall commercial bay-shrimp seasons 1993-1995. Management Data Series Number 180. Coastal Fisheries Division, Texas Parks and Wildlife Department, Austin, Texas.

Gallaway, B.J., and K. Strawn. 1974. Seasonal abundance and distribution of marine fishes at a hot water discharge in Galveston Bay, Texas. Contributions in Marine Science 18:71-137.

Galstoff, P. (editor). 1954. Gulf of Mexico, its origin, waters, and marine life. Fishery Bulletin 55(89):1-604.

Ginsburg, I. 1931. On the difference in the habitat and size of *Cynoscion arenarius* and *Cynoscion nothus*. Copeia 3:1-144.

Ginsburg, I. 1930. Review of the weakfishes (Cynoscion) of the Atlantic and Gulf coasts of the United States, with a description of a new species (for 1929). Bulletin of the U.S. Bureau of Fisheries. 45:71-85.

Glass, K.A., and B.D. Waters. 2009. Osprey diet composition and quality in high- and low salinity areas of lower Chesapeake Bay. Journal of Raptor Research 43(1):27–36.

Gledhill, C.T. 1991. Status of Gulf butterfish stocks report for 1991. National Marine Fisheries Service, Pascagoula, Mississippi.

Green, L.M., and R.P. Campbell. 2005. Trends in finfish landings of sport-boat anglers in Texas marine waters, May 1974-May 2003. Management Data Series 234. Coastal Fisheries Division, Texas Parks and Wildlife Department, Austin, Texas.

Grimes, C.B., and M.J. Kingsford. 1996. How do riverine plumes of different sizes influence fish larvae: Do they enhance recruitment? Marine Freshwater Research 4**7**:191-208.

Gulf of Mexico Fishery Management Council (GMFMC). 1981. Draft fishery management plan, environmental impact statement, and regulatory analysis for ground fish in the Gulf of Mexico. Unpublished Manuscript. GMFMC, Tampa, Florida.

Gulf of Mexico Fishery Management Council (GMFMC). 1998. Generic amendment for addressing essential fish habitat requirements in fishery management plans of the Gulf of Mexico. GMFMC, Tampa, Florida.

Guest, W. C., and G. Gunter. 1958. The seatrout or weakfishes (genus *Cynoscion*) of the Gulf of Mexico. Gulf States Marine Fisheries Commission Technical Summary 1:1-40.

Guillory, V., and G. Hutton. 1982. A survey of bycatch in the Louisiana gulf menhaden fishery. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 36:213-223.

Gunter, G. 1936. Studies of the destruction of marine fish by shrimp trawlers in Louisiana. Louisiana Conservation Review 5(4):1-64.

Gunter, G. 1938. Seasonal variations in abundance of certain estuarine and marine fishes in Louisiana with particular reference to life histories. Ecological Monographs 8(3):313-346.

Gunter, G.A. 1945. Studies on marine fishes of Texas. Publication of the Institute of Marine Science, University of Texas, Austin, Texas 1(1):1-190.

Gunter, G. 1956. Should shrimp and game fishes become more or less abundant as pressure increases in the trash fish fishery of the Gulf of Mexico. Louisiana Conservationist, 8(4).

Gutherz, E.J., G.M. Russell, A.F. Serra, and B.A. Rohr. 1975. Synopsis of the northern Gulf of Mexico industrial and foodfish industries. Marine Fisheries Review 1:1-11.

Handley, L., D. Altsman, and R. DeMay (editors). 2007. Seagrass status and trends in the northern Gulf of Mexico: 1940-2002: U.S. Geological Survey Scientific Investigations Report 2006-5287 and U.S. Environmental Protection Agency 855-R-04-003.

Haskell, W.A. 1961. Gulf of Mexico trawl fishery for industrial species. Commercial Fisheries Review 23(2):1-6.

Heil, C. Personal Communication. Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, St. Petersburg, Florida.

Hein, S., P. Meier, G. Adkins, H. Holloway, and D. Lavergne. 1999. A biological and fisheries profile for sand seatrout *Cynoscion arenarius* in Louisiana. Louisiana Department of Wildlife and Fisheries. Fishery Management Plan Series.

Herke, W.H. 1971. Use of natural and semi-impounded Louisiana tidal marshes as nurseries for fishes and crustaceans. Doctoral dissertation. Louisiana State University, Baton Rouge, Louisiana.

Hildebrand, H.H. 1955. A study of (*Penaeus duorarum* Burkenroad) grounds in the Gulf of Campeche. Publications of the Institute of Marine Science, University of Texas 4(1):169-232.

Hildebrand, S.F., and L.E. Cable. 1934. Reproduction and development of whitings or kingfish, drums, spot, croaker, and weakfishes or sea trouts, family Sciaenidae, of the Atlantic coast of the United States. Bulletin of the U.S. Bureau of Fisheries 48:41–117.

Hoese, H.D. 1965. Spawning of marine fishes in the Port Aransas, Texas area as determined by the distribution of young and larvae. Doctoral dissertation. University of Texas, Austin.

Hoff, R., P. Hensel, E.C. Proffitt, P. Delgado, G. Shigenaka, R. Yender, and A. Mearns. 2002. Oil spills in mangroves, planning and response considerations, 72 pp. National Oceanic and Atmospheric Administration, NOAA Ocean Service, Office of Response and Restoration.

Hoff, R.Z. 1995. Responding to oil spills in coastal marshes: the fine line between help and hindrance. Hazardous Materials Response and Assessment Division, National Oceanic and Atmospheric Administration, Seattle, WA, USA, HAZMAT Report 96-1, December 1995.

Hoff, R.Z. 2002. Oil spills in mangroves: planning & response considerations. Seattle, WA: National Oceanic and Atmospheric Administration, NOAA Ocean Service, Office of Response and Restoration.

Holbrook, J.E. 1848. Southern ichthyology: or, a description of the fishes inhabiting the waters of South Carolina, Georgia and Florida. No. III. New York & London: Wiley & Putnam. Southern ichthyology: or, a description of the fishes inhabiting the waters of South Carolina Georgia and Florida. No. III.: 33-60, Pls.

Holbrook, J.E. 1855. Ichthyology of South Carolina. John Russell (Publisher). Charleston, South Carolina.

Holt, G.J., M. Bartz, and J. Lehman. 1983. Final regional environmental impact statement. United States Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, Louisiana.

Holt, G.J., S.A. Holt, and C.R. Arnold. 1985. Diel periodicity of spawning in sciaenids. Marine Ecology Progress Series 27:1-7.

Holt, S.A., G.J Holt, and L. Young-Abel. 1988. A procedure for identifying sciaenid eggs. Contributions in Marine Science 30 (Supplement):99-107.

Horst, J., and M. Lane. 2008. Angler's guide to fishes of the Gulf of Mexico. RodnReel.com.

Hoss, D.E., and G.W. Thayer. 1993. The importance of habitat to early life history of estuarine dependent fishes. American Fisheries Society Symposium 14:147-158.

Impact Assessment, Inc. (IAI). 2007. Final technical report: preliminary assessment of the impacts of Hurricane Katrina on Gulf of Mexico coastal fishing communities. Submitted to National Marine Fisheries Service Southeast Regional Office Contract # WC133F-06-CN-0003.

Ichiye, T. 1962. Circulation and water mass distribution in the Gulf of Mexico. Geofisica Internacional 2:47-76.

