Status and Trends of Selected Marine Fauna In the Coastal Bend Bays and Estuary Program Study Area 1984-2004

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PREFACE

In 1992 the coastal bend bay systems composed of Aransas, Corpus Christi Bay, and the upper Laguna Madre were designated as one of 28 estuaries of national significance in part because of increasing concerns about the long-term health, productivity and stability of the system and the importance of their commercial and recreational fisheries.

Coastal Bend Bays and Estuary Program (CBBEP) was formed to identify problems facing coastal bend bays and estuaries and develop long range goals and management plans to protect, restore, or enhance the quality and quantity of coastal living resources.

Resource management has changed over last couple of decades from relying solely on enforcement of mandated regulations to broadening knowledge of users helping them become stewards of their resources. Effective management of the interactive resource elements of these three complex ecosystems must be based on the best available science and data. Texas Parks and Wildlife Department's (TPWD) long-term fisheries independent and dependent monitoring programs provides the data base that enables managers monitor trends in recruitment, relative abundance and harvest of recreational and commercial important species. The TPWD database was used extensively by the CBBEP to determine status and trends of populations in the three ecosystems in 1993.

The information presented in this report is intended to provide historic as well as current status and trends in recruitment, relative abundance, and harvest of important commercial and recreational species in order to assist policy-makers, managers, and other stewards of the resource make management decisions that will ensure the long-term health and stability of these important natural resources.

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INTRODUCTION

I. BAY DISCRIPTIONS

The Coastal Bend Bays and Estuary Program (CBBEP) study area includes three of the seven major estuary systems in the Texas Gulf Coast and two of the 8 major tidal passes to the Gulf of Mexico. These three estuaries comprise 1,331 square kilometers of bay surface area and include 12 coastal counties: Aransas, Bee, Brooks, Duval, Jim Wells, Kleberg, Kenedy, Live Oak, McMullen, Nueces, San Patricio, and Refugio (Figure 1). These estuaries are biogeographically distinct; increasing in salinity form north to south, from the Aransas Bay estuary which receives fresh water inflow from the Mission and Aransas rivers to the upper Laguna Madre, one of three hypersaline lagoon system in the world. The Mission, Aransas, and Nueces rivers contribute the majority of the fresh water inflows; however, each system receives additional fresh water from its drainage area which totals 58,521 square kilometers (Ward 1997).

The CBBEP region is a product of the Pleistocene epoch when the last glacial period diminished and sea level rose and covered the present continental shelf. During this period, sea level reached its present level and covered the old river valleys. Barrier Islands were formed by the longshore currents eroding river banks and depositing the sediments parallel to the shoreline. The enclosure of the bays allowed the formation of salinity gradients which created today's coastal bend estuaries.

The CBBEP study area is semi-arid with a subtropical climate and receives an annual rainfall total between 25 to 38 inches. This region is part of the Gulf Coast and South Texas Plain, which are characterized by gently sloping plains. Soils are generally clay to sandy loams. The major rivers (Aransas, Mission, and Nueces) providing fresh water inflow to the region. The vegetation is a mixture of coastal prairie and mesquite chaparral savanna. Land use is mainly rangeland, (61%), followed by cropland and pastureland (27%) and other uses (12%).

Data presented in this manuscript is presented by bay system and as a CBBEP unit. The boundaries of each of the three bay systems, as presented in the Texas Parks and Wildlife Marine Resource Monitoring Manual (2002), are described below:

> Aransas Bay system: All waters, including all saltwater bayous in the bay system, behind the surfline from the eastern edge of Mesquite Bay to the causeway between Port Aransas and Aransas Pass, including the ICWW (intracoastal waterway). TPWD recognizes 21 minor zones (Allyns Lake, Aransas Bay, Big Brundrett Lake, Little Brundrett Lake, Carlos Bay, Cedar Bayou, Lydia Ann Channel, Aransas Channel, Copano Bay, Dunham Bay, Long Lake, Little Bay, Mission Bay, Mesquite Bay, Port Bay, Redfish Bay, South Bay, Salt Lake, St. Charles Bay, Sundown Bay, Swan Lake) within the Aransas Bay system.
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> Corpus Christi Bay system: All waters, including all saltwater bayous, behind the surfline from the western edge of the causeway between Aransas Pass and Port Aransas to the powerline connecting Demit Island to Mustang Island, and the mouth of the Nueces River. TPWD recognizes eight minor zones (Port Aransas Pass, Corpus Christi Channel, Corpus Christi Bay, Nueces Bay, Oso Bay, Redfish Bay, Sunset Lake, Water Exchange Channel) within the Corpus Christi Bay system.

Upper Laguna Madre system: All waters, including all saltwater bayous, from the powerline connecting Demit Island to Mustang Island to the land cut (middle ground to Rincon de San Jose), including Baffin Bay and its tributaries. TPWD recognizes six minor zones (Alazan Bay, Baffin Bay, Cayo del Grullo, Laguna Salada, Upper Laguna Madre, Corpus Christi Pass) within the Upper Laguna Madre system.

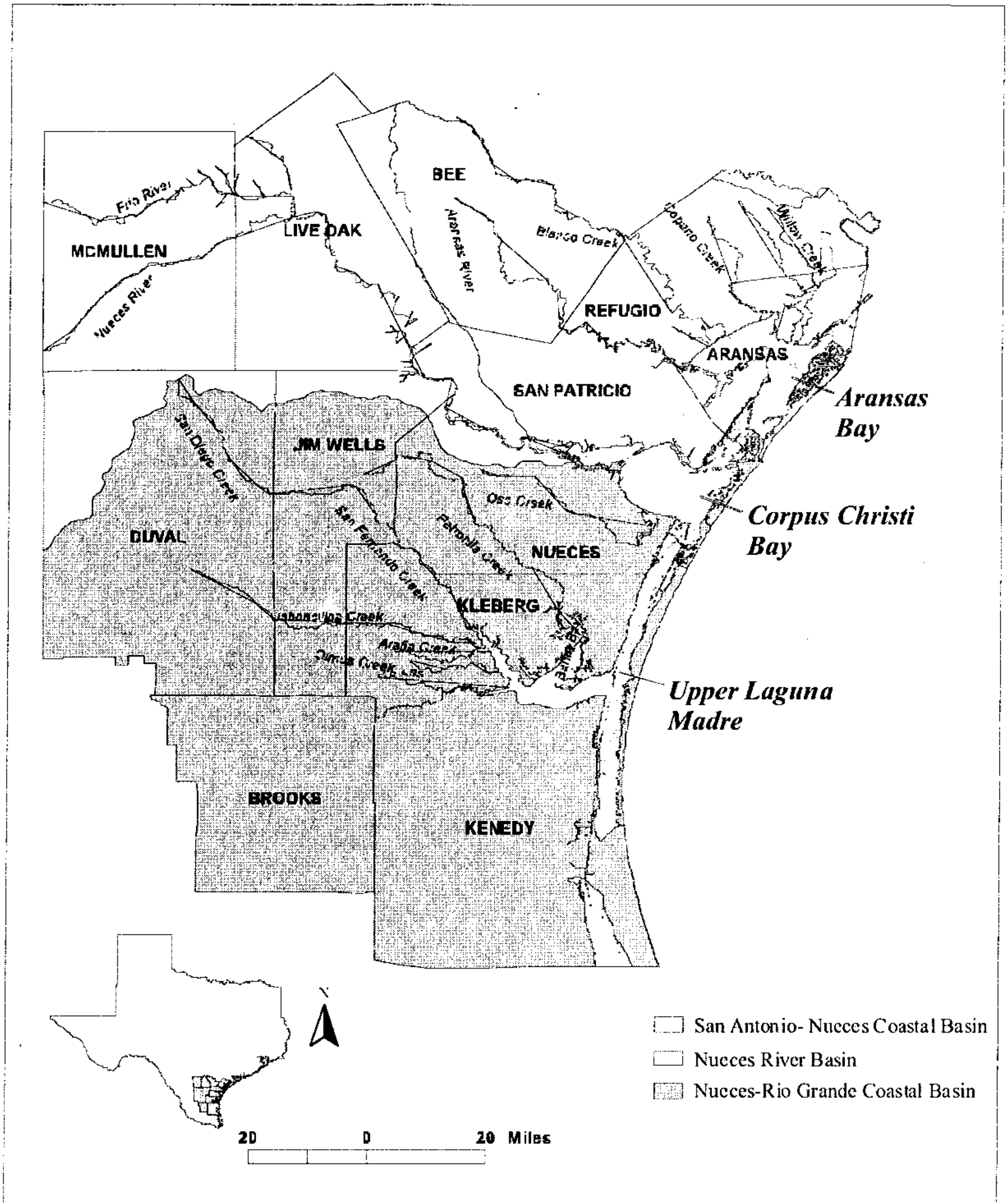

Figure 1. Corpus Christi Bay National Estuary Program study area.

Aransas Bay

Aransas Bay estuary complex has an aerial coverage at mean low tide of 119,960 acres. This includes, in decreasing order of size, Aransas Bay, Copano Bay, Mesquite Bay, St. Charles Bay, South Bay, Mission Bay, Port Bay, Carlos Bay, Sundown Bay, Salt Lake, Mission Lake, and Swan Lake. The Mission-Aransas estuary is part of the San Antonio-Nueces Coastal Basin and has a drainage area of 1,694,648 acres. Its main tributaries are the Mission River discharging into Mission Bay and eventually Copano Bay, and the Aransas River emptying into Copano Bay (Texas Department of Water Resources 1981, Tunnell and Dokken 1996). The Guadalupe River contributes significant inflows into Mesquite and Aransas Bays via San Antonio Bay.

The Aransas Bay ecosystem is composed of a primary estuary (Aransas Bay), two secondary bays (Copano Bay to the northwest and Mesquite Bay to the northeast), and three tertiary bays (St. Charles Bay to the north, Mission Bay to the west, and Port Bay to the southwest). The system is bounded by two barrier islands to the east, Matagorda Island at the north end and St. Joseph Island to the south end. Aransas Pass to the south is the major pass connecting the bay to the Gulf of Mexico, while a minor pass to the north, Cedar Bayou, has been opened and closed intermittently over the last 50 years.

The Aransas Bay ecosystem has 839 acres of well-developed natural oyster reef habitat (Quast et al. 1988). These reefs are located at the northern end of Aransas Bay, centrally in Copano Bay and at the north and south ends of Mesquite Bay. They are arranged perpendicular to water currents and shorelines in these areas (Tunnell and Dokken 1996). There are numerous small patch reefs found in St. Charles, Mission, and Port bays.

The Aransas Bay Ecosystem contains a variety of coastal habitats. The upland habitats include coastal woodlands and coastal prairie. These two habitat types contain freshwater wetlands with marshes, potholes, and riparian forests. Estuarine wetlands include emergent marsh, sand flats, and seagrass beds. Many of the estuarine wetlands are associated with the barrier island complexes of San Jose and Matagorda Islands.

Barrier islands are a dynamic landform that frequently experiences washover events for the Gulf into the bay (Tunnell and Judd 2002). This changing environment prevents them from becoming colonized by vegetation except locally along their margins and on small coppice dunes which might include scattered stands of salt-tolerant plants such as *Salicornia* sp., *Batis* sp., *Distichlis* sp., *Monanthochloe* sp., and *Sesuvium* sp. with *Spartina patens*, *Spartina spartinae, Ipomoea* spp., and *Croton punctatus* occurring in higher fringing areas.

Sand flats, once a dominant feature of the barrier complex have been converted to emergent wetlands as a result of relative (earth subsidence and sea level) sea level rise (White et al. 1998) . From the 1950s to 1992, 35,000 acres of emergent marsh have developed within the Aransas Bay system and there has been a loss of approximately 26,000 acres of sand flats. Much of this change has occurred on San Jose Island and along the fringes and tidal streams of Aransas and Copano Bays (White et al. 1998).

Seagrass beds are present in this ecosystem, with Redfish Bay having the greatest coverage of this habitat. This is part of the Aransas Ecosystem is managed as a scientific study area as an effort to document and assess the impacts from prop scarring and proactive stewardship education efforts.

Along the tidal rivers areas of estuarine emergent marshes have developed since the 1950s as well as forested riparian woodlands at their upper and fresher reaches. The prairie potholes that were associated with the uplands have suffered some losses as a result various activities including residential development and agricultural conversion (White et al. 1998).

The 1994 distribution of seagrass beds in the Aransas system, excluding Redfish Bay, totaled about 8,000 acres. Shoal grass (*Halodule wrightii*) is the predominant species found in Aransas Bay with numerous beds of widgeon grass (*Ruppia maritima*) growing in Copano, St. Charles, Mesquite and Aransas bays. The occurrence of turtle grass (*Thalassia testudinum*) is limited to Redfish Bay and nearby waters while patches of clover grass (*Halophila engelmannii*) and manatee grass (*Syringodium filiforme*) are found scattered throughout Aransas Bay (Pulich and Blair 1997). There are no data on seagrass trends in Aransas Bay. However, an assessment of propeller scarring in seagrass beds was conducted in 1997 that included Estes Flats in northern Redfish Bay (Dunton et al. 1998). This study estimated 97% of the area surveyed was scarred with 75% rated as severe.

The Aransas Bay system has generally good water quality which supports aquatic life. There is restricted shellfish harvesting due to bacteria in oyster waters for some areas in the Copano/Port/Mission Bay segment near Bayside, and there is a concern for this use along the northern edge of Aransas Bay near Rockport. Work is underway to track the sources of pollution and suggest remedies. Phosphorus enrichment has been identified in the waters south of Bayside, as well as concern due to depressed dissolved oxygen west of Rockport. St. Charles Bay is impaired due to bacteria northeast of Goose Island State Park, and is not supporting its contact recreation use. Rockport Beach is now being monitored as part of the General Land Office's beach monitoring program. Numerous pollution complaints involving petroleum products have been reported in the Aransas Bay area and significant fish kills associated with red tide have occurred (Buskey et al. 1996).

The gauged freshwater inflow into the Aransas system is primarily from the Mission and Aransas rivers and several small streams such as Copano and Chiltipin creeks which all flow into Copano Bay. Annual surface inflow (the sum of gauged inflow plus ungauged inflow) to the Mission Aransas Estuary averaged 0.44 million acre-feet per year since 1941. The minimum surface inflow of 7,503 acre-feet occurred in 1950. The maximum surface inflow of 1.5 million acre-feet occurred in 1967. Total inflow into the Aransas Bay ecosystem was estimated to be 711,700 acre-feet/yr. Inflows are highest during fall and winter seasons. San Antonio Bay inflow, from primarily the San Antonio and Guadalupe rivers, contributes about 20% of the total inflow into the Aransas ecosystem (Aswuith et a. 1997).

Corpus Christi Bay

The Corpus Christi Bay complex has an areal coverage at mean low tide of 106,990 acres. This includes Corpus Christi Bay, Nueces Bay, Redfish Bay (south of Texas road 361) and Oso Bay. The Nueces River basin has a drainage area of 10,847,926 acres. Principle streams include the

Atascosa and Frio Rivers, which flow into Choke Canyon Reservoir, and the Nueces River, which flows into Lake Corpus Christi (Tunnell et al. 1996).

The Corpus Christi Bay ecosystem is composed of Corpus Christi Bay, the primary estuary, and three secondary bays which include Nueces Bay to the northwest, and Oso Bay (south) and Redfish Bay (northeast). The system is bounded by Mustang Island to the east. The major jettied pass (Aransas Pass) in the CBBEP area connects the Corpus Christi bay to the Gulf of Mexico. This pass is the opening of the Christi Ship Channel, which transverses Corpus Christi Bay and allows maritime traffic between the Gulf of Mexico and the ninth largest port in the Nations. Packery Channel is the second jettied pass in the CBBEP area. It was dredged and opened in 2005, allowing water exchange from the southern portions of Corpus Christi Bay and northern Laguna Madre, with the Gulf of Mexico. Other historical water exchange passes, which are currently closed, include the Corpus Christi-Water Exchange Pass (Fish Pass), and Newport Pass.

Diener (1975) documented 565 acres of natural oyster reef habitat in the Corpus Christi Bay ecosystem. These reefs were located in Nueces Bay, the northern and western shorelines of Corpus Christi Bay, Redfish Bay and adjacent to Shamrock Island near eastern edge of the system. Reefs in Nueces and Corpus Christi bays are predominantly small scattered patch reefs, typically accumulations of shell material in mound form. The highest point of intertidal reefs, frequently exposed by low tides and subject to sediment accumulation, is mostly composed of dead shell with a few live oysters (Tunnell et al. 1996).

The major wetland types found in the Corpus Christi Bay estuary are seagrass beds, intertidal marshes, intertidal sandflats, and mangrove stands. Freshwater marshes, shrub wetlands, prairie potholes, and forested wetlands are found in the headwater areas of Nueces Bay, other freshwater tributaries, and within upland areas surrounding the bay. Upland habitat types include coastal prairie, live oak and mesquite woodlands.

Estuarine emergent marshes (*Salicornia, Batis, Borrichia, Monanthochloe*) are the dominant wetland type found in the Nueces River and Delta, Oso Creek and Bay, northern shorelines of Nueces and Corpus Christi Bays, and Mustang Island shorelines of the ecosystem. Palustrine emergent marshes appear to be increasing in the central part of Mustang Island. Along the bay margins, estuarine emergent marshes showed slight to moderate increases from 1958 to 1979. Aerial photographs of Nueces River delta indicate vegetated wetlands showed a decrease of 318 acres from 1930 to 1979 (Smith et al. 1997). For most wetland types remain stable. However there have been shifts in where the different wetlands exist with gains in one location and losses at a different location in the bay. Significant gains in estuarine marsh and loss of intertidal sandflats is due to relative sea level rise. Prairie pothole wetlands have suffered losses primarily due to conversion to agriculture, excavation for sand mining, and general development.

The 1994 distribution of seagrass beds in the Corpus Christi/Nueces/Redfish Bay system (including the Laguna Madre north of the Kennedy Causeway) totaled 10,693 hectares (26,412 acres). Except for the Laguna Madre, this was the largest amount (11.2%) of seagrass coverage found in one bay system on the Texas coast. Relative percent occurrence by species reveals the dominance of *Halodule* (73-90%), and the scarcity of *Syringodium* (2-3%) and *Halophila* (1.7-6%). *Thalassia* appeared much more frequent in Redfish Bay/Harbor Island area (34.6%) than in east Corpus Christi Bay (15.8%). Seagrass trends in Nueces Bay were unusually dynamic, ranging from 79 ha in 1961, 100% loss of beds by 1967 following Hurricane Beulah, and increasing to 200 ha by 1989 and 294 ha by 1994. Probable causes for changes in seagrass trends are documented in this report (Pulich and Blair 1997).

Three important upland habitats associated with the bay include the live oak scrub habitat, coastal prairie, and coastal woodlots. These are important to the watershed, water quality, migratory songbirds, and other species.

The Corpus Christi Bay system generally has good water quality, although issues associated with a populated and industrialized area are seen. The Texas Commission on Environmental Quality (TCEQ) has identified a concern for bacteria in oyster waters in Corpus Christi Bay along the shoreline, and the Texas Department of State Health Services (DSHS) restricts shellfish harvesting in this and other areas. In the Corpus Christi inner harbor, nutrient enrichment due to nitrogen is a concern. Nueces Bay is impaired due to zinc in oyster tissue, and has shellfish harvesting restrictions. An on-going study attributes the majority of the zinc loading (66%) to cooling water from the Central Power and Light's Nueces Bay Plant, with 23% coming from atmospheric deposition, 5% from Lake Corpus Christi, 5% from surface runoff, and 1% from the other point source discharges in the area (Quenzer et al. 1998).

There are concerns and impairments in several areas of the Corpus Christi Bay system due to low dissolved oxygen. There are also concerns over nutrient enrichment and excessive algal growth in Oso Bay. High bacteria levels in several parts of Oso Bay indicate that this area is not supporting its contact recreation use. Numerous beaches in the Corpus Christi area are now being monitored through the General Land Office's beach monitoring program. Fish kills in this system have mostly been attributed to low dissolved oxygen, weather events, oil exploration activity, and red tide. Pollution events associated with petroleum products have been commonly reported (Quenzer et al. 1998).

Annual surface inflow (the sum of gauged inflow plus ungauged inflow) to Corpus Christi Bay averaged 0.57 million acre-feet per year since 1941. The minimum surface inflow of 42,551 acre-feet occurred in 1962. The maximum surface inflow of 2.7 million acre-feet occurred in 1971. (TWDB 1992)

Upper Laguna Madre Bay

The upper Laguna Madre ecosystem, which includes the Baffin Bay complex, covers about 40,954 ha of surface area at mean low water. No major rivers drain into the ecosystem; however, three creeks, Los Olmos, San Fernando and Petronila, provide intermittent fresh water inflows into the system. The ecosystem is composed of the upper Laguna Madre and the Baffin Bay complex, which consists of Alazan Bay, Cayo del Infiernello, Laguna Salada, Cayo del Grulla and Baffin Bay Proper.

As with the other bays in the CBBEP area, the upper Laguna Madre is separated from the Gulf by a barrier island, in this case Padre Island. Gulf water circulates to the bay through Port Mansfield Pass to the south and through Packery and Aransas Pass to the north.

Unlike Aransas and Corpus Christi Bays, the upper Laguna Madre is lacking oyster reef complexes; however, there are two types of hard substrates found in this ecosystem. Beach rocks, which formed about 18,000 years ago, are composed of shells and shell fragments, sand and clay bound together in calcium carbonate cement are found along the mainland shoreline of the upper Laguna Madre. Two types of serpulid reefs (patch reefs and reef fields) are found in the Baffin Bay complex (Alazan Bay, Cayo del Grullo and Laguna Salada). These reefs which formed between 3,000 and 300 years ago are composed of the calcareous external tubes of serpulid polychaete worms. Some living serpulid worms are found on the reefs today; however, they no longer build reef structures. The reefs are distributed along the margins and shallower parts of the system, particularly in within Baffin Bay (Tunnell and Dokken 1996).

In 1994 it was estimated that seagrass meadows covered about 27,149 ha acres of the upper Laguna Madre - Baffin Bay ecosystem. It represents about 29% of Texas coastal seagrass meadows. These meadows are primarily comprised of shoalgrass (*Halodule wrightii*); but widgeon grass (*Ruppia maritime*), manatee grass (*Syringodium filiforme*), and clover grass (*Halophia engelmanni*). Although historically rare, manatee grass (*Syringodium filiforme*) is becoming more abundant (Quammen and Onuf 1993, Tunnell and Dokken 1996).

Considering that the upper Laguna Madre is basically a closed, hypersaline environment, the water quality is generally considered good. There are impairments in various areas of the Laguna Madre due to low dissolved oxygen. Data collected as part of a larger study have suggested that low dissolved oxygen may occur naturally in the bay's waters. There is also concerns excessive algal growth in Baffin Bay, believed to be caused by nutrient runoffs from adjacent agricultural lands. The largest natural fish kills in the Laguna and associated areas were caused by weather (mostly cold fronts), low dissolved oxygen when flows stopped or areas dried up, and harmful algal blooms. Although not shown to have a direct or immediate negative effect on fish populations, the brown tide (*Aureoumbra lagunensis*) is of concern in the Laguna Madre. Shading from the dense concentration of algae during a bloom is thought to harm the sgearass beds which are vital to the health of fish and shellfish populations. A persistent brown tide event took place between 1990 and 1998. In 2005, it reappeared, but has not extended to the 1990's levels (Buskey et al. 1996).

Annual surface inflow (the sum of gaged inflow plus ungaged inflow) to the Laguna Madre averaged 607,971 acre-feet per year since 1941. The minimum surface inflow of 123,000 acre-feet occurred in 1952. The maximum surface inflow of 2.9 million acre-feet occurred in 1958.

Low freshwater inflow and an evaporation rate that exceeds the rate of precipitation is the primary reason for the hypersaline condition that is characteristic of the upper Laguna Madre - Baffin Bay ecosystem (average precipitation is 74 cm/yr [29 in/yr] and evaporation averages 158 cm/yr [62 in/yr]). Most years between 1980 and 2003 the upper Laguna Madre – Baffin Bay system were dominated by salinities that ranged from 30-50%. Three periods of very high salinity (>50%) were observed in 1986-1988, in 1996 and for a brief period in 2002 (X = 36‰ range from 17‰ is July 1992 to 57‰ in August 1989).

In 2000 the population of the three counties (Nueces, Kleberg, Kennedy) bordering the upper Laguna Madre – Baffin Bay ecosystem was 345,608 with 91% (313,645) residing in Nueces County.

There are many issues and threats which will directly and indirectly impact the coastal region of Texas. Of these, one of the largest is directly associated with population growth. Corpus Christi, in Nueces County, is the largest city in the three county area with a population of 277,454 and Kingsville, in Kleberg County, is the second largest city in the area with a population of about 31,000. Increases in the population will lead to increased demand for water which in turn will place more stress on water current resources. Population growth predictions are necessary for proper water planning and to address impacts potential to coastal ecosystems.

The 2000 Census shows Texas as the second most populous state in the nation with more than 20.8 million residents. By 2050, the population is projected to double to 41 million people. By 2050 more than 6% of the Texas population will live in one of the 14 coastal counties. These 14 coastal counties grew by more than 63% from 1960 – 2000 and are expected to grow by another 67% between 2000 and 2050 and be home to more than 2.7 million people. Cameron, Chambers, and San Patricio counties are predicted to double their population by 2050.

II. SPECIES PROFILES

NOTE: The species profiles presented in this report, including associated literature cited, were taken directly from Pattillo et al. 1997.

Atlantic Croaker

Scientific Name: *Micropogonias undulatus*

Other Common Names: Croaker, crocus, hardhead, king billy; tambour bresilien (French); *la corbina, corvinon brasilieno,* and *gorrubata* (Spanish) (Fischer 1978, Lassuy 1983a, NOAA 1985).

Classification (Robins et al. 1991)

Phylum:	Chordata
Class:	Osteichthyes
Order:	Perciformes
Family:	Sciaenidae

Range

Overall: The Atlantic croaker occurs in coastal waters of the western Atlantic, from the Gulf of Maine to southern Florida and along the Greater Antilles. It is rare around the Florida Keys. In the Gulf of Mexico, it is found from southern Florida to central Mexico. It may also occur in the southern Gulf and the lesser Antilles down to Argentina, but is may be confused with a similar species, *Micropogonias furnied* (Chao and Musick 1977, Hoese and Moore 1977, Fischer 1978).

The Atlantic croaker occurs from Florida Bay to the Rio Grande River in Texas. It is considered one of the most common bottom dwelling, estuarine fish in the northern Gulf of Mexico (White and Chittenden 1976, Hoese and Moore 1977).

Life Mode

Atlantic croaker are estuarine dependent. Eggs are pelagic and buoyant (Ditty and Shaw 1994), and early larvae are pelagic and planktonic. Early larvae are found on the mid to outer continental shelf, but become generally uniform throughout the shelf. Later stages become more demersal and occur in more inshore to estuarine areas. Juveniles become still more demersal and move into tidal creeks. Adults are demersal and move between estuarine and oceanic waters (Lassuy 1983a, Cowan 1985, Cowan and Shaw 1988).

Habitat

Type: Adults are estuarine to marine, and have been collected from depths of 1 to 90 m. They appear to be most abundant in mesohaline and polyhaline salinities, and are rare below 10‰ (Christmas and Waller 1973, Wagner 1973). Juveniles are estuarine to riverine and prefer fresh to mesohaline salinities (Parker 1971).

Eggs and early larvae are marine, and later larvae are marine to estuarine. Recently spawned larvae have, been collected at depths ranging from 15 to 115 m, although most occur in the upper 30 m, about 20 to 200 km from shore (Cowan 1985, Sogard et al. 1987, Cowan and Shaw 1988). Most small larvae were collected near midshelf about 65 125 km from shore in euhaline salinities. Fish three years old tend to dominate estuaries in North Carolina while those >3 years old are found mostly offshore (Ross 1988).

Substrate: Practically all sizes of croaker beyond the larval stage are associated with soft bottoms (Lassuy 1983a). Juveniles occur over mud sand in shallow estuarine and tidal creek areas, i.e., fine unconsolidated substrates. Adults are associated with mud sand, oyster reefs, shell and live bottoms in deeper waters.

Physical/Chemical Characteristics:

Temperature - Eggs and Larvae: While eggs and newly hatched larvae are found at 18-25° C, larger and older larvae can be found at progressively decreasing temperatures. Larvae have been found in temperatures as low as 10° C in the Gulf of Mexico (Cowan 1985, Cowan and Shaw 1988), but in the Chesapeake Bay area, they are found from 0° to 24° C (Ward and Armstrong 1980).

Temperature - Juveniles and Adults: The Atlantic croaker has been collected from 0.4° to 35.5° C in the Gulf of Mexico (Miller 1964, Parker 1971, Warren and Sutter 1982). Juveniles are generally more tolerant of low temperatures (0.4° - 38° C) than adults (5° - 35.5° C) (Parker 1971, Wagner 1973, Pineda 1975, Rogers 1979, Ward and Armstrong 1980, Benson 1982). Preferred temperatures for juveniles range from 6° to 20° C, and they grow well between 12.8° and 28.4° C. In Mississippi waters, adults were found in highest numbers at <30° C (Christmas and Waller 1973). They are rarely found below 10° C in Texas waters (Parker 1971). Lethal minimum and maximum temperatures are 0.6° and 38° C for juveniles and 3.3° and 36° C for adults (Parker 1971, Ward and Armstrong 1980).

Salinity - Eggs and Larvae: Eggs and larvae are found in euhaline waters. In the Gulf of Mexico, larvae have been found in salinities ranging from 15 to 36‰ (Cowan 1985, Cowan and Shaw 1988), but in the Chesapeake Bay area, they are found from <1 to 21‰ (Ward and Armstrong 1980).

Salinity - Juveniles and Adults: Atlantic croaker are euryhaline, having been collected from 0 to 40‰ and rarely at 75‰ (Simmons 1957, Parker 1971, Wang and Raney 1971, Warren and Sutter 1982, Darovec 1983, Lassuy 1983a). Juvenile croaker have been taken in salinities of 0.0 to 36.7‰ (Miller 1964, Parker 1971, Wagner 1973, Rogers 1979). In Texas and Louisiana bays, they have been found to be most abundant at <15‰ (Gunter 1945, Wang and Raney 1971, Wagner 1973, Ward and Armstrong 1980), but they appear to be relatively abundant from 10‰ to 20‰ in Alabama and Mississippi (Swingle 1971, Etzold and Christmas 1979). Juveniles are reportedly more tolerant of low salinities than adults (Gunter 1975). Adults are collected in waters with salinities that range from 0 to 70‰ (Simmons 1957, Ward and Armstrong 1980). In Mississippi, adults were most abundant in waters with salinities of 15 to 19.9‰ (Christmas and Waller 1973, Ward and Armstrong 1980).

Dissolved Oxygen (DO): Dissolved oxygen (DO) requirements are not well known, but the presence of this species in poorly oxygenated canals indicates a tolerance for low DO (Lassuy 1983a). Juveniles are found in waters with a dissolved oxygen content of 5.7 to 8.6 parts per million (ppm) (Hoese et al. 1968). Captures at DO concentrations from 1 through 13 ppm have been reported with most occurring between 8 and 13 ppm (Marotz 1984).

Turbidity: Densities of Atlantic croaker have been noted as more abundant in areas of high water turbidity possibly as the result of increased food availability and predator protection due to lower visibility (Lassuy 1983a).

Migrations and Movements: Adults have seasonal inshore and offshore migrations, although some appear to remain in offshore waters (55 to 118 m) all year (Perry 1970). Adults move up bays and estuaries in spring, randomly in summer, and seaward and southerly in fall. Larvae are carried by longshore currents into nearshore areas where tidal flow transports them into estuarine areas (Cowan and Shaw 1988). Larval recruitment into estuaries occurs from October to May, peaking between November and February (Wagner 1973, Marotz 1984). As they mature into juveniles, they move up into headwater areas. After spending 6-8 months in the estuary, offshore emigration begins in late March or early April at about 50 mm standard length (SL) or larger and continues until November (Kelley 1965, Perry 1970, Wagner 1973, Yakupzack et al. 1977, Rogers 1979, Marotz 1984). Emigration is probably governed by cues from fluctuations in environmental conditions in the nursery area (e.g. tides, temperature, salinity, day length, etc.), and is not just a function of fish size (Clairain 1974, Yakupzack et al. 1977).

Reproduction
Mode: This species has separate male and female sexes (gonochoristic). Fertilization is external, by broadcast of milt and roe into the water column, and development is oviparous.

Spawning: Spawning in the Gulf of Mexico has been reported from September through May, with a peak in October, specifically around mid-October, and possibly November (Sabins and Truesdale 1974, White and Chittenden 1976, Allshouse 1983, Marotz 1984). Based on the presence of larval croaker in the northern Gulf of Mexico, it can be inferred that spawning occurs September through April, with a peak from October through January (Ditty 1986, Ditty et al.1988). Based on larval growth information, the spawning season off western Louisiana is probably limited to November-January, with very little spawning occurring after January (Cowan 1988). Most spawning probably takes place in the nearshore Gulf of Mexico near island passes (Sabins and Truesdale 1974, Lassuy 1983a, Sogard et al. 1987).

Fecundity: Sheridan et al. (1984) found fecundities for Gulf of Mexico fish ranged from 27,000 eggs for 136 mm SL to 1,075,000 for a 318 mm SL specimen. Fish collected from Cape Hatteras, North Carolina northward were reported to have a fecundity range of 100,800 to 1,742,000 for fish 196 to 390 mm total length (TL) (Morse 1980).

Growth and Development
Egg Size and Embryonic Development: Eggs are spherical, and sizes range from 0.49 to 0.58 mm (Wang and Kernehan 1979).

Age and Size of Larvae: Larvae upon hatching are 1.3 to 2.0 mm TL (Wang and Kernehan 1979). Incubation time is 29-32 hours at 23° C and 26-30 hours at 25° C. Fruge and Truesdale (1978) collected 103 larval croaker in coastal waters of Louisiana, ranging in size from 1.7 to 10.5 mm SL. Cowan (1988) determined growth for 40-80 day larvae to be approximately 0.19 mm/day. In Texas, young-of-the-year appear from November to January at 10 50 mm TL. Larval stage is complete by approximately 10 mm TL when the full complement of spines and soft rays in the dorsal and anal fins are reached (Johnson 1978).

Juvenile Size of Larvae: Transformation to the juvenile stage occurs at a length of approximately 12 mm (Ditty and Shaw 1994). Juveniles may range in size from 11 to 140 mm TL (Johnson 1978, White and Chittenden 1976). One study from western Louisiana estimates juvenile growth rate at 0.47 mm/day or 14.2 mm/month (Arnoldi et al. 1973), while other estimates from the Mississippi Sound area are 3.1 mm/week (Warren 1981) and 13.0 mm/month (Warren and Sutter 1982).

Age and Size of Adults: Maturity in fish sampled from Texas and Louisiana areas was reached after the first year of growth when individuals reached 140 to 170 mm TL (White and Chittenden 1976). Most adults live up to 3 years with some living 4 to 5 years, but rarely longer (Etzold and Christmas 1979, Lassuy 1983a). In North Carolina, fish older than 3 years were found offshore, but were rare in estuaries (Ross 1988). The oldest fish recovered there were estimated to be 7 years old. The predicted TLs for year classes are: 176.6 mm for age 1; 261.5 mm at age 2; 331.0 mm at age 3; 388.0 mm at age 4; 434.5 mm at age 5; and 472.7 mm at age 6 (Ross 1988). The largest reported specimen was 668 mm TL (Rivas and Roithmayr 1970). Ross (1988) has derived Van Bertalanffy growth models for this species.

Food and Feeding

Trophic mode: Larvae and early juveniles are carnivores, feeding on zooplankton in the water column (Lassuy 1983a). Older juveniles and adults are opportunistic bottom feeding carnivores that prey on polychaetes, molluscs, crustaceans, and fish. Juveniles feed by forcefully diving into the substrate, digging as they feed. Adults feed similarly to juveniles, but are capable of taking larger invertebrates and some fishes. Atlantic croaker can, therefore, feed on a secondary or higher trophic level. Feeding is by sight, olfaction, and touch (Mercer 1989).

Food Items: Young of the year fish are reported to consume polychaete worms, copepods, and mysids, while older fish principally feed on crustaceans (stomatopods, shrimps and crabs), molluscs (gastropods and bivalves), and fish (Levine 1980, Darovec 1983, Sheridan et al. 1984, Mercer 1989). Early juveniles (15-30 mm) feed on zooplankton, switching to benthic mode as they become older and begin consuming infaunal and epifaunal organisms sorted from bottom debris (Mercer 1989). Food items include molluscs (common rangia, *Macoma mitchilli, Congeria leucophaeta, Probythinella protera, Texadina sphinctosoma*), isopods, amphipods, insects, fish (mostly bay anchovy), and detritus (Levine 1980).

Biological Interactions

Predation: Predators of Atlantic croaker are larger piscivorous species such as striped bass, southern flounder, bull shark; blue catfish yellow bass, spotted seatrout, Atlantic croaker, red drum, sheepshead, bluefish, and weakfish (Levine 1980, Mercer 1989).

Factors Influencing Populations: White and Chittenden (1976) show some habitat segregation by life stage, with smaller (<200 mm TL), younger individuals (age 0) occupying the bays and muddy bottoms, while the larger (>200 mm TL), older individuals (age 1+) are more localized around oyster reefs. Hoese et al. (1968) noted that faster growing individuals tend to leave Texas bays before the slower growing individuals, resulting in a bay population of smaller than average sized fish. Warren and Suffer (1983) noted that abundance in Mississippi Sound drops dramatically in July and that these drops may be due to shrimping which begins in June. Shrimping activities may be having an effect on the population of this species. Atlantic croaker comprise an estimated 50% of the fish discarded as bycatch and destroyed during the brown shrimp season, and 18% of those during the white shrimp season (Rogers 1979). The average bycatch from 1972 to 1989 was estimated as 7.5 billion croaker (NOAA 1993). This species is considered overexploited in the southeastern U.S.

Black Drum
Scientific Name: *Pogonias cromis*
Other Common Names: sea drum, gray drum, oyster cracker, drum fish, striped drum, puppy drum, butterfly drum (Suffer et al. 1986); *grand tambour* (French), *tambor, corvinon negro* (Spanish) (Fischer 1978, NOAA 1985).
Classification (Robins et al. 1991)

Phylum:	Chordata
Class:	Osteichthyes
Order:	Perciformes
Family:	Sciaenidae

Range
Overall: The black drum ranges from Massachusetts to Argentina. It is common from Chesapeake Bay to Florida, and in the Gulf of Mexico. It occurs along the southern coasts of the Greater Antilles and all of the Lesser Antilles, but is rare, and the South American shelf from Guyana to Brazil. It is apparently absent in the southern Gulf, and mainland Central America (Hoese and Moore 1977, Fischer 1978, Shipp 1986, Sutter et al. 1986).

The black drum is common in the northern portion of the Gulf of Mexico from Florida Bay, Florida to the Rio Grande, Texas. It is relatively abundant along the coasts of Louisiana, near the Mississippi Riverdelta, and Texas (Benson 1982, Shipp 1986, Sutter et al. 1986, Nieland and Wilson 1993).

Life Mode
The black drum is an estuarine-dependent species (Benson 1982). Spawning occurs primarily in nearshore waters and estuarine passes. Eggs are pelagic and buoyant (Joseph et al. 1964, Ditty and Shaw 1994). Larvae are pelagic, and are transported by tidal currents through passes to estuarine waters. Juveniles prefer shallow, nutrient rich, turbid waters, such as tidal creeks and channels, but they have also been found in fresh water habitats (Gunter 1942, Gunter 1956, Sutter 1986). Adults are demersal throughout the estuaries and bays of the northern Gulf (Simmons and Breuer 1962, Cornelius 1984). At maturity there is constant movement in search of food, and feeding fish will typically travel in large schools (Richards 1973, Bryant et al. 1989).

Habitat
Type: Eggs are marine to estuarine. Larvae are marine, occurring over the inner continental shelf (Cowan 1985, Peters and McMichael 1990), to estuarine. Juveniles are marine to riverine. Adults are marine to estuarine occurring primarily in inshore neretic waters just outside the ocean littoral zone and in estuaries (Richards 1973). Juveniles and young adults prefer estuarine habitats, but older adults (>4 yrs.) move to nearshore Gulf waters (Sutter et al.1986, Leard et al. 1993).

Substrate: Black drum juveniles prefer unvegetated muddy bottoms in marsh habitats. Adults are found over unvegetated sand, mud and oyster/worm reefs (Pearson 1929, Mok and Gilmore 1983, Cornelius 1984, Peters and McMichael 1990). Adult black drum have been collected over heavily vegetated seagrass beds during summer fish kill events in Florida Bay (Schmidt 1993).

Physical/Chemical Characteristics:

Temperature - Eggs and Larvae: Eggs and larvae successfully develop at 18° to 20° C (Garza et al.1978, Johnson 1978). Larvae have been collected at over a temperature range of 11° to 22° C (Cowan 1985, Peters and McMichael 1990).

Temperature - Juveniles and Adults: Adults and juveniles are eurythermal. They have been found in water temperatures ranging from 3° to 35° C (Wang and Raney 1971, McIliam 1978). Sharp decreases in water temperature cause movements to deeper water, and mass mortalities result when conditions remain adverse for long periods of time (Cowan 1985).

Salinity - Eggs and Larvae: Laboratory spawned eggs hatched successfully at 8.8 to 34.‰, with highest survival occurring at 23 to 34‰ (Garza et al. 1978). Larvae have been collected at 0 to 36‰ (Cowan 1985, Peters and McMichael 1990).

Salinity - Juveniles and Adults: Adults and juveniles are euryhaline (Gunter 1942, Gunter 1956). They are found from 0 to 80‰ and are common at 9 to 26‰ (Simmons and Breuer 1962, McIliam 1978). In hypersaline waters at the upper end of this salinity range, fish can be blinded and have body lesions (Simmons and Breurer 1962). In Florida, juveniles 16 to 90 mm SL occur most often in low to moderate salinities while large juveniles are mainly found in moderate to high salinities (Peters and McMichael 1990).

Migrations and Movements

Larvae and small young move into upper estuarine areas and tidal creeks to low salinity nursery areas during flood tides (Wang and Kernehan 1979). Juveniles move out of creeks and secondary bays at about 100 mm SL (Peters and McMichael 1990). As they reach 150-200 mm SL they move into the open waters of river mouths, bays, passes, and the nearshore Gulf. Mature individuals often remain in bays until nearly ripe before migrating to passes to spawn. After spawning, they quickly return to their preferred bay habitat (Simmons and Breuer 1962). In fish less than 4 years old, there is little interbay and bay-Gulf movement throughout the year (Osburn and Matlock1984). There is little intra-bay movement except for the spawning migration, and during adverse conditions such as temperature extremes and/or insufficient food. Black drum move constantly in their search for food, and these movements within a bay system can be considerable if food is not abundant (Simmons and Breuer 1962, Osburn and Matlock 1984, Bryant et al. 1989).

Reproduction

Mode: This species has separate male and female sexes (gonochoristic). Mature adults are known to form spawning aggregations. Fertilization is external, by broadcast of milt and roe into the water column. Development is oviparous.

Spawning: Black drum exhibit group synchronous maturation of oocytes and multiple, or batch spawning (Peters and McMichael 1990, Nieland and Wilson 1993). Mature fish spawn near passes, in open bays and channels, and nearshore waters of the northern Gulf of Mexico (Simmons and Breuer 1962, Mok and Gilmore 1983, Peters and McMichael 1990, Fitzhugh et al. 1993, Ditty pers. comm.). Depth of spawning appears to be around 20 to 27 m (Ross et al. 1983, Cody et al. 1985). Ripe individuals are usually present from November until May. Peak spawning occurs from January to mid-April with a secondary peak sometimes reported in Texas during early fall (Pearson 1929, Simmons and Breuer 1962, Allshouse 1983, Cornelius 1984, Murphy and Taylor 1989, Peters and McMichael 1990, Nieland and Wilson 1993). Saucier and Baltz (1993) reported that black drum form "drumming" aggregations in estuarine waters of

Louisiana from January to April, at salinities from 10 to 27‰, and temperatures from 15 to 24° C, from 6pm to 10pm, and that spawning sites were primarily located in deep, moving water in passes between barrier islands. Based on the presence of larval black drum in the northern Gulf of Mexico, it can be inferred that spawning occurs December through May, with a peak from February through April (Ditty et al.1988). Spawning peaks occur during the period of rising water temperatures in the spring (Peters and McMichael 1990). Tides may also influence the amount of spawning activity or successful recruitment. Laboratory spawning has been achieved at 21° C and 28-31‰ (Garza et al. 1978).

Fecundity: In one study, average fecundity of 451 females was 1,090,000 eggs (Cornelius 1984). In Louisiana, the estimated mean annual egg production during three breeding seasons ranged from 31.05 to 41.69 million eggs (Nieland and Wilson 1993). Estimated annual egg production by a 6.1 kg female could be as high as 32 million eggs (Fitzhugh et al. 1993), and the maximum observed was 67.33 million in an 11.51 kg female (age 19, 855 mm FL) (Nieland and Wilson 1993). Spawning may occur as often as every 3 or 4 days .during the breeding season, with an average clutch size of 1.6 million eggs over 20 spawns (Fitzhugh et al. 1993, Nieland and Wilson 1993). Batch fecundity increases with age and size, and no evidence of spawning senescence has been observed.

Growth and Development

Egg Size and Embryonic Development: Reported egg sizes are from 0.8 to 1.1 mm in diameter, with a mean of 0.9 mm (Ditty and Shaw 1994). Eggs have been reported to hatch in 24 hours at 20° C (Joseph et al. 1964, Johnson 1978, Wang and Kernehan 1979).

Age and Size of Larvae: Larvae are 1.9 to 2.4 mm TL at hatching (Joseph et al. 1964, Johnson 1978) and are as large as 9.2 mm SL before becoming juveniles (Peters and McMichael 1990). Larval growth rates range from 0.2 mm/day to 0.9 mm/day.

Juvenile Size Range: Transformation to the juvenile stage occurs at a total length of approximately 12 mm (Ditty and Shaw 1994). By 15 mm TL, juveniles attain a general adult body shape (Johnson 1978). Juveniles growing from 35 to 150 mm SL average 0.9 mm/day, and reach 140-180 mm standard length (SL) at the end of the first year; 210-250 mm SL at 1.5 years; and 290-330 mm SL in two years (Simmons and Breuer 1962, Peters and McMichael 1990). Ages and sizes at maturity are similar for most U.S. locations with the exception of Texas (Leard et al. 1993). In Texas, studies indicate females reach maturity at 275-320 mm total length (TL) when at the end of their second year (Pearson 1929, Simmons and Breuer 1962). Florida studies found males mature at sizes beginning at 450-499 mm TL at age 4 or 5 years (Murphy and Taylor 1989). Florida females mature when older and slightly longer during their fifth or sixth year and between 650-699 mm TL (Murphy and Taylor 1989). In Louisiana, males and females are first mature at 600-640 mm FL and most are age 5 or older (Fitzhugh et al. 1993, Nieland and Wilson 1993). All males and females studied whose lengths were greater than 640 mm FL and 690 mm respectively were mature. The minimum lengths for mature males and females were 552 mm FL (age 3) and 628 mm FL (age 5), respectively.

Age and Size of Adults: In Texas waters, Simmons and Breuer (1962) reported adults growing to 400-430 mm SL by the end of the third year; beyond that tag returns indicate a growth of 25 to 50 mm/year (Simmons and Breuer 1962, Matlock 1990). There is a sharp decrease in growth rate at 4-5 years that may reflect a reallocation of energy from growth to reproduction, because black drum mature at approximately this age (Beckman et al. 1990). This is a relatively long lived species. Based on size, some individuals may live as long as 35 years (Benson 1982), while otolith studies indicate some individuals may live up to 43 years in Louisiana (Beckman et al. 1990) and 58 years in Florida (Murphy and Taylor 1989). Black drum are the largest sciaenids in the southeastern United States (Peters and McMichael 1990), and they grow to be the largest members of the family Sciaenidae (Fitzhugh et al.1993). The average maximum total length typically reached in Texas appears to be approximately 1000 to 1200 mm (Matlock 1990). The largest recorded adult weighed 66.3 kg (Cave 1978). The average maximum TL for black drum in the Gulf of Mexico appears to be smaller than that occurring in the colder waters north of Cape Hatteras. This may be due to zoogeographic variation in black drum population dynamics (Beckman et al. 1990, Matlock 1990). Beckman et al. (1990) have developed Von Bertalanffy growth equations for this species.

Foods and Feeding

Trophic Mode: All free swimming life stages are carnivorous. Larvae feed on zooplankton in the water column, while juveniles and adults are benthic feeders. In shallow depths, their tails will stick out of the water at times (flagging) while they feed in a vertical position (Pearson 1929, Leard et al. 1993). Bottom feeding is aided by the presence of a sensitive chin barbel for finding food, and powerful pharyngeal teeth for crushing molluscs and crabs (Simmons and Breuer 1962).

Food Items: The major food organism groups in order of importance are molluscs (mostly bivalves), arthropods (mostly decapod crustaceans), annelids, and fish (Dugas 1986, Leard et al.1993). Some sand and plant material have also been found that were probably ingested incidentally while feeding. Larvae feed on zooplankton with copepods being the primary prey item found in stomachs (Peters and McMichael 1990). The numeric and volumetric importance of copepods declines with increasing fish size. They are rarely found in 30-60 mm black drum and are not evident in any fish >60 mm SL. Juveniles and adults feed on benthic organisms. Small juveniles eat soft foods such as small fish, polychaetes, bivalve siphon tops, and crustaceans (Pearson 1929, Simmons and Breuer 1962, Martin 1979, Peters and McMichael 1990). In larger juveniles, bivalve and gastropod molluscs are the predominant food items (Peters and McMichael 1990). The consumption of soft food decreases as size increases, shifting to the main adult diet of molluscs and crabs (Dugas 1986, Peters and McMichael 1990). This change in feeding habits occurs as the pharyngeal teeth become developed and the black drum can start consuming hard-bodied prey (Peters and McMichael 1990). Large juveniles (>200 mm SL) with well developed pharyngeal teeth have diets similar to adults. Martin (1979) reported that black drum >300 mm TL favored bivalve molluscs, with *Mulinia lateralis* most frequently encountered. Dugas (1986) found black drum >700 mm SL prey on oysters approximately 75 mm in length. Another study observed that drum <900 mm TL consumed oysters 25-75 mm in length while drum >900 mm TL consumed oysters 25-115 in length (Cave 1978). Other prey items include: common rangia, hard clam, *Ensis minor*, tellin clams, xanthid crabs, insects, mysids, amphipods, barnacles, isopods, penaeid shrimp, mud shrimp, hermit crabs, blue crab, polychaetes, bay anchovy, Atlantic spadefish, gobies, and Atlantic croaker (Cave 1978, Benson 1982, Dugas 1986, Peters and McMichael 1990).

Biological Interactions

Predation: Little information is available that describes specific predators of black drum; however, it is likely that larvae and juveniles are utilized as a food source by larger predator species during their life cycle (Leard et al. 1993). Potential predators include various drums (Sciaenidae), jacks (Carangidae), and mackerels (Scombridae) as well as sharks. Filter feeding fish such as anchovies are potential predators of black drum eggs and larvae.

Factors Influencing Populations: Rapid and extreme fluctuations in temperature may cause mortalities; however, the most limiting habitat requirements appear to be amount of estuarine habitat and the accompanying availability of food (Leard et al.1993). Interaction with other species have not been well studied (Suffer et al. 1986). Some competition may exist with red drum and other bottom feeders for benthic resources. Fishing pressure on the black drum has increased since the mid-1980s in the northern Gulf of Mexico, with the reductions of harvest of the red drum (Beckman et al. 1990). The long life span of this species implies an extremely low natural mortality rate which probably means little surplus production is available for commercial fishery yield (Murphy and Taylor 1989). This would tend to make this species a poor candidate for an intensive or even moderate fishery. The normal feeding habits of this species may have a detrimental effect on the spawning and nursery grounds of spotted seatrout, red drum, and juvenile penaeid shrimp by the destruction of seagrass beds (Cave 1978).

Red Drum

Scientific Name: *Sciaenops ocellatus*

Other Common Names: red fish, red bass, channel bass, drum, branded drum, school drum, spotted bass, spottail (Welsh and Breder 1923, Pearson 1929, Yokel 1966, Bryan 1971, Hoese and Moore 1977, Overstreet and Heard 1978a, Benson 1982, Daniels and Robinson 1986, WRGF 1991); *tambour rouge* (French), *corvinon ocelado* (Spanish), *corvina* (Spanish) (Fischer 1978, NOAA 1985). Smaller fish (<2.27 kg) are called rat reds or puppy drum while larger fish (>2.27 kg) are referred to as bull reds (Welsh and Breder 1923, Breuer 1957, Yokel 1966, Christmas and Waller 1973).

Classification (Robins et al. 1991)

Phylum:	Chordata
Class:	Osteichthyes
Order:	Perciformes
Family:	Sciaenidae

Range

Overall: The red drum occurs in the western Atlantic from the Gulf of Maine off Massachusetts to Key West, Florida, and in the Gulf of Mexico from Florida to Tuxpan, Mexico (Welsh and Breder 1923, Simmons and Breuer 1962, Yokel 1966, Lux 1969, Boothby and Avault 1971, Hoese and Moore 1977, Lee et al. 1980, Matlock 1980, Ward and Armstrong 1980, Holt et al. 1983b, Overstreet 1983, Matlock 1987). Since 1950, populations of red drum have virtually disappeared in waters north of Chesapeake Bay, and New Jersey is now probably the northern limit of this species. Centers of abundance exist in the waters of North Carolina, and the Gulf of Mexico (Yokel 1966, Matlock 1980, Ward and Armstrong 1980).

Within U.S. Gulf of Mexico estuaries, the red drum occurs from the Rio Grande, Texas, to Florida Bay, Florida (Welsh and Breder 1923, Simmons and Brauer 1962, Yokel 1966, Boothby and Avault 1971, Hoese and Moore 1977, Matlock 1980, Ward and Armstrong 1980, Holt et al.

1983, Overstreet 1983, NOAA 1985, Matlock 1987). The species is most abundant in waters of Texas and Louisiana (Ward and Armstrong 1980). It is also abundant in Mississippi, but this may be due to the benefits of the extensive estuaries present in nearby Louisiana (Yokel 1966).

Life Mode

Red drum are estuarine dependent. Eggs, larvae, and early juveniles are planktonic and pelagic (Breuer 1957, Ward and Armstrong 1980, Peters and McMichael 1987). Juveniles and adults are pelagic and nektonic (Gunter 1945, Breuer 1957, Ward and Armstrong 1980, Holt et al. 1981a, Osburn et al. 1982, Benson 1982, Peters and McMichael 1987). Juveniles are often found in schools, but adults are largely solitary when living in shallow water (Pearson 1929, Breuer 1957, Simmons and Breuer 1962, Christmas and Waller 1973, Adkins et al. 1979, Benson 1982, Osburn et al. 1982, Overstreet 1983, Peters and McMichael 1987). Some schools in the Gulf of Mexico are associated with schools of black drum, tarpon, blue runner, little tunny (*Euthynnus alletteratus*), and Florida pompano, at least when near shore, although the red drum does not randomly mix with schools of other species. Large schools can contain 150,000 to 200,000 individuals and first appear about April and disappear offshore from September to October. Schools are often more dispersed during summer than in spring or autumn (Perret et al. 1980, Overstreet 1983). Activity seems to be equally divided between night and day (Zimmerman 1969, Benson 1982, Minello and Zimmerman 1983, Peters and McMichael 1987).

Habitat

Type:

Eggs: Eggs are spawned in nearshore and inshore waters close to barrier island passes and channels. After hatching, larvae and post-larvae are carried by tidal currents into the shallow inside waters of bays and estuaries (Pearson 1929, Yokel 1966, Heffernan 1973, Holt et al. 1981a, Benson 1982, Peters and McMichael 1987, Johnson and Funicelli 1991). Eggs from hatchery, spawns develop best in polyhaline to euhaline waters (Arnold et al. 1979, Holt et al. 1983).

Larvae: Larvae move through the passes and tend to seek shallow, slack water along the sides of the channels to avoid being carried offshore during periods of ebb tide (King 1971). As larvae enter estuarine waters, they seek grassy quiet coves, tidal flats, and lagoons where the vegetation protects them from predators and currents, and where they can avoid rough waters until they are strong enough to swim actively (Pearson 1929, Simmons and Breuer 1962, Yokel 1966, Perret et al. 1980, Ward and Armstrong 1980, Holt et al. 1983, Overstreet 1983). Early larvae are found in mesohaline to euhaline waters, and older larvae and post larvae are euryhaline (Yokel 1966, Perret et al. 1980, Ward and Armstrong 1980, Crocker et al. 1981, Holt et al. 1981a, Overstreet 1983, Vetter et al. 1983, Peters and McMichael 1987).

Juveniles: Juveniles are euryhaline (Gunter 1942, Gunter 1956, Simmons 1957, Simmons and Breuer 1962, Yokel 1966, Perret et al. 1980, Crocker et al. 1981, Holt et al. 1981a, Benson 1982, Crocker et al. 1983, Daniels and Robinson 1986, Peters and McMichael 1987). They are found in a wide variety of habitats perhaps due to their movements from bay shores to quiet backwater areas as they grow and begin to disperse through the bay (Peters and McMichael 1987). They prefer shallow, protected, open waters of estuaries, coves, and secondary bays with depths up to 3.05 m, but may also be found near the mouths of tidal passes. Juveniles have also been reported from shallow shorelines, tidal pools, marsh habitats, depressions in marshy areas, boat basins, bayous, flats, channels, reefs, back bays, around islands, in rivers and near their mouths, and occasionally the surf along the Gulf of Mexico in the spring following hatching. Older juveniles tend to move into slightly deeper, more open waters and into primary bays (Pearson 1929, Reid 1955, Simmons 1957, Breuer 1957, Simmons and Breuer 1962, Yokel 1966, Zimmerman 1969, Swingle 1971, Christmas and Waller 1973, Perret et al. 1980, Ward and Armstrong 1980, Crocker et al. 1981, Holt et al. 1981a, Pafford 1981, Benson 1982, Osburn et al. 1982, Overstreet 1983, Peterson 1986, Loftus and Kushlan 1987, Peters and McMichael 1987, Van Hoose 1987).

Adults: Adults are also euryhaline (Gunter 1942, Gunter 1956, Simmons and Breuer 1962, Holt et al. 1981a, Crocker et al. 1981, Benson 1982, Daniels and Robinson 1986). They are occasionally found in shallow bays, but tend to spend more time in marine habitats after their first spawning. They are typically found in the Gulf of Mexico in littoral and shallow nearshore waters off beaches (Perret et al. 1980, Ward and Armstrong 1980, Pafford 1981, Benson 1982, Overstreet 1983, Ross et al. 1983). Adults are often caught in more offshore waters as far as 25 km from shore in depths up to 40 m, and are commonly reported from depths of 40 to 70 m. They are occasionally caught on Gulf reefs (Lux 1969, Heffernan 1973, Benson 1982, Overstreet 1983, Ross et al. 1983).

Substrate: Newly hatched larvae are found in the Gulf surf over pure sand bottoms. After entering bays and estuaries, they occur over substrates of mud, sand, or sandy mud bottoms as well as in and among patchy sea grass meadows, but prefer muddy bottoms. Small juveniles seem to prefer medium soft mud to firm sandy substrates (Peterson 1986). Small fish are probably more successful at capturing prey in the less dense vegetation areas, while living in areas of greater sea grass density probably helps them to avoid predation (Pearson 1929, Simmons and Breuer 1962, Yokel 1966, Perret et al. 1980, Ward and Armstrong 1980, Benson 1982, Holt et al. 1983, Overstreet 1983). They are normally associated with such sea grasses as *Halodule beaudettes*, *Ruppia maritima*, and *Thalassia testudinum* (Zimmerman 1969, Perret et al. 1980). Large juveniles and adults are common over muddy, sandy, or oyster reef bottoms with little or no sea grass (Yokel 1966, Lee et al. 1980, Perret et al. 1980).

Physical/Chemical Characteristics:
Temperature: Tolerance of environmental conditions changes with age, life history stage, season, and geography (Crocker et al. 1981). No major difference between thermal tolerances appears to exist between populations of red drum from the Gulf of Mexico and mid-Atlantic coast (Ward et al. 1993).

Temperature - Eggs and Larvae: Eggs and newly hatched larvae tend to be stenothermal while 10 day and older larvae are more eurythermal (Crocker et al. 1981). Eggs and larvae from captive spawns have developed over a temperature range of 20° to 30° C with optimal survival at 25° C. Higher temperatures (30 and 35° C) are associated with poor survival of yolk sac larvae (Holt et al. 1981a, Overstreet 1983, Lee et al. 1984). Larvae and post-larvae have been collected in the wild from 18.3° to 31.0° C (Yokel 1966, Perret et al. 1980, Peters and McMichael 1987, Van Hoose 1987).

Temperature - Juveniles: Juveniles are eurythermal, and are found in waters ranging in temperature from 2.0° to 34.9° C (Gunter 1945, Simmons and Breuer 1962, Yokel 1966, Franks 1970, Perret et al. 1971, Wang and Raney 1971, Christmas and Waller 1973, Pineda 1975, Tarver and Savoie 1976, Bonin 1977, Barret et al. 1978, Adkins et al.1979, Perret et al. 1980, Holt et al. 1981a, Daniels and Robinson 1986, Peters and McMichael 1987). They appear to prefer temperatures ranging from 10° to 30° (Ward and Armstrong 1980). Juveniles in heated discharge waters have survived up to 35° C, but at 39° C some died, apparently from handling stress (Overstreet 1983). Large numbers have been killed in sudden severe cold spells, but normally fish will move into deeper waters during periods of extreme temperatures (Simmons and Breuer 1962, Adkins et al. 1979). In a laboratory study, fish ceased feeding between 7° to 9° C and death generally occurred when temperatures fell to 4° C or lower for several days (Miranda and Sonski 1985).

Temperature - Adults: Adults are also eurythermal, and have been collected over a temperature range from 2.0° to 33° C (Simmons and Breuer 1962, Yokel 1966, Juneau 1975, Perret et al. 1980, Ward and Armstrong 1980, Daniels and Robinson 1986). Adults are considered more susceptible to the effects of winter cold waves than smaller fish (Yokel 1966), and they normally move into deeper waters for refuge (Simmons and Breuer 1962).

Salinity: All life stages are sensitive to high salinities when combined with high temperatures, but susceptibility is influenced by the size of the fish (Simmons 1957).

Salinity - Eggs and Larvae: Eggs and larvae in particular sensitive to environmental conditions (Overstreet 1983). Eggs from hatchery spawns develop successfully into feeding larvae at salinities of 10 to 40‰ in a temperature of 25° C. Below 10‰ the hatch rate is poor, and below 25‰ eggs sink resulting in losses from fungal infection, crowding, and low oxygen (Vetter et al. 1983). High salinities coupled with high temperatures were associated with poor yolk sac larvae survival (Holt et al. 1981a). The best salinities reported for 24 hour survival and hatch are 30‰ at 25° C and 34 to 36.5‰ at 23° to 26° C (Neff et al. 1982, Overstreet 1983, Lee et al. 1984). Eggs have been collected in the field from 21° C to 23° C in a salinity range of 29 to 32‰ (Johnson and Funicelli 1991). Larvae from hatchery spawns were more stenohaline than older life stages, particularly during the first two weeks after hatching with best survival at about 30‰ (Crocker et al. 1981, Holt et al. 1981a, Overstreet 1983). One article reports tolerance from <1 to 50‰ and a preference of 20 to 40‰ salinity (Ward and Armstrong 1980). Larvae and post larvae collected in the wild were found over a salinity range of 8 to 36.4‰ (Yokel 1966, Peters and McMichael 1987, Van Hoose 1987). One study reports spawning occurring during a salinity range of 14.7 to 18.5‰ (Hein and Shepard 1986a).

Salinity - Juveniles and Adults: Both juveniles and adults are euryhaline (Gunter 1942, Gunter 1956, Simmons and Breuer 1962, Yokel 1966, Perret et al. 1980, Crocker et al. 1981, .Holt et al. 1981a, Benson 1982, Daniels and Robinson 1986). They are very efficient osmoregulators with the ability to tolerate abrupt changes in salinity which is especially important to juveniles in the estuarine environment. Juveniles appear more tolerant to low salinity, whereas adults which are less dependent on estuarine areas and spend more time at sea are more tolerant of high salinity (Yokel 1966, Crocker et al. 1983). Both groups have been collected from salinities ranging from 0 to 45‰, but only rarely at 50‰ or above (Gunter 1945, Simmons 1957, Simmons and Breuer 1962, Yokel 1966, Franks 1970, Perret et al. 1971, Christmas and Waller 1973, Juneau 1975, Tarver and Savoie 1976, Bonin 1977, Swift et al. 1977, Barret et al. 1978, Ward and Armstrong 1980, Perret et al. 1980, Crocker et al. 1981, Holt et al. 1981a, Daniels and Robinson 1986, Loftus and Kushlan 1987, Peters and McMichael 1987). Juveniles and adults appear to prefer salinities from 20 to 40‰ with maximum growth for juveniles occurring at 35‰ (Bonin 1977, Perret et al. 1980, Ward and Armstrong 1980, Crocker et al. 1981, Holt et al. 1981a, Benson 1982, Peterson 1986). One report found the greatest abundance of small juveniles (17-58 mm total length (TL)) in salinities below 15‰ (Gunter 1945). Captive juveniles survived best at salinities of 1.3‰ or greater (Miranda and Sonski 1985).

Dissolved Oxygen: Fry can not survive low dissolved oxygen (DO) concentrations of 0.6 to 1.8 parts per million (ppm) (Overstreet 1983). Large juveniles have been reported in waters with oxygen concentrations of 5.2 and 8.4 ppm (Barret et al. 1978).

Other: The maximum ammonia (NH_3) concentration allowing normal growth of larvae is 0.11 mg/l, but older fish are able to tolerate higher concentrations (Holt and Arnold 1983).

Movements and Migrations: The red drum is relatively non-migratory with no major coastwise movements, but does have broad random movements, loosely coordinated temperature induced migrations, and strong offshore or deep water spawning migrations (Simmons and Breuer 1962, Moe 1972, Adkins et al. 1979, Perret et al. 1980, Ward arid Armstrong 1980, Osburn et al. 1982). Larger fish (>750 mm) appear to move greater distances than smaller fish (Bryant et al. 1989). Tagging studies have shown little intra-bay movement or bay-Gulf travel except, perhaps, for short periods, and a few infrequent individuals with some extensive movement (Simmons and Breuer 1962, Beaumariage 1969, Pafford 1981, Osburn et al. 1982, Bryant et al. 1989). These studies also indicated that fish tagged in the Gulf of Mexico tended to stay there (Simmons and Hoese 1959, Simmons and Breuer 1962). Eggs, larvae, and early juveniles are carried by tides and currents in late fall into the shallow estuaries and bays with peaks occurring in October. Larvae tend to move through barrier island passes in mid channel surface waters with the tidal current (King 1971, Bass and Avault 1975, Holt et al. 1981a, Benson 1982). Fish move from bay shores farther into the estuary to quiet back water areas as they grow, eventually occupying secondary bays considerable distances from their original point of entry (Yokel 1966, Perret et al.1980, Peters and McMichael 1987). Young drum will leave these shallow areas when about 40 to 120 mm TL and move into primary bays and somewhat deeper waters (>1.8 m). This movement may be accelerated by cold temperatures (Pearson 1929, Yokel 1966, Osburn et al. 1982, Peters and McMichael 1987). Movement of sub-adults (<3 years) in bays appears limited with schools remaining in a single locale for several months (Osburn et al. 1982). Most of their movements apparently consist of responses to temperature and salinity, and foraging which can be considerable even if these fish remain within a small general area (Pafford 1981, Overstreet 1983). As juveniles approach 200 mm TL during their first spring, they may remain in deep water areas of bays or congregate near passes usually in large aggregations (Simmons and Hoese 1959, Peters and McMichael 1987). Sub-adults may remain in the bays throughout the year, but older fish (≥2) move into the open Gulf in fall and winter, and possibly during late summer (Perry 1970, Perret et al. 1980, Hein and Shepard 1986a, Matlock 1987, Beckman et al. 1988). This seasonal movement is a general, gradual one with fish disappearing offshore presumably to spawn (Pearson 1929, Benson 1982). Class I juveniles leaving bay systems in the fall probably reenter with older juveniles the following spring in a more contracted migration (Pearson 1929, Ward and Armstrong 1980, Benson 1982). Migrating fish may use salinity gradients as predictive cues for directed movements from estuarine to oceanic habitats and back (Owens et al. 1982). Results from recent studies suggest large fish in offshore waters may have a more extensive migration over time than was previously thought. These movements may be due to the abundance of specific food items, causing the red drum to continually migrate in a relatively consistent pattern in order to optimize feeding in specific rich and different areas on a seasonal basis (Overstreet and Heard 1978a, Pafford 1981, Overstreet 1983).

Reproduction

Mode: This species has separate male and female sexes (gonochoristic). Fertilization is external, by broadcast of milt and roe into the water column, and egg development is oviparous. Mature adults probably form spawning aggregations (Johnson and Funicelli 1991). Red drum are multiple batch spawners, with group-synchronous oocyte maturation (Wilson and Nieland 1994).

Spawning: The spawning season typically lasts from summer through early winter, but its onset and duration vary with photoperiod, water temperature, and possibly other factors (Holt et al. 1981a, Overstreet 1983). Spawning can start as early as August in some parts of the study area, but it usually begins in September and ends in early January with peaks occurring in mid-September through October, and then declining (Welsh and Breder 1923, Gunter 1945, Yokel 1966, Boothby and Avault 1971, Christmas and Waller 1973, Heffernan 1973, Sabins and Truesdale 1974, Perret et al. 1980, Holt et al. 1981a, Benson 1982, Overstreet 1983, Lee et al. 1984, Hein and Shepard 1986a, Peterson 1986, Matlock 1987, Van Hoose 1987, Murphy and Taylor 1990). Gonadosomatic index (GSI) studies in the northern Gulf of Mexico suggest an 8 to 9 week spawning season, mid-August to early October (Wilson and Nieland 1994). Based on the presence of larval red drum in the northern Gulf of Mexico, it can be inferred that spawning occurs August through November, with a peak from September through October (Ditty 1986, Ditty et al. 1988). Spawning principally occurs in nearshore coastal waters on the Gulf side of barrier islands, usually in or near the passes and channels between islands where currents can carry the eggs to shallow inside waters (Higgins and Lord 1926, Pearson 1929, Gunter 1945, Breuer 1957, Yokel 1966, Sabins and Truesdale 1974, Perret et al. 1980, Holt et al. 1981a, Benson 1982, Lee et al. 1984, Hein and Shepard 1986a, Matlock 1987, Peters and McMichael 1987, Murphy and Taylor 1990). Freshly spawned eggs were recovered during one investigation in water depths ranging from 1.5 to 2.1 m (Johnson and Funicelli 1991). One study estimated spawning occurring 7.3 to 21.9 m offshore of a natural pass in Texas (Heffernan 1973). In Florida, ripe adults have been collected 4.8 km offshore in the Gulf of Mexico suggesting that some offshore spawning may also occur (Murphy and Taylor 1990). Some spawning can also occur inside large estuaries. Spawning activities are initiated in early evening or night (Guest 1978, Holt et al. 1981 b, Overstreet 1983, Johnson and Funicelli 1991), in an average salinity of 28‰ and in temperatures of 21° to 24° C (Hopkins et al. 1986, Johnson and Funicelli 1991).

Fecundity: Captive fish spawn repeatedly and produce large numbers (about 1 million per spawn) of small buoyant eggs (Vetter et al. 1983). The estimated number of oocytes from a female with a standard length (SL) of 758 mm was 61,998,776 when calculated by volumetric means or 94,513,172 using the gravimetric method (Overstreet 1983). In one experiment, 10 to 12 spawns per fish over 90 to 100 days were typical with one captive fish spawning 31 times over 90 days, while another reported females spawning 52 times in 76 days producing an estimated total of 60 million eggs. Captive fish spawned about 1 million eggs per spawn during the first 45 days, dropping to 10 to 100 thousand thereafter. The maximum recorded spawn was 2,058,000 per fish during one night (Arnold et al. 1979, Overstreet 1983), and a maximum individual annual fecundity is estimated as 30,000,000 for 9 to 14 kg fish (Overstreet 1983). In the northern Gulf of Mexico, Wilson and Nieland (1994) reported a typical batch spawning frequency of 3 days, and a batch fecundity range of 160,000 to 3.27 million eggs for females 3 to 33 years old.

Growth and Development

Egg Size and Embryonic Development: Eggs develop oviparously. They are buoyant, and their shape is spherical with a mean diameter of 0.95 mm and a range of 0.86 to 0.98 mm diameter (Ditty and Shaw 1994). Usually one and up to six clear oil globules averaging 0.27 mm (0.24 0.31 mm) are present. The perivitelline space varies in size, but is generally less than 2% of the egg diameter (Holt et al. 1981b, Vetter et al. 1983). Eggs spawned at 24° C and 28‰ hatch in 19 to 20 hours (Arnold et al. 1979), 22 hours when spawned at 23° C and 36‰ (Vetter et al. 1983), and 28 to 29 hours at 22 to 23° C (Holt et al. 1981b). Live eggs float with the oil globule on top, and animal pole downward. Holt et al. (1981b) has thoroughly described the embryonic development of this species. Hatching usually occurs in late summer to early winter, peaking in September and October (Matlock 1987).

Age and Size of Larvae: Larvae are less than 8.0 mm SL, and those 8 to 15 mm SL are considered transitional juveniles (Peters and McMichael 1987). Larvae are either transparent with no pigment patterns at hatching, or have a compressed band of dendritic melanophores on the ventral surface of the body in the yolk sac region (Holt et al. 1981b). Newly hatched larvae are negatively buoyant with a SL range of 1.71 to 1.79 mm (mean 1.74). Three days after hatching, at 25° C, the mouth forms, eyes are pigmented, and more time is spent swimming to stay near the surface. The swim bladder is well developed by day 4 and larvae remain in a horizontal position in the water column with little effort (Holt et al. 1981b). The yolk sac is present in larvae 3 to 5 mm TL, but has disappeared at 7 mm TL. Temperature has a pronounced effect on larval growth (Holt et al. 1981b, Lee et al 1984, Comyns et al. 1989). In laboratory raised fish, the yolk sac stage can range from 40 hours at 30° C to 85 hours at 20° C (Holt et al. 1981a, Holt et al. 1981b), and larval weight increase can average 17.74 μg/day at 24° and 30.25 μg/day at 28° C. Larvae in the field grow at faster rates than similar aged laboratory spawned larvae (Comyns et al.1989). Wild larvae have an average weight gain of 141 μg/day at 27.8° to 29.0° C. The growth rate for wild larvae smaller than 4 mm is about 0.3 mm/day, but growth increases rapidly in sizes greater than 4 mm (0.42 mm/day for 4 to 6 mm larvae). Two distinct growth periods are evident in early larval development. One extends from hatching through depletion of the yolk sac, while the other begins with the onset of active feeding. Growth rate in terms of SL was low in the first stage, averaging less than 0.06 mm/day or more (Lee et al. 1984).

Juvenile Size Range: Transformation to the juvenile stage occurs at a total length (TL) of approximately 12 mm (Ditty and Shaw 1994). The size range for the juvenile stage is from 8.0 mm SL until about 40 mm TL (Gunter 1945, Peters and McMichael 1987). Above 10 mm. TL, pigment rapidly appears with distinctive color patterns at about 25 mm TL. Twenty to 50 dark distinct blotches are present at this point from the lateral line to the dorsal fin on each side of the trunk. At 36 mm TL, a pronounced chromatophore enlargement at the base of the upper part of the caudal fin appears that results in the characteristic black ocelli. Juveniles are morphologically identical to adults by 42 mm TL except for a slightly more pointed caudal fin and lack of distinct ocelli. Ocelli are faintly visible at 50 mm TL and are very apparent at 75 mm TL. Brown lateral blotches enlarge with the fish until it reaches 150 mm TL, and then tend to fade and finally disappear (Pearson 1929, Simmons and Breuer 1962). Growth tends to be sporadic in juveniles, averaging 18.8 mm TL/month or 20.4 mm SL/month for the first 7.5 months of life (Bass and Avault 1975). Other estimates based on Texas red drum report sizes of 320 to 360 mm SL for the first year, 500 mm SL for the second year, 550 to 600 mm SL for the third year, 875 mm SL for the sixth year, 925 mm SL for the seventh year, and 975 to 1000 mm SL for the eighth (Miles 1950). Growth has been expressed modally in year class lengths of: 340 mm SL first year, 540 mm SL second year, 640 mm third year, 750 mm SL fourth year, 840 mm SL fifth year; 330 to 356 mm first year, 484 to 559 second year, 660 to 762 mm third year, 890 to 965 fourth or fifth year (Johnson 1978). Growth is rapid until age 4 or 5 years and then slows markedly (Murphy and Taylor 1990). Sexual maturity occurs at the end of the third, fourth, or fifth year with 5 year old fish constituting the bulk of the spawning population. Males mature at smaller sizes than females with most mature at age 1 or 2, and all mature by age 3 years. Some females are mature by age 3, and all are mature by age 6 years (Pearson 1929, Simmons and Breuer 1962, Johnson 1978, Benson 1982, Murphy and Taylor 1990). Red drum generally mature at approximately 700 to 800 mm TL (Miles 1950, Simmons and Breuer 1962), with 50% of the males maturing when they reach a fork length (FL) of 529 mm and 50% of the females mature by 825 mm FL (Murphy and Taylor 1990). Smaller ripe fish are occasionally found. Mature fish have been collected in Texas as small as 425 mm TL. Males are presumed to mature at a smaller size than females and have been reported to reach maturity at 320 to 395 mm in Mississippi. Another study reported ripe males 500 mm SL and ripe females 550 mm SL from Texas samples (Gunter 1945, Miles 1950, Perret et al. 1980). In Florida, some males and females are mature by 400 and 600 mm FL, respectively (Yokel 1966, Murphy and Taylor 1990). A Louisiana study reported spawnable males ranging 779 to 1130 mm TL and spawnable females ranging 850 to 1135 mm TL (Hein and Shepard 1986a). Wilson and Nieland (1994) reported that both males and females reach maturity in the northern Gulf of Mexico at four years of age, when females are 690-700 mm FL and 4.0-4.1 kg total weight (TW), and males are 660-670 mm FL and 3.4-3.5 kg TW.

Age and Size of Adults: Average adult size is 800 to 850 mm SL (Pearson 1929, Miles 1949). This is a long lived species with fish surviving over 37 years (Johnson 1978, Mercer 1984, Beckman et al. 1988, Murphy and Taylor 1990). A 36 year old female was 995 mm FL and weighed 11.96 kg, and a 37 year old male was 940 mm FL and weighed 10.49 kg (Beckman et al. 1988). Pearson (1928) recorded a 1520 mm TL fish. The largest red drum caught by hook and line was caught in North Carolina waters and weighed 42.69 kg (WRGF 1991). The red drum fishery is largely comprised of newly recruited fish. The mean size and age of this population depends heavily on recent recruitment (Tilmant et al. 1989). Beckman et al. (1988) have derived Von Bertalanffy growth equations for both sexes of red drum by length and by weight.

Food and Feeding

Trophic Mode: All free swimming life stages are carnivorous. Juveniles appear to hunt for food using a sweep style method to search for suitable prey (Fuiman and Ottey 1993).

Food Items: The red drum diet consists of food items from five major groups: copepods, mysid shrimp, amphipods, decapods, and fish (Bass and Avault 1975, Levine 1980). Utilization of these groups is determined by prey size and availability (Boothby and Avault 1971, Bass and Avault 1975, Overstreet and Heard 1978a, Morales and Dardeau 1987), and so their dominance in the diet of red drum may vary among locations.

Larvae: The major prey of larval red drum are copepods, including cyclopoids, calanoids, and harpacticoids, as well as various other zooplankton (Bass and Avault 1975, Benson 1982, Peters and McMichael 1987). Larvae up to 9 mm TL subsist on copepods and their nauplii that range from 0.06 to 1.5 mm TL (Bass and Avault 1975, Comyns et al. 1989). The calanoid *Acartia* sp. is eaten most frequently, but species of cyclopoids, harpacticoids, and other calanoids are also consumed.

Juveniles: Although they appear in the diet of juveniles 10 to 39 mm TL, copepods cease to be important in volume by 10 to 19 mm TL. Mysid shrimp, particularly *Mysidopsis almyra*, are eaten by fish 10 to 169 mm TL, but are most important in small juveniles 10 to 49 mm TL, constituting 70 to 100% of their diet (Bass and Avault 1975, Peters and McMichael 1987). Fish 30 mm TL and overeat small crustaceans like schizopods and amphipods (Darnell 1958). Gammarid amphipods are consistently found in 10-109 mm TL fish and are a dominant food item in fish 30 to 60 mm TL (Bass and Avault 1975, Peters and McMichael 1987). Generally, at least five species of amphipods, including *Ampelisca* sp. and *Carinogammarius* sp., are a minor part of the diet, but are moderately important in fish 30 to 49 mm TL. A large variety of decapods are eaten by fish 8 to 120 mm TL. The first to appear in the diet are caridean shrimp, usually grass shrimp (*Palaemonetes* sp.), as well as zostera shrimp (*Hippolyte zostericola*), bay shrimp (*Crangon* sp.), and snapping shrimp (*Alpheus* sp.). These are eaten until fish reach 150 to 159 mm TL. Penaeid shrimp, including white shrimp, pink shrimp, and brown shrimp, enter the diet of fish 70 to 79 mm, and become important for fish 90 to 99 mm TL and larger (Miles 1949, Bass and Avault 1975, Overstreet and Heard 1978, Peters and McMichael 1987). Crabs, though insignificant in the size classes from 30-69 mm SL, begin to gain importance in juveniles >70 mm long but remain secondary to shrimp (Morales and Dardeau 1987). At 100 to 175 mm TL, the chief food items are small penaeid shrimp, palaemonetid shrimp, small mullet, silversides, gobies, and small crabs (Simmons and Breuer 1962, Morales and Dardeau 1987). Blue crab and other portunid crabs are eaten by fish 40 to 49 mm TL, and are a common food item for fish 70 to 79 mm TL. Other crabs are found predominantly in larger juveniles (>105 mm TL) and include fiddler crabs (*Uca* sp.), heavy marsh crab (*Sesarma reticulatum*), mud crabs, *Eupagurus* spp., and spider crab (*Libinia dubia*), but these are generally unimportant (Miles 1949, Bass and Avault 1975, Peters and McMichael 1987, Morales and Dardeau 1987). Crabs predominate in the diet of fish 184 to 625 mm TL, particularly blue crab and Harris mud crab (*Rhithropanopeus harrisii*, and some fish as well (Darnell 1958). Fish play a substantial role in the diet of juveniles ≥15 mm TL, but were most abundant in juveniles > 90 mm TL (Bass and Avault 1975, Peters and McMichael 1987). Juveniles 20 to 29 mm TL began eating other sciaenids, usually spot, but also some Atlantic croaker. Other fish consumed include: speckled worm eel (*Myrophis punctatus*), gulf menhaden, anchovies (Anchoa sp.), inshore lizardfish (Synodus foetens), mullet, inland silverside (*Menidia beryllina*), darter goby (*Gobionellus boleosoma*), and bay whiff (*Citharichthys spilopterus*).

Food habits vary little in fish 250 to 924 mm SL (Boothby and Avault 1971). Smaller fish generally eat smaller sized items, but the three main groups, shrimp, crabs, and fish, are eaten by all size classes. No noticeable difference has been observed between the diets of males and females (Boothby and Avault 1971). Red drum 245 to 745 mm TL have been found to consume algae, grass, eggs, cysts, detritus, mud and sand, annelids, ostracods, amphipods, fish, penaeid shrimp, and squid. Specific prey items include grass shrimp, blue crab, mud crabs, bay shrimp (*Crangon* sp.), estuarine ghost shrimp (*Callianassa jamaicense*), mullet, speckled worm eel (*Myrophis punctatus*), naked goby (*Gobiosoma bosci*), sheepshead minnow, gulf pipefish (*Sygnathus scovelli*), anchovies, menhaden, hardhead catfish, rainwater killifish (*Lucania parva*), spot, and blackcheek tonguefish (*Symphunrs plagiusa*) (Pearson 1929, Gunter 1945, Knapp 1949, Reid 1955, Reid et al. 1956, Simmons 1957, Breuer 1957, Bryan 1971, Diener et al. 1974). Although crustaceans as a group exceed fish in frequency of occurrence and per cent volume of stomach contents, fish are consumed more frequently, in greater numbers, and in greater volume than shrimp or crabs alone. Plant and substrate material that occurs in stomach contents are probably taken incidentally during feeding activities. Fish are generally more prevalent in the diet of red drum during winter and spring months, menhaden being a favorite. Crustaceans become increasingly more important during late spring and by summer are the main staple and continue as such until late fall. Shrimp appear more frequently in stomach contents in the spring, summer, and fall. Crabs are more frequent than shrimp only in the winter (Boothby and Avault 1971). Other organisms eaten by juveniles contributed little to stomach contents volume with the possible exception of polychaetes, especially *Glycera americana* (Bass and Avault 1975, Peters and McMichael 1987, Morales and Dardeau 1987). These were eaten by 30-139 mm TL fish, but were most important to 60-79 mm TL fish (Bass and Avault 1975, Overstreet and Heard 1978). Echinoderms are eaten regularly by large fish, but are not an important diet item (Overstreet and Heard 1978). Other species consumed in addition to the main food species are: molluscs- Atlantic mud-piddock (*Barnea truncata*), false angelwing (*Petricola pholodiformes*), white baby-ear (*Sinum perspectivum*); crustaceans- lesser blue crab (*Callinectes simulis*), calico box crab (*Hepatus epheliticus*), lady crab (*Ovalipes ocellatus*), longwrist hermit crab (*Pagurus longicarpus*), iridescent swimming crab (*Portunus gibbesi*), sea lice (*Squilla* sp.); echinoderms- *Mellita quinquiesperforata*, *Sclerodactyla briareus*; fishes-striped killifish (*Fundulus majalis*), southern kingfish (*Menticirrhus americanus*), pinfish, oyster toadfish (*Opsanus tau*), Florida pompano, and hogchoker (*Trinectes maculatus*) (Pearson 1929, Miles 1949, Boothby and Avault 1971, Overstreet and Heard 1978). Bivalve molluscs, bivalve mollusc siphons, isopod crustaceans, and a marsh rat have also been reported from stomach contents, but these items are not typical (Pearson 1929, Peters and McMichael 1987).

Biological Interactions
Predation: Predation on red drum has not been well studied (Killam et al. 1992). Larvae and juveniles are potential prey items of larger piscivorous fish including larger red drum. Juvenile red drum feeding along the shorelines of mariculture ponds are subject to predation by piscivorous wading birds.

Factors Influencing Populations: Red tides, caused by the blooms of certain dinoflagellates, that occur during the spawning season can affect larval survival rates and possibly impact recruitment of the affected year-class in following years (Riley et al. 1989, Killam et al. 1992). Several organisms are known to parasitize red drum possibly as a consequence of the diverse foods consumed, and these can affect health and mortality (Yokel 1966, Perret et al. 1980, Overstreet 1983, Landsberg 1993). Known parasites include: Sporozoans- *Henneguya ocellata*; *Parvicapsula renalis*, Trematodes- unidentified; Cestodes- *Poecilan cistrium robustum* (known as spaghetti worm) infecting muscles and often resulting in fish being discarded by fishermen; Copepods, which parasitize red drum the most heavily, include- *Brachiella qulosa*, *B. intermedia*, *Echetus typicus*, *Lernaennicus radiatus*, *Caliqus latifrons*, *C. repax*, *C. bonito*, *C. elongatus*, *C. haemulonis*, and *Lernanthropus paenulatus*, *Lemaennicus affixus*; Isopods- *Nerocila* sp. (Simmons 1957, Yokel 1966, Perret et al.1980, Hein and Shepard 1986b, Landsberg et al. 1991, Landsberg 1993); Barnacles- *Balanus improvisus*, are known to attach to the flanks of red drums (Overstreet 1983). The destruction of estuarine nursery habitat utilized by late larval and juvenile stages, as well as growth overfishing and recruitment overfishing, are thought to have a serious impact on red drum (NMFS 1986).

Sheepshead
Scientific Name: *Archosargus probatocephalus*
Other Common Names: Sheepshead bream, sheepshead porgie, convict fish (Jennings 1985); *rondeau mouton* (French), *sargo chopa* (Spanish) (Fischer 1978).

Classification (Robins et al. 1991)

Phylum:	Chordata
Class:	Osteichthyes
Order:	Perciformes
Family:	Sparidae

There are three subspecies of sheepshead along the western Atlantic seaboard. A. p. probatocephalus is the more northern race ranging from Nova Scotia to Cedar Key, Florida. A. p. oviceps limited to the Gulf of Mexico ranging from St. Marks, Florida to Campeche Bank, Mexico. A. p.aries is the southern form ranging from Belize to Brazil (Jennings 1985).

Range

Overall: Sheepshead range from Nova Scotia to Florida, and the Gulf of Mexico in continental waters. It is found from Honduras to Rio de Janeiro, but is absent from islands of the Caribbean Sea (Fischer 1978, Johnson 1978, Shipp 1986). It is common south of Cape Hatteras.

A. probatocephalus has been divided into three subspecies, with *A. p. oviceps* occurring through the Gulf of Mexico from St. Marks, Florida to Campeche Bank Mexico (Caldwell 1965, Fischer 1978, Lee et al. 1980). Greatest abundance in the Gulf of Mexico probably occurs off of southwest Florida (Shipp 1986).

Life Mode

Eggs are buoyant, and spawning typically occurs over the inner continental shelf. Larvae are pelagic. Juveniles and adults are demersal omnivores, and prefer "live hard bottomed areas." This fish does not school, but may form feeding aggregations (Johnson 1978, Lee et al. 1980, Sedberry 1987).

Habitat

Type: Eggs are typically marine, in coastal waters of the inner continental shelf. Larvae are known to be present in the Gulf of Mexico January through May, with peak abundance February through April (Ditty 1986, Ditty et al. 1988). Larvae are pelagic as they move into estuaries, then become estuarine dependent and associated with seagrass beds. The pelagic stage probably lasts until larvae are about 30 to 40 days old when metamorphosis into juveniles occurs. After metamorphosis, juveniles "settle out," becoming substrate-oriented, then move to nearshore reefs as they mature (Sedberry 1987, Parsons and Peters 1989). Both juveniles and adults are demersal. Adults occur in nearshore waters over "live bottom" areas.

Substrate: Juveniles are usually associated with grass beds until they are around 50 mm, then they move into the more typical adult habitats (McClane 1964, Dugas 1970, Lee et al. 1980, Juneau and Pollard 1981). Adults occur around oyster beds, shallow muddy bottoms, *Spartina* marshes, piers and rocks, and jetties. They can also be found in some abundance in bare sand surf zones feeding on infaunal bivalves and crustaceans (Shipp 1986).

Physical/Chemical Characteristic

Temperature: Optimal growth in captivity has been reported at around 25° C (Tucker 1989). Juveniles have been collected in temperatures ranging from 8.0 to 29.6° C (Wang and Raney 1971, Pineda 1975, Jennings 1985). Temperature tolerance in adults ranges from 5° (Christmas and Waller 1973, Perret et al. 1971) to 35.1° C (Roessler 1970).

Salinity: The sheepshead is euryhaline (Gunter 1956) with collection sites ranging in salinities from 0 to 45‰ (Simmons 1957, Kelly 1965, Dugas 1970, Perret et al. 1971, Wang and Raney 1971, Dunham 1972, Perret and Caillouet 1974, Juneau 1975, Tarver and Savoie 1976, Benson 1982). Larvae have been collected from 5.0 to 24.9‰ (Christmas and Waller 1973). Juveniles and adults are found in salinities from nearly fresh (0.26‰) to 43.8‰ (Herald and Strickland 1949, Gunter and Hall 1965, Lee et al. 1980, Loftus and Kushlan 1987).

Dissolved Oxygen:
Minimum dissolved oxygen (DO) tolerances for this species are not well known, but kills have been reported in semi-open and closed canals in coastal Louisiana where severe oxygen depletion occurred (Adkins and Bowman 1976).