International Game Fish Association (IGFA). 2010. 2010 world record game fishes. Dania Beach, Forida.

Invasive Species Focus Team (ISFT). 2000. An initial survey of aquatic invasive species issues in the Gulf of Mexico region. U.S. Environmental Protection Agency, Gulf of Mexico Program, Stennis Space Center, Mississippi.

Isaacs, J.C. 2009. The Louisiana senior anglers report. Louisiana Department of Wildlife and Fisheries. Baton Rouge, Louisiana. S.R.D. Publication # 13.

Iverson, R.L., and H.F. Bittaker. 1985. Seagrass distribution and abundance in eastern Gulf of Mexico coastal waters. Estuarine, Coastal and Shelf Science 22:577-602.

Janke, T.E. 1971. Abundance of young sciaenid fishes in Everglades National Park, Florida, in relation to season and other variables. University of Miami, Sea Grant Technical Bulletin 11.

Johnston, S.A. 1981. Estuarine dredge and fill activities: A review of impacts. Environmental Management 5(5):427-440.

Jones, J.I., R.E. Ring, M.O. Rinkel, and R.E. Smith (editors). 1973. A summary of knowledge of the eastern Gulf of Mexico, State University System of Florida Institute of Oceanography, St. Petersburg, Florida.

Juhl, R., and S.B. Drummond. 1976. Shrimp bycatch investigation in the USA - a status report. Pascagoula, Mississippi, NOAA, NMFS, Southeast Fisheries Center.

Karel, W.J. 2002. Project CR028: Allozyme and mitochondrial DNA analysis of population structure in sand seatrout (*Cynoscion arenarius*) inhabiting the Texas Gulf coast. Texas Parks and Wildlife. Grant number F-36-R.

Kasprzak, R.A., and V. Guillory. 1984. Food habits of sand seatrout in Barataria Bay, Louisiana. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 38:480-487.

Kelso, W.E., B.D. Rogers, D.A. Rutherford, and D.R. Rodgers. 1991. Survey of Louisiana sport fishermen – 1990. Louisiana Agricultural Experiment Station Mimeo Report 57.

Kelso, W.E., B.D. Rogers, T.A. Bahel, D.A. Rutherford, and D.R. Rogers. 1994. A 1993 survey of Louisiana saltwater anglers, Louisiana State University Agricultural Center, Louisiana Agricultural Experiment Station.

King, K.A. 1989. Food habits and organochlorine contaminants in the diet of olivaceous cormorants in Galveston Bay, Texas. The Southwestern Naturalist 34(3):338-343.

Klima, E.F. 1988. Approaches to research and management of U.S. fisheries for penaeid shrimp in the Gulf of Mexico. U.S. Fisheries for Penaeid Shrimp in the Gulf of Mexico.

Knapp, A.R., and C.H. Purtlebaugh. 2008. Relative abundance and distribution of sand seatrout (*Cynoscion arenarius*) in relation to environmental conditions, habitat, and river discharge in two Florida estuaries. Gulf of Mexico Science. 2008(2):89-99.

Korschgen, C.E., and W.L. Green. 1988. American wild celery (*Vallisneria americana*): Ecological considerations for restoration. U.S. Fish and Wildlife Service, Fish and Wildlife Technical Report 19.

Kvenvolden, K.A., and C.K. Cooper. 2003. Natural seepage of crude oil into the marine environment. GeoMarine Letters 23:140-146.

Lamkin, J.T. 1984. A study of the Galveston Bay bait-shrimp fishery. M.S. Thesis. Texas A&M University, Department of Wildlife and Fisheries Science. College Station, Texas.

Laroche, J.L., and S.L. Richardson. 1980. Use of otolith growth increments to estimate age and growth of larval *Leiostomus xanthurus*, *Micropogonias undulates*, and *Cynoscion arenarius* from Mississippi Sound and surrounding waters. Gulf Coast Research Laboratory, Mississippi.

Law, R.J., and J. Hellou. 1999. Contamination of fish and shellfish following oil spill incidents. Environmental Geoscience 6:90-98.

Leffler, D.L. 1989. Composition, abundance, and small-scale distribution of ichthyoplankton off the Louisiana-Mississippi barrier islands, with special emphasis on the age, growth. and mortality of *Chloroscombrus chrysurus.* M.S. thesis. Louisiana State University, Baton Rouge, Louisiana.

Lindall, W.N., Jr., A. Mager, Jr., G.W. Thayer, and D.R. Ekberg. 1979. Estuarine habitat mitigation planning in the southeast. *In*: The Mitigation Symposium: a national workshop on mitigating losses of fish and wildlife habitats. Ft. Collins, Colorado. July 16-20, 1979. U.S. Department of Agriculture Technical Report RM:65.

Lindall, W.N., Jr., and C.H. Saloman. 1977. Alteration and destruction of estuaries affecting fishery resources of the Gulf of Mexico. Marine Fisheries Review 39(9):1-7.

Lippson, A.J., and R.L. Moran. 1974. Manual for the identification of early developmental stages of fishes of the Potomoc River Estuary. Maryland Department of Natural Resources Publication PPSP-MP-13. Baltimore, Maryland.

Lowery, T., and E.S. Garrett III. 2005. Synoptic survey of total mercury in recreational finfish of the Gulf of Mexico; Report Findings. NOAA Fisheries, Office of Sustainable Fisheries, National Seafood Inspection Laboratory. Pascagoula, Mississippi.

Lyczkowski-Shultz, J., D.L. Ruple, S.L. Richardson, and J.H. Cowan, Jr. 1990. Distribution of fish larvae relative to time and tide in a Gulf of Mexico barrier island pass. Bulletin of Marine Science 46(3):563-577.

Mahood, R.K. 1974. Seatrout of the genus *Cynoscion* in coastal waters of Georgia. Georgia Department of Natural Resources Contribution Series 26:1-35.

Marmer, H.A. 1954. Tides and sea level in the Gulf of Mexico. Bulletin of the U.S. Fish and Wildlife Service 89:101-118.

Martinez, E.X., J.M. Nance, Z.P. Zein-Eldin, J. Davis, L. Rathmell, and D. Emiliani. 1993. Trawling bycatch in the Galveston Bay System. Galveston Bay National Estuary Program, Report No. GBNEP-34.

McCawley, J. Personal Communication. Florida Fish and Wildlife Conservation Commission. Tallahassee, Florida.

McDonald, D.L., J.D. Anderson, B.W. Bumguardner, F. Martinez-Andrade, and J.O. Harper. 2009. Spatial and seasonal abundance of sand seatrout (*Cynoscion arenarius*) and silver seatrout (*C. nothus*) off the coast of Texas, determined with twenty years of data (1987–2006). Fisheries Bulletin 107:24-35

McEachron, L., D. Pridgen, and R. Hensley. 1998. Texas red tide fish kill estimates. Abstract, April 17-18, 1998 workshop meeting, red tide in Texas: from science to action. University of Texas Marine Science Institute, Port Aransas, Texas.

McLean, P.K., and M.A. Byrd. 1991. The diet of Chesapeake Bay ospreys and their impact on the local fishery. Journal of Raptor Research. 25(4):109-112.

McNulty, J.K., W.N. Lindall, Jr., and J.E. Sykes. 1972. Cooperative Gulf of Mexico estuarine inventory and study, Florida: Phase I, Area Description. United States Department of Commerce, NOAA Technical Report, NMFS CIRC-368.

Mendelssohn, I.A., M.W. Hester, and J.M. Hill. 1993. Effects of oil spills on coastal wetlands and their recovery. OCS Study MMS 93-0045. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, Louisiana.

Mineral Management Service (MMS). 1983. Final regional environmental impact statement. Volume 1. U.S. Department of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office, New Orleans, Louisiana.

Mississippi Department of Marine Resources (MDMR). Unpublished Data. 1141 Bayview Avenue, Biloxi, Mississippi.

Moberg, M. and J.S. Thomas. 1993. Class segmentation and divided labor: Asian workers in the Gulf of Mexico seafood industry. Ethnology 32:1-13.

Moffett, A.W. 1975. The hydrography and macro-biota of the Chocolate Bayou estuary, Brazoria County, Texas (1969-1971). Texas Parks and Wildlife Department, Technical Series Number 14.

Moffett, A.W., L.W. McEachron, and J.G. Key. 1979. Observations on the biology of sand seatrout (*Cynoscion arenarius*) in Galveston and Trinity Bays, Texas. Contributions in Marine Science 22:163-172.

Moncrieff, C.A. Personal Communication. University of Southern Mississippi, Institute of Marine Sciences, Gulf Coast Research Laboratory, Ocean Springs, Mississippi.

Moncreiff, C.A., T.A. Randall, and J.D. Caldwell. 1998. Mapping of seagrass resources in Mississippi Sound. Gulf Coast Research Laboratory Project Number BY3-156-3238. Mississippi Department of Marine Resources, Report.

Moser, M.L., and L.R. Gerry. 1989. Differential effects of salinity changes on two estuarine fishes, *Leiostomus xanthurus* and *Micropogonias undulatus*. Estuaries 12:35-41

Moulton, D.W., T.E. Dahl, and D.M. Dahl. 1997. Texas coastal wetlands; status and trends, mid 1950s to early 1990s. U.S. Department of the Interior, Fish and Wildlife Service, Albuquerque, New Mexico.

National Academy of Sciences (NAS). 2000. El Niño and La Niña: tracing the dance of ocean and atmosphere. National Academy of Sciences, Office on Public Understanding of Science, Washington, D.C.

National Marine Fisheries Service (NMFS). Various Years. *Fishery Statistics of the United States*. United States Department of Commerce, National Oceanic and Atmospheric Administration.

National Marine Fisheries Service (NMFS). Unpublished Data. Marine Recreational Fishing Statistical Survey (MRFSS). Fisheries Statistics and Economics Division, Silver Spring, Maryland.

National Oceanic and Atmospheric Administration (NOAA). 2000. Characteristic coastal habitats; choosing spill response alternatives. National Oceanic and Atmospheric Administration, National Ocean Service Office of Response and Restoration-Hazardous Materials Response Division. November 2000.

National Research Council (NRC). 1997. Striking a balance: improving stewardship of marine areas. National Academy Press, Washington, D.C.

National Science Board (NSB). 2007. Hurricane warning: the critical need for a national hurricane research initiative, NSB-06-115, 1-36.

Nelson G.A., and D. Leffler. 2001. Abundance, spatial distribution and mortality of young-of-the-year spotted seatrout (*Cynoscion nebulosus*) along the Gulf coast of Florida. Gulf of Mexico Science 2001; 2001:30-42.

Nelson, J.S., E.J. Crossman, H. Espinosa-Pérez, L.T. Findley, C.R. Gilbert, R.N. Lea, and J.D. Williams. 2004. Common and scientific names of fishes from the United States, Canada, and Mexico. American Fisheries Society, Special Publication 29, Bethesda, Maryland.

Nemeth, D.J., J.B. Jackson, A.R. Knapp, and C.H. Purtlebaugh. 2006. Age and growth of sand seatrout (*Cynoscion arenarius*) in the estuarine waters of the eastern Gulf of Mexico. Gulf of Mexico Science 24(1/2):45-60.

Norcross, B.L., and R.F. Shaw. 1984. Oceanic and estuarine transport of fish eggs and larvae: a review. Transactions of the American Fisheries Society 113:153-165.

Norris, D.E., and R.M. Overstreet. 1975. *Thynnascaris reliquens sp. N*. and *T. habena* (Linton, 1900) (Nematoda: Ascaridoidea) from fishes in the northern Gulf of Mexico and eastern U.S. seaboard. The Journal of Parasitology 61(2): 330-336.

Nowlin, W.D. 1971. Water masses and general circulation of the Gulf of Mexico. Oceanographic International 6(2):28-33.

Onuf, C.P. 1994. Seagrasses, dredging and light in Laguna Madre, Texas, USA: Estuarine Coastal and Shelf Science 39:75-91.

Osburn, H.R, D.L. Trimm, G.C. Matlock, and K.Q. Tran. 1990. Characteristics of Indochinese seafood dealers and commercial fishermen in Texas. Management Data Series Number 47. Texas Parks and Wildlife Department, Coastal Fisheries Branch, Austin, Texas.

Overstreet, R.M. 1977. *Poecilancistrium caryophyllum* and other trpanorhynch cestode plerocercoids from the musculature of *Cynoscion nebulosus* and other sciaenid fishes in the Gulf of Mexico. Journal of Parasitology 63(5):780-789.

Overstreet, R.M. 1978. Marine Maladies? Worms, germs, and other symbionts from the northern Gulf of Mexico. Mississippi-Alabama Sea Grant Program MASGP-78-021.

Overstreet, R.M. 1983. Aspects of the biology of the spotted seatrout, *Cynoscion nebulosus*, in Mississippi. Gulf Research Reports, Supplement 1.

Overstreet, R.M. 1993. Parasitic diseases of fishes and their relationship with toxicants and other environmental factors. Pathobiology of Marine and Estuarine Organisms. CRC Press (Boca Raton, Florida): 111-156.

Overstreet, R.M., and G.W. Meyer. 1981. Hemorrhagic lesions in stomach of rhesus monkey caused by a piscine ascaridoid nematode. Journal of Parasitology 67(2):226-235.

Overstreet, R.M., and H.D. Howse. 1977. Some parasites and diseases of estuarine fishes in polluted habitats of Mississippi. Annals of the New York Academy of Sciences 298:427-462.

Overstreet, R.M., and R.W. Heard. 1982. Food contents of six commercial fishes from Mississippi Sound. Gulf Research Reports 7(2):137-149.

Parr, A.E. 1935. Report on hydrographic observations in the Gulf of Mexico and the adjacent straits made during the Yale Oceanographic Expedition on the MABEL TAYLOR in 1932. Bulletin of the Bingham Oceanographic Collections 5(1):1-93.

Paschal, R.L., Jr. 1986. Biochemical systematics of the seatrouts of the western Atlantic, Genus *Cynoscion*. University of New Orleans, New Orleans, Louisiana.

Parizek, J., and I. Ostadalova 1967. The protective effect of small amounts of selenium in sublimate intoxication. Experientia 23:142.

Peebles, E.B. 1987. Early life history of the sand trout, *Cynoscion arenarius*, in southwest Florida. M.S. Thesis. University of South Florida, Tampa, Florida.

Peebles, E.B., and S.G. Tolley. 1988. Distribution, growth and mortality of larval spotted seatrout, *Cynoscion nebulosus*: a comparison between two adjacent estuarine areas of southwest Florida. Bulletin of Marine Science 42(3):397-410.