Movements and Migrations: This is not considered a true migratory species (Jennings 1985), but one tagging study showed a maximum traveled distance of 109 km prior to the spawning season (Bryant et al. 1989). Adults move to offshore waters in the spring and return to bays after spawning. The sheepshead remains in nearshore waters during warm seasons and moves out of the estuaries during periods of low temperatures (Gunter 1945, Dugas 1970, Jennings 1985, Bryant et al. 1989).

Reproduction

Mode: This species has separate male and female sexes (gonochoristic). Fertilization is external, by broadcast of milt and roe into the water column.

Spawning: Spawning probably occurs offshore (Springer and Woodburn 1960), from February through April (Hildebrand and Cable 1938, Springer and Woodburn 1960, Christmas and Waller 1973, Render and Wilson 1992). The reported peak occurs during the months of March and April (Beckman et al. 1991).

Fecundity: Fecundity appears to vary between fish from the inshore area, and older, larger fish that are caught offshore (Render and Wilson 1992). Fish caught offshore had an average fecundity of 87,000 eggs/batch and ranged from 14,000 to 250,000 eggs/ batch. The average fecundity of fish from the inshore area was 11,000 eggs/batch, and ranged 1,100 to 40,000 eggs/batch. Frequency of spawning was estimated to be every 1 to 20 days.

Growth and Development

Egg Size and Embryonic Development: Eggs are approximately 0.8 mm diameter, and are buoyant. Hatching occurs in about 40 hours at 24-25° C (Johnson 1978, Tucker 1989).

Age and Size of Larvae: Larvae are about 2.0 mm when they hatch, and by 5 mm, they have absorbed the yolk sac. Transition to the juvenile stage begins at about 11 to 12 mm (Mook 1977).

Juvenile Size Range: Juveniles attain adult pigmentation patterns by approximately 25 to 30 mm (Johnson 1978). Growth is rapid up to 6 to 8 years of age, after which it levels off (Beckman et al. 1991).

Age and Size of Adults: Sexual maturity is reported to occur in most individuals by age 2 (Beckman et al. 1991, Render and Wilson 1992). All males are usually mature by age 3, and all females by age 4. The sheepshead is one of the largest members of its family (Shipp 1986). It can grow up to 610 mm (Hoese and Moore 1977), and the record size in Louisiana is 9.6 kg. Females exhibit a faster growth rate and achieve larger maximum sizes than males. This is a long-lived species with a life span of at least 20 years. Von Bertalanffy growth equations have been developed for both sexes (Beckman et al. 1991).

Food and Feeding

Trophic Mode: Little information is available regarding the role of sheepshead in the trophic dynamics of estuaries (Jennings 1985). Larvae are carnivorous. Juveniles and adults are omnivores, but adults in offshore environments function more as sessile animal feeders, while juveniles feed primarily on plant material in inshore habitats (Sedberry 1987).

Food Items: Hildebrand and Cable (1938) found that ostracods were the primary food for fishes less than 30 mm. Benson (1982) summarizes the diet of sheepshead as: larvae consuming primarily zooplankton, juveniles consuming zooplankton as well as polychaetes and chironomid larvae; large juveniles and adults eat blue crab, young oysters, clams, crustaceans and small fish. Juveniles and adults are basically omnivorous feeding on plant material as well as crustaceans, molluscs and small fishes (primarily young Atlantic croaker) (Gunter 1945, Darnell 1961, Tabb and Manning 1961, Kelly 1965, Levine 1980, Odum et al. 1982, Overstreet and Heard 1982, Shipp 1986). In one study, smaller adults (<350 mm SL) were found to consume mostly bryozoans, while larger fish (>350 mm SL), that also fed heavily on bryozoans, included more bivalves, echinoderms, and ascidians in their diet. Both size groups consumed barnacles and decapods in lesser amounts. Foraminiferans, cnidarians, polychaetes, gastropods, and small arthropods were also eaten. Algae may be important in the diet of sheepshead in inshore habitats (Ogburn 1984), but plant material becomes less important in the diet of adults as they move offshore (Sedberry 1987).

Biological Interactions

Predation: Little information is available regarding predation of sheepshead, but it seems likely that larvae and juveniles could be utilized as a food source by predatory fishes.

Factors Influencing Populations: The sheepshead is host to ciliates, nematodes, trematodes, and isopods, none of which are known to endanger populations of the species (Jennings 1985). Adkins and Bowman (1976) found oxygen depletion in a semi-open and closed canals in Louisiana to result in death of this species. The sheepshead is frequently found associated with black drum (Wang and Raney 1971).

Southern Flounder

Scientific Name: *Paralichthys lethostigma*

Other Common Names: mud flounder, doormat, halibut (Reagan and Wingo 1985); southern large flounder, fluke (Gilbert 1986), *cardeau de Floride (*French), *lenguado de Florida* (Spanish) (Fischer 1978, NOAA 1985); saddleblanket.

Classification (Robins et al. 1991)

Phylum:	Chordata
Class:	Osteichthyes
Order:	Pleuronectiformes
Family:	Bothidae

Range
Overall: On the U.S. east coast, this species ranges from Albermarle Sound, North Carolina, southward to the Loxahatchee River, Florida. In the Gulf of Mexico, it is present from Florida to Texas and northern Mexico (Hoese and Moore 1977, Lee et al. 1980, Manooch 1984). It is not common in the southwest Florida estuaries, and its range is apparently not continuous around the southern tip of Florida.

The southern flounder is distributed throughout the coastal and estuarine habitats of the U.S. Gulf of Mexico from Florida to Texas, and is particularly abundant along the Texas coast (Ginsburg 1952, Hoese and Moore 1977, Manooch 1984, Reagan and Wingo 1985, Gilbert 1986).

Life Mode
Eggs are planktonic, buoyant, and float at or near the surface (Arnold et al. 1977). Larvae are planktonic and can be found throughout the water column (King 1971). King (1971) has shown no difference between night and day larval distributions. Juveniles and adults are demersal, and they are more active at night (Powell and Schwartz 1977).

Habitat
Type: Eggs are marine, occurring in neritic waters. Early larval stages are marine, while postlarvae become estuarine. Juveniles and adults are estuarine, riverine and marine in coastal areas usually depending on size of the flounder and hydrography (Fischer 1978, Lee et al.1980, Shipp 1986). Southern flounder can be found at depths up to about 40 m (Fischer 1978).

Substrate: Southern flounder frequent fine unconsolidated substrates of clayey silts and organic-rich muddy sands (Fischer 1978, Lee et al. 1980, Gilbert 1986, Powell and Schwartz 1977). Juvenile fish have been reported in association with seagrass beds (Stokes 1977). In marshes they appear to be equally abundant in vegetated and non-vegetated habitats (Minello et al. 1989a). Juveniles and adults are associated with fine sediments in flooded *Spartina* marshes, seagrasses and muddy substrates while in estuaries (Stokes 1977, Ward et al. 1980).

Physical/Chemical Characteristics
Temperature: This is an eurythermal species. The reported temperature range for eggs is 9.1 to 22.9° C with 14° C preferred; and for larvae 2 to 30° C with a preferred range of 20 to 25° C (Ward et al. 1980). Juveniles are apparently widespread over water temperatures ranging from 2 to 31.2° C. Adults are found in temperatures ranging from 7 to 32° C and show a preference for temperature between 14 and 22° C (Pineda 1975, Ward et al. 1980, Prentice 1989). Young southern flounder appear to be more tolerant of cold than adults, and both groups show increasing tolerance to cold as salinity is increased (Prentice 1989). Temperature appears to have a greater effect on growth than salinity (Peters 1971). Adults in salt water will cease feeding below 7.3° C (Prentice 1989).

Salinity: The southern flounder is euryhaline. Larvae have been found in salinities of 10 to 30‰ (Ward et al. 1980). Salinities in which juveniles have been collected range from 2 to 60‰, but they apparently prefer waters that are 2 to 37‰ (Ward et al. 1980). Adult southern flounder have been collected in waters with salinities that range from 0 to 60‰, with a preference for 20 to

30‰ (Ward et al. 1980). Adults, while in estuaries, prefer the mixing and tidal fresh zones (Gunter 1945).

Dissolved Oxygen (DO): Deubler and Posner (1963) demonstrated avoidance behavior in juvenile southern flounder when dissolved oxygen levels fell below 3.7 mg/l, for temperatures 6.1°, 14.4°, and 25.3° C.

Migrations and Movements: Adults emigrate from the estuaries to spawn in deeper offshore waters during fall and winter. The migrations coincide with falling water temperatures (Gunter 1945, Kelley 1965, Shepard 1986a). Males usually leave estuaries for the Gulf earlier than females (Stokes 1977). Hoese and Moore (1977) report severe "northers" will result in mass emigrations, while moderate to warm winters cause flounders to leave dispersed over longer periods of time. Stokes (1977) indicates that only those emigrating are gravid: Some juveniles and adults overwinter in the deeper holes and channels of bays and estuaries (Ogren and Brusher 1977, Stokes 1977, Ward et al. 1980). Postlarvae and juveniles immigrate into the bays and estuaries from late winter to spring. Williams and Deubler (1968) indicated postlarval immigration correlates with lunar phase. In addition, adults migrate back into estuarine habitats throughout spring and into summer. Juveniles tend to migrate to low salinity water, often going up into river channels (Williams and Deubler 1968, Pineda 1975). Stokes (1977) reported that local movements within and between estuaries rarely exceeded 18 km.

Reproduction

Mode: The southern flounder has separate male and female sexes (gonochoristic). Fertilization is external, by broadcast of milt and roe into the water column. The eggs are buoyant, and float at or near the water surface (Arnold et al. 1977, Gilbert 1986). Development is oviparous.

Spawning: Spawning occurs during late fall and early winter in marine neritic waters (Sabins and Truesdale 1974, Reagan and Wingo 1985, Gilbert 1986) with a December peak reported in Louisiana (Shepard 1986a). In laboratory studies, Arnold et al. (1977) reported that males attended females for a period of 3 weeks prior to spawning. At spawning, the females would swim to the surface and release eggs which were immediately fertilized by the attending male. Larvae of *Paralichthys* species are known to occur in the northern Gulf of Mexico from September through April, with a peak from December to February (Ditty et al. 1988).

Fecundity: Arnold et al. (1977) reported that 13 spawns from 3 pairs of southern flounder produced a total of 120,000 eggs.

Growth and Development

Egg Size and Embryonic Development: Eggs are spawned oviparously. Eggs are spherical, with an approximate mean diameter of 0.91 to 0.92 mm, and one oil globule with an approximate diameter of 0.18 mm (Henderson-Arzapalo et al. 1988, Powell and Henley 1995). In a laboratory study, spawned eggs hatched in 61-76 hours at 17° C and 28‰ (Arnold et al. 1977).

Age and Size of Larvae: Recently-hatched larvae are approximately 2.1 mm notochord length (NL) (Powell and Henley 1995). Larvae, 40 to 46 days old and 8 to 11 mm long, begin metamorphosis into the postlarval stage. Transformation is complete by about 50 days (Arnold et al. 1977). Optimal growth in early postlarvae occurs at high salinities (Deubler 1960); while advanced postlarvae grow better at salinities of 5 to 15‰ (Stickney and White 1973). In general, at any given size, larval gulf flounder (*P. albigutta*) are further developed than southern flounder (*P. lethostigma*) (Powell and Henley 1995). There are differences in pigmentation patterns between the two species, but these may be difficult to discern with field-collected specimens.

Juvenile Size Range: The minimum size of settled juveniles overlaps that of the postlarvae in some cases (10-15 mm TL). Peters (1971) concluded *P. lethostigma* grows faster at warm temperatures and low salinities. Size-at-age is highly variable for this species, and age 0 year classes are known to develop bimodal length-frequency distributions (Fitzhugh et al. 1996). This may be the result of faster growth after an ontogenetic shift to piscivory at a size of 70 to 180 mm TL. Size estimated after the first and second year of growth is 201 and 250 mm TL for male, 225 and 364 mm TL for female southern flounder (Stokes 1977). Immature fish >170 mm TL have distinctive gonads and maturation occurs by the second year in fish ranging from 341 to 560 mm TL. Maturity occurred in one study at 243 mm TL for females and 170 mm TL for males (Shepard 1986a).

Age and Size of Adults: Stokes (1977) reported a 3 to 5 year life span for this species. Females appear to grow faster, live longer, and attain greater size than males (Stokes 1977). The largest individuals reported range from 595 to 910 mm TL (Ginsburg 1952, Hoese and Moore 1977, Stokes 1977).

Food and Feeding

Trophic Mode: The southern flounder is carnivorous during all life stages. Larvae feed on pelagic zooplankton, while juveniles and adults feed on crustaceans, and benthic and pelagic fishes (Gilbert 1986). Young southern flounder are dominant predators in Texas estuaries on small brown shrimp during the spring (Minello et al. 1989a).

Food Items: Larvae feed on zooplankton (Peters 1971). Small crustaceans, particularly mysids, but also grass shrimp, penaeid shrimp, amphipods, and crabs make up the diet of small juveniles (10 160 mm TL) (Diener et al. 1974, Stokes 1977, Minello et al. 1989). Larger juveniles and adults are basically piscivorous, feeding on small benthic and pelagic fishes; but, shrimp, crabs and polychaetes are also utilized to a lesser extent (Darnell 1958, Fox and White 1969, Powell 1974, Stokes 1977, Powell and Schwartz 1979, Overstreet and Heard 1982). In a North Carolina study, invertebrate prey included the mysids *Mysidopsis bigelowi* and *Neomysis americana*, and fish prey included bay anchovy, spot, and croaker (Fitzhugh et al. 1996). The ontogenetic shift to piscivory occurred as fish grew from 70 to 180 mm TL.

Biological Interactions

Predation: Information on predation of flounder is scarce. Larvae and juveniles are probably the most susceptible to predation due to their smaller size. Known and suspected species that prey on flounder species in the Gulf of Mexico are: tiger shark (*Galeocerdo cuvier*), gafttopsail catfish (*Bagre marinus*), inshore lizard fish (*Synodus foetens*), various searobins (family Triglidae), various sculpins (family Cottidae), jewfish (*Epinephelus itaiara*), and larger sized southern flounder (Kemp 1949, Miles 1949, Diener et al. 1974, Tanaka et al. 1989).

Factors Influencing Populations: Southern flounder and gulf flounder are very difficult to distinguish from each other during early life stages (Woolcott et al. 1968). Early stages are often summarized as "*Paralichthys* species" (King 1971) or just "southern flounder" (Stokes 1977). Adult southern flounder generally outnumber gulf flounder in the northern Gulf of Mexico, and catches containing the two species are not usually separated. This makes catch data for the two species very hard to analyze. The shrimp fishery unintentionally catches large numbers of juvenile flounder, almost all of which are discarded (Gunter 1945, Matlock 1991). This reduces the number of sexually immature fish available for recruitment into the fishery.

Spotted Seatrout
Scientific Name: *Cynoscion nebulosus*
Other Common Names: spotted weakfish, spotted squeteague, speckles, speckled trout, salmon trout, simon trout (Hildebrand and Schroeder 1972); *acoupa pintade* (French), *corvinata pintada* (Spanish) (Fischer 1978, NOAA 1985).
Classification (Robins et al. 1991)

Phylum:	Chordata
Class:	Osteichthyes
Order:	Perciformes
Fatuity:	Sciaenidae

Range
Overall: The spotted seatrout is found in coastal waters from Cape Cod, Massachusetts to Carmen Island in the Bay of Campeche, Mexico. It is most abundant from Florida to Texas (Fischer 1978, Lee et al. 1980, Lassuy 1983b, Mercer 1984, NOAA 1985).

The spotted seatrout is found from Key West, Florida to the Rio Grande, Texas. Areas of abundance occur around eastern Louisiana, south Texas, Mississippi, Alabama, and along the west coast of southern Florida (Tabb and Manning 1961, Hoese and Moore 1977, Lee et al. 1980, Lassuy 1983b, Johnson and Seaman 1986).

Life Mode
Eggs are pelagic (>30‰) or demersal (25‰) depending on salinity; initially, larvae are pelagic and become demersal after 4 to 7 days. Juveniles and adults are demersal, completing their entire life cycle in inshore waters (Ditty and Shaw 1994). Large juveniles and adults form small schools. This species possesses a definite diel pattern of metabolic activity, with increased activity occurring at night (Pearson 1929, Wagner 1973, Vetter 1977).

Habitat
Type: This species is estuarine-dependent, and it completes its entire life cycle in inshore waters (Wagner 1973). Seasonal abundance appears to be associated with estuarine zones, with different estuarine habitats utilized by different life history stages (Helser et al. 1993). Eggs are found from marine to estuarine environments, are buoyant or demersal depending on salinity, and are generally associated with grass beds at or near barrier island passes. They are also found in areas with fine to medium texture detritus devoid of vegetation (Sabins and Truesdale 1974). Larvae are demersal in deep channels with shell rubble, or in bottom vegetation (Tabb 1966). Juveniles in Florida have been reported from a water depth range of 0.5 to 2.2 m (Rutherford et al. 1989a). Seagrass appears to be a critical habitat for juveniles and adults, but backwaters (bayous, tidal creeks, slow flowing rivers), marshes, and other areas without extensive seagrass beds can contain substantial numbers of juveniles as well (Van Hoose 1987, McMichael and Peters 1989, Killam et al. 1992). Juveniles and adults have been found in the sea grasses *Thalassia testudinum*, *Syringodium filiforme*, and *Halodule wrightii*, and abundance and distribution of

juveniles may be influenced by biomass, shoot density, and species composition of seagrass beds (Hettler 1989, Killam et al.1992). The preferred habitat in Louisiana is along relatively shallow marsh edges of small, saline water bodies in *Spartina alterniflora* dominated areas (Peterson 1986, McMichael and Peters 1989, Chester and Thayer 1990). Individuals have also been found around oil drilling platforms in the nearshore area (Stanley and Wilson 1990). Juveniles and adults can occur in a variety of estuarine habitats including seagrass beds, mangrove-lined depressions, and in relatively deep basins, tidal river mouths, channels and canals (Mok and Gilmore 1983, Van Hoose 1987, Thayer et al. 1988, Chester and Thayer 1990, Killam et al. 1992). Juveniles remain in submerged vegetation during summer, but may move to deeper water during the winter months when water temperatures drop. Adults also occur in the surf zones of barrier islands, particularly in fall months (Perry 1970).

Substrate: The substrate for larvae is highly variable. Vetter (1977) states larvae are dependent on grass beds, while Benson (1982) indicates that the deep channels near grass beds may serve as their initial habitat rather than algae and muddy sand (Tabb 1961), prior to movement into the grass bed as juveniles. In Louisiana, where inshore salinities can be fairly low due to the influence of the Mississippi River, nursery habitat is probably higher salinity lower bays and the nearshore Gulf of Mexico (Herke et al. 1984). Juveniles and adults are generally associated with seagrasses, particularly *Halodule* and *Thalassia*, but they are also common over sand, sand mud, or medium to soft, mud-detritus substrates, shallow muddy areas, oil platforms and shell reefs (Benson 1982, Peterson 1986, Rutherford et al. 1989a, McMichael and Peters 1989, Chester and Thayer 1990, Killam et al. 1992).

Physical/Chemical Characteristics:
Temperature: Spotted seatrout appear to have a high capacity for metabolic compensation for dealing with the wide extremes in temperature that occur in the estuarine habitats that they exploit on a year-round basis (Vetter 1982).

Temperature - Eggs: Eggs and yolk sac larvae have an optimal temperature of 28° C, but have been hatched experimentally at 32° C (Taniguchi 1980, Gray and Colura 1988). However, complete survival is expected between 23.1° and 32.7°. Eggs incubated at 20° C had a lower mean hatch rate (Gray and Colura 1988).

Temperature - Larvae and Juveniles: Larvae and juveniles have been collected in temperatures of 5° to 36° C (Wang and Raney 1971, Perret et al. 1980, Benson 1982, Rutherford et al. 1989a, Killam et al. 1992); their preferred temperatures range from 20° to 30° C (Arnold et al. 1976).

Temperature - Adults: Adults prefer temperatures from 15° to 27° C, and may move seaward if estuarine temperatures become extreme (Mahood 1974). Simmons (1957) reported active feeding and movement between 4° to 33° C with gradual acclimation; however, sudden drops in temperature can result in mass mortality (Gunter 1941, Moore 1976). Temperatures for spawning range from 20° to 30° C (Benson 1982).

Salinity - Eggs: The highest hatch rates for experimentally incubated eggs have been reported to occur at 15 to 25‰ and 19 to 38‰ at 28° C (Shepard 1986b, Gray and Colura 1988), and it is suspected that in lower salinities in the wild, survival may be reduced (Tabb 1966). The optimum salinity for eggs has been reported to be 28.1‰ (Killam et al. 1992). These eggs had a significantly lower hatch rate at 5‰ and all eggs died at any temperature when the salinity was

45‰. Eggs at 5‰ would also sink to the bottom, which would probably increase mortality in the wild. A critical minimum (0‰) and a critical maximum (50‰) has been determined that corresponds to 0% embryo survival at 28° C (Shepard 1986). Salinity acclimation of parents may also affect salinity tolerance of eggs (Gray and Colura 1988).

Salinity - Larvae: Spotted seatrout larvae are considered the most euryhaline of all sciaenid larvae (Killam et al.1992). They have been collected in Florida from 8.0 to 40.0‰ (Rutherford et al. 1989a, Killam et al. 1992) and optimal salinity has been reported to range from 20 to 35‰ in hatchery conditions (Arnold et al. 1976, Killam et al. 1992).

Salinity - Juveniles: Juveniles seem to prefer mesohaline and polyhaline waters where salinities range from 8 to 25‰ (Peterson 1986). They have been collected in waters with salinities ranging from 0 to 48‰ (Gunter 1945, Wang and Raney 1971, Wagner 1973, Peterson 1986, Rutherford et al. 1989a, Killam et al. 1992).

Salinity - Adults: Adults are considered euryhaline and have been collected over a salinity range of 0.2 to 75‰ (Simmons 1957, Perret et al. 1971, Mercer 1984, Killam et al. 1992). Juveniles and adults appear to prefer moderate salinities (Wagner 1973). Optimum salinities, as judged by swimming performance, occurred at salinities of 20 to 25‰ (for fish with a total length (TL) of 174-438 mm), but were reduced above and below these salinities (Wakeman and Wohlschlag 1977). They are rarely collected below 10‰ or above 45‰ in south Texas waters.

Dissolved Oxygen: Fish kills of spotted seatrout that were due to low dissolved oxygen (DO) concentrations have been reported in Mississippi (Etzold and Christmas 1979).

Turbidity: Spotted seatrout appear to prefer areas of low turbidity (Pearson 1929). Increased mortality due to hurricane induced high turbidity levels has been reported from Louisiana (Perret et al. 1980).

Movements and Migrations: In Alabama, early juveniles move into tidal rivers in late fall to overwinter (Van Hoose 1987). Adult seatrout migrate very little with most movements occurring seasonally in association with thermal and salinity tolerances, and with spawning activities (Tabb 1966, Bryant et al. 1989, Heiser et al. 1993). Large individuals often seek cooler deeper water during the summer, and deeper, warmer waters of bays or the nearshore Gulf of Mexico during the winter (Pearson 1929, Gunter 1945). Several studies indicate that spotted seatrout are estuary-specific, particularly in Florida, with very little movement occurring between estuaries (Killam et al. 1992). This is further substantiated by the existence of independent populations of this species in different estuaries (Iversen and Tabb 1962, Weinstein and Yerger 1976). In Texas, although evidence suggests that sub-populations in bay systems mingle very little, mixing of different groups may occur during the spawning season which may be the reason for the low degree of variability between major bays in this state (King and Pate 1992, Baker and Matlock 1993).

Reproduction

Mode: Spotted seatrout have separate male and female sexes (gonochoristic). Fertilization is external, by broadcast of milt and roe into the water column, and development is oviparous.

Spawning: Sound produced by specialized muscles inserted at the swim bladder wall may have a purpose in spawning activities (Mok and Gilmore 1983). The spawning season is protracted and varies throughout the Gulf of Mexico. It can begin as early as February and continue until October (Pearson 1929, Gunter 1945, Herke et al. 1984, Van Hoose 1987, McMichael and Peters 1989), but generally runs from March to October (Hein and Shepard 1980). Saucier and Baltz (1993) reported that spotted seatrout form "drumming" aggregations in estuarine waters of Louisiana from late May to early October, at salinities from 7 to 27‰, and temperatures from 24.5 to 33.5° C, from 6pm to midnight, and that spawning sites were primarily located in deep, moving water in passes between barrier islands. Based on the presence of larval spotted seatrout in the northern Gulf of Mexico, it can be inferred that spawning occurs February through October, with a peak from April through August (Ditty et al. 1988). Spawning may occur throughout the year in southern Florida and Mexican waters (Tabb 1961, Tabb and Manning 1961, NOAA 1985). Spawning occurs at dusk with the peak activity periods usually in late April-June and August-September, and is probably related to water temperature and increasing or decreasing photoperiods (Tabb and Manning 1961, Hein and Shepard 1980, Perret et al. 1980, Wade 1981, Van Hoose 1987, Brown-Peterson et al. 1988, McMichael and Peters 1989, Chester and Thayer 1990). The recorded temperature range for spawning is 24 to 30° C, with 23° C suggested as the minimum temperature for successful spawning (Brown-Peterson et al. 1988). A Florida study recorded surface water temperatures of 15.5 to 31° C during spawning months (McMichael and Peters 1989). In Florida, spawning is essentially completed by the time temperatures rise to 28.3° C (Tabb 1966, Johnson 1978). Spawning probably occurs in moderate to high salinities (Powell et al. 1989). The surface salinity during spawning months can range from 18.5 to 36° (McMichael and Peters 1989), and peak spawning occurs between 30 and 35‰ (Tabb 1966). No spawning has been observed above 45‰ (Simmons 1957). Spawning occurs primarily within coastal bays, estuaries, and lagoons, usually in shallow grassy areas, or near passes, and in deeper holes or channels with the eggs drifting into the grassy areas (Welsh and Breder 1923, Pearson 1929, Guest and Gunter 1958, Tabb 1966, Etzold and Christmas 1979, Mok and Gilmore 1983, McMichael and Peters 1989, Powell et al. 1989, Chester and Thayer 1990). Spawning probably occurs in water that is 3 to 4.6 m deep. Spawning may also occur in tidal passes, areas of little or no vegetation, and, in Louisiana, the higher salinity waters of lower bays and the nearshore Gulf of Mexico (Sabins and Truesdale 1974, Allshouse 1983, Herke et al. 1984, Heiser et al. 1993).

Fecundity: Spotted seatrout are multiple spawners and their fecundity is difficult to estimate (Brown-Peterson et al. 1988). Estimates of fecundity range from a mean of 14,000 from 283 mm TL I-year class females to 1.1 million eggs for IV-year class averaging 504 mm TL (Sundararaj and Suttkus 1962). Recent evidence suggests that these fecundity estimates may be low and that actual annual fecundity may average greater than 10 million eggs. Spawning frequency appears to be high and is estimated to occur every 3.6 days, but this frequency is probably not sustained throughout the entire spawning season (Brown-Peterson et al. 1988).

Growth and Development

Egg Size and Embryonic Development: Eggs are spherical, usually with one oil droplet. Their diameter ranges from 0.7 to 0.85 mm, and hatching occurs 16 to 20 hours after fertilization at 25° C (Fable et al. 1978). Incubation times of 21 hours at 23° C and 15 hours at 27° C have also been reported (Ditty and Shaw 1994).

Age and Size of Larvae: In one laboratory study, larvae grew from a standard length (SL) of 1.5 mm at hatching to 4.5 mm SL in 15 days at about 25° C (Fable et al. 1978). Peebles and Tolley (1988) report growth rates for larval spotted seatrout in south Florida to be approximately 0.4 mm/day. Larval stage sizes range from about 1.8 to 10-12 mm TL (Johnson 1978).

Juvenile Size Range: Transformation to the juvenile stage occurs at a length of 10-12 mm (Ditty and Shaw 1994). Juveniles range from 10-12 to 180-200 mm TL (Johnson 1978). Juvenile growth rates during the fall are about 13 to 18 mm/month (McMichael and Peters 1989). Along the Gulf coast of Florida, spotted seatrout have been reported to reach 301-337 mm TL at the end of their first year, but growth slows after age I (Murphy and Taylor 1994). Hatchery reared juveniles have been reported to reach 160 mm TL in 100 days (Van Hoose 1987). Size at maturity varies among estuaries (Mercer 1984). Spotted seatrout mature between one and three years of age with males tending to mature at smaller sizes than females.

Age and Size of Adults: Maturity and spawning may first occur at 2 years of age (Pearson 1929), but they can occur at the end of their first year (Lassuy 1983b). Males mature as early as their first year and females by the end of the second year (Klima and Tabb 1959). Some females mature as early as 271 mm SL in Texas, and they are generally all mature by 300 mm SL (Brown-Peterson et al.1988). Males are much smaller than females at maturity with all fish 200 mm SL and longer being mature. In a northwest Florida study, 50% of females 200-220 mm FL and 90% of females 220-240 mm FL were mature, all of which were age I (DeVries et al. 1995). Seventy of 73 males, all age I, were found to be mature. There is some variation in growth rate of spotted seatrout throughout its range (Benson 1982), and this variation may be due to ecological rather than genetic factors (Murphy and Taylor 1994). In Florida, estimated maximum ages are 6 to 8 years for females and 5 to 9 years for males (Murphy and Taylor 1994). Adults up to 15 years old have also been reported (Mercer 1984).

Food and Feeding
Trophic Mode: The spotted seatrout is an opportunistic, visual carnivore that feeds near the surface and in mid-water depths. It feeds mainly in seagrass areas, and relies almost solely on free swimming organisms for food (Darnell 1958, Stewart 1961, Vetter 1977).

Food Items: The diet of the spotted seatrout changes as it grows and with the seasonal abundance of food items (Pearson 1929, Gunter 1945). Larvae feed primarily on zooplankton, especially copepods, and switch to mostly benthic invertebrates as small juveniles. Juveniles have been found to consume: planktonic schizopods, mysids, copepods, isopods, amphipods, gastropods, bivalves, caridean and penaeid shrimp, and fish (Stewart 1961, Hettler 1989, McMichael and Peters 1989). Juveniles <30 mm SL consume amphipods, mysids and carideans in equal proportions (Heftier 1989). The single most important food for juveniles >30 mm SL was shrimp. Fish increase in dietary occurrence as juveniles reach 50 mm SL and larger, and can comprise almost 90% of the volume in individuals 105-120 mm SL. Fish species consumed include: bay anchovy, gulf menhaden, shad (*Dorosoma sp.*), silversides (*Menidia sp.*), striped mullet, sheeps head minnow, rainwater killifish (*Lucania parva*), gulf toadfish (*Opsanus beta*), inshore lizardfish (*Synodus foetens*), pipefish (*Syngnathus sp.*), pinfish, pigfish (*Orthopristes chrysopterus*), silverjenny (*Eucinostomus gula*), gray snapper, unidentified snappers (*Lutjanus sp.*), hardhead silverside (*Atherinomorus stipes*), goldspotted killifish (*Floddichthys carpio*), code goby (*Gobiosoma robustum*), naked goby (*G. bosc*), clown goby (*Microgobius gulosus*), Atlantic croaker, and spotted seatrout. Young adults prey on a variety of invertebrates and fish, changing almost exclusively to fish as large adults (Gunter 1945, Darnell 1958, Seagle 1969, Danker 1979, Levine 1980, Hettler 1989, McMichael and Peters 1989). Some marine vegetation and shell fragments have been noted that were probably picked up while capturing prey (Tabb and Manning 1961). The diets of larger juveniles and adults are skewed to the consumption of shrimp in the warmer months and fish in the cooler months when shrimp are not as available (Pearson 1929, Gunter 1945). Variations in food habits indicates that geographical location and type of estuary influences available prey, and that spotted seatrout stomach contents reflect this availability (Hettler 1989).

Biological Interactions

Predation: Known predators of juvenile spotted seatrout include alligator gar (*Lepisosteus spatula*), striped bass (*Morone saxatilis*), ladyfish (*Elops saurus*), tarpon, bluefish, silver perch, Atlantic croaker, snook, yellow bass (*Morone mississippiensis*), spotted seatrout, barracuda (*Sphyraena barracuda*), Spanish mackerel, and king mackerel (*Scomberomorus cavalla*) (Miles 1949, Darnell 1958, Benson 1982, Killam et al. 1992).

Factors Influencing Populations: Species that may possibly compete with spotted seatrout for habitat and food include hardhead catfish, grouper (*Mycteroperca sp.*), silver perch, red drum, spot, and Atlantic croaker (Killam et al. 1992). Distribution and abundance of juvenile spotted seatrout in Florida Bay appears to be influenced by the biomass, shoot density, and species composition of the seagrass community (Shipp 1986, Chester and Thayer 1990, Killam et al.1992). Losses in seagrass beds and other key habitat areas have been linked with declining seatrout populations. Overfishing may also be contributing to this decline (Shipp 1986). Periods of low rainfall and high salinity may lower recruitment of young fish into the population (Rutherford et al. 1989b). Catastrophic mortalities have been attributed to severe cold, hurricanes, high turbidity, excessive fresh water, red tide, and supersaturated dissolved oxygen conditions (Gunter 1941, Gunter and Hildebrand 1951, Springer and Woodburn 1960, Renfro 1963, Perret et al. 1980, Killam et al. 1992). In Louisiana, the use of weirs in canals may impede migration of young-of-the-year fish into the marsh areas of impounded water bodies or the movement of fish trying to escape environmental extremes (Herke et al. 1984). Larger adults are frequently infected with pleurocerci of the tapeworm *Poecilancistrium robustrum* (spaghetti worm) (Lorio and Perret 1978). Fish with these worms are frequently discarded although they do not affect the taste of the fish, nor are they infectious to humans.

Blue Crab

Scientific Name: *Callinectes sapidus*

Other Common Names: jimmies (males), sooks (adult females), common edible crab, sallies, spongers, sponge crab, berry crab, soft shell, soft shelled crab, hard crab; *crabe bleu* (French), *cangrejo azul, jaiba azul* (Spanish) (Fischer 1978, NOAA 1985).

Classification (McLaughin et al. 2005)

Phylum:	Arthropoda
Class:	Crustacea
Order:	Decapoda
Family:	Portunidae

Range

Overall: The blue crab is a cosmopolitan species found in coastal waters, primarily in bays and brackish estuaries. It occurs occasionally from Nova Scotia, Maine, and northern Massachusetts to northern Argentina, and also Bermuda and the Antilles (Millikin and Williams 1984, Williams 1974, Williams 1984). It is found north of Cape Cod only during favorable warm periods that allow it to move into these waters. This species has also been introduced into coastal waters of Europe and Japan.

This species is abundant throughout the nearshore and estuarine areas of the Gulf of Mexico(Millikin and Williams 1984, Williams 1974, Williams 1984).

Life Mode

The blue crab spends most of its life in estuaries and nearshore Gulf waters. Eggs are carried externally by the female for approximately two weeks. Egg-bearing females are commonly known as sponge or berry crabs. Eggs hatch near the mouths of estuaries, and the zoeal larvae are carried offshore. Zoeae are planktonic, and remain in offshore waters for up to one month. Metamorphosis to the megalopal stage follows the seventh zoeal molt. Re-entry to estuarine waters occurs during the megalopal stage. Juveniles and adults tend to be demersal and estuarine. Adult males spend most of their time in low salinity waters; females move into these lower salinities as they approach their terminal molt to mate. After mating, females move to higher salinity areas of estuaries and nearshore environments for spawning (Dudley and Judy 1971, Millikin and Williams 1984, Van Den Avyle and Fowler 1984, Williams 1984).

Habitat

Type: The blue crab is dependent on estuaries during portions of its life. Depending on the life stage, individuals can be neritic, estuarine and/or riverine. Zoeae are found in oceanic habitats (Williams 1984), and they are positively phototropic (Costlow et al. 1959). The megalopae swim freely and may be found in the surf area near the bottom in nearshore or lower estuarine high-salinity areas. In Tampa Bay, the primary habitat that megalopae use for settlement appears to be seagrass or vegetated bottom (Killam et al. 1992). In the northern Gulf of Mexico, megalopae move into nearshore marshes where molt to the first crab stage occurs. Within an estuarine system, habitat is partitioned for use by blue crabs based on size class, and may be related to food availability, predator avoidance, nutritional requirements, reproductive success, and growth (Steele and Bert 1994). Juveniles have been found in greatest numbers in low to intermediate salinities characteristic of upper and middle estuarine waters (Steele and Perry 1990). They prefer seagrass as nursery habitat but also utilize salt marsh habitat (Thomas et al. 1990, Killam et al. 1992). Juveniles and adults tend to be demersal and estuarine. Adult males spend most of their time in low salinity water and females move from higher to lower salinities as they approach their terminal molt in order to mate (Dudley and Judy 1971, Millikin and Williams 1984, Van Den Avyle and Williams 1984, Williams 1984). Although juvenile and adult blue crab distributions are affected by salinity (Killam et al. 1992, Steele and Bert 1994), other factors such as substrate type and food availability also play a major role (Steele and Perry 1990).

Substrate: Juveniles and adults are found on muddy and sandy bottoms. Juveniles have been found in greatest abundances in association with soft mud bottoms (Van Engel 1958, Perry 1975, Perry and McIlwain 1986).

Physical/Chemical Characteristics: Environmental requirements affecting the growth, survival, and distribution of the blue crab vary with the life stage and sex of the individual (Killam et al. 1992). The eggs of the blue crab are the most sensitive to change in environmental conditions such as temperature and salinity, while juveniles and adults have greater tolerances to fluctuations. Juveniles and adults are also more mobile, and can avoid degraded areas if possible.

Temperature - Eggs: Eggs have been successfully hatched under laboratory conditions in temperatures ranging from 19° to 29° C (Sandoz and Rogers 1944).

Temperature - Larvae: Megalopal survival is highest at temperatures between 21.5° and 34.5° C, but larval development is fastest between 24° to 31° C (Costlow 1967, Copeland and Bechtel 1974).

Temperature - Juveniles and Adults: Blue crabs have been collected at temperatures from 3° to 35° C (Copeland and Bechtel 1974). Adults cease feeding at temperatures below 10.8° C, and burrow in mud at 5° C. Mortalities of blue crabs have been related to extreme cold and sudden drops in water temperature (Van Engel 1982, Couch and Martin 1982). Tagatz (1969) evaluated maximum and minimum median thermal tolerance limits (48 hours) of juvenile and adult blue crab from St. Johns River, Florida, and found them to be 3° C and 37° C. However, thermal limits are highly dependent on acclimation temperature and salinity. Adult males are more tolerant of temperature extremes than females and juveniles. Temperature apparently plays a key role in molting (Copeland and Bechtel 1974).

Salinity: This species is euryhaline and has been found from freshwater to hypersaline lagoons (0-50‰). Upper and lower lethal limits (LC-50s) determined for two different Gulf of Mexico populations were 56‰ and 67‰ for the upper limits, and 0‰ and 1‰ for the lower limits (Guerin and Stickle 1990).

Salinity - Eggs: Eggs have been observed to hatch under laboratory conditions in salinities ranging from 10.3 to 32.6‰, but the optimum salinities ranged from 23‰ to 28‰ (Sandoz and Rogers 1944).

Salinity - Larvae: Early zoeae are found at high salinities, usually 20%o or greater (Dittel and Epifanio 1982). Megalopae may be transported to lower salinities, and have been found in waters as low as 5‰ (Costlow 1967, Benson 1982). Highest survival occurs between 16 and 43‰, but larval development is fastest from 11.5 to 35.5‰ at 24° to 31° C (Costlow 1967, Copeland and Bechtel 1974).

Salinity - Juveniles: Juvenile crabs are found in lower salinity waters, typically 2-21‰. Reported salinity values for juveniles vary, and specific salinities are not critical to postlarval crabs.

Salinity - Adults: Adult males are usually found at less than 10‰. Egg-bearing females (sponge) are found in 23-33‰ and 19-29° C waters (Millikin and Williams 1984, Van Den Avyle and Fowler 1984, Williams 1984). The interaction of salinity and temperature reveals the blue crab to be less tolerant of low salinities at high temperatures and high salinities at low temperatures (McKenzie 1970).

Dissolved Oxygen (DO): The blue crab is very sensitive to low DO conditions. Survival times of 2 hours at 0 parts per million (ppm) DO (32° C and 15‰ salinity) and 4.3 hours at 0 ppm DO

(25° C and 15‰ salinity) were reported by Lowery and Tate (1986). The occurrence of dead crabs in traps is fairly common during warm water conditions. The fishermen usually remedy the problem by moving their traps into shallower water to avoid any low DO water layers. Often the presence or boundary of a low DO water mass can be inferred by the placement of crab traps in any given area. Mass mortalities have been reported to be associated with low DO conditions (May 1973).

Migration and Movements: Migrations within estuarine systems are related to phases of life cycle, season, and, to a lesser extent, the search for favorable environmental conditions. Most crabs move to relatively deeper, warmer waters during winter, but some juveniles will burrow in shallow water substrate for protection. Blue crab return to rivers, tidal creeks, salt marshes and sounds when conditions become more favorable. They also move out of waters with low DO levels, and in some cases will actually leave the water to escape anoxic conditions (Lowery 1987, Killam et al. 1992). In Mobile Bay, large masses of migrating blue crabs and other animals occasionally occur while attempting to avoid low DO conditions, and such events are referred to as "jubilees". Blue crabs are recruited to Gulf estuaries as megalopae, with molt to the first crab stage occurring in nearshore waters (Thomas et al. 1990, Perry et al. 1995). Oesterling and Evink (1977) proposed a larval dispersal mechanism for the northeastern Gulf in which larvae could be transported 300 km or more. If such mechanisms do exist, larvae produced by spawning females in one estuary could be responsible for recruitment in others. In the Gulf of Mexico, immature females approaching their final molt during the spring, move to lower salinities to mate, and then, typically, migrate back to higher salinity waters within the estuary during June and July (Adkins 1972b, Millikin and Williams 1984). In Florida, females may leave estuaries after mating and move along the coast to specific spawning areas near Apalachicola Bay (Oesterling and Evink 1977). Adult males appear to remain in lower salinity waters, and rarely move to higher salinities. Adults are known to migrate between estuaries along the Florida Gulf coast (Adkins 1972b, Oesterling 1976). Movement of mated females from Lakes Pontchartrain and Borgne into Mississippi waters occurs in the fall and early winter months (Perry 1975).

Reproduction

Mode: Sexes are separate (gonochoristic), fertilization is internal, and eggs develop oviparously (Williams 1965).

Mating and Spawning: Mating normally occurs in low salinity waters in the upper reaches of the estuary. Females mate while in the soft shell stage during their pubertal or terminal molt. The females are vulnerable to cannibalism and predation during these molts, and as a result, the recognition of amorous males interested in mating is important. Females approaching their pubertal or terminal molts initiate mating behavior upon recognition of a mature male via olfactory and visual stimuli (Teytaud 1971). Males recognize the females via a pheromone that triggers male mating behavior (Gleeson 1980). Males protect their mates during the females molt. The males accomplish this by grasping the females with their first pair of walking legs and "cradle-carry" her in an upright position underneath the male. The males transmit their spermatophores by tube-like pleopods into the females' seminal receptacle (Cronin 1974). The sperm are stored in the seminal receptacle to be released later. Soon after mating, females move to the higher salinity waters near the mouths of estuaries or into the Gulf of Mexico in preparation for spawning.

Spawning may occur any time from 2 to 9 months after mating, but usually occurs during the spring by females that mated in August-September of the previous year (Van Engel 1958, Williams 1965). In the northern Gulf of Mexico, larvae have been found throughout the year except January and February, but their occurrence is low from December to April (Stuck and Perry 1981). Two spawning peaks typically occur in the Gulf, one in late spring and the other during late summer or early fall (More 1969, Jaworski 1972, Stuck and Perry 1981). In Florida's St. Johns River, spawning occurs from February through October, with peak occurrence from March through October (Tagatz 1968a). The primary spawning grounds along the Gulf coast of Florida are located off Apalachicola Bay (Oesterling 1976). Eggs are fertilized as they are passed from the ovaries to the seminal receptacle and are extruded out to the pleopods (Millikin and Williams 1984). Egg extrusion may be completed within 2 hours (Van Engel 1958). Females may ovulate more than once and sperm can survive for at least one year in their seminal receptacle.

Fecundity: Fecundity estimates range from 723,500 to 2,173,300 eggs per spawning (Truitt 1939), but generally between 1,750,000 and 2,000,000 eggs are produced per spawning (Millikin and Williams 1984). The egg mass (sponge) ranges from 24 to 98 g, with an average of 37 g (Tagatz 1965). Females may ovulate and spawn more than once (Millikin and Williams 1984). Second spawnings can occur for some females later in the summer after the first one, and it is possible for a third one to occur, possibly as late as the succeeding spring or at an age of three years (Williams 1965).

Growth and Development

Egg Size and Embryonic Development: Approximate ages (after fertilization and extrusion) of blue crab egg masses (sponges) can be estimated according to coloration. Yellow to orange egg masses are from 1 to 7 days old. Brown to black egg masses are from 8 to 15 days old (Bland and Amerson 1974). Hatching occurs from 14 to 17 days after egg extrusion at 26° C, and 12 to 15 days at 29° C (Churchill 1921). Freshly extruded eggs in the early stages of development are 273 x 263 µm, and enlarge to 320 x 278 µm before hatching (Davis 1965). Hatching occurs in high salinity waters in the lower estuary, and in adjacent Gulf waters. In laboratory experiments, successful hatching did not occur below 20‰ (Costlow and Bookout 1959).

Age and Size of Larvae: Newly hatched blue crab larvae are 0.25 mm in carapace width (CW) and usually develop through seven zoeal stages. Laboratory studies indicate that 31 to 43 days are required to complete the zoeal larval stages at 25° C and 26‰ salinity (Costlow and Bookout 1959). After the final zoeal stage when approximately 1 mm CW, larvae metamorphose into the megalopal larval stage (Costlow and Bookout 1959). The optimal salinity and temperature combination for zoeal and megalopal development is 30‰ and 25° C (Bookout et al. 1976, Costlow 1967). At 30‰ and 25° C, 6 to 12 days were required to develop through the megalopal larval stage into the first crab (juvenile) stage at 2.2-3.0 mm CW (Costlow 1967). In Mississippi Sound, settlement of blue crab megalopae is episodic, occurring primarily from late summer to early fall (Perry et al. 1995). Settlement in Mississippi Sound was associated with spring tides and onshore winds, rather than with salinity, temperature, or lunar period (Perry et al. 1995). Megalopal settlement in the northern Gulf of Mexico may be asynchronous among sites (Rabalais et al. 1995).

Juvenile Size Range: Juvenile blue crabs may reach maturity within one year along the Gulf coast (Perry 1975), while populations in more temperate climates may take up to 20 months

(Millikin and Williams 1984). Salinities from 6 to 30‰ do not differentially affect growth of juveniles (Millikin and Williams 1984). Tagatz (1968b) observed that growth per molt remained similar regardless of temperature (summer vs. winter) in the St. Johns River, Florida, but that intermolt intervals were three to four times longer in the winter. Juvenile blue crabs may range in size from approximately 2 mm CW when the first crab stage is attained, to over 150 mm CW. Maturity in blue crabs is attained over a wide range of carapace widths. Guillory and Hein sampled 2,925 blue crabs in Louisiana estuarine waters, and reported that 50% of males were mature by 110-115 mm CW, and 50% of females were mature by 125-130 mm CW. The smallest mature male was 96 mm CW, and the smallest mature female 113 mm CW. One hundred percent of the males were mature by 130 mm CW, and 100% of the females by 160 mm CW.

Age and Size of Adults: Tagatz (1968b), sampling blue crabs from St. Johns River, Florida, reported mean carapace widths and ranges: adult males averaged 147 mm, ranging from 117 mm to 181 mm; adult females averaged 148 mm, ranging from 128 to 182 mm. Tagatz (1965) reported a maximum carapace width of 246 mm (male), and a heaviest weight of 550 g (male), from commercial catches in the St. Johns River, Florida. Adult males generally weigh more than females of a given size (excluding gravid females) (Millikin and Williams 1984). Females may vary in size from mature at 51 mm to immature at 177 mm. Females mate at their terminal molt, males continue to grow and molt after reaching sexual maturity. The blue crab has an estimated life span of 3-4 years (Tagatz 1968a). Growth equations for the blue crab have been calculated by Pullen and Trent (1970).

Food and Feeding

Trophic Mode: This crab is an omnivore, scavenger, detritivore, predator, and cannibal that feeds on a wide variety of plants and animals, selecting whatever is locally available at any time (Costlow and Sastry 1966, Laughlin 1982). Its feeding habits change with its ontogeny. Larval blue crabs are believed to feed on phytoplankton and zooplankton, while juveniles and adults are described as general scavengers, bottom carnivores, detritivores, and omnivores, that consume whatever is in the area (Costlow and Sastry 1966, Laughlin 1982).

Food Items: Food habits of the blue crab are variable, changing with season of the year, geographic location, and the developmental stages of its life cycle (Laughlin 1982, Steele and Perry 1990). Zoea consume phytoplankton and copepod nauplii. Aquaculture protocols recommend that zoeal stages be fed sea urchin embryos, *Artemia* nauplii, and/or rotifers (Millikin and Williams 1984, Schmidt 1993). The megalopal stage is omnivorous and consumes fish larvae, small shellfish and aquatic plants. The diet of juveniles and adults consists mainly of molluscs, crustaceans, and fish (Tagatz 1968a, Jaworski 1972, Alexander 1986). Laughlin (1982) evaluated stomach contents of blue crabs from Apalachicola Bay, Florida and observed the following: small juveniles (less than 31 mm carapace width) fed mainly on bivalves, plant matter, ostracods, and detritus; intermediate juveniles (31-60 mm) fed mostly on fishes, gastropods, and xanthid crabs; large juveniles and adults (greater than 60 mm) fed on bivalve molluscs, fishes, xanthid crabs, and smaller blue crabs. Molluscs known to be food items for blue crab include American oyster, hard clams, coot clam (*Mulina lateralis*), Atlantic ribbed mussel (*Geukensia demissa*), darkfalsemussel (*Mytilopsis leucophaeata*), scorched mussel (*Brachidontes exustus*), Atlantic rangia, and marsh periwinkle (*Littorina irrorata*) (Millikin and Williams 1984). The blue crab has been characterized as an opportunistic benthic omnivore, whose food habits are governed by availability of food items (Darnell 1959, Seed and Hughes

1997). Feeding generally decreases as temperature decreases, especially from 34° to 13° C (Leffler 1972).

Biological Interactions

Predation: Blue crab postlarvae can be 10 to 100 times more abundant in estuaries of the U.S. Gulf Coast (AL, MS, TX) than along the East Coast (DE, VA, NC, SC), but this does not necessarily result in elevated abundance of juveniles and higher fishery landings (Heck and Coen 1995). Abundances of blue crab juveniles are similar in estuaries of the two regions, suggesting that there is higher mortality of recently-metamorphosed juveniles in the Gulf region, possibly as a result of predation (Heck and Coen 1995). Numerous species of fish, mammals, and birds prey on the blue crab (Killam et al. 1992). Different species of shrimp, including *Palaemonetes pugio*, have been found to prey on blue crab megalopae (Olmi 1990). Fish that consume zooplankton, such as herring and menhaden species, are also probably important predators of blue crab larvae (Millikin and Williams 1984, Schmidt 1993). Major fish predators on juveniles are snook, black drum, juvenile and adult red drum, Atlantic croaker, spotted seatrout, and sheepshead (Fontenot and Rogillio 1970, Boothby and Avault 1971, Adkins 1972b, Fore and Schmidt 1973, Bass and Avault 1975, Overstreet and Heard 1978a, Overstreet and Heard 1978b). They have also been found in the stomach contents of the sandbar shark (*Carcharhinus plumbeus*) and spot (Levine 1980, Medved and Marshall 1981, Rozas and Hackney 1984). In addition, adult blue crabs will often cannibalize juveniles (Costlow and Sastry 1966). Several freshwater fishes may prey on blue crab in oligohaline waters, including alligator gar (*Lepisosteus spatula*), spotted gar (*Lepisosteus oculatus*), and largemouth bass (*Micropterus salmoides*)(Lambou 1961). The primary mammalian predator (other than humans) is the raccoon (*Procyon lotor*) (Steele and Perry 1990, Killam et al. 1992). Avian predators include the clapper rail, great blue heron, American merganser, and hooded merganser. Other vertebrate predators include the Kemp's ridley sea turtle and the American alligator (Byles 1989, Platt et al. 1990).

Factors Influencing Populations: Natural mortality rates of juvenile (5-20 mm CW) blue crab have been estimated at 70-91%/day in Alabama, 68-88%/day in Virginia, and 25-38%/day in New Jersey (Heck and Coen 1995). Estimated natural mortality rates were lower at sites with seagrass, and higher at sites with sand substrate. Estimation of fishery mortality is complicated by: (1) the lack of data on incidental harvest by non-directed fisheries, (2) inadequate recreational catch statistics, and (3) widespread under-reporting of soft and hard crab harvest (Adkins 1972b, Steele and Perry 1990). In addition to catches made by the recreational and commercial fisheries, large numbers of blue crabs are harvested incidentally by the shrimp trawl fishery (Adkins 1972b, Steele and Perry 1990). At present, increases in fishing effort have resulted in only slight declines in catch per fisherman, indicating that the fishery has remained fairly stable. Destruction of wetland habitat due to dredging, filling, impoundment, flow alteration, and pollution has been suggested to cause a decrease in fishery production, and, therefore, may be a significant factor in determining blue crab production (Steele and Perry 1990).

The blue crab can be infected by several diseases caused by viral, bacterial and fungal agents that result in mortality or morbidity (Steele and Perry 1990, Messick and Sinderman 1992). A variety of ecto-commensal symbionts and parasites are associated with blue crabs. Heavy infestations of symbionts may interfere with metabolic processes. Infested crabs are more vulnerable to predations, and less tolerant of unfavorable environmental conditions (Overstreet 1978). The cypris stage of the parasitic sacculinid barnacle, *Loxothylacus texanus*, infects soft juveniles retarding their growth (Overstreet 1978, Overstreet et al. 1983, Hochberg et al. 1992), and resulting in their loss to the fishery (Adkins 1972a). Predation and cannibalism may significantly affect abundance (Adkins 1972a, Heck and Coen 1995). Abiotic environmental variables may affect survival directly or indirectly. Mortality of blue crabs exposed to low dissolved oxygen coupled with high temperatures is common during the summer (May 1973, Tagatz 1969). Abiotic factors can influence blue crab populations indirectly through predator-prey relationships if they exert a greater influence on the distribution of food organisms than they do on the blue crab (Laughlin 1982).

Brown Shrimp
Scientific Name: *Farfantepenaeus aztecus*
Other Common Names: brownies, golden shrimp, green lake shrimp, native shrimp, red or red tail shrimp (Motoh 1977); *crevette royale grise* (French), *Cameron cafe norteno* (Spanish) (Fischer 1978, NOAA 1985).
Classification (McLaughin et al. 2005)

Phylum:	Arthropoda
Class:	Crustacea
Order:	Decapoda
Family:	Penaeidae

Range
Overall: The brown shrimp extends farther north than any of the other western Atlantic species of Penaeus (Fischer 1978). It is distributed from Martha's Vinyard, Massachusetts, around the tip of Florida and throughout the Gulf of Mexico to the northwestern Yucatan Peninsula.

In U.S. waters of the Gulf of Mexico, the brown shrimp is distributed throughout bays, estuaries and coastal waters. However, the brown shrimp is uncommon in Florida Bay and is conspicuously absent along the western Florida coast from the Sanibel grounds to Apalachicola Bay. Its maximum density occurs along the coasts of Texas, Louisiana, and Mississippi (Allen et al. 1980, Williams 1984, NOAA 1985).

Life Mode
This species is found in neritic to estuarine habitats and is pelagic to demersal, depending on life stage. Eggs are denser than seawater and are demersal (Kutkuhn 1966). Larval stages are planktonic, their position in the water column is dependent on time of day, water temperature and clarity (Temple and Fischer 1965, 1967, Kutkuhn, et al. 1969). Nauplii are demersal, becoming pelagic as they develop through the protozoeae and mysis stages (Lassuy 1983c). Postlarvae spawned in the fall may burrow into the sediments to escape cooler temperatures and overwinter (St. Amant et al. 1963, Aldrich et al. 1968). Postlarvae move into estuaries and transform into juveniles (Cook and Lindner 1970). Adults generally inhabit offshore waters ranging from 14 to 110 m in depth (Renfro and Brusher 1982). The brown shrimp is most abundant from March to December with optimum catches occurring from March to September (Copeland and Bechtel 1974). This species typically seems to have an annual life cycle; however, captive individuals have survived for over two years (Pérez-Farfante 1969).

Habitat

Type: Eggs occur offshore and are demersal. Larvae occur offshore and begin to immigrate to estuaries as postlarvae around 8 to 14 mm total length (TL) (Cook and Lindner 1970). In estuaries, postlarvae and small juveniles are associated with shallow vegetated habitats, but are also found over silty sand and non-vegetated mud bottoms. Juveniles and subadults are found from secondary estuarine channels out to the continental shelf, but prefer shallow marsh areas and estuarine bays, showing a preference for vegetated habitats. Adults occur in neritic Gulf waters (Pérez-Farfante 1969, Copeland and Bechtel 1974, Williams 1984, Minello et al. 1990, Zimmerman et al. 1990).

Substrate: Substrate suitable for burrowing activity generally seems to be preferred (Minello et al. 1990). Postlarvae and juveniles inhabit soft, muddy areas, especially in association with plant-water interfaces. Adults are associated with terrigenous silt, muddy sand, and sandy substrates (Hildebrand 1954, Ward et al. 1980, Lassuy 1983c, Williams 1984).

Physical/Chemical Characteristics:
Temperature: Eggs will not hatch at temperatures below 24° C (Cook and Lindner 1970). Postlarvae have been collected from temperatures of 12.6° to 30.6° C. Aldrich et al. (1968) demonstrated postlarval burrowing in temperatures below 18° C. Extended exposure to temperatures below 20° C may be detrimental to population survival (Zein-Eldin and Renaud 1986). Brown shrimp greater than 75 mm tolerate temperatures between 4° and 36° C, with a preferred range of 14.9° to 31.0° C (Ward et al. 1980, Copeland and Bechtel 1974). Estuarine water temperature appears to affect growth more than salinity does (Herke et al. 1987). Maximum growth, survival, and conversion efficiency occurs at 26° C (Ward et al. 1980, Copeland and Bechtel 1974). No growth occurs below 16° C and growth is reduced above 32.2° C (Ward et al. 1980, Lassuy 1983c).

Salinity: Brown shrimp are euryhaline to stenohaline depending on life stage. Larvae tolerate salinities ranging from 24.1 to 36‰ (Cook and Murphy 1966). Postlarvae have been collected from salinities of 0.1 to 69‰, and have good growth at 2 to 40‰. Juvenile brown shrimp are distributed over 0 to 45‰, but have been reported to prefer 10 to 20‰ (Cook and Murphy 1966, Copeland and Bechtel 1974, Zimmerman et al. 1990). Adults tolerate salinities of 0.8 to 45‰, but their optimum range is 24 to 38.9‰ (Cook and Murphy 1966). Salinity tolerance is significantly narrowed below 20° C (Copeland and Bechtel 1974). Salinity and temperature effects are more conspicuous at either extremes (Ward et al. 1980, Zein-Eldin and Renaud 1986).

Dissolved Oxygen: In one field study, abundance levels were lower in areas that had been altered by development where dissolved oxygen content had dropped below 3 ppm (Trent et al. 1976). Detailed laboratory studies of brown shrimp oxygen consumption and its interactions with temperature, salinity, and body size are presented by Bishop et al. (1980).

Turbidity: The effects of turbidity on shrimp distribution and abundance are not well known (Kutkuhn 1966). General observations indicate that turbid water areas tend to have higher concentrations of young shrimp than clear water areas. Water turbidity has also been observed to strongly affect the brown shrimp's habitat selection preference for structure in laboratory experiments (Minello et al. 1990). Significant reductions in abundance occurred in habitats with structure when turbidity levels were high.

Migrations and Movements: Brown shrimp postlarvae (10-15 mm TL) move into estuaries from February to April with the incoming tides and migrate to shallow and often vegetated nursery areas (Copeland and Truitt 1966, King 1971, Minello et al. 1989b). In the northern Gulf of Mexico, estuarine recruitment may occur all year (Baxter and Renfro 1967). Rogers et al. (1993) hypothesized that the estuarine recruitment is enhanced by downward migration of brown shrimp postlarvae as northerly cold fronts force out estuarine water, and upward migration into the tidal water column as waters is forced back into the estuary. When juveniles reach a size generally greater than 55-60 mm, they move out into open bays. The sub-adults then migrate into the coastal waters (Minello et al. 1989b). Emigration to offshore spawning grounds occurs from May through August, coinciding with full moons and ebb tides (Copeland 1965). Some tagging studies in the northern Gulf indicate a west and southward movement of the adults with the prevailing currents (Cook and Lindner 1970, Hollaway and Baxter 1981); but other studies do not indicate a net movement in any direction when fishing effort is taken into account (Sheridan et al. 1989).

Reproduction

Mode: Brown shrimp reproduce sexually by external fertilization in offshore Gulf of Mexico waters (Cook and Lindner 1970, Lassuy 1983c). This species has separate male and female sexes (gonochoristic).

Mating/Spawning: Mating probably occurs soon after the female molts and before the exoskeleton hardens (Cook and Lindner 1970). A spermatophore is placed inside the thelycum of the female by the male before her eggs are spawned. Spawning occurs offshore usually between depths of 46 to 91 m, but can range from 18 to 137 m (Renfro and Brusher 1982). The major spawning season is September through May; however, spawning may occur throughout the year at depths greater than 46 meters. In the northern Gulf of Mexico, there are two spawning peaks: September November, and April - May. In waters off Texas, spawning occurs in spring and fall at depths greater than 14 m, and throughout the year at depths of 64 to 110 m. In shallower water, peaks of spawning are during late spring and in the fall (Renfro and Brusher 1982). Brown shrimp may spawn more than once during a season (Pérez-Farfante 1969), and usually spawn at night (Henley and Rauschuber 1981).

Fecundity: Reitsema et al. (1982) found brown shrimp that averaged 192 mm TL released an average of 246,000 viable eggs, of which 15% hatched.

Growth and Development

Egg Size and Embryonic Development: Eggs are round, golden brown, and translucent measuring approximately 0.26 mm in diameter (Cook and Murphy 1971). They are demersal and hatch within 24 hours after release into the water column (Kutkuhn 1966, Christmas and Etzold 1977).

Age and Size of Larvae: Larvae transform through 5 naupliar stages with average total lengths of 0.35, 0.39, 0.40, 0.44 and 0.50 mm respectively; 3 protozoeal stages, average total lengths of 0.96, 1.71, and 2.59 mm; and 3 mysis stages, average total lengths of 3.3, 3.8 and 4.3 mm, to become postlarvae at an average total length of 4.6 mm, in a period of 10 to 25 days (Cook and Murphy 1969, Cook and Murphy 1971). Postlarvae enter the estuaries and transform into juveniles around 25 mm TL. Larval growth rate estimates are: nauplii, 0.1-0.2 mm/day;

protozoeae 0.3-0.35 mm/day; myses 0.4-0.5 mm/day (Ward et al. 1980). Postlarval growth is at a maximum between 25 to 27° C, greater than 0.5 mm/day.

Juvenile Size Range: Estuarine juveniles range from 25 to 90 mm. The shrimp spend about 3 months on the nursery grounds, and then move back offshore at sizes ranging from 80 to 100 mm TL (Copeland 1965, Cook and Lindner 1970, Parker 1970). Growth rates are temperature dependent and tend to decrease after maturity. Juveniles have grown 3.3 mm/day at temperatures above 25° C; growth decreases from 29 to 33° C (Zein-Eldin and Renaud 1986).

Age and Size of Adults: Growth of offshore adults has not been studied in detail. Females usually reach sexual maturity at about 140 mm TL (Henley and Rauschuber 1981). Brown shrimp have lived over two years in captivity.

Food and Feeding

Trophic Mode: Larvae are omnivorous, and feeding begins with the first protozoeal stage (Cook and Murphy 1969). Juveniles and adults forage nocturnally on available food, and are more carnivorous, progressing from "encounter-feeders" to selective omnivore-predators (GMFMC 1981, Zein-Eldin and Renaud 1986, Minello and Zimmerman 1991).

Food Items: Larval stages feed on phytoplankton and zooplankton. Postlarvae feed on epiphytes, phytoplankton and detritus, but faster growth is attained on animal food (e.g. *Arternia*, fish meal, shrimp meal, and squid meal) (Gleason and Zimmerman 1984, Zein-Eldin and Renaud 1986). Juveniles and adults prey on polychaetes, amphipods, and chironomid larvae, but also detritus and algae (GMFMC 1981, Zein-Eldin and Renaud 1986). Optimal growth of juveniles in a laboratory feeding study was obtained using a diet that consisted of a mixture of animal and plant material (McTigue and Zimmerman1991). Brown shrimp were found to rely more heavily on animal material in their diet than white shrimp, and this may be the result of interspecific competition.

Biological Interactions

Predation: Predation is probably the most usual direct cause of brown shrimp mortality in estuarine nurseries, in the northern Gulf of Mexico (Minello et al. 1989b). Habitat location may affect the degree of predation with such factors as differences in vegetation, substrate, and water turbidity altering mortality rates (Minello et al. 1989a). A wide variety of predators, including carnivorous fishes and crustaceans feed on this species. In estuarine waters, the southern flounder is considered the major predator of juvenile brown shrimp especially during the spring, but spotted seatrout, sand seatrout, and inshore lizard fish also prey heavily on penaeid shrimp (Stokes 1977, Minello et al.1989a, Minello et al. 1989b). Other piscine predators include: sand tiger shark, bull shark, dusky shark, ladyfish, gafftopsail catfish, hardhead catfish, sheepshead, rock sea bass, bluefish, common snook, silver seatrout, pinfish, pigfish, gulf killifish, red snapper, lane snapper, southern kingfish, spot, silver perch, black drum, red drum, Atlantic croaker, crevalle jack, cobia, code goby, Spanish mackerel, gulf flounder (Gunter 1945, Kemp 1949, Miles 1949, Springer and Woodburn 1960, Harris and Rose 1968, Boothby and Avault 1971. Odum 1971, Carr and Adams 1973, Diener et al. 1974, Bass and Avault 1975, Stokes 1977, Overstreet and Heard 1978a, Overstreet and Heard 1978b, Danker 1979, Overstreet and Heard 1982a, Divita et al. 1983, Saloman and Naughton 1984, Sheridan et al. 1984, Minello et al. 1989a, Minello et al. 1989b). Penaeid shrimp are an important link in the energy flow of food webs by feeding on benthic organisms, detritus, and other organic material found in sediments (Odum 1971, Carr and Adams 1973).

Factors Influencing .Populations: Disease is second only to predation and periodic physical catastrophes in limiting numbers of penaeid shrimps in nature (Couch 1978). A high proportion (up to 40%) of postlarval and juvenile brown shrimp in Mississippi waters may be infected with the *Baculovirus penaei* (BP) virus (Overstreet 1994), which may be highly pathogenic to these life stages (Couch et al. 1975, Lightner and Redman 1991). The commercial fishery has a major impact on parental stock during a given year, but does not seem to affect production of young for recruitment into the next year's fishery. Environmental conditions, habitat alteration, food availability and substrate type may also affect brown shrimp abundance and distribution (Christmas and Etzold 1977, Herke et al. 1987, Minello et al. 1989b, Minello et al. 1990). Salinity, turbidity, and light conditions can interact with the brown shrimp's preference for vegetated areas, causing it to inhabit non-vegetated areas where it may be more vulnerable to predation (Minello et al. 1989b, Minello et al. 1990).

Pink Shrimp
Scientific Name: *Farfantepenaeus duorarum*
Other Common Names
Brown spotted shrimp; Green shrimp, grooved shrimp, hopper, pink spotted shrimp, pink night shrimp, pushed shrimp, red shrimp, skipper, spotted shrimp (Costello and Allen 1970, Motoh 1977, McKenzie 1981, Bielsa et al. 1983, Williams 1984); *crevette roché du nord* (French), *camarón rosado norteño* (Spanish) (Fischer 1978, NOAA 1985).
Classification (McLaughin et al. 2005)

Phylum:	Arthropoda
Class:	Crustacea
Order:	Decapoda
Family:	Penaeidae

Range
Overall: The pink shrimp ranges from lower Chesapeake Bay to southern Florida, through the Gulf of Mexico to Cape Catoche and the Isla Mujeres at the tip of the Yucatan Peninsula. Maximum densities in the Gulf of Mexico occur along the coast of southwestern Florida and in the Gulf of Campeche (Pérez-Farfante 1969).

The primary nursery ground is the Florida Bay region within Everglades National Park. This area is known as the "Tortugas Shrimp Sanctuary", and is closed to most commercial shrimping. However, it supports the fisheries of the Tortugas fishing grounds (Beardsley 1970, Bielsa et al. 1983, Robblee et al. 1991). Highly productive fishery areas also occur at the Sanibel grounds, supported by the Charlotte Harbor-Pine Island Sound and Tampa Bay nurseries, and the Big Bend grounds which receives stock from Apalachicola Bay and nearby estuarine areas (Bielsa et al. 1983). Other areas of high abundance are in the Laguna Madre, Texas and offshore from Brownsville and Galveston, often associated with coarse substrate.

Life Mode
Eggs and adults are demersal; larvae are planktonic to the postlarval stage (Costello and Allen 1970). Postlarval and juvenile stages are demersal in estuaries and coastal bays (Pérez-Farfante

1969, Costello and Allen 1970, Williams 1984). Juvenile pink shrimp burrow during the day and are active nocturnally. The nocturnal activity is most obvious during new and full moons (Hughes 1967, Williams 1984). In the Florida Bay region juvenile pink shrimp are most abundant between September and December (Robblee et al. 1991, Schmidt 1993).

Habitat

Type: Eggs and early planktonic larval stages are oceanic. Postlarval and juvenile stages occur in oligohaline to euhaline estuarine waters and bays, and adults occur in estuaries and nearshore waters to 64 m depth. Mature pink shrimp inhabit deep offshore marine waters with the highest concentrations in depths of 9 to 44 m. Largest numbers of pink shrimp occur where shallow bays and estuaries border on a broad shallow shelf (Pérez-Farfante 1969, Costello and Allen 1970, McKenzie 1981, Bielsa et al. 1983, Williams 1984). Costello et al. (1986) indicate optimum habitats have daily tidal flushing with marine water and large seagrass beds with high blade densities. Protozoeal and mysis stage larvae on the Tortugas Shelf were found in depths of 14.6 to 47.6 m (Jones et al. 1970). Larvae most generally occurred at depths of 18.3 to 36.6 m. Older pink shrimp occurred almost entirely in inshore waters, and in Florida Bay appeared to be most abundant in shallow water habitats (Jones et al. 1970, Robblee et al. 1991). Optimum catches in Texas occur in secondary bays, but this species occurs from secondary estuarine channels out to the continental shelf (Copeland and Bechtel 1974).

Substrate: Pink shrimp inhabit a range of bottom substrates including shell-sand, sand, coral-mud, and mud. Immature pink shrimp prefer shell-sand or loose peat, and adults prefer shell-sand over loose peat (Williams 1958, Williams 1984). Juvenile shrimp are also commonly found in estuarine areas with seagrass where they burrow into the substrate by day and emerge and are active by night (Pérez-Farfante 1969, Costello and Allen 1970, Williams 1984). Juveniles have been frequently associated with seagrasses, and it has been suggested that the distribution of seagrasses may influence the geographic distribution of pink shrimp populations (Costello and Allen 1970). In inshore Florida waters, small juveniles were found close to shore in beds of shoal grass, *Halodule wrightii*, while large juveniles occurred in deeper waters in turtle grass, *Thalassia testudinum* (Robblee et al. 1991, Schmidt 1993). Turtle grass has also been found to provide a suitable habitat for many organisms that penaeids and other species utilize as food (Moore 1963).

Physical/Chemical Characteristics:

Temperature: One laboratory study found larvae showed normal growth at 21° and 26° C, but died at temperatures exceeding 31° C (Williams 1955a). While larval development may be restricted to a narrower range, juveniles may be fairly tolerant of a wide range of temperatures (Williams 1955a). Juveniles tolerate temperatures between 4° to 38° C, but extended periods of low water temperatures may result in death. In Texas, they become more abundant with increasing temperature, and optimal catches occur between 20° and 38° C (Copeland and Bechtel 1974). Adult pink shrimp tolerate temperatures between 10° to 35.5° C (Williams 1955a), and temperature may be a limiting factor in the northern part of their range (Hettler 1992).

Salinity: Pink shrimp show different degrees of salinity preference at different life stages (Bielsa et al. 1983). Postlarvae have been observed in salinities ranging from 12 to 43‰ with little apparent differences in their growth (Williams 1955a). At a constant temperature of 24° C postlarvae showed no difference in growth at salinities ranging from 2 to 40‰ (Zein-Eldin 1963). Juveniles have been observed between <1 to 47‰ although they prefer salinities greater than 20‰ (Costello and Allen 1970, Copeland and Bechtel 1974). Optimum catches in Texas occur between 20 and 35‰ (Copeland and Bechtel 1974). Salinity does not appear to be a major factor in the distribution of adults or in controlling spawning activity (Roessler et al. 1969). Adults are generally found in 25 to 45‰, although they have been found in salinities as high as 69‰. Abundances are reduced above 45‰. At their lower salinity tolerance, pink shrimp have been observed in 2.7‰ in the western Gulf of Mexico; and close to 1‰ in the Caloosahatchee estuary and Ten Thousand Islands of Florida. One study indicates a possible positive relationship with freshwater runoff in the Everglades and landings in the Tortugas shrimping grounds (Browder 1985). Salinity requirements or preferences vary with geographic area and shrimp size (Costello and Allen 1970). The pink shrimp appears to have superior osmoregulatory capabilities to those of the brown shrimp during periods of low water temperature, and thus shows a greater capability for overwintering in estuaries in the northern part of its range (Williams 1955a).

Migrations and Movements: Larval stages are capable of vertical migration to control their position in the water column (Costello and Allen 1970, Allen et al. 1980). Both larval and juvenile stages show phototaxic responses in their movements (Ewald 1965, Costello and Allen 1970, Jones et al. 1970). Larvae migrate vertically away from the water surface during the day, and juveniles move to the water surface during full moon tides. Pink shrimp postlarvae enter estuarine nursery areas during the summer months after 21 to 28 days of larval and postlarval development and remain there for 2 to 6 months (Costello and Allen 1970, Jones et al. 1970, Copeland and Bechtel 1974, Allen et al. 1980). Entry into estuaries may be facilitated by net inflows of sea water after periods of low water levels. The annual rise in sea level that occurs during the warmer months when spawning is occurring may facilitate current-borne movement of postlarvae from the continental shelf into these nursery areas (Allen et al. 1980). Late juveniles and early adults (95-100 mm total length (TL)) migrate to deeper offshore waters as they grow, often migrating 150 nautical miles (Joyce 1965, Costello and Allen 1970). There is no evidence that adults from different spawning stocks migrate to different spawning grounds (Costello and Allen 1966). The intensity of the migrations at the surface appears to be associated with moon phase, with greater numbers captured during full moon tides compared to captures during new and quarter moon tides (Beardsley 1970, Costello and Allen 1970). Although emigration occurs throughout the year, the main activity peak occurs in the fall with a secondary peak in the spring. Decreasing water temperature triggers the pink shrimp to move into deeper waters (Joyce 1965, Costello and Allen 1970, Copeland and Bechtel 1974). In Florida during this time, maturing juveniles move from Florida Bay westward into the Tortugas fishery area (Costello and Allen 1966, Allen et al. 1980, Gitschlag 1986). Western Gulf of Mexico pink shrimp typically move southward as they mature into adults, but some movement to the north has been observed (Klima et al. 1987). Movement patterns are influenced by patterns in fishing effort (Sheridan et al. 1989). Shrimp stocks in northern Mexico and south Texas cross the U.S.-Mexico border and probably comprise a single management entity. The pink shrimp may also overwinter in estuaries by burrowing into sediment (Williams 1955b, Joyce and Eldred 1966, Costello and Allen 1970, Copeland and Bechtel 1974, Bielsa et al. 1983).

Reproduction

Mode: Sexual reproduction occurs through external fertilization by sexually dimorphic (gonochoristic) male and female individuals (Costello and Allen 1970, McKenzie 1981).

Mating/Spawning: Spawning occurs in sea water at depths of 4 to 48 m and probably in deeper waters as well (Pérez-Farfante 1969). Mating may occur several times during a female's growth and development and is not always associated with spawning. Mating occurs between midnight and early morning between a hardshell male and a soft-shell female (Eldred 1958). A spermatophore is placed on the female's abdomen during mating. When the female releases eggs the spermatophore releases sperm and fertilization occurs externally (Costello and Allen 1970, McKenzie 1981, Williams 1984). In one study, the smallest impregnated female observed was 89 mm, and the smallest ripe female was 101 mm. In the Gulf of Mexico, the two principal spawning grounds are the Sanibel and Tortuga shelf regions between depths of 15 to 48 m. The Tortugas shrimp grounds receives emigrants from nursery areas between Florida Bay and Indian Key, and the Sanibel grounds receives shrimp from nursery areas between Indian Key and Pine Island Sound. Although ripening females and postlarvae have been observed throughout the year, the number of larvae indicates the height of spawning activity occurs from April through September in the Florida Bay region (Costello and Allen 1970, Roessler and Rehrer 1971, McKenzie 1981, Williams 1984). Similar but seasonally more abbreviated patterns are seen in areas to the west and north of south Florida. Spawning occurs as water temperatures rise, and water temperature is apparently critical to reproductive development (Cummings 1961, Costello and Allen 1966, Jones et al. 1970, Allen et al. 1980, Bielsa et al. 1983). Most spawning activity in the Florida Tortugas grounds is during the waning moon (Costello and Allen 1970, Roessler and Rehrer 1971), and occurs between 20° to 31° C with maximum activity between 27° and 30.8° C (Roessler et al. 1969, Jones et al. 1970).

Fecundity: Shrimp with a weight of 10.1-66.8 g contain 44,000 to 534,000 developing ova (Martosubroto 1974).

Growth and Development

Egg Size and Embryonic Development: The average egg diameter is 0.31-0.33 mm. At 27-29° C, nauplii emerge 13-14 hours after the eggs are spawned (Dobkin 1961).

Age and Size of Larvae: Pink shrimp larvae undergo 5 naupliar stages with length ranges of 0.35-0.40, 0.40-0.45, 0.45-0.49, 0.48-0.55, and 0.53-0.61 mm. There are 3 protozoeal stages with length ranges of 0.86-1.02, 1.5-1.9, and 2.2-2.7 mm. There are 3 mysis stages with length ranges of 2.9-3.4, 3.3-3.9, and 3.7-4.4 mm. Two postlarval stages have been described, with length ranges of 3.8 to 4.8 mm, and 4.7 to nearly 10.0 mm (Ewald 1965, Costello and Allen 1970, Allen et al. 1980). The pink shrimp grows from nauplius to postlarva in 2 to 3 weeks depending on the temperature and location. Metamorphosis from protozoea to postlarva occurs in 15 days at 26° C, and in 25 days at 21° C (Ewald 1965).

Juvenile Size Range: Reported juvenile growth rates vary from 7 to 52 mm/month (Williams 1955a, Eldred et al. 1961, Iversen and Jones 1961), and subadults and adults grow approximately 0 to 22 mm/month (Costello and Allen 1960, Iversen and Jones 1961, McCoy and Brown 1967). Sexual maturity occurs at 85 mm TL for females and 74 mm TL for males (Dobkin 1961, Bielsa et al. 1983).

Age and Size of Adults: The average sizes of large male and female pink shrimp are 170 mm and 210 mm TL, respectively. The average maximum age is 83 weeks with an absolute maximum age of 2 years (Bielsa et al. 1983).

Food and Feeding

Trophic Mode: Pink shrimp are omnivorous consumers in marine and estuarine systems (Bielsa et al. 1983). Larvae in the naupliar stages do not feed, but first protozoea were observed to begin feeding immediately when food became available (Ewald 1965). Larvae and postlarvae feed on various plankton species. Juveniles and adults are opportunistic and forage primarily at night, on benthic prey, in shallow grass beds (Bielsa et al. 1983, Williams 1984, Nelson and Capone 1990, Schmidt 1993).

Food Items: Larvae raised in hatchery conditions are fed various cultures of algae initially, and increasing amounts of brine shrimp nauplii as they became older (Ewald 1965). Typical juvenile and adult prey includes nematodes, polychaetes, ostracods, copepods, dinoflagellates, annelids, gastropods, mollusks, filamentous green and blue-green algae, vascular detritus, and inorganic material (Bielsa et al. 1983, Williams 1984, Nelson and Capone 1990, Schmidt 1993).

Biological Interactions

Predation: Many inshore fish species utilize the pink shrimp in their diet. Sport fishes such as snook, spotted seatrout, and gray snapper feed heavily on this species, but it is found in varying amounts in the diets of other fishes. These include lemon shark (*Negaprion brevirostris*), hardhead catfish, gafftopsail catfish (*Bagre marinus*), pinfish, pigfish (*Orthopristis chrysoptera*), sheepshead, crevalle jack, red drum, code goby, Spanish mackerel, and red snapper (*Lutjanus campechanus*) (Kemp 1949, Miles 1949, Springer and Woodburn 1960, Odum 1971, Carr and Adams 1973, Overstreet and Heard 1978, Overstreet and Heard 1982, Saloman and Naughton 1984, Sheridan et al. 1984, Schmidt 1986, Harrigan et al. 1989, Hettler 1989). Many reef species, such as mutton snapper (*Lutjanus analis*), red grouper (*Epinephelus morio*), black grouper (*Mycteroperca bonaci*), and even pelagic species such as king mackerel (*Scomberomorus cavalla*) have been found to prey on pink shrimp (Bielsa et al. 1983). In addition, several birds prey on this species. These include wading birds, feeding opportunistically in coastal areas and seabirds foraging in mixed species flocks on concentrations of prey. Pink shrimp are probably an easy target for diving seabirds during periods of congregated movement. This species has also been found in the stomachs of some marine mammals (*Tursiops truncatus* and *Stenella coeruleoalba*), and may possibly be a prey item of marine reptiles (Bielsa et al. 1983). The bay squid (*Lolliguncula bre*vis) is known to consume penaeid shrimp, and may include the pink shrimp as a prey item (Hargis 1979).

Factors Influencing Populations: Disease is second only to predation and periodic physical catastrophes in limiting numbers of penaeid shrimps in nature (Couch 1978). A significant number of pink and brown shrimp in the Gulf of Mexico may be infected with the *Baculovirus penaei* (BP) virus (Overstreet 1994). This virus is highly pathogenic to the early life stages of penaeid shrimp (Lightner and Redman 1991), and it maybe responsible for epizootic mortalities of pink shrimp (Couch et al.1975). Penaeid shrimp infected with symbiotic organisms may be weakened and more susceptible to mortality in waters with low DO (Overstreet 1978). Distribution, abundance, and recruitment of the pink shrimp may be limited by salinity, freshwater runoff, temperature, seagrass habitat, and substrate (Williams 1965, Bielsa 1983, Browder 1985, Hettler 1992, Schmidt 1993). Recruitment over-fishing by commercial shrimpers does not appear to be a problem for this species, but annual catch is managed to prevent the parent stock from falling below the level considered necessary to maintain recruitment (Nance 1989, Klima et al. 1990). Environmental changes may cause variable recruitment (Klima et al. 1990, Sheridan 1996). The pink shrimp may compete for or be displaced by brown shrimp from habitats. This species can be difficult to distinguish from the brown shrimp, often resulting in unreliable data.

White Shrimp
Scientific Name: *Litopenaeus setiferus*
Other Common Names: Blue shrimp, blue-tailed shrimp, common shrimp, Daytona shrimp; gray shrimp, green shrimp, green-tailed shrimp, lake shrimp, rainbow shrimp, southern shrimp (Pérez-Farfante 1969, Lindner and Cook 1970, Motoh 1977, McKenzie 1981, Muncy 1984); *crevette ligubam du nord* (French), *camarón blanco norteño* (Spanish) (Fischer 1978, NOAA 1985).
Classification (McLaughin et al. 2005)

Phylum:	Arthropoda
Class:	Crustacea
Order:	Decapoda
Family:	Penaeidae

Range
Overall: The white shrimp ranges from Fire Island, New York, to the St. Lucie Inlet, Florida, on the Atlantic coast. In the Gulf of Mexico, it is found from Ochlockonee River, Florida, to Campeche, Mexico. It is rarely found near the Dry Tortugas, Florida, and is absent around the southernmost portion of the Florida peninsula. The centers of abundance occur off Georgia and northeastern Florida for the Atlantic coast; and Louisiana, Texas and Tabasco for the Gulf of Mexico (Williams 1984, Klima et al. 1987), but greatest densities occur off the coast of Louisiana (Klima et al. 1982). NOAA (1985) reports the range within the Gulf of Mexico from Apalachee Bay, Florida, to northeast Campeche Bay, Mexico. Pérez-Farfante (1969) distinguishes the area of Ciudad, Mexico as the southern limit in the Gulf of Mexico.

Postlarval to subadult white shrimp are well established throughout the Texas, Louisiana, and Mississippi estuaries and nearshore Gulf waters, utilizing the nursery habitat generally from June/July through October/November (Christmas and Etzold 1977).

Life Mode
Eggs are spawned from spring through fall in offshore waters, where they hatch and develop into larvae (Etzold and Christmas 1977, Klima et al. 1982). Eggs are demersal and larval stages are planktonic. Postlarvae become benthic upon reaching the nursery areas of estuaries, and begin development into the juvenile stage Pérez-Farfante 1969, Lindner and Cook 1970, McKenzie 1981, Muncy 1984, Williams 1984). As juveniles approach adulthood, they move out of estuaries into coastal waters where they mature and spawn. Both juveniles and adults are demersal in estuarine and coastal waters, and are usually found at depths of <30 m (Pérez-Farfante 1969, Lindner and Cook 1970, Etzold and Christmas 1977, McKenzie 1981, Muncy 1984, Williams 1984).

Habitat
Type: The white shrimp is neritic to estuarine, and pelagic to demersal, depending on the life stage. Eggs and early planktonic larval stages occur in nearshore marine waters. Postlarvae seek estuarine habitats of shallow water with muddy/sand bottoms high in organic detritus, or abundant in marsh grass in oligohaline to euhaline salinities. Juveniles prefer lower salinity waters, and are frequently found in tidal rivers and tributaries throughout their range (Christmas and Etzold 1977). Juveniles and sub-adults move into offshore waters during fall and winter. Adults generally inhabit nearshore waters of the Gulf in depths less than 27 m, and are usually

more abundant at a depth of 14 m (Pérez-Farfante 1969, Lindner and Cook 1970, Renfro and Brusher 1982, Muncy 1984, Williams 1984).

Substrate: Postlarvae and juveniles inhabit mostly mud or peat bottoms with large quantities of decaying organic matter or vegetative cover (Williams 1955b, Williams 1958). Adults are found on bottoms of soft mud or silt in offshore waters (Pérez-Farfante 1969, Lindner and Cook 1970, Muncy 1984, Williams 1984). It has been suggested that white shrimp densities are related to the amount of marsh vegetation available in intertidal estuarine habitats (Turner 1977), but other studies have found abundances to be quite variable in relationship to vegetation (Minello et al. 1990, Zimmerman et al. 1990).

Physical/Chemical Characteristics:
Temperature: This species is tolerant of temperatures ranging from approximately 7° to 38° C (Williams 1955b, Joyce 1965, Zein-Eldin and Griffith 1969). Sudden changes in temperature, however, can be detrimental. White shrimp are more tolerant of high temperatures and less tolerant of low temperatures than brown or pink shrimp (Christmas and Etzold 1977). Postlarval white shrimp have been collected in temperatures from 12.6° to 30.6° C. Juveniles have been collected in temperatures ranging from 6.5° to 39.0° C, with peaks in abundance between 15° and 33° C (Zein-Eldin and Renaud 1986). Normal growth of juveniles occurs between 15°-16° and 25°-30° C with growth rates decreasing as temperatures approach > 35° C (Zein-Eldin and Griffith 1969) or drop below 15° C (Christmas and Etzold 1977, St. Amant and Lindner 1966).

Salinity: White shrimp can be considered euryhaline since most life stages tolerate fairly wide salinity ranges (Gunter 1961, Zein-Eldin and Griffith 1969, Lindner and Cook 1970, Copeland and Bechtel 1974). This species is apparently more tolerant of lower salinities than brown shrimp (Gunter 1961), and does not appear to be affected by sudden salinity drops as the brown shrimp is (Minello et al.1990). White shrimp post larvae have been collected in salinities ranging from 0.4 to 37.4‰. Juveniles seem to prefer or tolerate lower salinities than do other penaeid species (Williams 1955a). They prefer salinities less than 10‰ (Zein-Eldin and Renaud 1986), and have been found several kilometers upstream in rivers and tributaries (Christmas and Etzold 1977). Collections of juveniles have occurred in salinities from 0.3‰ in Florida to as high as 41.3‰ in the Laguna Madre of Texas (Gunter 1961, Joyce 1965). Adults are usually found offshore in waters with salinities greater than 27‰ (Muncy 1984). Size appears to be related to salinity tolerance (Williams 1955a, Joyce 1965). In laboratory studies no growth differences were detected over a salinity range from 2 to 40‰ (Zein-Eldin and Griffith 1969).

Migrations and Movements: White shrimp postlarvae migrate into the estuarine nurseries through passes from May to November, with peaks in June and a second peak in September for the northwest Gulf of Mexico (Baxter and Renfro 1967, Klima et al. 1982). Juveniles migrate farther up the estuary into less saline water than brown or pink shrimp (Pérez-Farfante 1969). As shrimp grow and mature they leave the marsh habitat for deeper, higher salinity parts of the estuary prior to their emigration to Gulf waters (Lindner and Cook 1970). The emigration of juveniles and sub-adults from estuaries usually occurs in late August and September, and appears to be related to the size of the shrimp and the environmental conditions within the estuarine system (Klima et al. 1982). One factor that may influence this emigration is sharp drops in water temperature occurring during the fall and winter (Pullen and Trent 1969). After leaving the estuaries, there is a general westward movement of adult white shrimp in offshore waters combined with movement to deeper waters (Baxter and Hollaway 1981, Hollaway and Sullivan

1982, Lyon and Boudreaux 1983). In April to mid-May, white shrimp move back to nearshore and inshore waters (Hollaway and Sullivan 1982).

Reproduction

Mode: Reproduction is by external fertilization between sexually dimorphic male and female individuals (Pérez-Farfante 1969, Lindner and Cook 1970, Muncy 1984). Although this species has separate male and female sexes (gonochoristic), hermaphroditism has been reported in white shrimp parasitized by Thelohania sp. (Rigdon et al. 1975).

Mating/Spawning: The external genital organ (thelycum) in female white shrimp is open, unlike those in brown shrimp, making copulation possible between two hard-shelled individuals (Overstreet 1978, Muncy 1984). The male places a spermatophore on the female's abdomen, and when eggs are released the spermatophore releases sperm fertilizing the eggs externally (Pérez-Farfante 1969). Spawning along the Atlantic coast probably begins in May and extends through September (Lindner and Anderson 1956, Williams 1984); in the Gulf, the season probably extends from March to September or October (spring to late fall) (Franks et al. 1972). Spawning occurs offshore at depths of 9 to 34 m deep and peaks in the summer (June-July). There is also some suggestion of limited spawning within estuaries and bays (Lindner and Cook 1970). Females that spawn early may spawn a second time in late summer or fall, and possibly up to 4 times in a season (Lindner and Anderson 1956, Lindner and Cook 1970). The ability of shrimp over one year old to spawn is unknown, but considered possible (Lindner and Cook 1970). Other shrimp species with similar methods of reproduction have been found to spawn again in their second year. Rapid temperature changes, such as the sudden increases and decreases that occur in the summer and fall, seem to trigger spawning (Henley and Rauschuber 1981).

Fecundity: A large female is estimated to produce 0.5 to 1.0 million eggs at a single spawning (Anderson et al. 1949, Lindner and Cook 1970, Williams 1984).

Growth and Development

Egg Size and Embryonic Development: Egg development is oviparous. Fertilized eggs are demersal, nonadhesive, spherical, and are approximately 0.28 mm in diameter (Lindner and Cook 1970). Ripe eggs are 0.2 to 0.3 mm in diameter and hatch in 10 to 12 hours after fertilization (Klima et al. 1982).