Perret, W.S., and C.W. Caillouet, Jr. 1974. Abundance and size of fishes taken by trawling in Vermilion Bay, Louisiana. Bulletin of Marine Science 24:52-75.

Perret, W.S., B.B. Barrett, W.R. Latapie, J.F. Pollard, W.R. Mock, B.G. Adkins, W.J. Gaidry, and C.J. White. 1971. Cooperative Gulf of Mexico estuarine inventory and study, Louisiana. Phase I, Area Description and Phase IV, Biology. Louisiana Wildlife and Fisheries Commission.

Perry, H. Personal Communication. Gulf Coast Research Laboratory, University of Southern Mississippi, Ocean Springs, Mississippi.

Phillips, R.C., and E.G. Menez. 1988. Seagrasses. Smithsonian Institution Press. Smithsonian Contributions to the Marine Sciences 34:1-104.

Pitre, R.L., and A.M. Landry, Jr. 1981. Gonadal development, growth and condition of sand seatrout from Louisiana. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 35:647-653.

Plumb, J.A., J.H. Schachte, J.L. Gaines, W. Peltier, and B. Carroll. 1974. *Streptococcus* sp. from marine fishes along the Alabama and northwest Florida coast of the Gulf of Mexico. Transactions of the American Fisheries Society 103(2):358-361.

Pulich, W.M., and W.A. White. 1990. Decline of submerged vegetation in the Galveston Bay system: chronology and relationships to physical processes. Prepared for Texas Parks and Wildlife, Resource Protection Division and Bureau of Economic Geology, University of Texas at Austin.

Purtlebaugh, C.H., and K.R. Rogers. 2007. Recruitment and essential habitat of juvenile sand seatrout (*Cynoscion arenarius*) in four estuaries along the west coast of Florida. Gulf of Mexico Science 1:15-32.

Rabalais, N.N., R.E. Turner, and W.J. Wiseman, Jr. 1997. Hypoxia in the northern Gulf of Mexico: past, present, and future. Proceedings of the First Gulf of Mexico Hypoxia Management Conference. Gulf of Mexico Program Office, EPA-55-R-001.

Rabalais, N.N., R.E. Turner, D. Justic, Q. Dortch, and W.J. Wiseman. 1999. Characterization of hypoxia. Topic 1: report for the integrated assessment of hypoxia in the Gulf of Mexico. NOAA, National Ocean Service, Coastal Ocean Program Decision Analysis Series No. 15.

Rabalais, N.N., R.E. Turner, W.J. Wiseman, Jr., and D.F. Boesch. 1991. A brief summary of hypoxia on the northern Gulf of Mexico Continental Shelf. Pages 35-47. *In*: R.V. Tyson and T.H. Pearson (editors.), Modern and Ancient Continental Shelf Anoxia. Geological Society Special Publication 58.

Rakocinski, C.F., B.H. Comyns, M.S. Peterson, and G.A. Zapfe. 2000. Field growth response of juvenile white trout (*Cynoscion arenarius*) to continuous variation in physical habitat conditions. Proceedings of the 53rd Annual Gulf and Caribbean Fisheries Institute 53:623-635.

Ralston, N.V.C., C.R. Ralston, J.L. Blackwell III, and L.J. Raymonda. 2008. Dietary and tissue selenium in relation to methylmercury toxicity. Twenty-Fourth International Neurotoxicology Conference: "Environmental Etiologies of Neurological Disorders - Modifiers of Risk." NeuroToxicology 29(5):802-811

Reid, G.K. 1954. An ecological study of the Gulf of Mexico fishes in the vicinity of Cedar Key, Florida. Bulletin of Marine Science of the Gulf and Caribbean 4(1):1-94.

Reid, G.K., Jr. 1955. A summer study of the biology and ecology of East Bay, Texas. Part 2: The fish fauna of East Bay, the Gulf beach, and summary. Texas Journal of Science 7(4):430-453.

Research Strategies, Incorporated (RSI). 1996. Louisiana seafood customer perception research. Unpublished data. New Orleans, Louisiana.

Rester, J.K. 2010. Distribution of sand and silver seatrout in the Gulf of Mexico. Unpublished Report.

Richards, W.J. (editor). 2006. Early stages of Atlantic fishes: an identification guide for the western central north Atlantic, Vol II. CRC Press. Boca Raton, Florida.

Roessler, M.A. 1970. Checklist of fishes in Buttonwood Canal, Everglades National Park, Florida, and observations on the seasonal occurrence and life histories of selected species. Bulletin of Marine Science 20:861-893.

Rogers, B.D., and W.H. Herke. 1985. Temporal patterns and size characteristics of migrating juvenile fishes and crustaceans in a Louisiana marsh. Louisiana State University Agricultural and Experiment Station, Research Report Number 5.

Rogers, R.M., Jr. 1977. Trophic interrelationships of selected fishes on the continental shelf of the northern Gulf of Mexico. Ph.D. Dissertation. Texas A&M University, College Station, Texas.

Roithmayr, C.M. 1965. Review of industrial bottomfish fishery in northern Gulf of Mexico, 1959–1962. Commercial Fisheries Review 27:1-6.

Rozas, L.P., T.J. Minello, and C.B. Henry. 2000. An assessment of potential oil spill damage to salt marsh habitats and fishery resources in Galveston Bay, Texas. Marine Pollution Bulletin 40(12):1148-1160.

Runcie, J., C. Macinnis-Ng, and P. Ralph. 2005. The toxic effects of petrochemicals on seagrasses. Institute for Water and Environmental Resource Management and Department of Environmental Sciences University of Technology, Sydney.

Sánchez, A.C. 1997. Listado taxonomico de las especies marinas identificadas en los océanos Pacífico y Atlántico (Caribe) de Nicaragua. Ministerio de Economía y Desarrollo. MEDE PESCA. Managua.

Shaw, R.F., B.D. Rogers, J.H. Cowan, Jr., and W.H. Herke. 1988. Ocean-estuary coupling of ichthyoplankton and nekton in the northern Gulf of Mexico. American Fisheries Society Symposium 3:77-89.

Shaw, R.F., W.J. Wiseman, Jr., R.E. Turner, L. Rouse, R.E. Condrey, and F.J. Kelley, Jr. 1985. Transport of larval gulf menhaden *Brevoortia patronus* in continental shelf waters of western Louisiana: a hypothesis. Transactions of the American Fisheries Society 114:452-460.

Sheridan, P.F. 1979. Trophic resource utilization by three species of sciaenid fishes in a northwest Florida estuary. Northeast Gulf Science 3(1):1-15.

Sheridan, P.F., and D.L. Trimm. 1983. Summer foods of Texas coastal fishes relative to age and habitat. Fishery Bulletin 81(3):643-647.

Sheridan, P.F., D.L. Trimm, and B.M. Baker. 1984. Reproduction and food habits of seven species of northern Gulf of Mexico fishes. Contributions in Marine Science 27:175-204.

Shipp, R. 1994. Dr. Bob Shipp's guide to fishes of the Gulf of Mexico. 4th printing. Dauphin Island Sea Lab, Dauphin Island, Alabama.

Shlossman, P.A. 1980. Aspects of life history of the sand seatrout, *Cynoscion arenarius*, in the Gulf of Mexico. M.S. Thesis. Texas A & M University, College Station, Texas.