Age and Size of Larvae: Eggs hatch into planktonic nauplii approximately 0.3 mm TL (Klima et al. 1982). Larvae transform through 5 naupliar stages, 3 protozoeal stages and 3 mysis stages Pérez-Farfante 1969). The length of larval life is from 10 to 12 days, depending on local food, habitat, and environmental conditions. They enter the estuaries as postlarvae at total lengths (TL) of approximately 7 mm. Rapid growth rates of 20-40 mm/month occur in nursery areas (Williams 1955a, Lindner and Anderson 1956, Pérez-Farfante 1969, Lindner and Cook 1970). Growth is far more strongly affected by changes in temperature than salinity (Zein-Eldin and Griffith 1969), with little or no growth occurring below 18° C (Zein-Eldin and Renaud 1986). Postlarvae develop into juveniles at about 25 mm TL (Christmas et al. 1976).

Juvenile Size Range: Juveniles can attain lengths of 98 to 146 mm TL in 4 to 6 weeks after entering estuarine areas (Zein-Eldin and Renaud 1986). Emigration of sub-adults occurs through the summer and fall at a size of 100 to 120 mm TL. Sexual maturity is generally reached at 140 mm TL in the northern Gulf of Mexico (Pérez-Farfante 1969, Lindner and Cook 1970).

Age and Size of Adults: The white shrimp has a life expectancy of 18 months, although some have been maintained in the laboratory for 3 to 4 years (Klima et al. 1982). Females become sexually mature at about 165 mm TL and ripe sperm first appears in males at about 119 mm TL (Burkenroad 1939, Lindner and Cook 1970).

Food and Feeding

Trophic Mode: White shrimp are omnivorous at all life stages, but may depend more heavily on plant matter than animal matter (McTigue and Zimmerman 1991). Larval white shrimp are planktivorous, while adults and juveniles are scavengers.

Food Items: Penaeid larvae subsist on egg yolk until the Protozoea I stage when active feeding begins (Lindner and Cook 1970). Larvae are reported to feed on plankton and suspended detrital material, and in the laboratory, they have been successfully fed microscopic green algae and brine shrimp nauplii. Both juveniles and adults are omnivorous. Juveniles combine detrital feeding with scavenging on the bottom sediment. As they mature, they combine predation with detrital feeding. Foods consist of detritus, insects, annelids, gastropods, and fish, and copepods, bryozoans, sponges, corals, filamentous algae, and vascular plant stems and roots (Darnell 1958, Pérez-Farfante 1969, Christmas and Etzold 1977).

Biological Interactions

Predation: Finfish prey heavily on this species. Known predators include tiger shark (*Galeocerdo cuvier*), Atlantic sharpnose shark (*Rhizoprionodon terraenovae*), bull shark, ladyfish (*Flops saurus*), hardhead catfish, crevalle jack, red snapper (*Lutjanus campechanus*), southern kingfish (*Menticirrhus americanus*), spotted seatrout, sand seatrout, red drum, black drum, cobia (*Rachycentron canadum*), code goby, Spanish mackerel, southern flounder, and gulf flounder (Gunter 1945, Kemp 1949, Miles 1949, Darnell 1958, Springer and Woodburn 1960, Boothby and Avault 1971, Stokes 1977, Overstreet and Heard 1978a, Overstreet and Heard 1978b, Danker 1979, Creel and Divita 1982, Overstreet and Heard 1982, Saloman and Naughton 1984, Sheridan et al. 1984). Some predation by bay squid (*Lolliguncula brevis*) is possible (Hargis 1979). Penaeid shrimp are an important link in the energy flow of food webs by feeding on benthic organisms, detritus, and other organic material found in sediments (Odum 1971, Carr and Adams 1973).

Factors Influencing Populations: The commercial shrimp fishery may be impacting the white shrimp population (Nance and Nichols 1988, Nance 1989, Nance et al. 1989). Catch statistics indicate that current harvest levels may be over-exploiting the resource, causing a decline in adult recruitment. Pathogens also affect the white shrimp. It is susceptible to diseases and parasites, but the extent of resultant mortality is largely unknown (Couch 1978, Muncy 1984). Predation and episodic catastrophes probably play more important roles as limiting factors of natural populations. Penaeid shrimp infected with biosymbionts may be weakened and die in low oxygen situations (Overstreet 1978). In the Mississippi Sound, adult white shrimp are infected with a cestode which invades the hepatopancreas (Muncy 1984). White shrimp tend to aggregate, forming a patchy distribution pattern in estuaries. The environmental factors that govern this type of distribution are not known (Zimmerman et al. 1990). Suitable estuarine habitat is critical to survival and recruitment of juveniles (Turner 1977, Nance et al. 1989). However, development has destroyed or altered large portions of these estuarine areas to a point of low productivity (Christmas and Etzold 1977). Continued loss of this habitat may result in declines in recruitment and harvest (Christmas and Etzold 1977, Nance et al. 1989). Episodic weather events such as hurricanes and freezes also impact white shrimp populations (Kutkuhn 1962, Barrett and Gillespie 1973). Hurricanes can result in high mortality of a spawning class by causing adverse environmental conditions. Such conditions include high tides and extensive flooding, higher salinities, excessive turbulence, turbidity, and habitat destruction. Freezes can cause mass mortalities by reducing the water temperature to lethal levels. Other factors felt to be related to penaeid shrimp population dynamics are productivity of estuarine nursery areas, food availability and content, refuge from predation, amount of fresh water inflow, light intensity, tide, and rainfall (Christmas and Etzold 1977, Gracia 1991).

III. RESOURCE DATA

MATERIALS AND METHODS

Bag seine, trawls and monofilament gill nets (Appendix A) were used in each of the three major bay systems that comprise the Coastal Bend Bays and Estuary Program (CBBEP). Species name, species code, collection date, collection time, collection location (identified by a major code [bay system], minor zone code [zone within the bay], station [station within the zone], latitude, and longitude), length descriptor (total length, standard length, fork length [methods of measurement are specific for each invertebrate taxonomic group]), and gear were recorded for organisms collected during sampling. Hydrologic and environmental data are gathered in conjunction with a biological sample. These include: location (major, minor, and station, as defined above), surface area, date, time, lighting conditions, latitude, longitude, wind speed, wind direction, cloud cover, barometric pressure, precipitation, fog, wave height, tide, water depth, water temperature, dissolved oxygen, salinity, turbidity, and bottom type.

To ensure random sampling, sampling sites were randomly selected from grids (1 minute latitude by 1 minute longitude). Each selected grid was subdivided into 144 5-second "gridlets". All "gridlets" that contained >15.2 m of shoreline were used to randomly choose gill net or bag seine sample sites. Trawl sample locations were selected randomly following the procedure described above for bag seines, under the additional conditions that at least 1/3 of the grid was at least one meter deep and free of obstructions. Trawling was not restricted to the vicinity of the shoreline and grids were not sampled more than once a month.

Gill nets were 183 m in length, 1.2 m in depth, and were divided into four panels, each 45.75 m in length with increasing mesh size (76 mm, 102 mm, 127 mm, and 152 mm). The nets were set perpendicular to the shoreline, with the smallest mesh panel closest to shore: nets were suspended by hard plastic floats and weighted by a leadline. Gill net sets were conducted overnight during each spring and fall season (Appendix A). The spring season began with the 2nd full week in April and extended for 10 full weeks. The fall season began with the 2nd full week in September and extended for 10 full weeks. Between three and five nets were set each week in each bay. Sample grids and gridlets, which were selected randomly according to the parameters used for bag seine grid and gridlet selection, conformed to additional conditions: (1) each grid could contain no more than one set per night; (2) each grid could contain no more than three gill nets per season, and; (3) sets occurring on the same night had to be at least one kilometer apart. Nets were set within one hour of sunset and retrieved within four hours after sunrise. Thus, the length duration of net emplacements varied with daylength, with an average set duration of 12.5 h in the spring and 14 h in the fall. Each sampling week extended from 1 h before sunset on Sunday through 4 h after sunrise the following Sunday.

Bag seines were 18.3 m in length, 1.8 m in depth, and had 19 mm stretched nylon #5 multifilament mesh wings (8.3 m in length) and a 13 mm stretched nylon #5 multifilament mesh bag (1.8 m in length). Bag seines were pulled parallel to the shoreline for 15.2 m. The surface area sampled (nearest 0.01 ha) was estimated using distance pulled and length of extension of the bag seine. No grid was sampled more than once in a month.. One half of the monthly bag seine samples were collected during each of two periods (1-15 and 16-31) of the month (Appendix A). Catch per unit effort (CPUE) was defined as the number of individuals captured per unit area (18.3 m [bag seine length] x length of pull) and was therefore standardized as the number of individuals captured per 0.03

Trawls were used in Corpus Christi Bay and Aransas were stratified into two zones: Zone 1 (upper bay nearest mouths of rivers) and Zone 2 (lower bay farthest from rivers). Since the upper Laguna Madre does not have fresh water inflow, the entire system is stratified as Zone 2. Trawl sites were randomly selected from bay grids (1 minute latitude by 1 minute longitude) that contained water >1 m deep in at least 1/3 of the grid and which were known to be free of obstructions. One half of the monthly trawl samples in each zone in each bay system were collected during each of two periods (1-15 and 16-31) of the month (Appendix A). Otter trawl nets were flat 6.1 m in width and constructed with 38 mm stretched #9 nylon. Samples were taken between dawn and dusk by pulling the net along the bay bottom at a speed of approximately 3 mph (4.8 km/h) in a circular pattern for ten minutes.

Lengths [total (TL) or standard (SL)] of organisms caught were recorded. In gill nets, up to 19 individuals of each species were measured, within each mesh size, on each sampling day. In trawls, up to 50 shrimp (length from tip of rostrum to tip of telson) of each species (brown, white, pink), 35 blue crabs (carapace width between spine tips) and 19 individuals of all other species were measured in each sample. For all other gears, up to 19 specimens were measured for each species in each sample collected.

DATA ANALYSIS

Sample catch rates for each species were calculated by dividing total number captured by either total hours fished (gill net and trawl) or hectors (ha) sampled (bag seine). Catch rates for each bay system were then calculated by year for each gear type (number per hour for trawls and gill nets; number per hectare for bag seine). Bay specific catch rates were weighted for coastwide estimates (Appendix A). Fish greater than 207 mm long were eliminated from bag seine catch rate calculations based on the findings of McEachron and Green (1986). Standard errors for the catch rates presented in the tables and figures were calculated using the SAS procedure Proc Survey Means.

Mean TL of individual species in gill nets were calculated for each of the four mesh sizes. Mean lengths for the combined meshes were calculated by weighting individual species mean total lengths by the number of individuals caught for each species in each mesh. CBBEP area total mean lengths for each species caught in gill nets were weighted according to the catch rate in each bay system and by bay specific weighting factors. Standard errors for the catch rates presented in the tables and figures were calculated using the SAS procedure Proc Survey Means.

RESULTS

Gill Nets

Gill nets are used to obtain data on the relative abundance of adult finfish. This gear has been used it the CBBEP area since 1975 (Appendix A). Of the six finfish species presented in this report, black drum are the most abundant, followed by red drum and spotted seatrout

Atlantic croaker
CBBEP

With the exception of the upper Laguna Madre, catch rates for Atlantic croaker in the CBBEP are consistently higher in the fall than in spring (Table 1and Table 2; Figure 2,). CBBEP spring gill net catch rates for Atlantic croaker averaged 0.05 #/h between 1984 and 2004. Spring catch rates ranged from 0.01 #/h in 1984 and 1989 to 0.14 #/h in 1986. During the same period fall gill net catch rates, while variable, generally declined (R^2 = 0.02). Fall catch rates between 1984 and 2004 averaged 0.30 #/h and ranged from 0.13 #/h in 1990 to 0.55 #/h in 1987.

Average spring gill net catch rates (0.05 #/hr) for Atlantic croaker caught within the CBBEP area have historically been lower than those observed in the fall (0.30 #/hr). In the past 20 years, the highest catch rate observed was in the fall of 1987 (0.55/h). This peek was driven by the high catch rate of croaker caught in Corpus Christi Bay (1.64 #/hr) (Table 1 and Table 2; Figure 2). On average, Atlantic croaker catch rates from Corpus Christi Bay are around 3 times those of Aransas Bay and 10 times those of the upper Laguna Madre.

Aransas Bay

The relative abundance of Atlantic croaker in Aransas Bay is historically higher during the fall gill net season than during the spring gill net season (Figure 3). Catch rates of Atlantic croaker in spring gill nets have steadily increased since 1984, reaching a peak of 0.12/hr. in 2002 (Table 1)Although the fall gill net catch rates of Atlantic croaker are highly variable, the overall trend remained fairly stable from 1984-2004 (R^2=0.01) at about 0.20/hr. The highest fall catch rates were observed during 1995 and 2002 at about 0.40/hr (Table 2).

Corpus Christi Bay

Corpus Christi Bay spring gill net catch rates for Atlantic croaker have historically been much lower than the fall gill net catch rates. In the past 20 years, the highest catch rate observed was in the fall of 1987 (1.64/hr), with an average catch rate of 0.70/h over this same period (Table 1and Table 2; Figure 4).

Upper Laguna Madre

The upper Laguna Madres Atlantic croaker spring and fall gill net catch rates are not as distinctive as those observed for Aransas and Corpus Christi Bay, probably because these are, on average, one tenth those found in Corpus Christi Bay. The spring gill net catch rates for Atlantic croaker generally decreased between 1984 and 2004 (R^2 = 0.023) but averaged 0.06 #/hr (Figure 5). Spring catch rates ranged from 0.20 #/hr in 1986 to 0.015 #/hr in 1989 (Table 1). During the same period fall gill net catch rates generally increased (R^2 = 0.015) and averaged 0.07 #/h (Figure 5). Fall gill net catch rates ranged from 0.18 #/h in 1985 to .003 #/h in 1989 (Table 2).

Black drum

CBBEP

While CCPNEP spring and fall gill net catch rates generally increased between 1984 and 2004 (spring R^2 = 0.76 and fall R^2 = 0.51)(Figure 6). These increases were driven by the very large and rapid increase spring and fall gill net catch rates observed in the upper Laguna Madre from1984 to 2004. Between spring 1984 and 2004 gill net catch rates averaged 1.58 #/h and ranged from 0.36 #/h in 1984 to 2.47 #/h in 2001(Table 1). During the same period fall catch rates averaged 1.47 #/h and ranged from 0.26 #/h in 1984 to 2.36 #/h in 2000 (Table 2). On average, the CBBEP black drum spring and fall gill net catch rates are similar (spring =1.57 #/hr, fall = 1.46 #/hr).

Aransas Bay

The relative abundance of black drum in Aransas Bay is high and has historically been about the same during both spring and fall gill net seasons. The catch rate trend for black drum in spring gill nets has increased since 1984 (R^2=0.73), reaching a peak of 2.2/hr. in 2001 Table 1). The average CPUE since 1996 was 1.4/hr., well above the long term mean of 1.0/hr. The trend of fall gill net catch rates for black drum in Aransas Bay have been increasing (R^2=0.46) since 1984 as well, reaching its peak in 2000, then declining somewhat (Figure 7). In spite of the apparent decline since 2000, average CPUE since 1996 (1.4/hr.) has remained above the long term mean of 1.1/hr.

Corpus Christi Bay

Corpus Christi Bay black drum spring and fall gill net catch rate have had an increasing trend between 1984-2004 (R^2= 0.07 and 0.06 respectfully); however in recent years lower average catch rates have been recorded than those observed in the mid 1990's (Figure 8). The highest overall catch rate was observed in the spring of 1993 (3.1 #/h), when the catch rate was 3 times the 20 year average (Table 1 and Table 2; Figure 8).

Upper Laguna Madre

Upper Laguna Madre fall and spring gill net catch rates for black drum generally increased between 1984 and 2004 (spring R^2 = 0.76 and fall R^2 = 0.50) (Figure 9). Spring gill net catch rates averaged 2.7 #/hr and ranged from 0.54 #/h in 1984 to 4.91 #/h in 2004. During the same period fall gill net catch rate averaged 2.5 and ranged from 0.39 #/h in 1984 to 4.89 #/h in 2004.

Red drum

CBBEP

Both spring and fall gill net catch rates in the CBBEP increased between 1984 and 2004 (spring R^2 = 0.43 and fall R^2 = 0.32). Spring catch rates between 1984 and 2004 averaged 0.80 #/h and ranged from 0.42 #/h in 1985 to 1.42 #/h in 1996. Spring gill net catch rates increased between 2002 and 2004, the highest recorded since 1996. During this period fall gill net catch rates also averaged 0.80 #/h and ranged from 0.46 #/h in 1987 to 1.15 #/h in 1993. Fall gill net catch rates have remained stable between 2002 and 2004 but are higher than any record since 1998 (Figure 10)

Aransas Bay

The relative abundance of red drum in Aransas Bay was historically higher during the fall than in the spring (Figure 11). However, since 1992 spring catch rates have equaled and/or surpassed the fall catch rates. Since 1990, red drum CPUE in the spring and fall seasons has averaged 1.2/hr. Catch rates from 1984-2004 for both fall (R^2=0.40) and spring (R^2=0.35) seasons have shown an increasing trend with both seasons having a mean CPUE of about 1.0/hr. The highest catch rate for red drum during this 20-year period, 2.1/hr., was observed during the 1996 spring gill net season (Table 1).

Corpus Christi Bay

Corpus Christi Bay red drum average spring catch rates (0.93#/h) are slightly above those observed in the fall (0.75 #/h). The spring catch rates trend is showing a larger increase (R^2= 0.31) than the fall gill net catch rate trend (R^2= 0.03). In 2003 and 2004, the spring gill net catch rates were 1.4 #/h, second only to that observed in 1996 (1.5 #/h) (Table 1Table 2; Figure 12).

Upper Laguna Madre

Both spring and fall gill net catch rates for red drum generally increased between 1984 and 2004 (spring R^2 = 0.15 and fall R^2 = 0.23) (Figure 13). Spring catch rates between 1984 and 2004 averaged 0.50 #/h and ranged from 0.23 #/h in 1990 to 0.86 #/h in 1998 (Table 1). During the same period fall gill net catch rates averaged 0.88 #/h and ranged from 0.27 #/h in 1988 to 0.88 #/h in 2004 (Table 2).

Sheepshead

CBBEP

Both spring and fall gill net catch rates for sheepshead increased between 1984 and 2004 (spring R^2 = 0.36 and fall R^2 = 0.35). Spring catch rates between 1984 and 2004 averaged 0.08 #/h and ranged from 0.02 #/h in 1994 to 0.24 #/h in 2003. During the same period fall catch rates also averaged 0.08 #/h but ranged from 0.03 #/h in 1985 to 0.17 #/h in 2000. Both spring and fall gill net catch rates have generally decreased since spring 1998 and fall 2000 (Figure 14).

Aransas Bay

Sheepshead catch rates in Aransas Bay for both spring (R^2=0.56) and fall (R^2=0.33) gill net seasons show an increasing trend from 1984-2004 (Figure 15). From 1994 to 2004, the average CPUE of sheepshead in spring gill nets was 0.13/hr. which is well above the long term mean of 0.08/hr. During the fall season, the average CPUE was 0.18/hr., above that long term mean of 0.13/hr.

Corpus Christi Bay

Sheepshead spring gill net catches rates in Corpus Christi Bay are highly variable from year to year (Figure 16). The highest spring catch rate was recorded in 2003 (0.45 #/hr) (Table 1). Overall, the spring gill catch rates show a small increasing trend (R^2=0.10) while the fall trend is almost level (R^2=0.02). The fall gill net catch rates for sheepshead in Corpus Christi Bay are lower than those observed in spring and are less variable, ranging from 0.02 to 0.11 #/hr.

Upper Laguna Madre

Spring and fall gill net catch rates for sheepshead averaged 0.04 #/h (Figure 17). Spring catch rates ranged from 0.01 #/h in 1994 to 0.08 #/h in 1998 (Table 1). Fall catch rates ranged from

0.004 #/h in 1994 to 0.10 #/h in 2001 (Table 2). Although the fall gill net catch rate shows a slight increase in the 20 year trend (R^2=0.04), the fall trend is level (R^2 <0.01).

Southern flounder
CBBEP
Both spring and fall gill net catch rates for southern flounder decreased between 1984 and 2004 (spring R^2 = 0.24 and fall R^2 = 0.17). Gill net catch rates for southern flounder in the CBBEP were consistently higher in the fall (Figure 18).. Spring catch rates between 1984 and 2004 averaged 0.02 #/h and ranged from 0.01 #/h in 1989 to 0.04 #/h in 1991. Spring catch rates have been fairly stable since 1996. Fall catch averaged 0.06 #/h between 1984 and 2004 and ranged from 0.03 #/h in 2001 to 0.10 #/h in 1985 (Figure 18).

Aransas Bay
Southern flounder in Aransas Bay is the only finfish that is on the decline in terms of gill net catch rates. Catch rates for southern flounder are generally three times higher during the fall season than in the spring (Figure 19). Fall catch rates ranged from highs of 0.09/hr. in 1984 and 1989 to lows of 0.03/hr. in 1998 and 0.04/hr. in 1986 (Table 2). While southern flounder showed a steady decline in the fall for nine years (1990-1998), the spring catch rates have remained relatively stable at 0.02/hr.

Corpus Christi Bay
Of the finfish listed in this report, southern flounder is the only species which has had a steady decrease in both the spring and fall gill net catch rates (Figure 20). The average catch rate for spring gill nets is 0.02 #/h and the fall catch rate is 0.07 #/h (Table 1 and Table 2). As is the case in Aransas Bay, fall southern flounder catch rates are around three time those observed in the spring Figure 20).

Upper Laguna Madre
Both spring and fall gill net catch rate for southern flounder decreased between 1984 and 2004 (spring R^2 = 0.22 and fall R^2 = 0.44) (Figure 21). Between 1984 and 2004 spring gill net catch rates averaged 0.01 #/h and ranged from 0.002 #/h in 1993 to 0.07 in 1991 (Table 1). During the same period fall catch rate averaged 0.04 #/h and ranged from 0.01 #/h in 1996 to 0.15 #/h in 1985 (Table 2). As is the case with the other two bay systems in the CBBEP area, the fall southern flounder gill net catch rate is higher than that those recorded in the spring, however the difference in not as large as those in Aransas and Corpus Christi Bay.

Spotted seatrout
CBBEP
Both spring and fall gill net catch rates increased between 1984 and 2004 (spring R^2 = 0.77 and fall R^2 = 0.53). While catch rates are increasing in both seasons, spring catch rates are higher and are increasing more rapidly than fall catch rates. This trend is observed in all three bay systems within the CBBEP area. Between 1984 and 2004 spring gill net catch rates averaged 0.74 #/h and ranged from 0.16 #/h in 1984 to 1.02 #/h in 2004, the highest catch rates recorded

since 1984. During the same period fall catch rates averaged 0.40 #/h and ranged from 0.11 #/h in 1984 to 0.57 #/h in 1996. The fall 2004 gill net catch rate is the second highest recorded since 1996 (Figure 22).

Aransas Bay

Spotted seatrout populations in Aransas Bay have been increasing since the Freeze of 1983. Spring gill net catch rates ranged from a low of 0.2/hr. in 1984 to the high of 1.2/hr. in 2001 (Table 1). The spring catch rate trend has been steadily increasing (R^2=0.83) since 1996, averaging 1.04/hr (Figure 23). . Catch rates for spotted seatrout during the fall season also shows an increasing trend (R^2=0.68). Fall catch rates of spotted seatrout ranged from 0.10/hr. in 1984 to 0.71/hr. in 2001 (Table 2).

Corpus Christi Bay

In Corpus Christi Bay, the spring spotted seatrout catch rates have shown an increasing trend (R^2= 0.14) while the fall has remained relatively level ($R^2 < 0.01$). The highest catch rate was observed in the spring of 1992 (1.30 #/h) and the lowest was in the fall of 1984 (0.16 #/h), following the 1983 freeze (Table 1 and Table 2; Figure 24). Between 1997 and 2000, spotted seatrout spring gill net catch rates decrease to levels close to those observed in 1984 and 1985; however these steadily increased to above average levels in 2002-2004 (Figure 24)

Upper Laguna Madre

Both spring and fall gill net catch rates for spotted seatrout generally increased between 1984 and 2004 (spring R^2 = 0.67 and fall R^2 = 0.40) (Figure 25). Between 1984 and 2004, spring gill net catch rates averaged 0.56 #/h and ranged from 0.03 #/h in 1984 and 0.88 in 2004 (Table 1). During the same period fall catch rates averaged 0.35 #/h and ranged from 0.08 #/h n 1984 to 0.62 #/h in 1996 (Table 2).

Bag Seines

Bag Seines are used to obtain data on recruitment estimates for many species of finfish and shellfish . This gear has been used it the CBBEP area since 1977 (Appendix A)
Of the finfish listed in this report, Atlantic croaker was the most abundant species captured in the CBBEP area with bag seines. Black drum and red drum were the second and third most abundant species. The most abundant invertebrate caught in CBBEP bag seine samples was brown shrimp followed by white shrimp and blue crab.

Atlantic croaker
CBBEP

Bag catch rates for Atlantic croaker generally decreased from 1984 to 2004 (R^2 = 0.3). Catch rates averaged 29.6 #/h and ranged from 3.37 #/h in 1988 to 113.4 #/h in 1992 (Table 5). Between 2001 and 2004, these have remained stable at about 24.6 #/ha (Figure 26).

Aransas Bay

Recruitment of Atlantic croaker into Aransas Bay has shown a slightly declining trend since 1984 (R2=0.01)(Figure 27). Seasonal bag seine catch rates ranged from 7.6/ha in 1988 to 210.4/ha in 1992 (Table 5). During the past five years, catch rates averaged 97.6/ha which is equal to the 20-year average of 98.1/ha.

Corpus Christi Bay
Annual (calendar year) bag seine catches for Atlantic croaker in Corpus Christi Bay show an slight decreasing trend between 1984-2004; however, this decreasing trend is being driven by the high catch rate observed in 1984 (Table 5; Figure 28).

Upper Laguna Madre
Annual bag seine catch rates from Atlantic croaker generally increased between 1984 and 2004 catch rates averaged from 5.58 #/ha and ranged from 0.00 in 1988 and 1989 to 25.97 #/ha in 1998 (Figure 29). In 2004, the catch rate increased to the second highest recorded since 1984 (14.9 #/ha) (Table 5).

Black drum
CBBEP
Black drum were the second most abundant finfish species caught in CBBEP bag seine samples. Bag seine catch rates for black drum have been highly variable among years but averaged 27.0 #/ha and ranged from 0.64 #/ha in 1986 to 286.5 #/ha in 1990. The high catch rate in 1990 was primarily driven by that year's upper Laguna Madre black drum recruitment. The 2004 bag seine catch rate is the second highest recorded since 1999 (Figure 30).

Aransas Bay
Seasonal bag seine catch rates for black drum in Aransas Bay show a slightly increasing trend for the 20-year period (R^2=0.09). Relatively few YOY black drum are caught in bag seines as compared to adults in gill nets, but the increasing trend is similar for both gears (Figure 7and Figure 31). During 1994-2000, four peak recruitment years were observed followed by four years with very low numbers of YOY black drum.

Corpus Christi Bay
Annual bag seine catch rates for black drum in Corpus Christi Bay show great variability between years (Figure 32). These range from 0.0 #/ha observed 1984 to 15.1 #/ha in 1990 (Table 3)

Upper Laguna Madre
Bag seine catch rate for black drum was highly variable among years between 1984 and 2004 (Figure 33). Black drum bag seine catch rate averaged 74.5 #/ha between 1984 and 2004 and ranged from 1.39 #/ha in 1993 to 833.0 #/h in 1990. The catch rate (27.1 #/ha) observed in 2004 was the highest recorded in three years (Table 5).

Red drum

CBBEP

Bag seine catch rates for red drum between 1984 and 2004 while highly variable generally increased ($R^2 = 0.21$). During this period catch rates averaged 13.4 #/ha and ranged from 2.6 #/ha in 1986 to 29.4 #/ha in 1994. The 2004 catch rate is the highest recorded since 1994 and the second highest recorded since 1984.
(Figure 34)

Aransas Bay

Seasonal bag seine CPUE for red drum in Aransas Bay showed a fairly constant trend since 1984 ($R^2<0.01$). Catch rates increased from the 1980's through the 1990's (Figure 35). Peak recruitment years in 1990 (95.8/ha) and 2004 (60.3/ha) brought the average CPUE since 1990 up to 28.0/ha.which was above the long term mean of 21.9/ha.

Corpus Christi Bay

Corpus Christi Bay red drum annual bag seine catch rates have shown an increasing trend between 1984 and 2004 ($R^2= 0.37$). The highest annual bag seine catch rate was recorded in 1994 (52.5 #/ha) and the second highest in 2004 (46.0 #/ha) (Table 3; Figure 36).

Upper Laguna Madre

Bag seine catch rates for red drum while highly variable among years generally increased between 1984 and 2004 (Figure 37). During this period catch rates for red drum averaged 6.13 #/ha and ranged from 1.1 #/ha in 1985 to 13.61 #/ha in 1992. The catch rates of 5.14 #/ha and 5.00 #/ha in 2003 and 2004 were two of the lowest recorded since 1990 (Table 5).

Sheepshead

CBBEP

Bag seine catch rates for sheepshead were highly variable betwen the years 1984 and 2004, but averaged 0.35 #/ha. Sheepshead bag seine catch rates ranged from 0 #/ha in 1987 and 1998 to 1.11 #/ha in 1988. The 2004 bag seine catch rate is the lowest recorded since 1998 and the second lowest recorded since 1990 (Figure 38).

Aransas Bay

Very few YOY sheepshead are caught in bag seines (Table 5). Annual bag seine catch rates for sheepshead in Aransas Bay have remained at low levels for the 20-year period (1984-2004) (Figure 39). Annual CPUE ranged from 0/ha in 1987, 1998 and 2001 to 2.1/ha in 1995.

Corpus Christi Bay

The highest sheepshead recruitment in Corpus Christi Bay was observed in 1988 (3.11 #/ha) (Figure 40 and Table 5). On average, the sheepshead catch rate in Corpus Christi Bay is 0.34 #/ha. The twenty year trend shows a slight decrease in the overall requirement of sheepshead in Corpus Christi Bay ($R^2= 0.01$)

Upper Laguna Madre
Bag seine catch rates for sheepshead averaged 0.10 #/ha between 1984 and 2004 and was 0.0 #/ha in all but 6 years between 1984 and 204 (Figure 41). The highest catch rate (0.69 #/ha) was recorded in 1999 and the lowest, non zero, catch rate was recorded in 1993 and 1995 (0.14 #/ha) (Table 5).

Southern flounder
CBBEP
Bag seine catch rates for southern flounder, while variable between 1984 and 2004, generally decreased during this time frame ($R^2 = 0.09$). Between 1984 and 2004 southern flounder bag seine catch rates averaged 2.84 #/ha and ranged from 0.52 #/ha in 2002 to 11.66 #/ha in 1989. Flounder bag seine catch rates increased between 2002 and 2004 but are still lower than bag seine catch rates reported between 1995 and 1999 (Figure 42).

Aransas Bay
Recruitment of southern flounder in Aransas Bay showed a declining catch rate trend through the 20-year period ($R^2=0.06$). Except for what is probably an anomaly in the bag seine catch rate in 1989 (23.6/ha), catch per unit effort ranged from 0.6/ha in 2000 to 6.9/ha in 1985 (Figure 43).

Corpus Christi Bay
The highest southern flounder annual bag seine catch rates were recorded in 1990 (11.6 #/ha). Since the low of 4.2 #/ha, the catch rates have remained below the 1984-2004 average of 3.7 #/ha (Table 5; Figure 44). As is the case in Aransas Bay and the upper Laguna Madre, flounder recruitment has shown a decreasing trend in the past twenty years.

Upper Laguna Madre
Upper Laguna Madre bag seine catch rates for southern flounder generally decreased between 1984 and 2004 (Figure RUPPER LAGUNA MADRE11). Catch rates during this period averaged 0.7 #/ha and ranged from 0.0 #/ha in 2003 to 3.82 #/ha in 1990. The 0.42 #/ha catch rate recorded in 2004 was the highest observed in three years (Figure 45).

Spotted seatrout
CBBEP
Bag seine catch rates for spotted seatrout generally increased between 1984 and 2004 ($R^2 = 0.68$) but averaged 11.89 #/ha. Catch rates ranged from 6.22 #/ha in 1984 to 20.85 #/ha in 1995. Between 2001 and 2004 catch rates increased to the highest recorded since 1999 (Figure 46).

Aransas Bay
Annual bag seine catch rates for spotted seatrout in Aransas Bay during 1984-2004 ranged from 8.3/ha in 2003 to 48.3/ha in 1988 (Table 5). The seasonal bag seine catch rate trend has declined

since 1984 (R^2=0.05) with abundance averaging 19.5/ha in the last 10 years, slightly below the long term average of 21.4/ha (Figure 47).

Corpus Christi Bay

Spotted seatrout annual bag seine catch rates trend have increased between 1984 and 2004 (R^2= 0.10). The highest annual catch rate was observed in 2004 (13.1 #/ha) which was 0.1 #/ha higher than the second highest catch rate which was recorded in 1990 (Table 5; Figure 48). Spotted seatrout seasonal catch rates closely follows the annual trend, with the most noticeable exceptions in 2000 when seasonal catch rates were below the annual and in 2003 when the seasonal catch rate increased more than the annual (Figure 48).

Upper Laguna Madre

Bag seine catch rates for spotted seatrout in the upper Laguna Madre has been variable among years between 1984 and 2004 but has generally increased (Figure 49). The spotted seatrout bag seine catch rate averaged 10.1 #/ha between 1984 and 2004. It ranged from 0.83 #/ha in 1987 to 21.4 #/ha in 2000. The catch rate of 16.53 #/ha recorded in 2004 was the highest recorded since 2000 (Table 5).

Blue crab

CBBEP

Of the four species of invertebrates include in this report, blue crabs were the third most abundant species caught in CBBEP bag seines between 1984 and 2004. Annual bag seine catch rates averaged 74.76 #/ha and ranged from 36.05 #/ha in 2000 to 129.8 #/ha in 1994. Between 2000 and 2004 blue crab catch rates increased to the highest recorded since 1994 (Figure 50). The blue crab bag seine catch rate has had a slight decreasing trend in the past 20 years (R^2= 0.02).

Aransas Bay

Bag seine catch rates for blue crab in Aransas Bay ranged from 9.2/ha in 1987 to 244.1/ha in 1985 (Table 5). Blue crab caught in bag seines show a declining trend since 1984 (R2=0.03). For the last 10 years the average catch per unit effort for blue crab was 49.5/ha., well below the long term average of 68.0/ha (Figure 51).

Corpus Christi Bay

Corpus Christi Bay blue crab annual bag seine catch rates were at their highest levels between 1990 and 1994, reaching the highest recorded catch rate of 207.9 #/ha in 1994. Since 1997, mean annual blue crab catch rates have remained below the 20 year average of 115.4 #/ha (Table 5; Figure 52). The overall twenty year trend has shown a slight decrease (R^2= 0.01).

Upper Laguna Madre

Upper Laguna Madre bag seine catch rate for blue crabs has been variable among years (1984-2004) (Figure 53). Between 1984 and 2004 the bag seine catch rate averaged 50.23 #/ha and ranged from 14.72 #/ha 2000 to 113.33 #/ha in 1994. The catch rate in 2004 of 49.3 #/ha is the highest recorded since 1999 (Table 5).

Brown shrimp
CBBEP

Brown shrimp were the most abundant invert species caught in CBBEP bag seine samples between 1984 and 2004. Annual brown shrimp catch rates averaged 432.26 #/ha between 1984 and 2004. During this period catch rates ranged from 211.05 #/ha in 1986 to 800.17 #/ha in 1997. The 2004 catch rate was the highest recorded since 1998 (Figure 54). Overall, there has been a slight decrease in the brown shrimp requirement trend in the CBBEP area (R^2= 0.01)

Aransas Bay

Brown shrimp are caught in large numbers with bag seines in Aransas Bay. Seasonal catch rates ranged from 529.2/ha in 1986 to 2431.2/ha in 1990 (Figure 55). Blue crab catch rate trends have declined in Aransas Bay since 1984 (R^2=0.04). During the last 10 years, the average CPUE has been 1178/ha., below the long term mean of 1265/ha.

Corpus Christi Bay

Annual bag seine catch rates for Corpus Christi Bay brown shrimp steadily increased between 1986 to 1994, reaching the highest observed catch rate in 1994 (708.6 #/ha). In 1996, annual brown shrimp bag seine catch rates were the second lowest recorded in the last 20 years (265.7 #/ha). Since then, mean annual catch rates has varied between 286.1 and 608.3 (Table 5; Figure 56).

Upper Laguna Madre

Upper Laguna Madre bag seine catch rate for brown shrimp averaged 318.59 #/ha between 1984 and 2004 and ranged from 76.74 #/ha in 1990 to 1,020.28 #/ha in 1997 (Figure 57). The brown shrimp catch rate of 241.8 #/ha recorded in 2004 was the highest observed since 1999 (Table 5). Unlike Arnasas and Corpus Christi Bay, which have a slightly decreasing brown shrimp recruitment trend, the upper Laguna Madre trend line is level (R^2< 0.001).

Pink shrimp
CBBEP

Pink shrimp were the least abundant shrimp species caught in CBBEP bag seine samples between 1984 and 2004. Annual pink shrimp bag catch rates averaged 40.18 #/ha and ranged from 11.70 #/ha in 1985 to 83.09 #/ha in 1994 (Figure 58). Between 2001 and 2004 pink shrimp catch rates decreased to the second lowest recorded since 1998 (Table 5). Even though the highest bag seine catch rates were recorded in the late 1980's and early 1990's, the overall twenty year trend has remained level ((R^2<0.001).

Aransas Bay

Pink shrimp are caught in relatively low numbers in Aransas Bay compared to brown and white shrimp numbers. During 1984-2004 catch rates ranged from 10.8/ha in 1987 to 135.3/ha in 1988

(Figure 59). The abundance trend remained fairly constant in these 20 years ($R^2<0.01$). In the last 10 years, CPUE averaged 45.1/ha which is slightly below the long term mean of 49.7/ha.

Corpus Christi Bay
Annual pink shrimp bag seine catch rates, in Corpus Christi Bay, have varied between 7.5 and 149.0 #/ha (Figure 60). There is no significant observed change in the 20 year trend ($R^2 < 0.01$) (Table 5).

Upper Laguna Madre
Upper Laguna Madre bag seine catch rates for pink shrimp are highly variable among years (1984–2004) (Figure 61). Between 1984 and 2004 pink shrimp bag seine catch rate averaged 15.27 #/ha and ranged from 0.48 #/ha in 1988 to 38.33 #/ha in 1992 (Table 5).

White shrimp
CBBEP
Annual bag seine catch rates for white shrimp while highly variable generally decreased between 1984 and 2004. White shrimp catch rates averaged 191.93 #/ha and ranged from 68.39 #/ha in 2000 to 480.21 #/ha in 1990. The 2004 white shrimp catch rate was the second lowest recorded since 1995.
(Figure 62)

Aransas Bay
White shrimp catch rates in bag seines for Aransas Bay showed a declining trend since 1984 (R2=0.21)(Figure 63). Seasonal bag seine catch rates ranged from 181.7/ha in 1993 to 1484.4/ha in 1989 (Table 5). During the last 10 years, the average CPUE was 390/ha, well below the long term mean of 537/ha.

Corpus Christi Bay
Over the past 20 years, there has not been a significant change ($R^2 < 0.01$) in the trend in white shrimp annual bag seine catch rates in Corpus Christi Bay (Figure 64). During this time frame, the annual catch rates have varied between 33.3 and 875.8 #/ha, with a mean catch rate of 274.6 #/ha (Table 5)

Upper Laguna Madre
Bag seine catch rates for white shrimp are highly variable among years (1984-2004) (Figure 65). White shrimp catch rates averaged 32.15 #/ha between 1984 and 2004 and ranged from 1.85 #/ha in 1989 to 136.67 #/ha in 1993 (Table 5). The twenty year trend for Atlantic croaker in the CBBEP area is level ($R^2<0.01$).

Bay Trawl
Atlantic croaker

CBBEP
Catch rates for Atlantic croaker in CBBEP bay trawls between 1984 and 2004 averaged 64.94 #/h and ranged from 29.85 #/h in 1994 to 121.53 #/h in 1991. The 2004 catch rate was the lowest recorded since 1994 (Figure 66).

Aransas Bay
Annual bay trawl catch rate trends of Atlantic croaker have been slightly increasing since 1984 (R^2=0.02)(Figure 67). Annual CPUE ranged from 32.7/hr. in 1985 to 242.5/hr. in 1992 (Table 6). Except for two high catch rates back to back (1991-92), bay trawl catch per unit effort for Atlantic croaker averaged about 90/hr.

Corpus Christi Bay
Annual Corpus Christi Bay trawl catch rates for Atlantic croaker show a slight decreasing trend. (R^2 = 0.01), ranging from a low of 7.9 #/h in 1994 to the high of 119.5 #/h in 1984 (Figure 68; Table 6). The twenty year mean catch rate is 57.2 #/h.

Upper Laguna Madre
Atlantic croaker trawl catch rates while variable among years (1984-2004) generally decreased (Figure 69). Between 1984 and 2004 Atlantic croaker catch rates averaged 8.71 #/h and ranged from 1.70 #/h in 1989 to 16.92 #/h in 1992. The Atlantic croaker trawl catch rate of 10.53 in 2004 is the second highest observed since 1997 (Table 6).

Blue crab
CBBEP
Blue crab catch rates in CBBEP bay trawls decreased between 1984 and 2004 (R^2 = 0.47). During this period, catch rates averaged 12.15 #/h and ranged from 3.95 #/h in 2000 to 25.30 #/h in 1988 (Figure 70). The 2004 blue crab catch rate in trawls was the second lowest since 1984.

Aransas Bay
Catch rates for blue crab caught in bay trawls in Aransas Bay were variable from 1984 through 1994 (Figure 71). CPUE for blue crab ranged from 17.4/hr. in 1990 to 58.5/hr. in 1988. Since 1994 catch rates have remained at or below 20/hr (Table 6).

Corpus Christi Bay
Blue crab bay trawl catch rates from Corpus Christi Bay have experienced an overall decreasing trend since 1984 (R^2 = 0.35)(Figure 72). The highest catch rate was observed in 1986 (14.5 #/hr), while the lowest was in 2000 (1.7 #/hr) (Table 6). Since 2000, the average catch rate has been 3.2 #/hr.

Upper Laguna Madre

Between 1984 and 2004 catch rate of blue crab in upper Laguna Madre trawls generally decreased (Figure 73). They averaged 9.30 #/h and ranged from 0.090 #/h in 2001 and 26.15 #/h in 1992. The catch rate (2.44 #/h) recorded in 2004 is one of the lowest recorded since 2000 (Table 6)

Brown shrimp
CBBEP
Brown shrimp catch rates in CBBEP bay trawls while variable among years generally decreased between 1984 and 2004. Between 1984 and 2004 brown shrimp catch rates averaged 43.59 #/h and ranged from 12.72 #/h in 1999 and 74.64 #/h in 1991. The 2004 catch rate is the third lowest recorded in 1994.
(Figure 74)

Aransas Bay
Annual bay trawl catch rates for brown shrimp in Aransas Bay have seen a declining trend (R^2=0.45) over the last 20 years (1984-2004)(Figure 75). They ranged from 21.8/hr. in 1999 to 161.2/hr. in 1991. From 1994-2004 CPUE averaged 52/hr., below the long term mean of 76.9/hr.

Corpus Christi Bay
Between 1984 and 2004, the annual trawl catch rates for brown shrimp in Corpus Christi Bay has had three major spikes in abundance (1987 = 67.2 #/hr, 1998 = 53.3 #/hr and 2002= 63.3 #/hr. The twenty year average = 27.5. There is a decreasing trend 20 year brown shrimp trawl catch rates from Corpus Christi Bay (R^2 = 0.01) (Table 6; Figure 76)

Upper Laguna Madre
Catch rate of brown shrimp in upper Laguna Madre trawl samples generally increased between 1984 and 2004 (Figure 77). Trawl catch rates averaged 16.53 #/h and ranged from 5.49 #/h in 1989 to 40.22 #/h in 1992. The 2004 catch rate of 18.66 #/h is the highest than all but three years since 1992.

Pink shrimp
CBBEP
Pink shrimp are the least abundant of the three penaid shrimp caught in CBBEP bay trawl samples. Between 1984 and 2004 pink shrimp has been variable among years but has generally declined. Catch rates during this period averaged 7.22 #/h and ranged from 1.43 #/h in 2003 to 14.20 #/h in 1991(Figure 78). The pink shrimp catch rates declined between 2001 and 2004 to the third lowest recorded since 1996.

Aransas Bay
As in the bag seines, pink shrimp are caught in low numbers in bay trawls in Aransas Bay (Figure 79). There is also a declining trend in pink shrimp catch rates since 1984 (R^2=0.13).

CPUE ranged from 0.7/hr. in 2003 to 27.2/hr. in 1991 (Table 6). In the last 10 years, pink shrimp CPUE average was 5.4/hr., lower than the long term mean of 8.7/hr.

Corpus Christi Bay
Between 1984 and 2004, the mean annual catch rate for pink shrimp in Corpus Christi Bay has ranged between 2.0 #/hr and 14.5 #/hr (Figure 80). The twenty year average is 7.2 #/hr (Table 6)

Upper Laguna Madre
Bay trawl catch rates generally increased between 1984 and 2004 (Figure 81). Between 1984 and 2004 pink shrimp trawl catch rates averaged 2.86 #/h and ranged from 0.27 #/h in 1984 to 9.13 #/h in 1992 (Table 6). The pink shrimp catch rate of 1.85 #/h observed in 2004 is the highest in the last three years but is lower than all but two years since 1994.

White shrimp
CBBEP
White shrimp are the second most abundant penaeid shrimp caught in CBBEP bay trawl samples. Between 1984 and 2004 white shrimp catch rates in bay trawls was variable among years but averaged 16.20 #/h and ranged from 3.83 #/h in 1996 to 33.50 #/h in 2003 (Figure 82). The 2003 catch rate was the highest recorded since 1984 while the 2004 catch rate was the third lowest recorded since 1999. As a whole, the twenty year bay trawl trend for white shrimp in the CBBEP area has remained relatively stable (R^2<.001); however this is an averaging of an increasing trend in Aransas Bay (R^2=0.13) and a decreasing trend in Corpus Christi Bay (R^2=0.27).

Aransas Bay
Annual catch rates of white shrimp in bay trawls in Aransas Bay have increased slightly since 1984 (R^2=0.13). Catch rates ranged from 4.8/hr. in 1996 to 69.4/hr. in 2003, the highest catch rate to date (Table 6). In the last five years, CPUE has averaged 36.7/hr., well above the long term mean of 24.1/hr (Figure 83).

Corpus Christi Bay
Annual Corpus Christi Bay trawl catch rates for white shrimp show a decreasing trend. (R^2 = 0.27), ranging from a peek in 1994 of 34.5 #/hr to a low in 2004 of 2.4 #/hr (Table 6; Figure 84). The twenty year average is 12.9 #/hr.

Upper Laguna Madre
White shrimp catch rate in bay trawls between 1984 and 2004 averaged 7.22 #/h (Figure 85) and ranged from 1.9 #/h in 1997 to 21.66 #/h in 1990. The white shrimp trawl catch rates of 11.08 #/h observed in 2004 is the highest recorded since 1994 (Table 6).

IV. RECREATIONAL HARVEST

INTRODUCTION

Marine sport-boat fishing is an economically and biologically important fishery in the CBBEP area. Accurate information collected on an on-going basis is needed to effectively manage this popular fishery. The first attempt to determine the number of fish landed annually by sport anglers in Texas coastal waters, through angler interviews, was conducted in 1957-58 (Belden Associates 1958). This study consisted of systematic interviews of a statewide sample of 2,000 households used to estimate the harvest of spotted seatrout, red drum, black drum, and flounder. This study was repeated in
1959-60 for comparison with previous findings (Belden Associates 1960). Interviews of sport-boat anglers at the ramp or launch site was attempted by Simmons (1961) in the upper Laguna Madre bay system during August 1959 through July 1960. It was soon determined that these studies would not allow estimation of the overall fishing effort and landings from collected data.

More detailed methods were used by Bowman et al. (1976) in an attempt to estimate total fish yield from the Corpus Christi Bay area. On-site trip-ending interviews of sport anglers were conducted at multiple boat-access and shore-based sites during June through August 1974. Based in part on these early attempts, Heffernan et al. (1976) and Breuer et al. (1977) initiated the survey design that is the foundation for the current Recreational Harvest Monitoring Program. On-site trip-ending interviews of sport anglers were conducted at multiple boat ramp sites in Aransas Bay and upper Laguna Madre during September 1974 through August 1975, and in Corpus Christi Bay during September 1975 through August 1976 (Heffernan and Green 1977). The primary objective of the Recreational Harvest Monitoring Program is to estimate daytime annual fishing pressure (effort in man-hours), landings (number of fish harvested), catch rates (harvest per unit effort as an indicator of resource availability or fishing success), species compositions, and size compositions (mean lengths and mean weights of fish harvested) for sport-boat anglers on trips lasting 12h or less in Texas marine waters. The secondary objective is to obtain information on residential origin, species sought, and trip satisfaction of these sport-boat anglers and to assemble supporting information to aid in interpretation of study results. In this report, only landings, effort, and CPUE are reported for the CBBEP area.

METHODS AND MATERIALS

The primary focus of the Texas Marine Recreational Harvest Monitoring Program is to collect recreational harvest information on private-boats fishing in bays and passes. Private-boat gulf fishing, party-boat bay and pass fishing, and party-boat gulf fishing are also surveyed. The target user group for surveys are sport-boat angling parties with trip lengths of 12 h or less that ended their fishing trips from 1000 to 1800 hours at inventoried boat access sites. These angling parties are divided into two groups: private- boat parties (i.e., those using privately-owned and rental boats, as well as those fishing in tournaments) and party-boat parties (i.e., those using a professional fishing guide and had ten or fewer people).

Texas marine waters are divided into two primary survey areas: bay and pass (i.e., marine waters shoreward of barrier islands, including the openings or passes that connect bays with the Gulf of Mexico) and gulf (i.e., Gulf of Mexico waters). Pass areas were defined as extending 1.9 km gulfward from the gulfward end of the pass. In this document, only recreational data from Aransas Bay, Corpus Christi Bay, and the upper Laguna Madre, will be presented.

Surveys are conducted year-round. A survey year extended from 15 May of one year to14 May of the next year. Each survey year is divided into a high-use season and a low-use season. These were determined from the distribution of fishing effort. The high-use season extended from 15 May to 20 November of one year and the low-use season extended from 21 November of one year to May 14th of the next year. For pressure distribution and analysis purposes, each season was further divided into weekend days (Saturday and Sunday) and weekdays (Monday through Friday).

The targeted level of precision for the survey from 15 May 1983 forward was based on survey data collected prior to that date. Sample sizes were set to detect a 50% difference in fishing pressure and landings estimates, 80% of the time, at the 95% confidence level. This level of sampling was expected to produce coefficients of variation around 10% for coastwide fishing pressure and landings. Since 15 May 1983, 1,014 routine surveys were scheduled annually to estimate bay and pass fishing pressure and landings. In the high-use season, 31 weekend and 66 weekday surveys were scheduled in each of Aransas and Corpus Christi bays and the lower Laguna Madre. During the low-use season, 12 weekend and 24 weekday surveys were scheduled for each of the three systems.

Methods used to calculate fishing pressure (effort) and harvest estimates from data collected prior to 15 May 1992 were described by Osburn and Osborn (1991) and Warren et al. (1994). With several exceptions, these methods have remained unchanged to the present. Updated survey methodology, sampling procedures, and data analysis and statistics are described by Green and Campbell (2005).

RESULTS

Effort

CBBEP

There has been an increasing trend in the private-boat fishing pressure in the CBBEP area since the 1983-84 year (**Figure 86**). During this 22-year span, the lowest fishing pressure observed was in 1984-85 immediately following the Freeze of 1983 when only 712,586 man-h were expended (Table 7). The highest fishing pressure by private-boat anglers was observed in 1999-2000 when almost 2 million man-h were expended. Aransas Bay private-boat anglers contributed about 44% to the total CBBEP fishing pressure, while anglers in Corpus Christi contributed about 30%; the remaining 26% was expended in the upper Laguna Madre. In the last five years private-boat fishing pressure in the CBBEP averaged over 1.5 million man-h each year.

An increasing trend for party-boat fishing pressure was also observed in the CBBEP during the last 22 years, especially since 1993-94 when the number of fishing guides began to grow rapidly in the area (Figure 86). Party-boat fishing pressure ranged from a low of 23,114 man-h in 1984-85 right after the Freeze of 1983 and when there were relatively few fishing guides on the Texas coast, to well over half a million man-h (545,763) in 2002-03 (**Table 8**). Aransas Bay contributes the most again to total party- boat fishing pressure in the CBBEP at 43%, followed by Corpus Christi Bay (29%) and the upper Laguna Madre (28%). During the last five years the annual party-boat fishing pressure averaged 452,293 man-h.

Aransas Bay
Fishing pressure exerted on Aransas Bay by recreational anglers has been steadily increasing since 1983-84 ($R^2 = 0.65$) (**Figure 87**). Private-boat fishing pressure ranged from a low of about 175,000 man-h in the 1984-85 year after the Freeze of 1983, to a high of >500,000 man-h during 1999-2000 (Table 7). The average fishing pressure by private-boat anglers over the last five years has been >450,000 man-h.

Aransas Bay boasts the highest fishing pressure by party-boat anglers on the Texas coast. It accounts for about 30% of the total party-boat pressure in Texas bays today. In the 1980's there were few guides in Aransas Bay and the fishing pressure averaged <200,000 man-h per year (**Table 8**). Their numbers have steadily grown and party-boat fishing pressure in Aransas Bay peaked during 2000-01 at over one million man-h ($R^2 = 0.93$) (**Figure 87**). During the last five years it has averaged almost 900,000 man-h each year.

Corpus Christi Bay
Private-boat effort (man-hours) in Corpus Christi Bay has had an increase in the last 20 years ($R^2 = 0.15$)(**Figure 88**). The lowest annual fishing pressure was observed in the 1984-1985 creel-year, probably caused by the high mortality experienced by the spotted seatrout and red drum populations during the 1983 freeze. Private-boat effort peaked in the 1993-1994 creel year (483,283 man-h) (Table 7). Since then, effort has fluctuated and averaged around 479,000 man-h.

Party-boat effort in Corpus Christi Bay has had a substantial increase ($R^2 = 0.68$), more than that observed in by private-boats (Figure hc1). In the1983-1984 creel-year, party boats expended around 13,972 man-h. This decreased in the 1984-1985 creel year and increased thereafter to the peak of 219,830 in 2002-2003 (**Table 8**).

Upper Laguna Madre
Private-boat fishing effort accounts for over 70% of recreational fishing effort in the upper Laguna Madre. Between 1983-1984 and 2003-2005, private-boat fishing effort generally increased ($R^2 = 0.05$) (Figure hu1). During this period, private-boat fishing effort averaged 372,260 man-h and ranged from 164,755 man-h in 1990-1991, following the 1989 freezes, to 477,934 man-h in 1999-2000. Fishing effort dropped from 375,643 man-h in 1983-1984 to 174,332 man-h in 1984-1985 following the December 1983 freeze (Table 7.
Fishing effort returned to or exceeded pre-freeze levels in two years following the December 1983 freeze but took over nine years to return to pre-freeze levels following the two freezes in 1989 (Figure hu1). Private boat fishing effort in 2004-2005 (458,702 man-h) is the highest recorded since 1999-2000.

Party-boat fishing pressure ranged from less than 1,000 man-h in 1983-1984 to 186,205 man-h in 1999-2000 ($R^2 = 0.71$) (Figure hu1). Since 1999-2000 party-boat fishing pressure in the upper Laguna Madre decreased to 97,060 man-h during 2003-2004. Between 1983-1984 and 2003-2004 party boat fishing pressure averaged 74,024 man-h and ranged from 874 man-h in 1983-1984 to 186,205 man-h in 1999-2000 (**Table 8**).

Landings

Atlantic croaker

Atlantic croaker contributes significantly to the recreational fishery in the eastern Gulf of Mexico (Warren and Suffer 1982). While not a particularly popular game fish, it is still caught by many fishermen. Large "bull croakers" are particularly sought for around oil rigs west of the Mississippi delta in Louisiana waters (NOAA 1985). The United States marine recreational catch was about 3,293 million croakers in 1993 for the Gulf of Mexico (except Texas), the majority being caught in nearshore waters (O'Bannon 1994).

CBBEP

Landings of Atlantic croaker by private-boat anglers in the CBBEP are historically low compared to other popular finfish and have decreased substantially since 1983-84 (**Figure 90**). The large mortality of Atlantic croaker from the 1983 freeze is reflected in the dramatic drop in landings during 1984-85. Landings rebounded somewhat during the next few years to 63,429 fish in 1987-88 (Table 7) but continually decreased to a low of 1,684 fish in 2000-01. Corpus Christi anglers landed the majority (56%) of Atlantic croaker during the 22-year period followed by upper Laguna Madre (29%). Party-boat anglers in the CBBEP rarely land Atlantic croaker (**Figure 90**).

Aransas Bay

Very few anglers seek Atlantic croaker when fishing in Aransas Bay. Annual landings of this species have been variable over the years and declining since 1983-84 ($R^2 = 0.23$) (**Figure 91**). Peak landings were observed at 15,302 fish in 1988-89 while the lowest values reported (21 fish) during 2000-01 (Table 7). In the last five years, landings of Atlantic croaker in Aransas Bay have averaged less than 300 fish. Party-boat anglers rarely land Atlantic croaker ($R^2 = 0.04$); in fact, landings were only recorded during four years of the 22 years of data used in this report (Figure ha2).

Corpus Christi Bay

The highest Atlantic croaker private-boat landings (72,056) from Corpus Christi Bay were observed in the 1983-1984 creel year (Figure hc2). Values decreased to 8,079 in the1984-1985 creel year, and with the exception of the 1987-1988 creel year, have continued to decrease to less than 1000 in 2004-2005 ($R^2 = 0.33$) (Table 7). Party-boat anglers rarely land Atlantic croaker ($R^2 = 0.15$)(**Figure 92** and **Table 8**).

Upper Laguna Madre

Upper Laguna Madre private-boat landings of Atlantic croaker generally decreased between 1983-1984 and 2004-2005 ($R^2 = 0.55$) (**Figure 93**). Landings averaged 5,061/yr and ranged from 22,746 in 1983-1984 to 391 in 2000-2001(Table 7). Party-boat anglers landed less than 1,000 croaker per year between 1983-1984 and 2004-2005 (**Figure 93** and **Table 8**).

Black drum

The recreational fishery is very seasonal with most effort occurring during the spring and summer (Hostettler 1982, NOAA 1985). The recreational catch for black drum was much greater than the commercial landing until the previously mentioned expansion of the commercial fishery (Sutter et al. 1986). However, this is not a preferred recreational species, and therefore, receives little directed effort by anglers (Leard et al. 1993). Texas probably has the largest directed recreational fishery for this species in the U.S. Gulf of Mexico, although its popularity is still low when compared to other species. An estimated 583,000 black drum were caught in 1991 for the central and eastern Gulf of Mexico region by recreational fisherman, making up over 64% of the reported catch for the combined Atlantic and Gulf regions (Van Voorhees et al. 1992). Over 93% of this was from Louisiana and Florida. Fishing gear, methods, and seasons vary from state to state (Leard et al. 1993). In Texas, the most successful baits used by anglers are crabs (*Callinectes* sp.), shrimp (*Farfantepenaeus* sp. and *Litopenaeus* sp.), and sea lice (*Squilla empusa*) (Hostettler 1982), but cut fish are also used (Simmons and Breurer 1962). Most catches are made with rod and reels equipped with bottom rigs. Angling regulations vary among the Gulf states (GSMFC 1993). Black drum have been experimentally hybridized with red drum to develop a potential hybrid gamefish (NMFS 1983).

CBBEP

Numbers of black drum brought in by recreational anglers in the CBBEP are much less than red drum and spotted seatrout but higher than Atlantic croaker numbers. Black drum landings by both private and party-boat anglers exhibit an increasing trend over the 22-yr period (**Figure 94**). Private-boat angler landings ranged from 5,399 fish in 1986-87 to 46,124 fish during 1994-95 (Table 7). All three bays contribute about a third of the total landings in the CBBEP. During the last five years, annual private-boat landings of black drum in the CBBEP have averaged 20,454 fish.

Very few black drum were landed by party-boat anglers during the 1980's (**Figure 94**). Landings increased throughout the CBBEP during the 1990's to a high of 18,217 black drum in 1994-95 (**Table 8**). In the last five years annual black drum landings by party- boat anglers averaged just under 10,000 fish. Upper Laguna Madre part-boat anglers contributed the most (44%) to total CBBEP black drum landings with Corpus Christi Bay next at 30%.

Aransas Bay

Black drum are not usually a preferred fish by recreational anglers in Aransas Bay. Although landings of black drum by private-boat anglers have increased in Aransas Bay since 1983-84 ($R^2 = 0.30$), they are generally <5,000 fish per year (**Figure 95**). They were variable through the 1990's and peaked out in 2004-05 at 9,140 fish (Table 7). Over the last five years, annual private-boat landings of black drum have averaged 6,277 fish. Black drum were rarely caught by party-boat anglers until the early 1990's when they became targeted if red drum and spotted seatrout were scarce on a particular trip. During 2002-04, their annual landings peaked at >5,000 fish (**Table 8**).

Corpus Christi Bay

Black drum have historically been more utilized by private-boat anglers than by party- boat anglers (**Figure 96**). Black drum private-boat landings in Corpus Christi Bay increased ($R^2 = 0.03$) from a low in the 1986-1987 creel-year (969) to a high in the 1994-1995 creel-year (16,852). Since 1995, private-boat black drum landings have steadily decreased to their current level of about 3,000 (**Table 5**). Party-boat black drum landings were very low until the 1994 through 1998 creel years when annual landings averaged around 6,000 fish. Since then landings have fluctuated between 30 and 4,616 (**Table 6**).

Upper Laguna Madre

Upper Laguna Madre private-boat landings of black drum generally increased between 1983-1984 and 2004-2005 ($R^2 = 0.13$) (**Figure 97**). Private-boat landings averaged 7,681 per year and peaked in 1997-1998 at 20,174 (Table 7). Between 1983-1984 and 2004-2005 party-boat anglers landed an average of 2,923/yr. Party-boat landings of black drum ranged from 0 in 1983-1984 and 1984-1985 to 15,455 in 1999-2000 (**Figure 97**). Since 1999-2000 party-boat anglers have landed less than 4,000 black drum per year (**Table 8**).

Red drum

Anglers revere this species as both a game and food fish. Its fighting ability on light tackle and delectable flavor has probably made this fish the most important recreational species of sciaenid in the Gulf of Mexico. It is especially esteemed for the table in the south, but in the northern part of its range its principal interest to sportsmen is as a game fish for surf fishing (Welsh and Breder 1923, Arnold et al. 1960, Boothby and Avault 1971, Bass and Avault 1975, Hoese and Moore 1977, Adkins et al. 1979, Matlock 1980, Perret et al. 1980, Overstreet 1983). All of these characteristics make this species one of the seven most sought gamefish in the Gulf of Mexico (Van Voorhees et al.1992). Fishery information for the Gulf of Mexico during 1991 showed a total recreational catch of over 5,549,000 fish weighing a total of 729.4 metric tons, with the majority caught in nearshore or inshore waters (Van Voorhees et al. 1992). The most sought after fish are those less than 2.2 kg. Larger fish are unpopular due to presence of parasites in the flesh and the belief that they have a poor flavor (Boothby and Avault 1971, Adkins et al. 1979, Benson 1982). The primary angling method is by hook and line in surf, island passes, and estuaries especially during seasonal runs in the spring and fall (Franks 1970, Boothby and Avault 1971, Matlock 1980, Benson 1982). Other fishing methods include drift fishing, jigging, casting, or slow trolling (WRGF 1991). Angling regulations vary, among the Gulf states (GSMFC 1993). Increased recreational harvest in federal waters of the U.S. Exclusive Economic Zone (EEZ) has made careful management necessary throughout the range of red drum. As a result, no sport harvest is now allowed in federal waters of the Gulf of Mexico, and any red drum caught must be released unharmed (GMFMC 1996b). Red drum have been experimentally hybridized with black drum to develop a potential hybrid gamefish (NMFS 1983).

CBBEP

Red drum is one of the most sought after fish by recreational anglers in the CBBEP, as well as in Texas. In recent (2002-03) TPWD interviews with recreational anglers along the Texas coast, they fished for red drum 51-60% of the time (Green and Campbell 2005). Landings of red drum by private-boat anglers in the CBBEP ranged from 19,557 fish in 1984-85 after the Freeze of 1983 and a 50% reduction in bag limits, to the peak of 112,382 in 1993-94 (Table 7). These high landings corresponded to very high catch rates in TPWD gill nets which indicated a strong 1990 year class of red drum moving through the fishery. Figure 98 shows an increasing trend for red drum landed by private-boat anglers in the CBBEP. Aransas Bay anglers contributed 50% to the total landings of red drum in the CBBEP with Corpus Christi Bay anglers second at 30%. During the last five years red drum landed annually by private-boat anglers averaged 67,585 fish.

Red drum is also heavily targeted by party-boat anglers in the CBBEP. Landings were relatively low in the 1980's when few fishing guides were established in the area (Figure 98). During the mid-1990's the number of party boat anglers increased substantially and as did red drum landings. During the 22-yr span, landings ranged from 693 fish in 1983-84 to 62,957 fish in

2002-03 (**Table 8**). Because there are more fishing guides in Aransas Bay, this bay contributes 48% of the total CBBEP landings of red drum by party-boat anglers. During the last five years, annual red drum landings in the CBBEP by party-boat anglers averaged 40,728 fish.

Aransas Bay
Red drum is sought after by many recreational anglers along the Texas coast and especially in Aransas Bay. Annual landings of red drum by both private ($R^2 = 0.18$) and party-boat ($R^2 = 0.69$) anglers have been increasing since 1983-84 (Figure 99). Private-boat anglers averaged about 35,000 annual landings of red drum per year from the mid-1990's until the present. Party-boat anglers averaged about 15,000 annual landings of red drum during this same period. These numbers imply that party-boat landings constitute >30% of the total recreational landings of red drum in Aransas Bay. Both private and party-boat anglers landed the highest number of red drum during the 1993-94 year representing the very strong year class of fish moving into the recreational fishery (Table 7 and **Table 8**).

Corpus Christi Bay
Red drum is second only to spotted seatrout in popularity by recreational anglers. Landings by private-boat anglers have increased over the past 20 years ($R^2 = 0.32$) (Figure 100). The lowest catches were observed in the 1984-1985 creel-year (8,006) and the highest were in 1993-1994 (29,791). Between 1995-2005, annual red drum landings by private-boat anglers averaged around 20,000. Party-boat red drum landings experienced an increasing trend between 1983-2003 ($R^2 = 0.44$). Between 2003 and 2005, they decreased from 40,754 to 5,523 (**Table 8**). This represents a decrease of around 87% in landings. During the same time period, party-boat effort decreased 53%.

Upper Laguna Madre
Red drum account for about 11% of the fish landed by upper Laguna Madre private-boat anglers. Private-boat landings of red drum generally increased between 1983-1984 and 2004-2005 ($R^2 = 0.20$) (Figure 101). During this period, private-boat landings averaged 12,160/yr and ranged from 3,712 in 1984-1985 to 24,080 in 1999-2000 (Table 7). During the same period, party-boat red drum landings generally increased ($R^2 = 0.46$) (Figure 101) from less than 300 fish in 1983-1984 to 15,933 in 2000-2001. Red drum make up about 9% of upper Laguna Madre party-boat landings.

Sheepshead
The sheepshead supports a moderate sport fishery during most months (Benson 1982, Beckman et al.1991). It is a common fish in inshore waters, often caught on fiddler crab or barnacle bait (Hoese and Moore 1977). Fishery information for the Gulf of Mexico showed a total catch of 4,054,000 sheepshead in 1992 (NMFS 1993). It is frequently discarded because the dorsal spines make cleaning difficult.

CBBEP
Sheepshead are landed more often in the winter months by recreational anglers in the CBBEP, and most often by Winter Texans. Landings by private-boat anglers have exhibited an increasing trend since 1989-90 (Figure 102). Sheepshead landings ranged from 7,561 in 1989-90 to a high of 63,642 in 1998-99 (Table 7). During the mid to late 1980's, Corpus Christi Bay landings

averaged 49% of the annual private-boat landings in the CBBEP while private-boat anglers in Aransas Bay landed 48%. For the last 15 years, Corpus Christi Bay anglers caught the majority (84%) of private-boat landings of sheepshead in the CBBEP. During the last five years, annual private-boat landings of sheepshead averaged just over 40,000 fish. Very few sheepshead have been landed by party-boat anglers in the CBBEP in the last 22 years.

Aransas Bay

Fewer sheepshead are caught in Aransas Bay than black drum. Private-boat annual landings of sheepshead ranged from almost 1,200 fish in 1989-90 to 18,732 fish in 1998-99 (R^2 = 0.17)(Table 7). This past year (2004-05) landings decreased to about 1,500 fish (Figure 103). Sheepshead were rare in party-boat landings until the mid-1990's (Figure 103). The highest annual landings occurred last year (2004-05) with 2,000 sheepshead being brought in by anglers on party-boats (**Table 8**).

Corpus Christi Bay

Sheepshead is an abundant and popular sport fish in Corpus Christi Bay. Over 50 % of all sheepshead landed in Texas on an annual basis, are caught in Corpus Christi Bay. Recreational private-boat landings have significantly increased in the last 20 years (R^2 = 0.61) (Figure 104). Sheepshead is primarily a winter fishery, when these fish congregate around the jetties or other hard substrates. Between 1996 and 2005, annual sheepshead landings from Corpus Christi Bay have averaged around 40,000 fish (Table 7). Party- boat landings for sheepshead in Corpus Christi Bay are very low, with the highest numbers recorded in 1997-1998 (**Table 8**).

Upper Laguna Madre

Private-boat landings of sheepshead generally decreased between 1983-1984 and 2004-2005 (R^2 = 0.01) but averaged 494/yr (Figure 105). Private-boat landings ranged from 116 in 1995-1996 to 2,089 in 1983-1984. Private-boat anglers landed less than 1,000 fish per year since 1996-1997. Party-boat landings of sheepshead generally increased between 1983-1984 and 2004-2005 (R^2 = 0.46) (Figure 105). Party-boat anglers land less than 250 sheepshead per year (**Table 8**).

Southern flounder

The southern flounder is a popular recreational species throughout its range (Shipp 1978). Fish are taken by hook and line and by gigging in shallow waters at night (Warlen 1975, Manooch 1984). In 1991, recreational landings of southern flounder along the Gulf coast states (except Texas) was 102,000 fish in Florida, 126,00 fish in Mississippi, and 471,000 fish in Louisiana (Van Voorhees et al. 1992). Estimated recreational landings along the Texas coast, calculated from data provided by Osborn and Fergusson (1987), averaged 94,258 kg from 1983 to 1986. Actual sport catches were probably greater as a large number of unidentified "flounders" were also reported during the same period. Minimum size limits and daily bag limits vary among the Gulf states (GSMFC 1993).

CBBEP

Recreational anglers usually target flounder on a seasonal basis in the CBBEP and are commonly caught incidental to other species. Annual landings by private-boat anglers have shown a decreasing trend since the early 1980's (Figure 106). Flounder landings in the CBBEP ranged from 4,360 in 1996-97 to a high of 35,716 in 1985-86 (Table 7). Although private-boat anglers in Corpus Christi Bay contributed 41% to the CBBEP landings since 1983-84, Aransas Bay private-boat anglers accounted for 54% of the flounder landed in the past 12 years; anglers from Corpus Christi Bay accounted for 30% while upper Laguna Madre anglers caught about 16%. During the last five years, annual landings of flounder by private-boat anglers averaged 6,660 fish.

Party-boat anglers landed about 10% of the flounder that the private-boat anglers landed within the CBBEP since 1983-84. Annual flounder landings ranged from 345 fish in 1989-90 to 4,410 fish in 2003-04 (Table 7). Landings have remained relatively low and stable throughout the 22-yr period (Figure 106). During the last five years, annual landings of flounder by party-boat anglers averaged 2,378 fish with anglers in Aransas and Corpus Christi Bay each accounting for 37% of the CBBEP landings.

Aransas Bay
Few southern flounder are landed in Aransas Bay. Annual landings by private-boat anglers slightly increased since 1983-84 but are variable through the past 20 years ($R^2 = 0.07$) (Figure 107). Private-boat landings ranged from 1,997 fish in 1990-91 to 10,155 in 1985-86 (Table 7). During the last year, annual landings of southern flounder by private-boats were 5,183. Very few southern flounder are landed by party-boat anglers but their numbers are increasing ($R^2 = 0.52$) (Figure 107). Over the last five years, annual landings averaged <1,000 fish.

Corpus Christi Bay
Private-boat landings of southern flounder have significantly decreased over the past 20 years ($R^2 = 0.73$), especially between 1983 and 1995 (Figure 108). Since 1995, annual landings have stabilized at an average of about 1800 fish per year. It is important to note that the TPWD Harvest Program design does not capture night time fishing activity, which is when the majority of the flounder are caught by recreational gig fishermen. As with sheepshead and black drum, annual party-boat landings of southern flounder are very low, averaging around 330 fish per year between 1983 and 2005 (**Table 8**).

Upper Laguna Madre
Private-boat landings of southern flounder decreased between 1983-1984 and 2004-2005 ($R^2 = 0.40$) (Figure 109). Private-boat angler flounder landings averaged 3,604/yr between 1983-1984 and 2004-2005 and ranged from 701 in 2004-2005 to 12,912 in 1985-1986. Private-boat flounder landings observed in 2004-2005 were the lowest recorded since 1995-1996. Upper Laguna Madre party-boat southern flounder landings peaked in 1991-1992 at 2,575 (Figure 109). Fewer than 1,300 southern flounder were landed in any year since 1991-1992 by party-boat anglers (**Table 8**).

Spotted seatrout
The spotted seatrout is one of the species most often sought by anglers, and the sport catch is substantially greater than the commercial harvest (Tabb and Manning 1961, Van Voorhees et al. 1992, NMFS 1993). Fishery information for the Gulf of Mexico (except Texas) showed a total catch of 18,188,000 spotted seatrout in 1992 (NMFS 1993). Seatrout are taken on light to heavy spinning tackle from shorelines, piers and boats in beach Gulf waters, inshore estuarine bays, sounds, bayous, and tidal streams (Lassuy 1983b, Perret et a1.1980). When interviewed in Texas, recreational anglers said they targeted spotted seatrout 55-71% of the time (Green and

Campbell 2005). Regulations for recreational fishing of this species vary among the Gulf states (GSMFC 1993).

CBBEP

Spotted seatrout is the number one targeted species by recreational anglers in the CBBEP as well as throughout the Texas coast. Since the mid-1990's spotted seatrout landings by private-boat anglers in the CBBEP have been increasing (Figure 110). The highest private-boat landings (335,100 fish) occurred in 1983-84 when a 12-inch size limit and a 20-fish bag limit were in place for spotted seatrout (Table 7). After the Freeze of December 1983, TPWD increased the size limit to 14 inches and cut the bag to 10 fish. Correspondingly, the lowest landings for the entire CBBEP were observed during 1984-85: 41,085 spotted seatrout. Spotted seatrout populations recovered fairly quickly and by 1987-89 landings by private-boat anglers topped 200,000 fish. Since that time, spotted seatrout landings have stabilized at about 200,000 fish/year. During the last five years, Aransas Bay private-boat anglers contributed 43% to the CBBEP landings, while upper Laguna Madre and Corpus Christi Bay anglers contributed 37% and 20%, respectively.

In the 22-yr span of data used in this report, landings of spotted seatrout by party-boat anglers in the CBBEP exhibit an increasing trend (Figure 110). Landings ranged from a low of 2,586 fish in 1984-85 when there were relatively few fish guides in the area and after the Freeze of December 1983, to a high of 226,464 fish in 1998-99 (Table 7). Since 1990-91 there has been a rapid increase in spotted seatrout landings by party-boat anglers in the CBBEP. During the last five years the annual party-boat landings of spotted seatrout in the CBBEP averaged 182,991 fish. During this same time span, Aransas Bay landings by party-boat anglers accounted for 43% of the CBBEP total, while upper Laguna Madre and Corpus Christi Bay contributed 36% and 21%, respectively.

Aransas Bay

Recreational anglers landed more spotted seatrout in Aransas Bay than any other fish. Annual landings of spotted seatrout caught by private-boat anglers have been steadily increasing since the early 1990's ($R^2 = 0.40$) (Figure 111). Landings ranged from 15,697 fish in 1990-91 to a high of 97,578 in 1999-2000 (Table 7). Another peak in landings occurred during this last year (2004-05) when 94,850 spotted seatrout were landed by private-boat anglers. Party-boat anglers have also been seeing an increasing trend in spotted seatrout landings since 1992-93 ($R^2 = 0.80$) (Figure 111). Party-boat landings have been rivaling private-boat landings for several years (Figure 111). In fact, four out of the last eight years, annual landings by party-boat anglers surpassed those of the private-boat anglers. Since the mid-1990's, annual landings by party-boats has accounted for about 50% of the total recreational harvest of spotted seatrout in Aransas Bay.

Corpus Christi Bay

Around 25 % of the fish landed by private-boat anglers in Corpus Christi Bay are spotted seatrout. The twenty-year trend shows a slight decrease in landings ($R^2 = 0.15$); however, this is heavily influenced by a high catch in the 1983-1984 creel year (Figure 112). Between 1984 and 2005, annual spotted seatrout landings by private-boat anglers ranged from 25,264 and 44, 349 fish and averaged around 47,000 (Table 7). Party-boat annual landings of spotted seatrout caught in Corpus Christi Bay has had a significant increase in the past 20 years ($R^2 = 0.40$). The highest observed annual landings occurred in the 1998-1999 creel year (90,901) (Table 8). Since then, annual landings decreased to 21,159 in 2001-2002, the lowest levels observed since the 1990 creel-year, the year following the 1989 freeze (Figure 112).

Upper Laguna Madre
Spotted seatrout make up 65% of the fish landed by upper Laguna Madre private-boat anglers (Table 7). Landings of spotted seatrout by private-boat anglers averaged 72,138 per year between 1983-1984 and 2004-2005 ($R^2 = <.01$) (Figure 113). Private-boat landings ranged from 7,246 in 1984-1985 following the December 1983 freeze to 113,835 fish in 1988-1989. Spotted seatrout landings dropped to 9,857 fish in 1990-1991 following the two freezes in 1989. After recovering from the 1989 freeze, landings of spotted seatrout were variable among year and reached a peak in 1999-2000 of 134,729 fish and gradually declined to about 71,748 fish in 2001-2002. Landings increased to 110,658 fish in 2003-2004.

Spotted seatrout make up 80% of the fish landed by upper Laguna Madre party-boat anglers. Since 1983-84 spotted seatrout landings from party-boats have increased ($R^2 = 0.73$) (Figure 113). Between 1984-1985 and 2004-2005 landings by party-boat anglers averaged 35,845 fish/yr and ranged from 0 fish in 1984-85, the year after the Freeze of 1983, to 99,351 fish in 1999-2000 (**Table 8**). Since 1999-2000, landings of spotted seatrout by party-boat anglers in the upper Laguna Madre have decreased to 58,771 fish in 2004-05.

V. COMMERCIAL FISHERY

INTRODUCTION

Gulland (1977) described the importance of knowing and understanding commercial fisheries information in order to properly manage marine resources. Recreational and commercial data supplied by fishermen are required to assess the needs for, and the impacts of, saltwater fishing regulations. To manage commercial fisheries based on a concept of optimum sustainable yield, economic and sociologic information is obtained in conjunction with landings data (Radovich 1975, Demory and Golden 1983, Prochaska and Cato 1983). Commercial landings data in the CBBEP area (Figure 1) date back to the late 1800's (Perret et al. 1880). Since 1936, the Texas Parks and Wildlife Department (TPWD) has monitored the commercial landings and their value through a mandatory self-reporting system currently known as the Monthly Aquatic Products Report (MAPR). In 1985, TPWD and the National Marine Fisheries Service (NMFS) instituted a cooperative agreement to collect and exchange commercial fisheries landings data. The data presented here summarize the landings and ex-vessel value of seafood products reported to TPWD and NMFS.

METHODS AND MATERIALS

Licensed seafood and bait dealers within the CBBEP area are required to complete a MAPR monthly. This report must list the water body, total weight and price paid for each species purchased from commercial fishermen. Each dealer's monthly report must be submitted to TPWD before the 10th day of the following month. TPWD personnel review all MAPRs for completeness. If errors are suspected or detected, the submitting dealer is contacted to verify accuracy of the data. Detailed methodology and historical procedural changes can be reviewed in Culbertson et al. (2004).

The Fisheries Statistics and Economics Division of NMFS collects shrimp landings and ex-vessel value data and provides it to TPWD. Marine products harvested as bait and sold to a licensed bait or seafood dealer were not required to be reported until September 1991. Implementation of the bait landings program was not completed until 1994. Increases in reported bait shrimp landings between 1991 and 1994 were expected, and can be attributed to incomplete reporting during the early years as dealers were being notified of the new requirement. Ex-vessel price per pound is determined by dividing the total value for each species and by the corresponding total weight.

RESULTS

Black drum, sheepshead, southern flounder, brown shrimp and pink shrimp, white shrimp and blue crab comprise about 97% by weight of seafood landed from the CBBEP area. Between 1984 and 2004 over 118 million lbs. of seafood with an ex-vessel value over $159 billion landed in the CBBEP area (Table 9). Total landings decreased from about 8.2 million lbs. in 1984 to 3.0 million in 2004 (Table 9, Figure 114). Between 1984 and 1989, landings decreased from 8.2 million to 3.8 million, then increased to 8.0 million in 1991 and have maintained an overall decreasing trend through the 2004. The 1991 spike in landings is attributed to an increase of about 1 million lbs. in brown and pink shrimp landings. Ex-vessel value has closely followed the trend landings, reaching its current low of about $2.8 million (Table 9, Figure 114).

Of the three bay systems in the CBBEP area, Aransas Bay historically records the highest combined commercial landings (Table 9, Figure 115). The majority of the landings are comprised of shrimp and blue crab. Total commercial landings from the Aransas Bay system generally decreased from about 5 million lbs. in 1984 to about 1 million lbs. in 2000 (Table 9, Figure 115).

Total commercial landings from the Corpus Christi Bay system generally increased from about 2.3 million lbs. in 1984 to about 3.3 million lbs. in 1992 (Table 9, Figure 115). Between 1992 and 2004 total landings decreased to about 400 thousand lbs., which is the lowest recorded since 1998 (Table 9, Figure 115).

Total commercial landings from the upper Laguna Madre generally decreased from about 800 thousand lbs. in 1984 to about 600 thousand lbs. in 1994 (Table 9, Figure 115). Upper Laguna Madre total commercial landings generally decreased from about 2.1 million lbs. in 1995 to about 1.2 million lbs. in 2004 (Table 9, Figure 115). Between 1997 and 2004 upper Laguna Madre total commercial landings averaged 1.7 million lbs. (Table 9).
Since black drum dominate upper Laguna Madre commercial landings and shrimp dominate commercial landings in Corpus Christi and Aransas Bay systems, the upper Laguna Madre is the only CBBEP bay system in which recent total commercial landings exceed those reported in the early 1980's and 1990's (Table 9, Figure 115).

Bait shrimp landings are substantial in the CBBEP area and have generally increased since the reporting of these products was fully implemented in 1995 (Table 10, Figure 116). The demand for bait by recreational anglers increased with the increase in fishing pressure estimated for the three bay systems in the CBBEP during 1995-2004. All three species of shrimp are harvested by bait shrimp license holders in the CBBEP depending on the time of year and availability. The majority of both dead and live bait were harvested from Corpus Christi Bay during 1995-2004 (Table 10).

Black Drum

Following the ban on commercial harvest and sale of red drum and spotted seatrout in 1981, black drum have become a major component of commercial landings in the CBBEP area. While commercial harvest of black drum occur in all three CBBEP bay systems, they are most important in the upper Laguna Madre (Figure 117, Table 9). Commercial harvest of black drum in CBBEP bays occurs throughout the year but is highest during spring and summer months. The majority of black drum are harvested by commercial fishermen using trot lines and a variety of natural baits. In 2004 black drum landings accounted for 74% of commercial landings by weight and 45% of ex-vessel value in the CBBEP (Table 9). Between 1984 and 2004, 72 % of the black drum landed in the CBBEP area were landed from the upper Laguna Madre, 21 % from Corpus Christi Bay, and 7 % from Aransas Bay. Between 1984 and 1993, black drum landings in the CBBEP area remained around 500 thousand lbs, increasing thereafter to around 3 million lbs in 1996 (Figure 118). Since 1996, landings decreased; however, they have remained above 1.4 million lbs.

In the Aransas Bay system, black drum are harvested by a handful of commercial trotliners fishing Copano and St. Charles bays. Commercial black drum landings from 1984-88 were relatively stable in Aransas Bay and were harvested using gill nets and trotlines (Table 9). After the ban on the use of nets in Texas waters in 1988, landings declined to about 2,600 lbs. in 1989. Over the last 10 years, Aransas Bay landings of black drum have ranged from about 75 thousand lbs. ($58,200) in 2000 to about 243 thousand lbs. ($221,000) in 1995 (Table 9).
In Corpus Christi Bay, black drum landings increased between 1991 and 1996 when they reached the highest observed landings of almost 1 million pounds (Figure 117). Since 1996 landings have decreased and stabilized around 150,000 lbs.

Commercial harvest of black drum occurs thoughout the upper Laguna Madre system. Between 1984 and 1993, upper Laguna Madre black drum landings were generally below 301 thousand lbs. In 1996, landings reached the highest observed level of 2 million lbs (Figure 117). Since 1996, landings have decreased; however, they still remain above 1 million lbs. (Table 9)

Sheepshead
Sheepshead are harvested commercially in all three CBBEP bay systems; however, most landings between 1984 and 1989 occur in Corpus Christi bay followed by the upper Laguna Madre and Aransas Bay (Table 9, Figure 119). Between 1997 and 2004 Aransas Bay commercial sheepshead landings exceeded both Corpus Christi and upper Laguna Madre landings (Table 9). Prior to 1989 most sheepshead were harvested using trammel nets and gill nets. Following the ban on the use of these gears in 1989, CBBEP commercial fishermen turned to gigs and hook and line to harvest sheepshead.
Commercial interest in this species has been variable during the past 20 years with an evident decrease in landings (Figure 120). In 1989 through 1991, sheepshead landings in the CBBEP area were at its lowest levels of around 4,200 lbs.

Landings of sheepshead are the lowest of the three finfish species commercially harvested in Aransas Bay (Table 9). Between 1987 and 1996 landings of sheepshead from Aransas Bay ranged from 6-66% of the CBBEP landings. Since 1997 Aransas Bay accounted for the majority (56-97%) of sheepshead landed in the CBBEP (Table 9, Figure 119). During 2004 29,258 lbs. of sheepshead with an ex-vessel valued of $14,682 were landed in Aransas Bay.

Sheepshead are the least important finfish landed commercially in the Corpus Christi Bay system (Table 9). Commercial landings of sheepshead from Corpus Christi Bay ranged from about 900 lbs. in 2004 to about 60 thousand lbs. in 1988 (Table 9). Sheepshead landings in Corpus Christi Bay in 2004 were the lowest recorded since 1990 (Table 9, Figure 119).

Between 1984 and 1988 sheepshead landings in the upper Laguna Madre ranged from about 43 thousand lbs. in 1984 to about 5 thousand lbs. in 1988 (Table 9, Figure 119). Following the 1989 net ban, sheepshead virtually disappeared from upper Laguna Madre commercial landings (Table 9, Figure 119).

Southern Flounder

The southern flounder is commercially fished throughout its range and comprises an important part of the seafood market (Fischer 1978, Mattock 1991). Flounder are landed by commercial finfish fishermen using gigs and as incidental catch in the shrimp fishery. Because it is difficult to differentiate Gulf flounder (*Paralichthys albigutta*) data from southern flounder data and gulf flounder represent a very small portion of the landings, commercial landings for both species were grouped and presented as flounder. We will consider the vast majority of the landings are southern flounder. CBBEP and bay system commercial flounder landings are under reported through the MAPR system since fishermen can legally sell their catch directly to restaurants which are not required to report these transactions to TPWD.

Commercial flounder landings in the CBBEP are substantially lower than landings of black drum (Table 9). Commercial harvest of flounder in the CBBEP occurs throughout the year but is highest during the fall when mature fish migrate through bay – Gulf passes on their spawning runs to the Gulf of Mexico. Prior to 1988 CBBEP commercial fishermen harvest most flounder with nets. Following the 1988 ban on use of nets, flounder were harvested by commercial fishermen using gigs and as incidental catch in commercial shrimping operations. Between 1984 and 2004 CBBEP flounder landings ranged from about 20 thousand lbs. ($36,000) in 1990 to about 236 thousand lbs. ($218,000) in 1986 (Table 9, Figure 121). Commercial flounder landings exceeded 105 thousand lbs. ($244,000) in 2004 which is the highest recorded since 1999 and the second highest since 1996 (Table 9, Figure 121).

Historically, flounder landings from Aransas Bay accounted for more than 50% of the flounder landed in the CBBEP area (Table 9, Figure 122). In 1999, 120,813 lbs. were landed from Aransas Bay, accounting for 97% of the total CBBEP flounder landings (Table 9, Figure 122). Since 1999, around 80% of the landings in the area were from Aransas Bay. During the last five years, flounder landings in Aransas Bay averaged about 70 thousand with an ex-vessel value of $150,000. Aransas Bay commercial flounder landings ranged from about 10 thousand lbs. ($18,000) in 1990, before the establishment of the gig fishery to over 120 thousand lbs. ($253,000) in 1999 (Table 9).

Between 1984 and 1999, Corpus Christi Bay flounder landings accounted for almost 50% of the flounder harvested from the CBBEP area (Table 9and Figure 122). Since 1999, these landings only contribute about 15% of total landings. Corpus Christi Bay commercial flounder landings ranged from less than 2 thousand lbs. ($4,000) in 1999 to over 120 thousand lbs. ($109,000) in 1986 (Table 9, Figure 122). Corpus Christi Bay flounder landings of 9 thousand lbs. ($20,000) during 2004 is the lowest recorded since 1999 (Table 9).

Commercial flounder landings from the upper Laguna Madre are well below those observed in Aransas and Corpus Christi Bay (Figure 122). In most years between 1984 and 2004, upper Laguna Madre flounder landings have been less than one thousand lbs. per year (Table 9). Commercial flounder landings in the upper Laguna Madre ranged from 38 lbs. in 2002 to over 28 thousand lbs. ($28,000) in 1984 (Table 9). In 2004 about 12 thousand lbs. ($30,000) of flounder were landed in the upper Laguna Madre , the highest recorded since 1986 (Table 9).

Blue Crab

Over the past 10 years, Aransas Bay accounted for about 92% of CBBEP commercial crab landings with about 7% and 1% coming from Corpus Christi Bay and the upper Laguna Madre, respectively (Table 9, Figure 123). While commercial crab landings occur throughout the year, highest catches occur from May through August with peak landings in June and July. CBBEP commercial blue crab landings ranged from 126 thousand lbs. ($90,000) in 2000 to about 2.9 million lbs. ($1.1 million) in 1988. Between 2002 and 2004 CBBEP commercial blue crab landings exceeded 1.1 million lbs./yr (Table 9, Figure 124).

The blue crab fishery is the most important commercial fishery by weight in Aransas Bay (Table 9). Between 1984 and 2004 Aransas Bay commercial blue crab landings ranged from 123 thousand lbs. ($89,000) in 2000 to about 2.6 million lbs. ($964,000) in 1988 (Table 9, Figure 124). Blue crab landings in 2004 are the third highest reported since 1993 (Table 9, Figure 124). The average annual price per pound for blue crabs has steadily increased since 1984 from $0.29 in 1984 to $0.73 in 2000. Most recently (2004) 1,019,400 lbs. of blue crab were landed in Aransas Bay and were valued at $698,880 (Figure 125).