Shlossman, P.A., and M.E Chittenden Jr. 1981. Reproduction, movements, and population dynamics of the sand seatrout, *Cynoscion arenarius*. Fishery Bulletin 79(4):649-669.

Simmons, E.G. 1951. Fish trap investigation, September 1, 1950 to August 31, 1951. Pages 98-132 *In:* Annual Report of the Marine Laboratory, Texas Game and Fish Commission, Rockport, Texas.

Simmons, E.G. 1957. An ecological survey of the upper Laguna Madre of Texas. Publications of the Institute of Marine Science 4:156-200.

Simmons, E.G., and H.D. Hoese. 1959. Studies on the hydrography and fish migrations of Cedar Bayou, a natural tidal inlet on the central Texas coast. Publication of the Institute of Marine Science, University of Texas 6:56-80.

Springer, V.G., and K.D. Woodburn. 1960. An ecological study of the fishes of the Tampa Bay area. Florida State Board of Conservation Marine Laboratory Professional Papers Series 1:1-104.

Starr, P.D. 1981. Troubled waters: Vietnamese fisherfolk on America's Gulf coast. International Migration Review 15:226-238.

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

Suchanek, T.H. 1993. Oil impact on marine invertebrate populations and communities. American Zoologist 33:510-523.

Sutter, F.C., and T.D. McIlwain. 1987. Species profile: life histories and environmental requirements of coastal fishes and invertebrates (Gulf of Mexico) -- sand seatrout and silver seatrout. U. S. Fish and Wildlife Service Biological Report 82 (11.72).

Swingle, H.A. 1971. Biology of Alabama estuarine areas. Cooperative Gulf of Mexico Estuarine Inventory, Alabama Marine Research Bulletin Number 5.

Tampa Bay Estuary Program (TBEP). 2005. Tampa Bay dredged hole habitat assessment project. Tampa Bay Estuary Program, Technical Report #04-05.

Taylor, J.L., and C.H. Saloman. 1968. Some effects of hydraulic dredging and coastal development in Boca Ciega Bay, Florida. U.S. Fish and Wildlife Service. Fisheries Bulletin 67:213-241.

Texas Parks and Wildlife Department (TPWD). Unpublished Data. Coastal Fisheries Division, 4200 Smith School Road, Austin, Texas.

Thayer, G.W., and J.F. Ustach. 1981. Gulf of Mexico wetlands: value, state of knowledge, and research needs. Pages 1-30 *In*: D.K. Atwood (convener) Proceedings of a Symposium on Environmental Research Needs in the Gulf of Mexico (GOMEX) Volume IIB.

Thomas, P., and N. Boyd. 1989. Reproduction in spotted seatrout and Atlantic croaker. Salinity requirements for reproduction and larval development of several important fishes in Texas estuaries. 1-45. 1989.

Tringali, M.D., S. Seyoum, M. Higham, and E. Wallace. Unpublished Report. Extensive introgressive hybridization between weakfish, *Cynoscion regalis*, and sand seatrout, *C. arenarius*, (family Sciaenidae) in Florida Atlantic waters.

Tringali, M.D., S. Seyoum, E. Wallace, and M. Higham. 2004. The distribution of weakfish (*Cynoscion regalis*), sand seatrout (*C. arenarius*), and their hybrids in Florida Atlantic waters. Florida Marine Research Institute Report number IHR2004-018. St. Petersburg, Florida.

Turner, R.E. 1990. Landscape development and coastal wetland losses in the northern Gulf of Mexico. American Zoologist 30:89-105.

Turner, R.E., and D.R. Cahoon. 1988. Causes of wetland loss in the coastal central Gulf of Mexico. Volume I, Executive Summary. Outer Continental Shelf Study, Minerals Management Service 87-0120. New Orleans, Louisiana.

United States Army Corps of Engineers (USACOE). 2004. Louisiana coastal area (LCA), Louisiana. Ecosystem Restoration Study. Final Programmatic Environmental Impact Statement Volume 2.

United States Department of Commerce (USDOC). 2003. Current fisheries statistics. Fisheries of the U.S. National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Silver Spring, Maryland.

United States Department of Commerce (USDOC). 2010. Characteristic coastal habitats; choosing spill response alternatives. National Oceanic and Atmospheric Administration, National Ocean Service, Office of Response and Restoration-Emergency Response.

United States Environmental Protection Agency (USEPA). 1994. Habitat degradation action agenda for the Gulf of Mexico. First Generation Management Committee Report. EPA 800-B-94-00.

United States Environmental Protection Agency (USEPA). 2005. National coastal condition report. EPA-620/R-03/002. Office of Research and Development and Office of Water, Washington, DC.

United States Environmental Protection Agency (USEPA). 2009. What you need to know about mercury in fish and shellfish. U.S. Food and Drug Administration and U.S. Environmental Protection Agency. EPA 823-F-04-009.

United States Fish and Wildlife Service (USFWS). 2007. 2006 national survey of fishing, hunting, and wildlife-associated recreation. U.S. Department of the Interior, Fish and Wildlife Service, and U.S. Department of Commerce, U.S. Census Bureau. FHW/06-NAT.

VanderKooy, S.J. Personal Communication. Gulf States Marine Fisheries Commission. Ocean Springs, Mississippi.

Vecchione, M. 1987. Commercial fishing for Gulf butterfish, *Perprilus burti*, in the Gulf of Mexico. Marine Fisheries Review 49(4):14-22.

Vick, N.G. 1964. The marine ichthyofauna of St. Andrew Bay, Florida, and nearshore habitats of the northeastern Gulf of Mexico. Texas A & M University Research Foundation, A & M Project 286-D.

Vittor, B.A., and Associates. 2004. Mapping of submerged aquatic vegetation in Mobile Bay and adjacent waters of coastal Alabama in 2002.

Wagner, T., S.R. Marwitz, G.E. Saul, and G.C. Matlock. 1990. Characteristics of Texas commercial net fishermen. Management Data Series Number 33. Texas Parks and Wildlife Department, Coastal Fisheries Branch, Austin, Texas.

Walker, N.D. 1994. Satellite-based assessment of the Mississippi River discharge plume's spatial structure and temporal variability. OCS Study MMS 94-0053. U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Region, New Orleans, Louisiana.

Walters, S., S. Lowerre, and J. Bicford. 2005. 2005 red tide impacts on fish spawning in Tampa Bay. Florida Fish and Wildlife Research Institute, 100 Eighth Avenue SE, St. Petersburg, Florida.

Ward, C.H., M.E. Bender, and D.J. Reish (editors). 1979. The Offshore Ecology Investigation. Effects of oil drilling and production in a coastal environment. Rice University Studies 65:1-589.

Warren, J.R., and F.C. Sutter. 1981. Industrial bottomfish – monitoring and assessment. Pages II-1-1 to II-1-69 *In*: T.D. McIlwain (editor). Fishery monitoring and assessment. Completion Report. PL88-309, Project. 2-296-R. Gulf Coast Research Laboratory, Ocean Springs, Mississippi.

Watershed Nutrient Task Force (WNTF) 2008. Action plan for reducing, mitigating, and controlling hypoxia in the northern Gulf of Mexico and improving water quality in the Mississippi River basin. Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, Washington, D.C.

Whitfield, A.K. 1999. Ichthyofaunal assemblages in estuaries: a South African case study. Reviews in Fish Biology and Fisheries 9:151-186.