Between 1984 and 1996 Corpus Christi Bay commercial blue crab landings ranged from about 76 thousand lbs. ($27,000) in 1984 to about 98 thousand lbs. ($399,000) in 1996 (Table 9, Figure 126). Between 1996 and 2004 Corpus Christi Bay blue crab landings decreased and exceeded 100 thousand lbs. only in 2003 (Table 9, Figure 126).

Between 1984 and 2004 upper Laguna Madre commercial landings averaged 60 thousand lbs. and exceeded 100 thousand lbs. in 1987 (179 thousand lbs), 1988 (103 thousand lbs), and 1992 (473 thousand lbs) (Table 9, Figure 124). The upper Laguna Madre blue crab landings in 2004 (600 lbs) is the lowest recorded since 1996 (Table 9, Figure 127).

Brown and Pink (grooved) Shrimp

Commercial shrimp fishing in CBBEP bays has both a food component and bait component, and both are dependent on three species: brown shrimp, pink shrimp, and white shrimp. Because it is often difficult to differentiate brown shrimp and pink shrimp, the landings of these species are combined and presented as grooved shrimp, even though some studies indicate that over 90% of these landings are composed of brown shrimp (Christmas and Etzold, 1977). The shrimp fishery is second in terms of weight and first in terms of value in the CBBEP commercial fisheries

(Table 9). Between 1984 and 2004, grooved shrimp landings ranged from about 338 thousand lbs ($428,000) in 2004 to about 4.6 million lbs. ($8 million) in 1991 (Table 9, Figure 128). The landings and ex-vessel value of grooved shrimp during 2004 was the lowest recorded since 1984 and continues the decline in landings and value that began in 1997 (Table 9, Figure 128). Management regulations such as area closures and time closures, the License Buy Back program, and the reduced price per pound caused by imports, resulted in a decrease in fishing effort in the CBBEP area where the overall landings of grooved shrimp have already been decreasing since 1998 (Figure 129 and Figure 128).

Aransas Bay has the largest grooved shrimp fishery of the three CBBEP bay systems with over 200 boats participating in the fishery (Figure 129). Between 1984 and 2004, the majority (62%) of CBBEP grooved shrimp landings occurred in the Aransas Bay system (Table 9, Figure 129). Grooved shrimp landings in Aransas Bay ranged from 186 thousand lbs ($234,000) in 2004 to about 3.1 million lbs ($5.3 million) in 1991 (Table 9, Figure 130). Aransas Bay grooved shrimp landings (186 thousand lbs) and ex-vessel value ($234,000) in 2004 was the lowest recorded since 1984 and continued a dramatic decline begun in 1997 (Table 9, Figure 130). The average annual price per pound has generally increased over this period from $0.90 in 1985 to $2.10 in 1997. During the last five years, grooved shrimp landings in Aransas Bay have only averaged 424,296 lbs. and the average price per pound has been variable between $0.99-2.01/lb. One factor that could explain some of the drop in landings is that in addition to the overall decrease in effort being experienced in the shrimp fleet, many shrimpers started bypassing the dealers around this time and began selling their catch directly to the consumer. These direct sales would not end up being reported as landings in the MAPR system and consequently are not reported here.

Corpus Christi Bay has the second largest grooved shrimp fishery of the three CBBEP bay systems (Figure 131). Between 1984 and 2004, Corpus Christi Bay grooved shrimp landings ranged from about 151 thousand lbs. ($193,000) in 2004 to about 1.5 million lbs. ($3.1 million) in 1992 (Table 9, Figure 131). The 2004 landings were the lowest recorded since 1984 and continued a decline that began in 1998 (Table 9, Figure 131). The price per pound between 1995 and 2001 averaged $2.08. Since then, the average price has been $1.33.

Grooved shrimp landings in the upper Laguna Madre between 1984 and 2004 ranged from (need number) reported landings in 1995 and 2002 to about 278 thousand lbs ($398,000) in 1984 and ex-value less than $6,000 (Table 9, Figure ca12). Upper Laguna Madre landings of grooved shrimp has been less than 2,500 lbs per years since 1998 (Table 9, Figure 132).

White Shrimp

The highest landings occur during summer and fall with the harvest of young of the year white shrimp. During the spring there is a fishery of white shrimp adults that have overwintered in the estuaries (Christmas and Etzold 1977, Nance et al.1991).

Between 1984 and 2004 Aransas Bay system accounted for about 60% of white shrimp landed from the three CBBEP bay systems followed by Corpus Christi Bay with about 40% of the landings (Figure 133). The upper Laguna Madre white shrimp landings averaged less than one percent and have contributed little to all CBBEP landings of white shrimp (Table 9, Figure 133). Between 1984 and 1989, CBBEP landings decreased from about 2.1 million lbs. to about 198 thousand lbs. White shrimp landings then increased sharply, reaching the highest recorded harvest of about 2.6 million lbs. in 1992 (Table 9, Figure 134). Between 1995 and 2004, landings remained below 250 thousand lbs. (Table 9, Figure 134). The lowest landings for the

CBBEP area (~54,000 lbs.) was recorded in 2004 (Table 9, Figure 134). This decrease in landings may have been caused by a reduction in fishing effort rather than a reduction in the abundance of white shrimp. During the 1980's, price per pound for white shrimp averaged $2.30. During the 1990's, it increased to over $3.00 per pound then steadily decreased duirng 2000-04 to a mean price of $1.96 per pound (Table 9, Figure 134).

White shrimp landings in Aransas Bay have never been as high as the brown shrimp landings. Between 1984-1993, landings of white shrimp averaged less than one million lbs.(Table 9, Figure 135). Since 1995 the average landings in Aransas Bay declined to less than 200 thousand lbs. per year. The average annual price per pound for white shrimp landed in Aransas Bay generally increased from $2.12/lb. in 1994 to $4.46/lb. in 1997(Table 9, Figure 136).

Between 1984 and 2004 Corpus Christi Bay white shrimp landings ranged from about 8 thousand lbs ($38,000) in 1997 to 882 thousand lbs ($1.8 million) in 1984(Table 9, Figure 136). Corpus Christi Bay white shrimp landings reported in 2004 (about 35 thousand lbs.) was the lowest reported since 2001 and the ex-vessel value ($66,000) was the lowest reported since 1997(Table 9, Figure 136).

In the upper Laguna Madre, almost 100 thousand lbs. of white shrimp valued at $398,000 were landed in 1984 (Table 9, Figure 137,). Between 1984 and 2004, white shrimp landings exceeded 10 thousand lbs. averaged 1,600 lbs, and exceeded 10 thousand lbs only in 1990 (Table 9, Figure 137). No white shrimp landings were reported for the upper Laguna Madre for the years 1989, 1991, 1999, 2000, 2002, and 2003 (Table 9, Figure 137).

Bait shrimp

Bait shrimp landings in the CBBEP area have been tracked since through the MAPR system since 1995. All species of shrimp are combined for bait landings; however these are reported as by dead and live reporting categories. Dead bait landings in the CBBEP area have remained relatively stable throughout the 10 years while live bait landings have steadily increased almost every year since 1995 (Table 10, Figure 116). Dead bait landings ranged from 112,913 lbs. in 1995 to a high of 221,123 lbs. in 1998. Corpus Christi Bay dead bait landings accounted for 55-74% of the CBBEP landings during 1995-2004. Aransas Bay contributed 7-20% and ULM contributed 7-29% of the dead bait landings during this same period. During the last five years dead bait landings in the CBBEP area have averaged about 160,000 lbs. each year. Live bait landings ranged from 138,374 lbs. in 1995 to a high of 285,486 lbs. during 2004. Corpus Christi Bay also landed the majority of live bait shrimp during 1995-2004 (42-70%) with Aransas Bay and the upper Laguna Madre contributing 17-38% and 5-21%, respectively. Most recently (2000-04) live bait landings in the CBBEP area averaged over 250,000 lbs. each year and maintained an ex-vessel value of over $ 800,000 (**Error! Reference source not found.**)

Aransas Bay supports a strong and diverse commercial fishing industry with bait shrimp landings being a substantial component. Dead bait landings ranged from 12,582 lbs. during 1999 to a high of 32,323 lbs during 2004 with an estimated ex-vessel value of $16,400 and $42,400 respectfully (Table 10) (Figure 140). In the last five years they have averaged almost 30,000 lbs. ($43,900) a year. The dead bait shrimp landings in Aransas Bay have shown a slightly increasing trend over the last 10 years (Figure 139). Ex-vessel value for dead bait was variable over the years and ranged from $1.30/lb. in 1999 to $1.74/lb. in 1997. Live bait shrimp landings in Aransas Bay have been substantially higher than dead bait landings and have steadily increased during the ten years except for 1999(Figure 141). That year reported the lowest landings (35,520 lbs.) while the very next year (2000) had the highest number of live bait landings at 70,368 lbs. Ex-vessel values for live bait in Aransas Bay ranged from $3.07/lb. in 1999 to $3.55/lb. in 2003.

Bait shrimp landings in the CBBEP area are dominated by the landings reported from Corpus Christi Bay. They have accounted for up to 74% of the dead bait and up to 70% of the live bait for the area during 1995-2004 (Table 10). Dead bait landings from Corpus Christi Bay ranged from 63,705 lbs. in 1995 to a high of 144,826 lbs. in 1998 with an estimated ex-vessel value of $100,400) and $202,100 respectfully. (Table 10, Figure 139, Figure 142). The ex-vessel value ranged from $1.40/lb. in 1998 and 2002 to the high price of $1.64/lb. in 1997. In the last five years dead bait shrimp landings from Corpus Christi Bay averaged about 104,000 lbs. and had an ex-vessel value of approximately $160,000. The live bait industry in Corpus Christi Bay has been steadily building since 1995 (Figure 141) with the highest landings recorded, almost 200,000 lbs., occurring in 2004. Price per pound increased over time as well with ex-vessel values ranging from a low of $2.91/lb. in 1996 to a high of $3.76/lb. during 2004 (Table 10).

The upper Laguna Madre bait landings have declined steadily from 1998 through 2003 (Figure 143). Both live and dead bait landings exhibited this trend but both increased during 2004. Dead bait landings from the upper Laguna Madre accounted for about 10% in 2002-04 but have ranged from 7-29% during 1995-2004 (Table 10). Their ex-vessel value ranged from $15,400 in 2003 to $80,500 in 1999 (Figure 144). Live bait landings coming from the upper Laguna Madre contributed 6-21% of the landings in the CBBEP during the 10 years. They ranged from 15,100 lbs. ($56,700) in 2003 to 51,600 lbs. ($151,100) during 1998.

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Table 1. Mean catch rates (No./h) ± 1SE of selected fishes caught with gill nets (all meshes combined) by bay systems during spring 1984-2004.

Species Year	Aransas Bay	Corpus Christi Bay	Upper Laguna Madre	CBBEP
Atlantic Croaker				
1984	0.01 ± 0.01	0.01 ± 0.00	0.02 ± 0.01	0.01 ± 0.00
1985	0.01 ± 0.00	0.07 ± 0.03	0.19 ± 0.05	0.09 ± 0.02
1986	0.00 ± 0.00	0.28 ± 0.08	0.20 ± 0.06	0.14 ± 0.03
1987	0.01 ± 0.01	0.05 ± 0.02	0.03 ± 0.01	0.03 ± 0.01
1988	0.00 ± 0.00	0.08 ± 0.03	0.06 ± 0.02	0.04 ± 0.01
1989	0.00 ± 0.00	0.03 ± 0.01	0.02 ± 0.01	0.01 ± 0.00
1990	0.02 ± 0.00	0.04 ± 0.02	0.00 ± 0.00	0.02 ± 0.00
1991	0.01 ± 0.01	0.07 ± 0.03	0.03 ± 0.01	0.03 ± 0.01
1992	0.01 ± 0.00	0.10 ± 0.03	0.04 ± 0.01	0.04 ± 0.01
1993	0.04 ± 0.01	0.07 ± 0.02	0.05 ± 0.01	0.05 ± 0.01
1994	0.02 ± 0.01	0.10 ± 0.03	0.03 ± 0.01	0.04 ± 0.01
1995	0.02 ± 0.01	0.06 ± 0.02	0.02 ± 0.01	0.03 ± 0.01
1996	0.03 ± 0.01	0.07 ± 0.02	0.02 ± 0.01	0.04 ± 0.01
1997	0.08 ± 0.02	0.05 ± 0.02	0.05 ± 0.01	0.06 ± 0.01
1998	0.02 ± 0.01	0.19 ± 0.05	0.07 ± 0.02	0.08 ± 0.02
1999	0.05 ± 0.02	0.08 ± 0.03	0.13 ± 0.04	0.09 ± 0.02
2000	0.04 ± 0.01	0.04 ± 0.02	0.09 ± 0.03	0.06 ± 0.01
2001	0.03 ± 0.01	0.04 ± 0.01	0.06 ± 0.02	0.04 ± 0.01
2002	0.12 ± 0.03	0.17 ± 0.05	0.03 ± 0.01	0.10 ± 0.02
2003	0.05 ± 0.02	0.04 ± 0.01	0.05 ± 0.02	0.05 ± 0.01
2004	0.08 ± 0.03	0.02 ± 0.01	0.06 ± 0.02	0.06 ± 0.01
Black Drum				
1984	0.14 ± 0.03	0.48 ± 0.09	0.54 ± 0.13	0.36 ± 0.05
1985	0.23 ± 0.06	0.20 ± 0.06	0.78 ± 0.18	0.41 ± 0.07
1986	0.35 ± 0.06	0.57 ± 0.21	0.63 ± 0.13	0.51 ± 0.08
1987	0.53 ± 0.13	0.45 ± 0.20	1.10 ± 0.23	0.70 ± 0.11
1988	0.37 ± 0.06	0.79 ± 0.29	0.67 ± 0.14	0.58 ± 0.09
1989	0.57 ± 0.10	0.40 ± 0.11	1.00 ± 0.19	0.67 ± 0.08
1990	0.65 ± 0.12	0.59 ± 0.11	1.46 ± 0.23	0.91 ± 0.10
1991	1.04 ± 0.14	0.39 ± 0.07	3.01 ± 0.35	1.54 ± 0.16
1992	0.74 ± 0.15	1.56 ± 0.30	2.94 ± 0.33	1.70 ± 0.17
1993	1.55 ± 0.23	3.09 ± 0.98	2.36 ± 0.31	2.22 ± 0.29
1994	1.03 ± 0.16	2.08 ± 0.43	4.23 ± 0.73	2.39 ± 0.30
1995	1.03 ± 0.29	0.95 ± 0.16	4.00 ± 0.49	2.02 ± 0.24
1996	1.07 ± 0.15	1.46 ± 0.40	3.26 ± 0.38	1.91 ± 0.20
1997	1.73 ± 0.25	1.03 ± 0.16	3.29 ± 0.43	2.08 ± 0.20
1998	1.32 ± 0.20	1.08 ± 0.28	4.18 ± 0.80	2.23 ± 0.31
1999	1.24 ± 0.21	0.69 ± 0.29	4.29 ± 0.65	2.13 ± 0.28
2000	1.32 ± 0.18	0.89 ± 0.21	2.96 ± 0.51	1.76 ± 0.21
2001	2.20 ± 0.29	0.91 ± 0.30	4.00 ± 0.38	2.47 ± 0.22
2002	1.27 ± 0.23	1.85 ± 0.37	3.06 ± 0.37	2.03 ± 0.19
2003	1.32 ± 0.25	0.79 ± 0.21	4.03 ± 0.64	2.10 ± 0.27
2004	1.59 ± 0.28	0.46 ± 0.12	4.91 ± 0.87	2.42 ± 0.35
Red Drum				
1984	0.30 ± 0.08	0.85 ± 0.11	0.32 ± 0.06	0.45 ± 0.05
1985	0.39 ± 0.07	0.55 ± 0.07	0.34 ± 0.06	0.42 ± 0.04
1986	0.56 ± 0.08	0.70 ± 0.11	0.29 ± 0.04	0.51 ± 0.05
1987	0.66 ± 0.15	0.62 ± 0.14	0.43 ± 0.05	0.57 ± 0.07
1988	0.50 ± 0.06	0.57 ± 0.07	0.56 ± 0.09	0.54 ± 0.04
1989	0.70 ± 0.07	0.52 ± 0.08	0.36 ± 0.04	0.54 ± 0.04
1990	0.48 ± 0.19	1.02 ± 0.11	0.23 ± 0.04	0.54 ± 0.08
1991	0.45 ± 0.12	0.92 ± 0.14	0.34 ± 0.05	0.54 ± 0.06
1992	1.59 ± 0.15	1.16 ± 0.16	0.72 ± 0.09	1.18 ± 0.08
1993	1.22 ± 0.13	1.10 ± 0.15	0.63 ± 0.07	0.99 ± 0.07
1994	1.19 ± 0.14	0.55 ± 0.09	0.77 ± 0.10	0.88 ± 0.07
1995	0.82 ± 0.11	0.59 ± 0.09	0.40 ± 0.06	0.61 ± 0.06
1996	2.14 ± 0.33	1.45 ± 0.23	0.54 ± 0.07	1.42 ± 0.16
1997	1.65 ± 0.26	1.32 ± 0.24	0.36 ± 0.06	1.13 ± 0.13
1998	1.30 ± 0.17	1.22 ± 0.20	0.86 ± 0.12	1.13 ± 0.10
1999	0.90 ± 0.10	0.65 ± 0.12	0.56 ± 0.06	0.72 ± 0.06
2000	1.04 ± 0.15	0.76 ± 0.14	0.55 ± 0.08	0.80 ± 0.08
2001	0.99 ± 0.13	1.28 ± 0.29	0.76 ± 0.09	0.99 ± 0.10
2002	1.15 ± 0.11	0.79 ± 0.12	0.48 ± 0.07	0.83 ± 0.06
2003	0.95 ± 0.11	1.44 ± 0.28	0.38 ± 0.05	0.88 ± 0.09
2004	1.39 ± 0.19	1.42 ± 0.22	0.69 ± 0.09	1.16 ± 0.10

CTable 1. (Cont'd.)

Species Year	Aransas Bay	Corpus Christi Bay	Upper Laguna Madre	CBBEP
Sheepshead				
1984	0.03 ± 0.01	0.16 ± 0.06	0.07 ± 0.03	0.08 ± 0.02
1985	0.02 ± 0.01	0.14 ± 0.05	0.03 ± 0.01	0.06 ± 0.02
1986	0.01 ± 0.01	0.06 ± 0.02	0.04 ± 0.01	0.03 ± 0.01
1987	0.03 ± 0.01	0.04 ± 0.01	0.03 ± 0.01	0.04 ± 0.01
1988	0.07 ± 0.03	0.10 ± 0.03	0.03 ± 0.01	0.06 ± 0.01
1989	0.05 ± 0.02	0.17 ± 0.06	0.02 ± 0.01	0.07 ± 0.02
1990	0.03 ± 0.02	0.23 ± 0.09	0.04 ± 0.01	0.09 ± 0.03
1991	0.01 ± 0.01	0.02 ± 0.01	0.04 ± 0.01	0.03 ± 0.00
1992	0.02 ± 0.01	0.12 ± 0.05	0.04 ± 0.01	0.05 ± 0.02
1993	0.03 ± 0.01	0.07 ± 0.02	0.03 ± 0.01	0.04 ± 0.01
1994	0.03 ± 0.01	0.03 ± 0.01	0.01 ± 0.00	0.02 ± 0.01
1995	0.10 ± 0.04	0.32 ± 0.20	0.01 ± 0.00	0.13 ± 0.05
1996	0.09 ± 0.02	0.15 ± 0.06	0.03 ± 0.01	0.09 ± 0.02
1997	0.13 ± 0.05	0.07 ± 0.02	0.05 ± 0.01	0.09 ± 0.02
1998	0.18 ± 0.04	0.11 ± 0.04	0.08 ± 0.02	0.13 ± 0.02
1999	0.14 ± 0.03	0.16 ± 0.04	0.04 ± 0.01	0.11 ± 0.02
2000	0.17 ± 0.05	0.12 ± 0.04	0.03 ± 0.01	0.11 ± 0.02
2001	0.12 ± 0.02	0.17 ± 0.06	0.04 ± 0.01	0.10 ± 0.02
2002	0.08 ± 0.02	0.16 ± 0.06	0.04 ± 0.01	0.09 ± 0.02
2003	0.28 ± 0.11	0.45 ± 0.23	0.03 ± 0.01	0.24 ± 0.07
2004	0.11 ± 0.03	0.11 ± 0.03	0.04 ± 0.01	0.08 ± 0.02
Spotted Seatrout				
1984	0.23 ± 0.05	0.23 ± 0.06	0.03 ± 0.01	0.16 ± 0.03
1985	0.36 ± 0.08	0.40 ± 0.08	0.14 ± 0.02	0.30 ± 0.04
1986	0.43 ± 0.07	1.01 ± 0.15	0.43 ± 0.10	0.58 ± 0.06
1987	0.53 ± 0.09	0.96 ± 0.14	0.39 ± 0.08	0.59 ± 0.06
1988	0.51 ± 0.08	0.82 ± 0.10	0.40 ± 0.06	0.55 ± 0.05
1989	0.59 ± 0.08	0.76 ± 0.11	0.40 ± 0.06	0.57 ± 0.05
1990	0.52 ± 0.06	1.10 ± 0.23	0.21 ± 0.08	0.57 ± 0.08
1991	0.97 ± 0.13	0.95 ± 0.13	0.56 ± 0.14	0.82 ± 0.08
1992	0.67 ± 0.11	1.30 ± 0.28	0.60 ± 0.10	0.81 ± 0.10
1993	0.59 ± 0.11	1.06 ± 0.16	0.51 ± 0.07	0.69 ± 0.07
1994	0.91 ± 0.12	0.96 ± 0.14	0.83 ± 0.12	0.90 ± 0.07
1995	0.65 ± 0.12	0.95 ± 0.14	0.63 ± 0.09	0.72 ± 0.07
1996	0.98 ± 0.10	0.84 ± 0.14	0.51 ± 0.11	0.78 ± 0.07
1997	0.93 ± 0.12	1.18 ± 0.22	0.73 ± 0.09	0.93 ± 0.08
1998	1.04 ± 0.14	1.00 ± 0.17	0.73 ± 0.11	0.92 ± 0.08
1999	1.00 ± 0.14	0.90 ± 0.13	0.90 ± 0.12	0.94 ± 0.08
2000	1.09 ± 0.15	0.63 ± 0.21	0.79 ± 0.13	0.87 ± 0.09
2001	1.16 ± 0.13	0.72 ± 0.09	0.85 ± 0.12	0.94 ± 0.07
2002	1.12 ± 0.11	1.06 ± 0.14	0.56 ± 0.07	0.91 ± 0.07
2003	0.94 ± 0.14	1.08 ± 0.16	0.66 ± 0.12	0.88 ± 0.08
2004	1.13 ± 0.22	1.04 ± 0.12	0.88 ± 0.12	1.02 ± 0.10
Southern Flounder				
1984	0.02 ± 0.01	0.05 ± 0.01	0.01 ± 0.00	0.02 ± 0.00
1985	0.02 ± 0.01	0.05 ± 0.01	0.05 ± 0.01	0.04 ± 0.00
1986	0.02 ± 0.01	0.02 ± 0.01	0.04 ± 0.01	0.03 ± 0.00
1987	0.01 ± 0.01	0.01 ± 0.00	0.03 ± 0.01	0.02 ± 0.00
1988	0.02 ± 0.00	0.02 ± 0.00	0.02 ± 0.01	0.02 ± 0.00
1989	0.02 ± 0.01	0.00 ± 0.00	0.00 ± 0.00	0.01 ± 0.00
1990	0.01 ± 0.01	0.02 ± 0.00	0.01 ± 0.00	0.01 ± 0.00
1991	0.02 ± 0.01	0.04 ± 0.01	0.07 ± 0.03	0.04 ± 0.01
1992	0.01 ± 0.00	0.02 ± 0.00	0.01 ± 0.00	0.01 ± 0.00
1993	0.01 ± 0.00	0.02 ± 0.01	0.00 ± 0.00	0.01 ± 0.00
1994	0.01 ± 0.00	0.01 ± 0.01	0.01 ± 0.00	0.01 ± 0.00
1995	0.02 ± 0.00	0.01 ± 0.00	0.01 ± 0.00	0.01 ± 0.00
1996	0.03 ± 0.01	0.01 ± 0.00	0.00 ± 0.00	0.02 ± 0.00
1997	0.01 ± 0.00	0.02 ± 0.01	0.01 ± 0.00	0.01 ± 0.00
1998	0.02 ± 0.01	0.02 ± 0.01	0.01 ± 0.00	0.02 ± 0.00
1999	0.01 ± 0.00	0.02 ± 0.00	0.01 ± 0.00	0.01 ± 0.00
2000	0.02 ± 0.00	0.02 ± 0.01	0.01 ± 0.00	0.02 ± 0.00
2001	0.01 ± 0.00	0.01 ± 0.00	0.01 ± 0.00	0.01 ± 0.00
2002	0.02 ± 0.01	0.03 ± 0.01	0.01 ± 0.00	0.02 ± 0.00
2003	0.02 ± 0.01	0.01 ± 0.00	0.00 ± 0.00	0.01 ± 0.00
2004	0.02 ± 0.01	0.02 ± 0.01	0.00 ± 0.00	0.01 ± 0.00

Table 2. Mean catch rates (No./h) ± 1SE of selected fishes caught with gill nets (all meshes combined) by bay systems during fall 1984-2004.

Species Year	Aransas Bay	Corpus Christi Bay	Upper Laguna Madre	CBBEP
Atlantic Croaker				
1984	0.09 ± 0.03	0.48 ± 0.14	0.08 ± 0.02	0.19 ± 0.04
1985	0.28 ± 0.10	0.63 ± 0.13	0.18 ± 0.07	0.34 ± 0.06
1986	0.26 ± 0.10	1.35 ± 0.56	0.12 ± 0.03	0.49 ± 0.15
1987	0.24 ± 0.07	1.64 ± 0.81	0.07 ± 0.03	0.55 ± 0.22
1988	0.27 ± 0.13	0.81 ± 0.16	0.06 ± 0.02	0.34 ± 0.07
1989	0.18 ± 0.04	0.30 ± 0.07	0.00 ± 0.00	0.15 ± 0.03
1990	0.12 ± 0.03	0.30 ± 0.08	0.00 ± 0.00	0.13 ± 0.03
1991	0.15 ± 0.04	0.38 ± 0.08	0.03 ± 0.01	0.17 ± 0.03
1992	0.31 ± 0.09	1.01 ± 0.36	0.06 ± 0.02	0.41 ± 0.10
1993	0.11 ± 0.02	0.94 ± 0.30	0.04 ± 0.01	0.30 ± 0.08
1994	0.13 ± 0.04	1.02 ± 0.68	0.09 ± 0.02	0.35 ± 0.18
1995	0.41 ± 0.11	0.57 ± 0.16	0.09 ± 0.03	0.35 ± 0.06
1996	0.29 ± 0.07	0.47 ± 0.10	0.03 ± 0.01	0.25 ± 0.04
1997	0.24 ± 0.05	0.36 ± 0.09	0.05 ± 0.02	0.21 ± 0.03
1998	0.21 ± 0.05	0.53 ± 0.09	0.09 ± 0.02	0.25 ± 0.03
1999	0.08 ± 0.02	0.66 ± 0.13	0.13 ± 0.03	0.25 ± 0.04
2000	0.12 ± 0.03	0.56 ± 0.13	0.06 ± 0.02	0.22 ± 0.04
2001	0.27 ± 0.05	0.60 ± 0.13	0.07 ± 0.02	0.29 ± 0.04
2002	0.40 ± 0.09	0.60 ± 0.12	0.07 ± 0.02	0.34 ± 0.05
2003	0.20 ± 0.09	0.97 ± 0.22	0.17 ± 0.04	0.39 ± 0.07
2004	0.22 ± 0.09	0.59 ± 0.13	0.08 ± 0.02	0.27 ± 0.05
Black Drum				
1984	0.17 ± 0.03	0.22 ± 0.04	0.39 ± 0.09	0.26 ± 0.04
1985	0.41 ± 0.08	0.21 ± 0.03	0.86 ± 0.21	0.51 ± 0.08
1986	0.49 ± 0.09	0.31 ± 0.07	0.53 ± 0.11	0.46 ± 0.06
1987	0.53 ± 0.08	0.19 ± 0.04	0.40 ± 0.09	0.40 ± 0.05
1988	0.70 ± 0.09	0.70 ± 0.18	1.49 ± 0.25	0.97 ± 0.11
1989	1.37 ± 0.22	1.27 ± 0.23	1.55 ± 0.23	1.40 ± 0.13
1990	0.96 ± 0.14	0.62 ± 0.14	1.04 ± 0.15	0.90 ± 0.08
1991	0.73 ± 0.16	0.92 ± 0.13	2.14 ± 0.32	1.26 ± 0.14
1992	0.88 ± 0.18	0.81 ± 0.14	1.36 ± 0.22	1.02 ± 0.11
1993	1.61 ± 0.46	1.71 ± 0.34	3.75 ± 0.40	2.36 ± 0.27
1994	0.89 ± 0.13	0.90 ± 0.18	4.88 ± 0.48	2.24 ± 0.24
1995	1.10 ± 0.17	1.47 ± 0.22	4.47 ± 0.46	2.34 ± 0.22
1996	1.42 ± 0.21	1.31 ± 0.29	4.03 ± 0.35	2.28 ± 0.19
1997	1.08 ± 0.16	0.65 ± 0.09	3.56 ± 0.51	1.81 ± 0.21
1998	1.22 ± 0.15	0.76 ± 0.19	3.20 ± 0.46	1.77 ± 0.19
1999	1.64 ± 0.29	0.56 ± 0.11	2.04 ± 0.26	1.50 ± 0.15
2000	2.05 ± 0.32	1.28 ± 0.25	3.50 ± 0.34	2.34 ± 0.21
2001	1.49 ± 0.20	0.70 ± 0.12	3.36 ± 0.35	1.92 ± 0.17
2002	1.33 ± 0.18	0.65 ± 0.11	3.53 ± 0.43	1.90 ± 0.19
2003	1.10 ± 0.15	0.59 ± 0.14	2.44 ± 0.30	1.42 ± 0.14
2004	0.91 ± 0.20	0.52 ± 0.10	3.62 ± 0.32	1.73 ± 0.18
Red Drum				
1984	0.54 ± 0.07	0.80 ± 0.19	0.69 ± 0.14	0.66 ± 0.08
1985	0.84 ± 0.13	0.71 ± 0.12	0.33 ± 0.06	0.64 ± 0.07
1986	0.88 ± 0.14	0.47 ± 0.10	0.40 ± 0.05	0.61 ± 0.07
1987	0.61 ± 0.06	0.40 ± 0.06	0.31 ± 0.05	0.46 ± 0.03
1988	0.84 ± 0.12	0.51 ± 0.09	0.27 ± 0.03	0.56 ± 0.06
1989	0.69 ± 0.08	0.57 ± 0.08	0.31 ± 0.04	0.53 ± 0.04
1990	0.97 ± 0.21	0.84 ± 0.11	0.66 ± 0.10	0.83 ± 0.09
1991	0.94 ± 0.19	1.47 ± 0.24	0.56 ± 0.11	0.95 ± 0.11
1992	1.38 ± 0.22	0.97 ± 0.11	0.70 ± 0.08	1.04 ± 0.10
1993	1.67 ± 0.20	0.95 ± 0.14	0.70 ± 0.08	1.15 ± 0.10
1994	0.95 ± 0.11	0.61 ± 0.09	0.44 ± 0.05	0.69 ± 0.06
1995	0.86 ± 0.15	0.59 ± 0.12	0.31 ± 0.05	0.60 ± 0.07
1996	1.10 ± 0.13	0.50 ± 0.07	0.51 ± 0.07	0.74 ± 0.06
1997	1.53 ± 0.20	0.85 ± 0.09	0.76 ± 0.14	1.09 ± 0.10
1998	1.38 ± 0.21	0.62 ± 0.08	0.47 ± 0.07	0.87 ± 0.10
1999	1.31 ± 0.14	0.66 ± 0.12	0.49 ± 0.06	0.86 ± 0.08
2000	1.04 ± 0.14	1.13 ± 0.21	0.74 ± 0.12	0.96 ± 0.09
2001	0.81 ± 0.10	0.69 ± 0.11	0.48 ± 0.06	0.67 ± 0.06
2002	1.52 ± 0.20	0.88 ± 0.12	0.44 ± 0.07	0.99 ± 0.10
2003	1.45 ± 0.15	0.78 ± 0.13	0.58 ± 0.07	0.98 ± 0.08
2004	1.26 ± 0.15	0.70 ± 0.10	0.88 ± 0.11	0.99 ± 0.08

CTable 2. (Cont'd.)

Species Year	Aransas Bay	Corpus Christi Bay	Upper Laguna Madre	CBBEP
Sheepshead				
1984	0.02 ± 0.01	0.02 ± 0.01	0.09 ± 0.03	0.05 ± 0.01
1985	0.04 ± 0.01	0.02 ± 0.01	0.02 ± 0.01	0.03 ± 0.01
1986	0.11 ± 0.03	0.08 ± 0.03	0.01 ± 0.00	0.07 ± 0.02
1987	0.17 ± 0.09	0.07 ± 0.02	0.01 ± 0.01	0.09 ± 0.04
1988	0.08 ± 0.02	0.05 ± 0.01	0.06 ± 0.04	0.07 ± 0.02
1989	0.08 ± 0.03	0.11 ± 0.06	0.03 ± 0.01	0.07 ± 0.02
1990	0.04 ± 0.01	0.04 ± 0.01	0.05 ± 0.01	0.04 ± 0.01
1991	0.01 ± 0.01	0.04 ± 0.01	0.03 ± 0.01	0.03 ± 0.01
1992	0.05 ± 0.01	0.03 ± 0.01	0.01 ± 0.00	0.03 ± 0.01
1993	0.06 ± 0.01	0.03 ± 0.01	0.01 ± 0.00	0.04 ± 0.01
1994	0.10 ± 0.03	0.02 ± 0.01	0.00 ± 0.00	0.05 ± 0.01
1995	0.10 ± 0.03	0.03 ± 0.01	0.02 ± 0.01	0.06 ± 0.01
1996	0.09 ± 0.02	0.05 ± 0.02	0.02 ± 0.01	0.06 ± 0.01
1997	0.15 ± 0.03	0.06 ± 0.01	0.04 ± 0.01	0.09 ± 0.01
1998	0.33 ± 0.11	0.08 ± 0.02	0.03 ± 0.01	0.16 ± 0.05
1999	0.21 ± 0.06	0.04 ± 0.01	0.02 ± 0.01	0.10 ± 0.02
2000	0.36 ± 0.10	0.07 ± 0.02	0.03 ± 0.01	0.17 ± 0.04
2001	0.17 ± 0.05	0.04 ± 0.01	0.10 ± 0.02	0.11 ± 0.02
2002	0.13 ± 0.03	0.05 ± 0.02	0.07 ± 0.02	0.09 ± 0.02
2003	0.19 ± 0.06	0.09 ± 0.04	0.03 ± 0.01	0.11 ± 0.03
2004	0.13 ± 0.03	0.05 ± 0.02	0.08 ± 0.03	0.09 ± 0.02
Spotted Seatrout				
1984	0.10 ± 0.02	0.16 ± 0.02	0.08 ± 0.02	0.11 ± 0.01
1985	0.17 ± 0.03	0.39 ± 0.06	0.17 ± 0.03	0.23 ± 0.02
1986	0.29 ± 0.05	0.41 ± 0.07	0.28 ± 0.06	0.32 ± 0.03
1987	0.31 ± 0.05	0.53 ± 0.06	0.18 ± 0.03	0.32 ± 0.03
1988	0.26 ± 0.04	0.44 ± 0.06	0.22 ± 0.04	0.29 ± 0.03
1989	0.31 ± 0.06	0.43 ± 0.07	0.12 ± 0.03	0.28 ± 0.03
1990	0.31 ± 0.08	0.48 ± 0.06	0.10 ± 0.02	0.28 ± 0.04
1991	0.27 ± 0.05	0.65 ± 0.08	0.37 ± 0.08	0.40 ± 0.04
1992	0.38 ± 0.05	0.59 ± 0.09	0.53 ± 0.09	0.49 ± 0.04
1993	0.32 ± 0.04	0.85 ± 0.20	0.45 ± 0.06	0.50 ± 0.06
1994	0.44 ± 0.07	0.59 ± 0.12	0.53 ± 0.09	0.51 ± 0.05
1995	0.44 ± 0.07	0.44 ± 0.09	0.41 ± 0.06	0.43 ± 0.04
1996	0.67 ± 0.07	0.35 ± 0.05	0.62 ± 0.10	0.57 ± 0.05
1997	0.52 ± 0.06	0.38 ± 0.08	0.36 ± 0.06	0.43 ± 0.04
1998	0.61 ± 0.09	0.34 ± 0.04	0.40 ± 0.08	0.47 ± 0.05
1999	0.49 ± 0.07	0.43 ± 0.06	0.39 ± 0.08	0.44 ± 0.04
2000	0.36 ± 0.05	0.26 ± 0.04	0.27 ± 0.05	0.31 ± 0.03
2001	0.71 ± 0.09	0.39 ± 0.05	0.47 ± 0.05	0.55 ± 0.04
2002	0.56 ± 0.07	0.68 ± 0.09	0.35 ± 0.06	0.52 ± 0.04
2003	0.45 ± 0.06	0.31 ± 0.03	0.50 ± 0.09	0.43 ± 0.04
2004	0.63 ± 0.09	0.50 ± 0.07	0.45 ± 0.06	0.54 ± 0.05
Southern Flounder				
1984	0.09 ± 0.02	0.12 ± 0.02	0.08 ± 0.01	0.10 ± 0.01
1985	0.07 ± 0.01	0.08 ± 0.02	0.15 ± 0.02	0.10 ± 0.01
1986	0.04 ± 0.01	0.06 ± 0.01	0.13 ± 0.02	0.07 ± 0.01
1987	0.07 ± 0.02	0.07 ± 0.02	0.03 ± 0.01	0.05 ± 0.01
1988	0.08 ± 0.01	0.03 ± 0.01	0.04 ± 0.01	0.05 ± 0.01
1989	0.09 ± 0.02	0.04 ± 0.01	0.02 ± 0.01	0.06 ± 0.01
1990	0.09 ± 0.01	0.12 ± 0.04	0.09 ± 0.02	0.10 ± 0.01
1991	0.07 ± 0.02	0.09 ± 0.02	0.11 ± 0.02	0.09 ± 0.01
1992	0.07 ± 0.02	0.10 ± 0.02	0.04 ± 0.01	0.07 ± 0.01
1993	0.06 ± 0.01	0.08 ± 0.02	0.03 ± 0.01	0.06 ± 0.01
1994	0.05 ± 0.01	0.05 ± 0.01	0.02 ± 0.01	0.04 ± 0.01
1995	0.06 ± 0.01	0.05 ± 0.01	0.02 ± 0.01	0.04 ± 0.01
1996	0.04 ± 0.01	0.07 ± 0.03	0.01 ± 0.00	0.04 ± 0.01
1997	0.04 ± 0.01	0.05 ± 0.01	0.02 ± 0.01	0.03 ± 0.01
1998	0.03 ± 0.01	0.07 ± 0.02	0.03 ± 0.01	0.04 ± 0.01
1999	0.08 ± 0.01	0.04 ± 0.01	0.01 ± 0.01	0.05 ± 0.01
2000	0.05 ± 0.01	0.07 ± 0.02	0.02 ± 0.01	0.05 ± 0.01
2001	0.05 ± 0.01	0.02 ± 0.01	0.01 ± 0.00	0.03 ± 0.01
2002	0.07 ± 0.01	0.07 ± 0.02	0.05 ± 0.02	0.06 ± 0.01
2003	0.04 ± 0.01	0.05 ± 0.01	0.02 ± 0.00	0.03 ± 0.01
2004	0.08 ± 0.01	0.05 ± 0.02	0.01 ± 0.00	0.05 ± 0.01

Table 3. Mean length (mm) ± 1SE of selected fishes caught with gill nets (all meshes combined) by bay systems during spring 1984-2004. Blanks indicate no data.

Species Year	Aransas Bay	Corpus Christi Bay	Upper Laguna Madre	CBBEP
Atlantic Croaker				
1984	264 ± 15	265 ± 31	305 ± 16	282 ± 12
1985	115 ± 0	265 ± 3	266 ± 4	264 ± 4
1986	294 ± 40	255 ± 4	297 ± 5	280 ± 5
1987	246 ± 2	272 ± 11	319 ± 7	289 ± 9
1988	261 ± 0	262 ± 4	337 ± 9	298 ± 12
1989	262 ± 0	284 ± 6	342 ± 15	307 ± 11
1990	277 ± 11	267 ± 7	247 ± 64	269 ± 7
1991	252 ± 9	262 ± 7	271 ± 15	263 ± 6
1992	231 ± 29	265 ± 4	291 ± 7	272 ± 5
1993	268 ± 8	265 ± 5	296 ± 8	276 ± 5
1994	256 ± 16	279 ± 8	330 ± 11	290 ± 8
1995	275 ± 12	301 ± 9	382 ± 12	313 ± 11
1996	263 ± 6	294 ± 15	355 ± 16	293 ± 9
1997	263 ± 3	300 ± 11	284 ± 8	277 ± 5
1998	267 ± 13	282 ± 5	302 ± 6	286 ± 4
1999	268 ± 4	290 ± 14	306 ± 5	293 ± 5
2000	267 ± 4	260 ± 7	294 ± 7	281 ± 5
2001	261 ± 6	265 ± 8	296 ± 10	279 ± 6
2002	258 ± 2	272 ± 5	305 ± 9	269 ± 3
2003	256 ± 5	280 ± 9	280 ± 9	270 ± 5
2004	267 ± 3	271 ± 3	315 ± 10	284 ± 6
Black Drum				
1984	563 ± 74	415 ± 9	442 ± 13	451 ± 15
1985	390 ± 50	340 ± 14	376 ± 14	375 ± 15
1986	318 ± 14	372 ± 11	417 ± 9	376 ± 8
1987	384 ± 9	458 ± 11	445 ± 11	429 ± 8
1988	373 ± 15	423 ± 11	398 ± 9	399 ± 7
1989	369 ± 13	408 ± 12	424 ± 10	402 ± 8
1990	336 ± 13	411 ± 7	413 ± 11	390 ± 8
1991	312 ± 12	363 ± 25	387 ± 17	364 ± 12
1992	340 ± 15	380 ± 6	367 ± 7	365 ± 5
1993	417 ± 10	409 ± 12	374 ± 8	399 ± 7
1994	469 ± 8	427 ± 6	402 ± 8	420 ± 6
1995	446 ± 27	453 ± 6	423 ± 3	432 ± 7
1996	386 ± 8	475 ± 15	451 ± 5	441 ± 6
1997	414 ± 10	472 ± 8	415 ± 6	422 ± 5
1998	390 ± 8	442 ± 9	389 ± 15	396 ± 9
1999	394 ± 18	420 ± 28	388 ± 12	392 ± 9
2000	369 ± 10	408 ± 20	420 ± 9	402 ± 7
2001	363 ± 6	404 ± 9	421 ± 6	399 ± 5
2002	383 ± 20	415 ± 8	433 ± 9	416 ± 7
2003	395 ± 15	436 ± 18	423 ± 8	417 ± 7
2004	432 ± 10	429 ± 10	435 ± 12	434 ± 9
Red Drum				
1984	418 ± 7	457 ± 11	434 ± 20	441 ± 8
1985	462 ± 8	456 ± 5	507 ± 9	473 ± 5
1986	400 ± 10	466 ± 9	473 ± 13	438 ± 7
1987	464 ± 13	462 ± 10	516 ± 10	477 ± 7
1988	436 ± 13	494 ± 13	550 ± 9	492 ± 9
1989	446 ± 16	468 ± 15	543 ± 14	474 ± 10
1990	492 ± 12	506 ± 6	536 ± 12	505 ± 6
1991	472 ± 15	474 ± 9	546 ± 12	489 ± 7
1992	414 ± 15	478 ± 9	546 ± 17	461 ± 10
1993	463 ± 10	510 ± 7	556 ± 8	497 ± 7
1994	474 ± 11	530 ± 10	573 ± 7	512 ± 8
1995	445 ± 9	486 ± 9	569 ± 11	482 ± 7
1996	475 ± 10	500 ± 8	547 ± 11	491 ± 6
1997	480 ± 11	505 ± 9	497 ± 14	489 ± 7
1998	454 ± 12	459 ± 15	508 ± 13	469 ± 8
1999	450 ± 13	472 ± 9	507 ± 11	470 ± 8
2000	463 ± 11	491 ± 9	542 ± 10	488 ± 7
2001	451 ± 12	506 ± 6	530 ± 11	490 ± 7
2002	431 ± 11	468 ± 14	537 ± 15	461 ± 9
2003	437 ± 10	487 ± 8	523 ± 11	471 ± 6
2004	477 ± 9	494 ± 9	528 ± 13	493 ± 6

CTable 3. (Cont'd.)