Wieland, R.G. 1994. Marine and estuarine habitat types and associated ecological communities of the Mississippi Coast. Mississippi Department of Wildlife, Fisheries, and Parks. Museum of Natural Science, Museum Technical Report 25:1-270.

Withers, K., and T.S. Brooks. 2004. Diet of double-crested cormorants (*Phalacrocorax auritus*) wintering on the Central Texas coast. The Southwestern Naturalist 49(1):48-53.

Wolfe, M.F., G.J.B. Schwartz, S. Singaram, E.E. Mielbrecht, R.S. Tjeerdema, and M.L. Sowby. 2001. Influence of dispersants on the bioavailability and trophic transfer of petroleum hydrocarbons to larval topsmelt (*Atherinops affinis*). Aquatic Toxicology 52:49-60.

Wohlschlag, D.E., and J.M. Wakeman. 1978. Salinity stresses, metabolic responses and distribution of the coastal spotted seatrout, Cynoscion nebulosus. Contributions in Marine Science 21:171-185.

Yamada, M., H. Takada, K. Toyoda, A. Yoshida, A. Shibata, H. Nomura, M. Wada, M. Nishimura, K. Okamoto, and K. Ohwada. 2003. Study on the fate of petroleum-derived polycyclic aromatic hydrocarbons (PAHs) and the effect of chemical dispersant using an enclosed ecosystem, mesocosm. Marine Pollution Bulletin 47**:**105-113.

Zieman, J.C. 1982. The ecology of seagrasses of south Florida: A community profile. United States Fish and Wildlife Service, Publication FWS/OBS-82/25.

12.0 APPENDIX

12.1 Glossary

12.2 Market Survey Instrument

12.1 GLOSSARY

A

A - See annual mortality.

ABC - See allowable biological catch.

Abiotic - Nonliving physical and chemical attribute of a system, for example light, temperature, wind patterns, rocks, soil, pH, pressure, etc. in an environment.

Absolute Abundance - The total number of a kind of organism in a population. This is rarely known, but usually estimated from relative abundance, although other methods may be used.

Abundance - See relative abundance and absolute abundance.

Age Frequency or Age Structure - A breakdown of the different age groups of a population or sample of organisms.

Alleles - Alternate forms of genes. Because genes occur in pairs in body cells, one gene of a pair may have one effect and another gene of that same pair (allele) may have a different effect on the same trait.

Allocation - Distribution of the opportunity to fish among user groups or individuals. The share a user group gets is sometimes based on historical harvest amounts.

Allowable Biological Catch (ABC) - A term used by a management agency which refers to the range of allowable catch for a species or species group. It is set each year by a scientific group created by the management agency. The agency then takes the ABC estimate and sets the annual total allowable catch (TAC).

Allozyme - Allelic forms of an enzyme that can be distinguished by gel electrophoresis. Allozyme analysis is used to observe genetic variation from the gene products.

Angler - A person catching fish or other organisms with no intent to sell and typically representing the recreational fishermen. This includes people releasing the catch.

Annual Mortality (A) - The percentage of a species dying in one year due to both fishing and natural causes.

Anthropogenic - Relating to or resulting from the influence that humans have on the natural world.

Aquaculture - The raising of fish or other aquatic organisms under some controls. Ponds, pens, tanks, or other containers may be used.

Artisanal Fishery - Commercial fishing using traditional or small scale gear and boats.

Availability - Describes whether a species of a certain size can be caught by a type of gear in an area.

B

Bag Limit - The number and/or size of a species that a person can legally take in a day or trip. This may or may not be the same as a possession limit.

Barbel - A whisker-like sensory appendage on the head or chin area of a fish.

Benthic - Refers to species that live on or below the water bottom including the sediment surface and some sub-surface layers.

Bioaccumulation - Bioaccumulation is defined as the accumulation of chemicals in the tissue of organisms through any route, including respiration, ingestion, or direct contact with contaminated water, sediment, and pore water in the sediment.

Biomass - The total weight or volume of a species in a given area.

Brackish - Somewhat salty, between 1-17ppt.

Bycatch - The harvest of species other than the species for which the fishing gear was set. Examples are blue crabs caught in shrimp trawls or sharks caught on a tuna longline. Bycatch is also often called incidental catch. Some bycatch is kept for sale.

C

CPUE - See catch per unit of effort.

Catch - The total number or poundage of a species captured from an area over some period of time.

This includes species that are caught but released or discarded instead of being landed. The catch may take place in an area different from where the species are landed. Note: Catch, harvest, and landings are different terms with different definitions.

Catch Curve - A breakdown of different age groups of a species, showing the decrease in numbers caught as the species become older and less numerous or less available. Catch curves are often used to estimate total mortality.

Catch Per Unit of Effort (CPUE) - The number of a particular species caught per an amount of effort. Typically, effort is a combination of gear type, gear size, and length of time gear is used. Catch per unit of effort is often used as a measurement of relative abundance for a particular species.

Caudal Peduncle - The narrow part of a fish's body to which the caudal or tail fin is attached.

Charter Boat - A boat available for hire, normally by a group of people for a short period of time. A charter boat is usually hired by anglers.

Chromatophores - A pigment-containing cell.

Cohort - A group of organisms spawned during a given period, usually within a year.

Commercial Fishery - A term related to the whole process of catching and marketing a species for sale. *It refers to and includes fisheries resources, fishermen, and related businesses directly or indirectly involved in harvesting, processing, or sales.

Common Property Resource - A term that indicates a resource owned by the public. It can be fish in public waters, trees on public land, and the air. The government regulates the use of a common property resource to ensure its future benefits.

Compensatory Growth - An increase in growth rate shown by a species when their populations fall below certain levels. This may be caused by less competition for food and living space.

Compensatory Survival - A decrease in the rate of natural mortality (natural deaths) that some species show when their populations fall below a certain level. This may be caused by less competition for food and living space.

Condition - A mathematical measurement of the degree of plumpness or general health of a fish or group of fish.

Confidence Interval - The probability, based on statistics, that a number will be between an upper and lower limit.

Cumulative Frequency Distribution - A chart showing the number of organisms that fall into certain categories, for example, the number of fish caught that are less than one pound, less than three pounds, and more than three pounds. A cumulative frequency distribution shows the number in a category, plus the number in previous categories.

D

Demersal - Describes species that live near water bottoms. Examples are flounder and croaker.

Directed Fishery - Fishing that is directed at a certain species or group of species. This applies to both sport fishing and commercial fishing.

E

EEZ - See exclusive economic zone.

Economic Efficiency - In commercial fishing, the point at which the added cost of producing a unit of a particular species is equal to what buyers pay. Producing fewer of the species brings the cost lower than what buyers are paying. Producing more of the species would raise the cost higher than what buyers are paying. Harvesting at the point of economic efficiency produces the maximum economic yield.

Economic Overfishing - A level of species harvesting that is higher than that of economic efficiency; harvesting more of a species than necessary to have maximum profits for the fishery.

Economic Rent - The total amount of profit that could be earned from a fishery owned by an individual. Individual ownership maximizes profit, but an open entry policy usually results in so many fishermen that opportunity cost is zero.

Effort - The amount of time and fishing power used to harvest a species. Fishing power includes gear size, boat size, and horsepower.

Electrophoresis - A method of determining the genetic differences or similarities between individual species or groups of species by using tissue samples.

Emergent Vegetation - Plants that are rooted in the water but with most of the plant growing above the surface of the water, such as cattails and wild rice.

Escapement - The percentage of fish in a particular fishery that escape from an inshore habitat and move offshore, where they eventually spawn.

Euryhaline - Refers to an organism that can live in a wide range of salinities.

Exvessel - Refers to activities that occur when a commercial fishing boat lands or unloads a catch. For example, the price received by a captain for the catch is an exvessel price.

Exclusive Economic Zone (EEZ) - All waters from the seaward boundary of coastal states out to 200 natural miles. This was formerly called the Fishery Conservation Zone.

F

F - See fishing mortality

FL – See fork length

FMP - See fishery management plan.

Fecundity - A measurement of the egg-producing ability of an organism, expressed as the number of eggs produced per reproduction cycle. Fecundity may change with the age and size of the organism.

Fishery - All the activities involved in catching and marketing a species or group of species, including the population of species itself.

Fishery-Dependent Data - Data collected on a species or fishery from sport fishermen, commercial fishermen, and seafood dealers.

Fishery-Independent Data - Data collected on a species by scientists who catch the species themselves, rather than depending on fishermen and seafood dealers.

Fishery Management Plan (FMP) - A plan to achieve specified management goals for a fishery. It includes data, analyses, and management measures for a fishery.

Fishing Effort - See effort.

Fishing Mortality (F) - A measurement of the rate of removal of a species from a population by fishing. Fishing mortality can be reported as either annual or instantaneous. Annual mortality is the percentage of a species dying in one year. Instantaneous is the percentage of a species dying at any one time. The acceptable rates of fishing mortality may vary from species to species.

Fork Length (FL) - The length of a fish as measured from the tip of its snout to the fork in the tail or to the middle of the tail fin rays.

G

GSI - See gonosomatic index.

Gonochoristic - An organism that maintains the same sex throughout its entire lifespan.

Gonosomatic Index (GSI) - The ratio of the weight of a fish's eggs or sperm to its body weight. This is used to determine the spawning time of species of fish.

Groundfish - A species or group of fish that lives most of its life on or near the sea bottom.

Growth - Usually an individual species' increase in length or weight with time. Also may refer to the increase in numbers of species in a population with time.

Growth Model - A mathematical formula that describes the increase in length or weight of an individual species with time.

Growth Overfishing - When fishing pressure on smaller species is too heavy to allow the fishery to produce its maximum poundage. Growth overfishing, by itself, does not affect the ability of a fish population to replace itself.

H

Harvest - The total number or poundage of a species caught and kept from an area over a period of time. Note that landings, catch, and harvest are different.

Head Boat - A fishing boat that takes recreational fishermen out for a fee per person. Different from a charter boat in that people on a head boat pay individual fees as opposed to renting the boat.

Hypoxia - Condition in which natural waters have a low concentration of dissolved oxygen.

I

ITQ - See individual transferable quota.

Incidental Catch - See bycatch.

Individual Transferable Quota (ITQ) - A form of limited entry that gives private property rights to fishermen by assigning a fixed share of the catch to each fishermen.

Instantaneous Mortality - See fishing mortality, natural mortality, and total mortality.

Introgressive Hybridization - Introgression, also known as introgressive hybridization, in genetics (particularly plant genetics), is the movement of a gene (gene flow) from one species into the gene pool of another by repeated backcrossing an interspecific hybrid with one of its parent species.

Isobath – A contour line on a map connecting points of equal depth in a body of water or below the earth’s surface.

J

Juvenile - A young fish or other organism that has not reached sexual maturity.

L

Landings - The number or poundage of a species unloaded at a dock by commercial fishermen or brought to shore by recreational fishermen. Landings are reported at the points at which the catch is brought to shore. Note that landings, catch, and harvest define different things.

Lapillus – The smallest of three pairs of earstones (otoliths) found in fish.

Larval Fish - The immature form of a fish that hatches from the egg and often has few juvenile or adult characteristics.

Latent Species - A species that has the potential to support a directed fishery.

Length Frequency - A breakdown of the different lengths of organisms in a population or sample.

Length-Weight Relationship - Mathematical formula for the weight of an organism in terms of its length. When only one is known, the scientist can use this formula to determine the other.

Limited Entry - A program that changes a common property resource like fish into private property for individual fishermen. License limitation and the ITQ are two forms of limited entry.

M

M - See natural mortality.

MSY - See maximum sustainable yield.

Mariculture - The raising of marine species under some controls. Ponds, pens, tanks, or other containers may be used, and feed is often used. A hatchery is also mariculture but the species are released before harvest size is reached.

Maximum Sustainable Yield (MSY) - The largest average catch that can be taken continuously (sustained) from a stock under average environmental conditions that will maintain the stock without depleting it. This is often used as a management goal.

Mean - Another word for the average of a set of numbers. Simply add up the individual numbers and then divide by the number of items.

Melanophore - A dark pigmented cell.

Meristics - A series of measurements on a fish, such as scale counts, spine counts, or fin ray counts which are used to separate different populations or races of fish.

Mesohaline - Referring to estuarine water with salinity ranging 5-18 ppt. Referring to moderately brackish water.

Model - In fisheries science, a description of something that cannot be directly observed. Often a set of equations and data used to make estimates.

Morphometrics - The physical features of a species, for example, coloration. Morphometric differences are sometimes used to identify separate species populations.

Morphology - The structure and configuration of an organism.

Multiplier - A number used to multiply a dollar amount to get an estimate of economic impact. It is a way of identifying impacts beyond the original expenditure. It can also be used with respect to income and employment.

Myomere - ‘W’ or ‘V’-shaped muscle fibers which compose the flesh of fish.

N

National Standards - The Fishery Conservation and Management Act requires that a fishery management plan and its regulations meet seven standards. The seven standards were developed to identify the nation’s interest in species management.

Natural Mortality (M) - A measurement of the rate of removal of a species from a population from natural causes. Natural mortality can be reported as either annual or instantaneous. Annual mortality is the percentage of a species dying in one year. Instantaneous mortality is the percentage of a species dying at any one time. The rates of natural mortality may vary from species to species.

Notochord - A flexible rod-like structure that runs the length of the body and forms the supporting axis of the body in lower chordates and in embryos of higher vertebrates. It is eventually replaced by the vertebral column (spine).

O

Oligohaline - Low salinity water around 0.5-5 ppt; brackish.

Open Access Fishery - A fishery in which any person can participate at any time. Almost all fisheries in federal waters are open to anyone with a fishing boat.

Opportunity Cost - An amount a fisherman could earn for his time and investment in another business or occupation.

Optimum Yield - The harvest level for a species that achieves the greatest overall benefits, including economic, social, and biological considerations. Optimum yield is different from maximum sustainable yield in that MSY considers only the biology of the species. The term includes both commercial and sport yields.

Overfishing - Harvesting at a rate such that a reduction of effort would lead to an increase in the total catch. For long-lived species, overfishing starts long before the stock becomes overfished.

P

Pelagic - Refers to species that live in the open sea, away from the sea bottom.

Phytoplankton - Minute, free-floating aquatic plants.

Piscivorous - Feeding on fish.

Polyhaline - A category term applied to brackish estuaries and other water bodies with salinities 18-30 ppt.

Population - Organisms of the same species inhabiting a specified area.

Population Dynamics - The study of species populations and how fishing mortality, growth, recruitment, and natural mortality affect them.

Possession Limit - The number and/or size of a species that a person can legally have at any one time. Refers to commercial and recreational fishermen. A possession limit generally does not apply to the wholesale market level and beyond.

Predator - A species that feeds on another species. The species being eaten is the prey.

Predator-Prey Relationship - The interaction between a species (predator) that eats another species (prey). The stage of each species’ life cycle and the degree of interaction are important factors.

Preopercle - The bone just anterior to the gill cover of many fish.

Prey - A species being fed upon by other species. The species eating the other is the predator.

Primary Productivity - A measurement of plant production that is the start of the food chain. Much primary productivity in marine or aquatic systems is made up of phytoplankton which are tiny one-celled algae that float freely in the water.

Pulse Fishing - Harvesting a stock of organisms, then moving on to other stocks or waiting until the original stock recovers.

Q

Quota - The maximum number of a species that can be legally landed in a time period. It can apply to the total fishery or an individual fisherman's share under an ITQ system. Could also include reference to size of a species.

R

Recreational Fishery - Harvesting a species for personal use, fun, and challenge. Recreational fishing does not include sale of catch. *The term refers to and includes the fishery resources, fishermen, and businesses providing needed goods and services.

Recruit - An individual organism that has moved into a certain class, such as the spawning class or fishing-size class.

Recruitment - A measure of the number of a species that enter a class during some time period, such as the spawning class or fishing-size class.

Recruitment Overfishing - When fishing pressure is too heavy to allow a fish population to replace itself.

Regression Analysis - A statistical method to estimate any trend that might exist among important factors. An example in fisheries management is the link between catch and other factors like fishing effort and natural mortality.

Relative Abundance - An index of a species population abundance used to compare the species population from year to year. This does not measure the actual numbers of a species but shows changes in the population over time.

S

SL - See standard length

Sagitta - The largest of three pairs of earstones (otoliths) found in fish, usually used for ageing fish.

Selectivity - The ability of a type of gear to catch a certain size or kind of species, compared with its ability to catch other sizes or kinds.

Size Distribution - A breakdown of the number of a species of various sizes in a sample or catch. The sizes can be in length or weight. This is most often shown on a chart.

Slot Limit - A limit on the size of fish that may be kept. Allows a harvester to keep fish under a minimum size and over a maximum size but not those in between the minimum and maximum. Can also refer to size limits that allow a harvester to keep only fish that fall between a minimum and maximum size.

Social Impacts - The changes in people, families, and communities resulting from a fishery management decision.

Spawning/Spawn - A form of sexual reproduction where microscopic eggs and sperm are discharged into the water column.

Species - A group of similar fish that can freely interbreed.

Sport Fishery - See recreational fishery.

Standard Length (SL) - The length of a fish measured from the tip of the snout to the posterior end of the last vertebra or to the posterior end of the midlateral portion of the hypural plate. Basically, this measurement excludes the length of the caudal fin.

Standing Stock - See biomass.

Stock - A grouping of organisms usually based on genetic relationship, geographic distribution, and movement patterns. Also a managed unit of organisms.

Stressed Area - An area in which there is special concern regarding harvest, perhaps because the species are small or because harvesters are in conflict.

Surplus Production Model - A model that estimates the catch in a given year and the change in stock size. The stock size could increase or decrease depending on new recruits and natural mortality. A surplus production model estimates the natural increase in weight or the sustainable yield.

T

TAC - See total allowable catch.

TIP - See trip interview program.

TL - See total length

Territorial Sea - The area from average low-water mark on the shore out to three nautical miles for the states of Louisiana, Alabama, and Mississippi and out to nine nautical miles for Texas and the west coast of Florida. The shore is not always the baseline from which the three miles are measured. In such cases, the outer limit can extend further than three miles from the shore.

Total Allowable Catch (TAC) - The annual recommended catch for a species group. The regional council sets the TAC from the range of the allowable biological catch.

Total Length (TL) - The length of a fish measured from the tip of the snout to the tip of the longer lobe of the caudal fin, usually measured with the lobes compressed along the midline. Total length applies to other organisms besides fish, and the measurement will depend on the type of organism.

Total Mortality (Z) - A measurement of the rate of removal of a species from a population by both fishing and natural causes. Total mortality can be reported as either annual or instantaneous. Annual mortality is the percentage of a species dying in one year. Instantaneous mortality is that percentage of a species dying at any one time. The rate of total mortality may vary from species to species.

Trip Interview Program (TIP) - A cooperative state-federal commercial fishery-dependent sampling activity conducted in the Southeast region of NMFS, concentrating on size and age information for stock assessments of federal, interstate, and state managed species. TIP also provides information on the species composition, quantity, and price for market categories, and catch-per-unit effort for individual trips that are sampled.

U

Underutilized Species - A species that has potential for large additional harvest.

Unit Stock - A population of species grouped together for assessment purposes which may or may not include all the species in a stock.

V

Virgin Stock - A stock with no history of commercial or recreational harvest. A virgin stock changes only in relation to environmental factors and its own growth, recruitment, and natural mortality.

Y

YOY - See young-of- the-year.

Year-Class - The species in a stock spawned and hatched in a given year, a “generation” of the species.

Yield - The production from a fishery in terms of numbers or weight.

Yield Per Recruit - A model that estimates yield in terms of weight (but more often as a percentage of the maximum yield) for various combinations of natural mortality, fishing mortality, and time exposed to the fishery.

Young-of-the-Year (YOY) - All the fish of a species younger than one year of age.

Z

Z - See total mortality.

Zooplankton - Microscopic animals which move passively in aquatic ecosystems.

12.2 MARKET SURVEY INSTRUMENT

SAND SEATROUT MARKET SURVEY

1. Did your processing facility handle any sand seatrout during 2009? ( ) Yes ( ) No

(If "no", then terminate the interview)

2. Of the total volume of sand seatrout you handled in 2009, what percent was obtained directly from each of the following sources?

   a. In-state fishermen ________ %

   b. Out-of-State fishermen ________ %

   c. Other Wholesale Distributor/Processor ________ %

   Total → 100 %

3. Of the total volume of sand seatrout you processed in 2009, what percent was processed into the following product forms prior to final sale by your firm?

   a. Whole form ________ %

   b. Fillets ________ %

   c. Other ____________________ ________ %

   Total → 100 %

4. What percent of the sand seatrout you handled in 2009 was sold by your firm as fresh or frozen?

   a. Fresh ________ %

   b. Frozen ________ %

   Total → 100 %

5. Of the total volume of sand seatrout you sold in 2009, what percent was sold to each of the following types of buyers?

   a. In-state Wholesale Distributor/Processor ________ %

   b. Out-of-state Wholesale Distributor/Processor ________ %

   c. In-state Retailer (grocery, seafood market, etc) ________ %

   d. Out-of –state Retailer ________ %

   e. In-state Restaurant ________ %

   f. Out-of-state Restaurant ________ %

   g. Retail Consumer ________ %

   Total → 100%

About the Artist

Steve Jones is an Ocean Springs, MS native and has been doing watercolor painting and all aspects of graphic design since he was a teenager. Although he does not currently work in the design profession, he continues to express himself through artwork whenever time allows. He has lived in various places around the country but has returned to Ocean Springs for good. Steve and his wife Gayle live on Graveline Bayou and love the water, its wildlife, and the islands. Gayle, who formerly worked for the Gulf States Marine Fisheries Commission, is an accomplished artist in her own right tending towards wildlife illustrations more in the Walter Anderson tradition.

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