Species Year	Aransas Bay	Corpus Christi Bay	Upper Laguna Madre	CBBEP
Sheepshead				
1984	400 ± 14	380 ± 6	384 ± 18	385 ± 6
1985	381 ± 10	424 ± 7	428 ± 7	418 ± 6
1986	308 ± 43	388 ± 16	425 ± 15	390 ± 12
1987	343 ± 15	349 ± 10	402 ± 14	363 ± 9
1988	346 ± 14	371 ± 17	408 ± 13	365 ± 9
1989	354 ± 21	409 ± 8	369 ± 21	390 ± 10
1990	372 ± 22	383 ± 14	358 ± 11	377 ± 12
1991	303 ± 17	367 ± 17	406 ± 7	376 ± 10
1992	347 ± 17	436 ± 10	434 ± 5	421 ± 13
1993	397 ± 21	420 ± 9	426 ± 14	414 ± 8
1994	344 ± 17	435 ± 19	431 ± 17	384 ± 18
1995	362 ± 12	446 ± 11	424 ± 13	418 ± 20
1996	368 ± 11	448 ± 16	397 ± 17	408 ± 15
1997	372 ± 14	393 ± 13	443 ± 11	390 ± 10
1998	370 ± 15	411 ± 15	395 ± 8	384 ± 10
1999	343 ± 17	425 ± 17	413 ± 15	382 ± 16
2000	338 ± 9	399 ± 7	432 ± 11	364 ± 8
2001	349 ± 15	391 ± 15	396 ± 13	372 ± 9
2002	353 ± 9	394 ± 12	391 ± 18	378 ± 10
2003	383 ± 16	407 ± 5	405 ± 16	396 ± 10
2004	408 ± 16	415 ± 6	415 ± 7	412 ± 8
Spotted Seatrout				
1984	435 ± 9	477 ± 12	482 ± 23	453 ± 8
1985	431 ± 9	472 ± 15	426 ± 9	445 ± 8
1986	430 ± 6	467 ± 10	458 ± 16	453 ± 6
1987	456 ± 11	483 ± 17	495 ± 17	475 ± 9
1988	454 ± 12	481 ± 7	508 ± 12	478 ± 6
1989	471 ± 11	486 ± 9	516 ± 18	487 ± 7
1990	445 ± 6	462 ± 9	479 ± 25	458 ± 6
1991	473 ± 8	463 ± 8	480 ± 16	472 ± 6
1992	445 ± 7	472 ± 6	535 ± 13	479 ± 6
1993	456 ± 11	444 ± 7	509 ± 13	464 ± 7
1994	454 ± 8	461 ± 10	476 ± 11	463 ± 5
1995	445 ± 10	481 ± 13	452 ± 8	459 ± 7
1996	429 ± 8	460 ± 10	497 ± 10	453 ± 6
1997	430 ± 5	461 ± 8	449 ± 8	445 ± 5
1998	462 ± 8	466 ± 7	476 ± 7	467 ± 4
1999	474 ± 8	468 ± 10	488 ± 10	477 ± 5
2000	460 ± 9	456 ± 24	496 ± 13	470 ± 8
2001	433 ± 7	447 ± 7	456 ± 12	443 ± 5
2002	451 ± 9	449 ± 9	448 ± 9	450 ± 6
2003	453 ± 10	492 ± 13	469 ± 16	469 ± 8
2004	494 ± 16	458 ± 10	498 ± 11	486 ± 9
Southern Flounder				
1984	307 ± 19	377 ± 11	344 ± 20	350 ± 11
1985	348 ± 11	352 ± 11	346 ± 9	348 ± 6
1986	356 ± 19	394 ± 8	354 ± 17	363 ± 10
1987	342 ± 24	333 ± 18	408 ± 9	375 ± 10
1988	332 ± 15	351 ± 12	399 ± 15	364 ± 9
1989	341 ± 15	383 ± 40	402 ± 15	353 ± 12
1990	317 ± 22	348 ± 19	335 ± 36	332 ± 14
1991	327 ± 15	344 ± 9	363 ± 4	351 ± 5
1992	354 ± 21	377 ± 12	437 ± 16	380 ± 11
1993	417 ± 20	397 ± 8	455 ± 27	410 ± 9
1994	334 ± 21	361 ± 12	334 ± 25	343 ± 11
1995	368 ± 14	396 ± 13	361 ± 11	375 ± 9
1996	378 ± 12	392 ± 9	341 ± 14	378 ± 9
1997	363 ± 16	352 ± 13	368 ± 14	361 ± 8
1998	334 ± 18	364 ± 12	398 ± 35	350 ± 12
1999	329 ± 19	405 ± 16	444 ± 18	377 ± 15
2000	363 ± 13	368 ± 13	384 ± 22	369 ± 9
2001	355 ± 11	359 ± 20	437 ± 26	377 ± 11
2002	340 ± 16	332 ± 14	385 ± 15	347 ± 9
2003	381 ± 12	417 ± 13	416 ± 8	395 ± 8
2004	381 ± 13	361 ± 16	409 ± 9	378 ± 10

Table 4. Mean length (mm) ± 1SE of selected fishes caught with gill nets (all meshes combined) by bay systems during fall 1984-2004. Blanks indicate no data.

Species Year	Aransas Bay	Corpus Christi Bay	Upper Laguna Madre	CBBEP
Atlantic Croaker				
1984	260 ± 4	277 ± 4	264 ± 5	272 ± 3
1985	284 ± 14	290 ± 7	308 ± 7	291 ± 6
1986	283 ± 7	319 ± 10	322 ± 8	311 ± 10
1987	294 ± 12	325 ± 5	324 ± 8	320 ± 5
1988	305 ± 7	329 ± 7	356 ± 9	323 ± 6
1989	275 ± 11	319 ± 5	324 ± 0	298 ± 6
1990	261 ± 2	290 ± 6	299 ± 1	279 ± 5
1991	262 ± 3	289 ± 8	267 ± 7	278 ± 5
1992	277 ± 5	304 ± 6	329 ± 2	297 ± 6
1993	281 ± 6	318 ± 3	309 ± 16	312 ± 4
1994	291 ± 9	326 ± 9	337 ± 12	322 ± 9
1995	294 ± 5	342 ± 8	333 ± 8	318 ± 6
1996	281 ± 4	315 ± 6	298 ± 11	299 ± 4
1997	282 ± 5	301 ± 10	320 ± 21	293 ± 6
1998	277 ± 3	299 ± 6	302 ± 8	292 ± 4
1999	288 ± 5	295 ± 8	310 ± 9	297 ± 6
2000	276 ± 4	329 ± 7	345 ± 13	319 ± 6
2001	277 ± 3	292 ± 7	293 ± 10	286 ± 5
2002	289 ± 5	292 ± 3	285 ± 8	290 ± 3
2003	272 ± 2	295 ± 9	278 ± 7	288 ± 6
2004	276 ± 4	316 ± 8	332 ± 9	304 ± 7
Black Drum				
1984	335 ± 28	376 ± 18	440 ± 21	398 ± 17
1985	332 ± 18	367 ± 18	375 ± 23	360 ± 14
1986	357 ± 9	387 ± 14	413 ± 10	384 ± 7
1987	371 ± 9	383 ± 16	402 ± 10	383 ± 7
1988	333 ± 13	327 ± 17	371 ± 16	351 ± 10
1989	366 ± 8	407 ± 14	414 ± 11	393 ± 6
1990	338 ± 16	401 ± 16	429 ± 9	385 ± 10
1991	326 ± 17	343 ± 16	394 ± 17	367 ± 10
1992	374 ± 15	373 ± 11	372 ± 11	373 ± 8
1993	441 ± 6	424 ± 8	424 ± 6	429 ± 4
1994	430 ± 19	433 ± 12	438 ± 7	436 ± 6
1995	408 ± 10	469 ± 9	461 ± 4	453 ± 4
1996	414 ± 7	454 ± 18	454 ± 8	444 ± 6
1997	411 ± 6	434 ± 10	404 ± 11	408 ± 7
1998	387 ± 6	421 ± 27	382 ± 17	388 ± 11
1999	387 ± 9	369 ± 13	433 ± 9	406 ± 6
2000	398 ± 11	407 ± 11	411 ± 9	406 ± 6
2001	375 ± 7	408 ± 23	402 ± 10	394 ± 7
2002	397 ± 9	406 ± 10	400 ± 13	400 ± 8
2003	399 ± 7	410 ± 11	433 ± 6	420 ± 4
2004	446 ± 9	438 ± 13	436 ± 9	439 ± 7
Red Drum				
1984	379 ± 11	415 ± 13	456 ± 10	418 ± 8
1985	436 ± 20	445 ± 17	463 ± 19	443 ± 12
1986	458 ± 16	447 ± 18	485 ± 8	462 ± 10
1987	458 ± 15	425 ± 20	524 ± 14	465 ± 10
1988	474 ± 19	460 ± 18	518 ± 19	478 ± 12
1989	441 ± 15	476 ± 9	533 ± 10	470 ± 9
1990	476 ± 23	463 ± 19	549 ± 18	493 ± 12
1991	438 ± 33	453 ± 14	515 ± 17	460 ± 13
1992	437 ± 11	477 ± 9	505 ± 8	463 ± 7
1993	499 ± 8	500 ± 14	557 ± 9	511 ± 6
1994	469 ± 10	476 ± 13	568 ± 6	492 ± 7
1995	459 ± 13	467 ± 11	522 ± 15	472 ± 8
1996	468 ± 7	464 ± 11	508 ± 11	477 ± 6
1997	492 ± 9	486 ± 12	511 ± 23	495 ± 8
1998	455 ± 14	435 ± 8	457 ± 9	452 ± 9
1999	484 ± 8	463 ± 11	499 ± 12	482 ± 6
2000	481 ± 9	520 ± 22	544 ± 10	509 ± 9
2001	467 ± 12	481 ± 11	511 ± 13	481 ± 7
2002	474 ± 11	441 ± 12	476 ± 10	467 ± 7
2003	489 ± 11	466 ± 10	509 ± 15	488 ± 8
2004	477 ± 9	474 ± 13	512 ± 13	487 ± 6

CTable 4. (Cont'd.)

Species Year	Aransas Bay	Corpus Christi Bay	Upper Laguna Madre	CBBEP
Sheepshead				
1984	436 ± 18	385 ± 19	415 ± 12	415 ± 10
1985	329 ± 21	351 ± 21	435 ± 18	354 ± 16
1986	304 ± 9	358 ± 10	409 ± 38	325 ± 9
1987	358 ± 9	341 ± 9	387 ± 19	355 ± 8
1988	302 ± 20	352 ± 16	397 ± 8	340 ± 18
1989	331 ± 17	361 ± 5	422 ± 9	356 ± 7
1990	359 ± 14	369 ± 17	422 ± 9	387 ± 9
1991	353 ± 15	413 ± 9	447 ± 16	413 ± 11
1992	308 ± 19	378 ± 14	442 ± 23	338 ± 13
1993	313 ± 16	404 ± 27	486 ± 16	350 ± 17
1994	365 ± 6	414 ± 17	454 ± 43	374 ± 6
1995	374 ± 9	350 ± 17	336 ± 40	367 ± 9
1996	372 ± 8	365 ± 11	468 ± 16	384 ± 9
1997	362 ± 9	372 ± 8	398 ± 12	369 ± 7
1998	347 ± 5	367 ± 12	390 ± 33	352 ± 4
1999	361 ± 12	383 ± 15	385 ± 12	365 ± 10
2000	367 ± 6	396 ± 14	422 ± 15	374 ± 6
2001	347 ± 7	367 ± 12	436 ± 9	375 ± 10
2002	380 ± 8	382 ± 14	408 ± 11	388 ± 7
2003	380 ± 7	388 ± 5	411 ± 17	385 ± 5
2004	382 ± 9	387 ± 13	470 ± 23	407 ± 15
Spotted Seatrout				
1984	453 ± 9	466 ± 11	401 ± 9	445 ± 7
1985	439 ± 8	438 ± 11	447 ± 9	441 ± 6
1986	445 ± 11	468 ± 15	459 ± 20	457 ± 9
1987	453 ± 9	465 ± 9	454 ± 14	458 ± 6
1988	430 ± 8	446 ± 9	433 ± 13	437 ± 6
1989	444 ± 10	476 ± 8	464 ± 9	460 ± 6
1990	458 ± 11	477 ± 10	501 ± 10	471 ± 7
1991	436 ± 13	450 ± 8	491 ± 13	459 ± 7
1992	463 ± 10	465 ± 12	510 ± 15	481 ± 8
1993	438 ± 11	436 ± 6	481 ± 18	450 ± 7
1994	440 ± 7	447 ± 9	451 ± 11	446 ± 5
1995	434 ± 8	455 ± 11	451 ± 9	445 ± 5
1996	430 ± 8	460 ± 8	430 ± 6	435 ± 5
1997	435 ± 7	477 ± 10	430 ± 7	443 ± 5
1998	442 ± 9	438 ± 8	454 ± 10	444 ± 6
1999	440 ± 8	446 ± 7	434 ± 12	440 ± 5
2000	450 ± 12	476 ± 12	453 ± 13	457 ± 7
2001	430 ± 6	441 ± 10	435 ± 11	434 ± 5
2002	433 ± 9	453 ± 10	435 ± 13	440 ± 6
2003	455 ± 10	453 ± 9	432 ± 12	446 ± 7
2004	447 ± 11	459 ± 10	475 ± 14	458 ± 7
Southern Flounder				
1984	324 ± 17	327 ± 12	327 ± 11	326 ± 8
1985	336 ± 10	335 ± 13	346 ± 9	341 ± 6
1986	349 ± 19	370 ± 13	367 ± 10	364 ± 8
1987	394 ± 16	335 ± 16	380 ± 29	372 ± 12
1988	371 ± 12	350 ± 15	418 ± 13	381 ± 9
1989	341 ± 13	335 ± 11	390 ± 33	347 ± 10
1990	343 ± 10	335 ± 19	278 ± 7	319 ± 8
1991	365 ± 12	354 ± 6	384 ± 6	370 ± 5
1992	385 ± 11	377 ± 12	462 ± 13	397 ± 8
1993	409 ± 11	378 ± 11	352 ± 17	388 ± 8
1994	384 ± 13	380 ± 10	416 ± 15	388 ± 8
1995	389 ± 15	379 ± 13	362 ± 27	382 ± 10
1996	363 ± 22	366 ± 14	386 ± 32	366 ± 12
1997	383 ± 17	377 ± 15	406 ± 23	385 ± 10
1998	368 ± 16	378 ± 11	375 ± 26	374 ± 9
1999	368 ± 8	396 ± 14	402 ± 35	377 ± 8
2000	382 ± 12	374 ± 15	370 ± 22	377 ± 9
2001	346 ± 10	378 ± 32	386 ± 36	358 ± 11
2002	400 ± 14	369 ± 11	423 ± 7	398 ± 8
2003	357 ± 15	406 ± 18	383 ± 20	378 ± 12
2004	380 ± 12	383 ± 14	461 ± 39	384 ± 9

Table 5. Annual mean catch rates (No./ha) ± 1SE of selected fishes and shellfish caught with 18.3-m bag seine by bay systems during 1984-2004.

Species Year	Aransas Bay	Corpus Christi Bay	Upper Laguna Madre	CBBEP
Atlantic Croaker				
1984	136.94 ± 46.41	173.86 ± 82.82	4.17 ± 1.90	101.64 ± 28.67
1985	45.56 ± 14.48	3.61 ± 1.80	11.11 ± 6.39	22.97 ± 6.28
1986	11.67 ± 3.43	12.22 ± 7.94	0.28 ± 0.28	7.96 ± 2.50
1987	8.89 ± 2.97	4.17 ± 1.65	0.28 ± 0.28	4.74 ± 1.28
1988	3.38 ± 2.01	7.73 ± 2.46	0.00 ± 0.00	3.37 ± 1.04
1989	18.29 ± 12.29	10.42 ± 5.35	0.00 ± 0.00	10.05 ± 5.13
1990	58.33 ± 23.36	14.24 ± 7.44	1.56 ± 1.40	27.63 ± 9.63
1991	62.85 ± 14.71	35.42 ± 10.79	10.76 ± 9.41	38.08 ± 7.32
1992	210.42 ± 56.38	94.72 ± 24.56	12.78 ± 5.57	113.39 ± 23.74
1993	24.58 ± 4.97	24.72 ± 20.29	1.94 ± 1.25	16.96 ± 5.67
1994	74.44 ± 41.71	25.28 ± 20.89	6.25 ± 4.62	38.56 ± 17.67
1995	35.97 ± 11.49	23.61 ± 17.09	1.81 ± 1.22	21.19 ± 6.44
1996	35.14 ± 10.95	5.83 ± 3.75	2.64 ± 2.64	16.50 ± 4.62
1997	56.67 ± 23.90	4.03 ± 1.16	5.56 ± 2.75	25.65 ± 9.67
1998	24.03 ± 5.23	58.61 ± 34.36	25.97 ± 13.85	33.70 ± 10.32
1999	61.25 ± 17.57	10.69 ± 3.53	10.69 ± 3.82	30.97 ± 7.28
2000	15.56 ± 5.66	8.89 ± 3.14	1.11 ± 0.62	8.93 ± 2.43
2001	50.56 ± 27.13	23.19 ± 12.70	1.39 ± 1.26	26.79 ± 11.39
2002	20.14 ± 7.13	55.28 ± 46.56	0.56 ± 0.28	22.67 ± 12.47
2003	25.42 ± 7.83	60.69 ± 21.22	3.47 ± 2.40	27.19 ± 6.45
2004	29.58 ± 13.39	18.75 ± 6.65	14.86 ± 10.33	21.78 ± 6.63
Black Drum				
1984	0.89 ± 0.45	0.00 ± 0.00	1.39 ± 0.69	0.83 ± 0.29
1985	0.56 ± 0.39	1.11 ± 0.88	6.11 ± 2.49	2.58 ± 0.90
1986	0.00 ± 0.00	0.28 ± 0.28	1.67 ± 1.03	0.64 ± 0.36
1987	0.00 ± 0.00	6.39 ± 4.52	44.17 ± 23.17	16.61 ± 7.98
1988	2.42 ± 1.74	1.93 ± 0.82	7.97 ± 3.30	4.17 ± 1.34
1989	2.78 ± 1.06	0.69 ± 0.52	10.65 ± 4.98	4.90 ± 1.75
1990	1.91 ± 0.75	15.10 ± 8.22	832.99 ± 246.79	286.53 ± 84.68
1991	0.52 ± 0.30	0.17 ± 0.17	60.59 ± 15.31	20.75 ± 5.31
1992	0.00 ± 0.00	2.64 ± 1.42	6.39 ± 1.92	2.85 ± 0.75
1993	0.28 ± 0.28	1.11 ± 0.85	1.39 ± 0.70	0.87 ± 0.34
1994	6.39 ± 3.08	4.17 ± 1.26	4.44 ± 3.53	5.15 ± 1.75
1995	3.61 ± 1.22	1.39 ± 0.68	77.36 ± 32.02	27.98 ± 10.91
1996	1.11 ± 0.85	0.28 ± 0.20	51.11 ± 17.50	17.81 ± 5.99
1997	10.83 ± 5.06	1.94 ± 0.70	192.22 ± 51.97	69.89 ± 17.94
1998	1.67 ± 0.75	4.44 ± 1.47	77.50 ± 66.38	28.05 ± 22.47
1999	7.50 ± 3.77	8.89 ± 3.05	16.25 ± 8.03	10.82 ± 3.21
2000	8.75 ± 3.02	3.06 ± 0.98	15.00 ± 4.64	9.38 ± 2.00
2001	1.11 ± 0.43	3.61 ± 1.64	125.69 ± 25.72	43.91 ± 8.98
2002	1.53 ± 0.79	1.39 ± 0.58	3.61 ± 1.25	2.20 ± 0.55
2003	0.69 ± 0.37	0.28 ± 0.28	1.39 ± 1.00	0.82 ± 0.38
2004	0.56 ± 0.34	0.42 ± 0.24	27.08 ± 9.50	9.49 ± 3.25
Red Drum				
1984	4.56 ± 1.45	4.15 ± 1.76	2.50 ± 1.73	3.76 ± 0.94
1985	18.33 ± 8.24	8.89 ± 3.50	1.11 ± 0.68	10.04 ± 3.45
1986	1.39 ± 0.73	3.89 ± 1.86	3.06 ± 1.63	2.60 ± 0.79
1987	8.89 ± 5.52	6.94 ± 3.34	1.94 ± 1.20	6.03 ± 2.41
1988	10.14 ± 3.25	9.42 ± 7.52	4.11 ± 2.73	7.91 ± 2.53
1989	8.10 ± 3.63	4.40 ± 1.24	1.39 ± 1.39	4.87 ± 1.57
1990	43.75 ± 25.98	20.49 ± 6.96	3.99 ± 2.00	24.24 ± 10.60
1991	25.52 ± 8.11	27.26 ± 8.86	5.03 ± 1.19	19.04 ± 4.02
1992	20.97 ± 4.79	7.36 ± 2.28	13.61 ± 5.42	14.93 ± 2.72
1993	13.33 ± 2.98	11.81 ± 3.90	8.47 ± 3.25	11.29 ± 1.92
1994	29.44 ± 9.08	52.50 ± 22.34	11.39 ± 3.14	29.35 ± 6.96
1995	15.14 ± 4.70	25.97 ± 6.75	7.36 ± 1.73	15.33 ± 2.65
1996	5.00 ± 1.69	8.06 ± 2.07	11.25 ± 2.73	7.91 ± 1.27
1997	8.75 ± 1.96	13.33 ± 3.22	6.39 ± 2.11	9.15 ± 1.35
1998	16.94 ± 5.09	42.92 ± 15.10	3.33 ± 1.00	19.11 ± 4.47
1999	19.03 ± 6.98	16.25 ± 4.17	11.94 ± 4.39	15.91 ± 3.35
2000	7.08 ± 3.04	11.81 ± 2.58	3.61 ± 1.00	7.14 ± 1.43
2001	11.67 ± 3.13	38.47 ± 12.82	5.56 ± 1.82	16.59 ± 3.65
2002	9.86 ± 3.45	36.25 ± 8.75	12.64 ± 4.26	17.68 ± 3.04
2003	10.28 ± 3.47	20.83 ± 5.13	5.14 ± 1.84	11.29 ± 2.04
2004	32.50 ± 19.22	45.97 ± 13.62	5.00 ± 1.49	26.71 ± 8.51

CTable 5. (Cont'd.)

Species Year	Aransas Bay	Corpus Christi Bay	Upper Laguna Madre	CBBEP
Sheepshead				
1984	0.33 ± 0.33	0.21 ± 0.21	0.00 ± 0.00	0.19 ± 0.14
1985	1.11 ± 0.68	0.00 ± 0.00	0.00 ± 0.00	0.45 ± 0.27
1986	0.56 ± 0.39	0.00 ± 0.00	0.00 ± 0.00	0.22 ± 0.16
1987	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
1988	0.72 ± 0.54	3.14 ± 2.70	0.00 ± 0.00	1.11 ± 0.74
1989	0.23 ± 0.23	0.00 ± 0.00	0.00 ± 0.00	0.09 ± 0.09
1990	0.17 ± 0.17	0.00 ± 0.00	0.00 ± 0.00	0.07 ± 0.07
1991	0.52 ± 0.39	0.00 ± 0.00	0.00 ± 0.00	0.21 ± 0.16
1992	0.28 ± 0.20	0.14 ± 0.14	0.00 ± 0.00	0.15 ± 0.09
1993	0.14 ± 0.14	0.14 ± 0.14	0.14 ± 0.14	0.14 ± 0.08
1994	1.25 ± 0.57	0.83 ± 0.52	0.42 ± 0.31	0.86 ± 0.28
1995	2.08 ± 0.74	0.28 ± 0.20	0.14 ± 0.14	0.95 ± 0.31
1996	0.69 ± 0.37	0.14 ± 0.14	0.00 ± 0.00	0.31 ± 0.15
1997	0.83 ± 0.39	1.11 ± 0.55	0.42 ± 0.42	0.76 ± 0.25
1998	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00	0.00 ± 0.00
1999	1.39 ± 0.78	0.00 ± 0.00	0.69 ± 0.37	0.79 ± 0.34
2000	0.42 ± 0.24	0.28 ± 0.20	0.00 ± 0.00	0.24 ± 0.11
2001	0.00 ± 0.00	0.00 ± 0.00	0.28 ± 0.28	0.09 ± 0.09
2002	0.69 ± 0.50	0.69 ± 0.37	0.00 ± 0.00	0.46 ± 0.22
2003	0.14 ± 0.14	0.00 ± 0.00	0.00 ± 0.00	0.06 ± 0.06
2004	0.14 ± 0.14	0.14 ± 0.14	0.00 ± 0.00	0.09 ± 0.07
Spotted Seatrout				
1984	13.11 ± 3.74	1.53 ± 0.79	1.67 ± 0.87	6.22 ± 1.57
1985	23.61 ± 8.27	3.33 ± 2.03	9.44 ± 3.40	13.53 ± 3.57
1986	11.94 ± 3.00	4.17 ± 1.70	1.39 ± 0.92	6.35 ± 1.34
1987	13.06 ± 4.20	10.00 ± 5.27	0.83 ± 0.62	8.12 ± 2.20
1988	27.78 ± 12.74	7.00 ± 2.13	5.07 ± 1.57	14.68 ± 5.18
1989	15.74 ± 4.56	6.02 ± 2.22	3.94 ± 1.69	9.21 ± 2.02
1990	14.41 ± 3.82	13.02 ± 3.69	2.08 ± 1.43	9.88 ± 1.88
1991	20.14 ± 4.78	7.81 ± 2.48	6.25 ± 2.17	12.23 ± 2.17
1992	12.22 ± 2.89	7.64 ± 2.08	17.92 ± 5.64	12.95 ± 2.30
1993	11.94 ± 2.86	7.08 ± 1.87	14.31 ± 5.07	11.48 ± 2.12
1994	28.47 ± 5.43	6.81 ± 1.43	5.28 ± 1.21	14.98 ± 2.29
1995	32.64 ± 6.93	4.72 ± 1.22	19.31 ± 4.93	20.85 ± 3.29
1996	12.08 ± 2.49	2.78 ± 1.20	8.75 ± 1.76	8.53 ± 1.21
1997	29.44 ± 8.00	9.44 ± 2.45	8.47 ± 2.47	17.14 ± 3.40
1998	16.53 ± 3.26	8.47 ± 2.42	17.92 ± 3.54	14.90 ± 1.88
1999	12.92 ± 2.98	5.42 ± 1.65	21.25 ± 4.08	13.78 ± 1.93
2000	8.89 ± 1.79	3.47 ± 0.97	21.39 ± 4.05	11.71 ± 1.59
2001	10.00 ± 2.15	5.28 ± 1.87	6.39 ± 1.45	7.55 ± 1.11
2002	13.19 ± 2.61	6.39 ± 1.69	10.00 ± 2.49	10.34 ± 1.42
2003	9.31 ± 1.72	11.81 ± 3.00	14.72 ± 3.62	11.79 ± 1.61
2004	11.25 ± 3.56	13.06 ± 3.64	16.53 ± 2.97	13.51 ± 1.99
Southern Flounder				
1984	2.61 ± 0.93	2.50 ± 1.35	0.83 ± 0.51	1.98 ± 0.54
1985	6.94 ± 2.33	5.28 ± 1.67	0.28 ± 0.28	4.25 ± 1.04
1986	3.89 ± 1.73	1.94 ± 1.20	0.56 ± 0.39	2.25 ± 0.77
1987	1.11 ± 0.68	1.39 ± 0.61	1.11 ± 0.88	1.18 ± 0.43
1988	5.31 ± 2.09	0.72 ± 0.42	0.48 ± 0.48	2.48 ± 0.87
1989	23.61 ± 19.73	8.10 ± 4.76	0.23 ± 0.23	11.66 ± 8.01
1990	3.12 ± 1.05	11.63 ± 3.33	3.82 ± 1.45	5.58 ± 1.09
1991	0.87 ± 0.46	1.91 ± 0.75	0.17 ± 0.17	0.90 ± 0.27
1992	0.69 ± 0.31	4.86 ± 2.11	0.14 ± 0.14	1.59 ± 0.57
1993	1.53 ± 0.57	2.92 ± 0.83	0.14 ± 0.14	1.42 ± 0.32
1994	4.86 ± 2.78	6.39 ± 2.53	0.28 ± 0.20	3.71 ± 1.30
1995	5.69 ± 2.56	4.72 ± 1.37	0.69 ± 0.42	3.75 ± 1.10
1996	2.50 ± 0.97	7.50 ± 2.40	0.97 ± 0.54	3.29 ± 0.76
1997	3.33 ± 1.53	6.94 ± 2.87	1.67 ± 0.58	3.71 ± 0.99
1998	5.97 ± 1.89	0.42 ± 0.31	1.11 ± 0.55	2.88 ± 0.79
1999	3.89 ± 1.37	2.36 ± 1.02	0.83 ± 0.48	2.46 ± 0.63
2000	0.56 ± 0.28	1.94 ± 0.73	0.14 ± 0.14	0.78 ± 0.23
2001	2.22 ± 0.64	3.47 ± 1.90	0.56 ± 0.28	1.98 ± 0.57
2002	0.69 ± 0.31	0.56 ± 0.28	0.28 ± 0.20	0.52 ± 0.16
2003	2.78 ± 1.86	1.25 ± 0.75	0.00 ± 0.00	1.44 ± 0.77
2004	3.33 ± 1.07	1.25 ± 0.89	0.42 ± 0.24	1.80 ± 0.50

CTable 5. (Cont'd.)

Species Year	Aransas Bay	Corpus Christi Bay	Upper Laguna Madre	CBBEP
Blue Crab				
1984	63.65 ± 10.54	63.86 ± 9.05	35.42 ± 7.02	54.15 ± 5.42
1985	141.11 ± 35.27	184.44 ± 50.43	73.06 ± 20.74	129.38 ± 20.61
1986	30.00 ± 6.44	76.67 ± 21.84	22.78 ± 5.88	39.72 ± 6.63
1987	35.28 ± 7.48	80.28 ± 21.66	49.72 ± 17.95	51.89 ± 8.84
1988	54.11 ± 9.23	89.37 ± 17.80	37.92 ± 10.12	57.82 ± 6.90
1989	55.56 ± 11.84	71.76 ± 12.98	22.45 ± 5.52	48.58 ± 6.18
1990	82.81 ± 13.43	149.13 ± 26.96	36.98 ± 8.94	84.59 ± 9.49
1991	106.60 ± 19.48	150.87 ± 21.50	49.13 ± 9.15	98.69 ± 10.20
1992	128.89 ± 19.26	163.19 ± 21.71	105.14 ± 14.56	129.80 ± 10.79
1993	102.36 ± 12.44	175.97 ± 24.80	66.81 ± 7.75	109.52 ± 8.68
1994	91.39 ± 14.71	207.92 ± 26.20	113.33 ± 13.96	129.19 ± 10.31
1995	55.56 ± 7.74	121.94 ± 25.26	62.36 ± 15.51	75.16 ± 9.02
1996	37.50 ± 6.56	118.75 ± 21.11	47.92 ± 8.31	62.20 ± 6.81
1997	64.44 ± 11.03	122.78 ± 19.45	60.83 ± 11.65	78.43 ± 7.84
1998	50.97 ± 9.59	101.67 ± 18.95	40.83 ± 8.91	60.76 ± 6.99
1999	38.75 ± 3.99	69.31 ± 10.95	57.36 ± 8.16	53.01 ± 4.30
2000	35.42 ± 12.03	64.72 ± 13.86	14.72 ± 3.01	36.05 ± 6.14
2001	49.58 ± 9.56	94.86 ± 14.59	26.39 ± 5.23	53.54 ± 5.75
2002	53.33 ± 6.81	91.25 ± 15.19	33.19 ± 4.86	56.40 ± 5.14
2003	86.81 ± 15.64	113.75 ± 17.63	49.17 ± 7.87	81.09 ± 8.24
2004	85.83 ± 13.47	110.83 ± 17.67	49.31 ± 11.85	79.99 ± 8.19
Brown Shrimp				
1984	646.49 ± 213.60	303.15 ± 83.67	78.33 ± 35.66	364.77 ± 90.02
1985	755.28 ± 168.92	369.72 ± 73.94	288.06 ± 98.67	496.71 ± 78.62
1986	231.11 ± 53.76	203.89 ± 72.33	192.78 ± 101.87	211.05 ± 44.70
1987	463.61 ± 197.48	292.78 ± 94.14	417.22 ± 230.85	403.39 ± 113.64
1988	356.76 ± 120.26	394.44 ± 118.35	756.52 ± 287.99	501.84 ± 113.11
1989	726.39 ± 157.03	521.76 ± 145.41	167.13 ± 107.97	483.84 ± 82.79
1990	1007.47 ± 224.46	591.84 ± 162.68	76.74 ± 39.92	584.24 ± 101.76
1991	511.46 ± 74.58	571.70 ± 154.87	248.26 ± 104.54	438.11 ± 61.62
1992	455.28 ± 75.56	621.25 ± 95.91	327.50 ± 68.27	455.31 ± 45.65
1993	568.06 ± 106.23	635.69 ± 155.85	278.75 ± 80.51	487.80 ± 65.03
1994	513.33 ± 104.52	708.61 ± 181.30	239.17 ± 76.04	471.47 ± 68.43
1995	359.44 ± 66.22	495.56 ± 86.34	477.36 ± 150.48	434.82 ± 61.65
1996	386.53 ± 72.48	265.69 ± 96.05	272.78 ± 107.92	316.55 ± 52.97
1997	739.17 ± 182.64	608.33 ± 178.25	1020.28 ± 774.19	800.17 ± 275.61
1998	521.81 ± 79.34	467.64 ± 106.51	620.00 ± 293.72	540.91 ± 107.85
1999	256.53 ± 36.93	286.11 ± 73.66	283.47 ± 88.20	273.35 ± 38.40
2000	566.67 ± 203.24	419.72 ± 89.83	206.81 ± 87.15	406.61 ± 90.92
2001	415.83 ± 89.15	420.42 ± 80.73	163.61 ± 81.35	331.69 ± 49.93
2002	365.56 ± 66.69	596.53 ± 127.34	170.42 ± 81.62	359.74 ± 51.06
2003	289.72 ± 59.02	458.47 ± 143.19	163.47 ± 79.76	290.99 ± 51.86
2004	590.42 ± 97.33	404.58 ± 112.44	241.81 ± 80.02	424.03 ± 56.05
Pink Shrimp				
1984	16.72 ± 5.02	35.49 ± 13.51	16.60 ± 9.24	21.57 ± 5.12
1985	17.50 ± 7.58	7.50 ± 4.16	8.06 ± 5.93	11.70 ± 3.80
1986	15.00 ± 9.31	24.72 ± 11.12	6.39 ± 2.93	14.62 ± 4.83
1987	10.83 ± 5.04	60.00 ± 21.78	13.89 ± 7.46	24.68 ± 6.60
1988	135.27 ± 47.41	105.56 ± 42.60	0.48 ± 0.48	81.92 ± 22.17
1989	44.91 ± 13.02	64.35 ± 18.30	20.37 ± 10.72	41.67 ± 7.97
1990	99.48 ± 36.11	106.42 ± 40.04	3.82 ± 1.79	68.92 ± 17.94
1991	60.94 ± 30.79	24.83 ± 7.26	31.42 ± 15.12	41.54 ± 13.49
1992	31.53 ± 10.94	77.36 ± 19.67	38.33 ± 11.26	45.78 ± 7.75
1993	57.78 ± 29.31	52.92 ± 16.08	31.81 ± 13.89	47.72 ± 13.32
1994	103.19 ± 43.57	149.03 ± 27.16	8.47 ± 3.29	83.09 ± 18.97
1995	87.50 ± 30.31	53.06 ± 19.79	7.22 ± 2.65	51.36 ± 13.32
1996	35.00 ± 10.41	25.28 ± 6.49	23.89 ± 7.35	28.71 ± 5.14
1997	52.36 ± 14.76	87.78 ± 34.08	12.64 ± 7.57	48.15 ± 11.01
1998	46.94 ± 15.55	46.67 ± 13.11	23.47 ± 14.50	38.93 ± 8.64
1999	26.53 ± 6.62	39.31 ± 12.50	14.03 ± 7.63	25.63 ± 4.94
2000	25.42 ± 13.38	33.75 ± 8.28	6.67 ± 2.61	21.25 ± 5.86
2001	99.44 ± 28.62	32.08 ± 10.16	18.47 ± 11.05	54.49 ± 12.43
2002	12.22 ± 4.26	81.81 ± 24.85	18.61 ± 10.90	32.52 ± 7.70
2003	47.36 ± 15.63	38.06 ± 11.93	4.17 ± 2.58	30.32 ± 7.08
2004	18.06 ± 5.29	69.17 ± 16.34	11.81 ± 5.52	29.26 ± 5.17

CTable 5. (Cont'd.)

Species Year	Aransas Bay	Corpus Christi Bay	Upper Laguna Madre	CBBEP
White Shrimp				
1984	447.06 ± 141.63	320.69 ± 127.00	17.78 ± 7.83	268.88 ± 66.40
1985	238.61 ± 105.51	33.33 ± 10.98	5.83 ± 2.55	106.35 ± 42.73
1986	286.67 ± 204.85	101.11 ± 43.15	2.50 ± 1.43	142.16 ± 82.97
1987	111.11 ± 70.89	151.67 ± 91.89	7.50 ± 5.36	86.63 ± 37.24
1988	424.88 ± 104.51	154.59 ± 53.98	73.19 ± 69.57	235.44 ± 50.63
1989	631.25 ± 315.65	371.76 ± 207.31	1.85 ± 0.97	350.67 ± 137.99
1990	818.75 ± 304.42	537.15 ± 206.02	35.07 ± 30.12	480.21 ± 134.33
1991	361.11 ± 113.12	445.49 ± 184.38	76.91 ± 42.69	286.95 ± 67.81
1992	211.11 ± 46.11	166.67 ± 46.14	32.22 ± 20.86	139.00 ± 23.33
1993	95.56 ± 30.95	875.83 ± 455.48	136.67 ± 60.20	312.84 ± 121.49
1994	447.36 ± 138.12	393.06 ± 133.77	54.58 ± 21.35	300.32 ± 66.11
1995	218.06 ± 45.93	269.72 ± 75.57	18.75 ± 4.49	164.09 ± 27.82
1996	94.44 ± 20.08	216.11 ± 132.29	13.06 ± 4.58	98.62 ± 35.50
1997	210.56 ± 88.55	162.92 ± 71.57	1.94 ± 1.31	127.56 ± 40.21
1998	258.47 ± 60.42	202.36 ± 50.69	15.14 ± 3.77	161.52 ± 27.90
1999	102.36 ± 39.45	285.69 ± 91.98	38.61 ± 16.90	128.58 ± 29.51
2000	96.25 ± 35.99	111.25 ± 48.71	2.36 ± 1.97	68.39 ± 19.29
2001	116.94 ± 33.94	343.33 ± 106.00	20.42 ± 9.99	143.29 ± 31.25
2002	88.61 ± 27.68	174.44 ± 62.78	60.69 ± 33.43	101.54 ± 22.80
2003	314.58 ± 119.14	347.64 ± 121.56	24.58 ± 5.77	225.08 ± 57.54
2004	159.03 ± 33.20	102.64 ± 25.48	35.42 ± 24.94	102.51 ± 17.19

Table 6. Annual mean catch rates (No./h) ± 1SE of selected fishes and shellfish caught with 6.1-m trawls in Texas bay systems during 1984-2004.

Species Year	Aransas Bay	Corpus Christi Bay	Upper Laguna Madre	CBBEP
Atlantic Croaker				
1984	52.28 ± 5.98	119.50 ± 11.65	14.53 ± 2.79	83.15 ± 6.69
1985	32.68 ± 5.12	41.67 ± 4.88	12.73 ± 2.13	35.01 ± 3.17
1986	57.73 ± 6.18	84.61 ± 6.42	14.37 ± 2.63	66.67 ± 4.12
1987	88.42 ± 10.79	50.45 ± 6.43	7.49 ± 1.71	58.68 ± 5.18
1988	101.87 ± 13.23	38.90 ± 4.18	5.09 ± 1.06	57.06 ± 5.32
1989	72.55 ± 9.57	40.82 ± 3.78	1.70 ± 0.45	47.31 ± 4.00
1990	46.26 ± 5.44	55.31 ± 8.14	12.13 ± 2.47	46.92 ± 4.72
1991	227.05 ± 23.25	75.30 ± 7.18	14.37 ± 4.10	121.53 ± 9.56
1992	242.51 ± 21.32	54.87 ± 7.67	16.92 ± 2.86	116.53 ± 9.31
1993	125.70 ± 17.15	37.10 ± 4.75	2.20 ± 0.58	64.17 ± 6.79
1994	57.11 ± 6.91	17.91 ± 2.81	2.10 ± 0.65	29.85 ± 2.96
1995	88.50 ± 10.48	42.61 ± 4.56	2.10 ± 0.68	53.94 ± 4.53
1996	60.78 ± 7.01	45.58 ± 5.38	7.58 ± 1.37	46.38 ± 3.80
1997	92.04 ± 11.77	60.60 ± 7.75	13.72 ± 2.60	66.06 ± 5.89
1998	75.42 ± 6.86	83.73 ± 12.00	9.58 ± 2.44	71.88 ± 6.81
1999	94.31 ± 12.48	55.21 ± 4.86	8.08 ± 2.29	63.34 ± 5.19
2000	80.59 ± 8.49	54.27 ± 5.41	3.89 ± 0.91	57.50 ± 4.21
2001	90.94 ± 8.93	65.19 ± 6.57	5.99 ± 1.23	67.16 ± 4.76
2002	115.32 ± 13.18	46.33 ± 5.26	4.49 ± 0.98	65.65 ± 5.60
2003	130.79 ± 15.19	87.25 ± 10.53	13.37 ± 3.54	93.73 ± 7.82
2004	74.73 ± 12.68	44.86 ± 6.81	10.53 ± 2.90	51.27 ± 5.79
Blue Crab				
1984	31.57 ± 2.83	7.83 ± 1.78	23.13 ± 3.18	18.05 ± 1.50
1985	22.70 ± 3.09	5.15 ± 0.64	20.13 ± 5.69	13.15 ± 1.38
1986	25.37 ± 3.35	14.47 ± 2.53	8.33 ± 1.67	17.58 ± 1.80
1987	18.01 ± 2.60	6.61 ± 0.86	8.08 ± 1.71	10.81 ± 1.07
1988	58.51 ± 9.35	7.21 ± 0.85	7.09 ± 1.42	25.30 ± 3.48
1989	24.10 ± 3.11	2.35 ± 0.34	2.54 ± 0.88	10.05 ± 1.19
1990	17.44 ± 2.65	13.97 ± 1.65	4.79 ± 1.28	14.09 ± 1.29
1991	52.10 ± 8.22	7.29 ± 1.03	4.69 ± 0.89	22.79 ± 3.08
1992	38.77 ± 5.97	10.10 ± 1.50	26.15 ± 4.98	22.15 ± 2.39
1993	35.18 ± 3.86	9.98 ± 1.17	16.67 ± 3.22	19.68 ± 1.62
1994	26.50 ± 3.69	3.32 ± 0.43	20.86 ± 3.81	13.61 ± 1.47
1995	11.58 ± 1.23	3.69 ± 0.70	11.13 ± 3.88	7.37 ± 0.75
1996	10.23 ± 1.23	4.94 ± 1.46	3.69 ± 0.78	6.66 ± 0.89
1997	12.20 ± 1.29	3.62 ± 0.62	7.04 ± 1.29	7.06 ± 0.60
1998	19.61 ± 1.83	6.46 ± 2.82	8.73 ± 1.95	11.38 ± 1.65
1999	8.86 ± 0.95	2.79 ± 0.33	8.43 ± 1.50	5.61 ± 0.44
2000	7.96 ± 0.72	1.75 ± 0.31	1.85 ± 0.50	3.95 ± 0.33
2001	12.30 ± 1.60	4.32 ± 0.91	0.90 ± 0.48	6.72 ± 0.76
2002	20.48 ± 2.09	2.77 ± 0.46	1.55 ± 0.46	8.88 ± 0.85
2003	9.46 ± 0.87	2.27 ± 0.30	7.14 ± 1.69	5.39 ± 0.42
2004	7.76 ± 0.83	3.34 ± 0.58	2.45 ± 0.65	4.79 ± 0.44
Brown Shrimp				
1984	106.63 ± 15.67	50.17 ± 14.28	24.00 ± 5.99	66.95 ± 9.43
1985	67.83 ± 12.88	23.60 ± 6.05	15.40 ± 3.02	38.23 ± 5.62
1986	113.00 ± 19.47	42.51 ± 8.00	7.49 ± 1.60	63.18 ± 8.19
1987	102.94 ± 20.57	67.19 ± 19.26	7.63 ± 1.57	72.65 ± 12.50
1988	141.09 ± 23.28	17.07 ± 2.16	5.64 ± 1.08	59.47 ± 8.63
1989	106.94 ± 24.49	16.89 ± 3.14	5.49 ± 1.88	47.30 ± 8.97
1990	79.54 ± 11.14	28.12 ± 5.39	12.62 ± 3.95	44.41 ± 4.98
1991	161.23 ± 21.02	29.17 ± 6.71	19.71 ± 5.13	74.64 ± 8.63
1992	65.39 ± 7.14	30.71 ± 7.24	40.22 ± 7.23	44.10 ± 4.69
1993	97.11 ± 13.35	22.73 ± 5.51	12.72 ± 2.81	47.78 ± 5.73
1994	37.48 ± 5.72	10.63 ± 2.31	18.76 ± 3.63	21.08 ± 2.45
1995	109.48 ± 27.10	22.93 ± 4.54	15.32 ± 2.71	52.56 ± 10.00
1996	70.48 ± 18.09	19.74 ± 4.73	13.07 ± 2.28	36.85 ± 6.92
1997	72.41 ± 16.44	16.02 ± 2.95	24.30 ± 6.35	36.92 ± 6.14
1998	33.56 ± 5.07	53.34 ± 10.64	24.30 ± 5.16	42.87 ± 5.93
1999	21.76 ± 7.77	5.94 ± 1.15	15.92 ± 3.69	12.72 ± 2.86
2000	48.10 ± 7.57	8.91 ± 2.04	16.92 ± 5.15	23.71 ± 3.04
2001	92.99 ± 37.94	22.73 ± 4.71	8.43 ± 2.13	45.81 ± 13.68
2002	38.22 ± 6.22	63.30 ± 18.12	10.98 ± 1.92	48.15 ± 9.81
2003	22.41 ± 4.23	6.34 ± 1.17	29.64 ± 13.07	14.81 ± 2.28
2004	25.97 ± 5.15	18.79 ± 4.78	18.66 ± 3.78	21.31 ± 3.14

CTable 6. (Cont'd.)

Species Year	Aransas Bay	Corpus Christi Bay	Upper Laguna Madre	CBBEP
Pink Shrimp				
1984	2.68 ± 0.90	3.02 ± 0.99	0.27 ± 0.16	2.57 ± 0.61
1985	3.80 ± 0.90	4.73 ± 1.01	4.27 ± 1.52	4.35 ± 0.64
1986	11.40 ± 2.34	12.15 ± 2.48	1.10 ± 0.43	10.56 ± 1.55
1987	5.99 ± 1.84	11.80 ± 1.53	0.85 ± 0.29	8.43 ± 1.04
1988	20.86 ± 3.01	8.66 ± 1.23	0.45 ± 0.20	11.98 ± 1.27
1989	14.42 ± 2.48	8.61 ± 1.81	0.45 ± 0.23	9.68 ± 1.30
1990	23.78 ± 8.16	4.29 ± 0.73	2.79 ± 1.96	10.99 ± 2.94
1991	27.25 ± 4.15	7.76 ± 1.50	4.14 ± 1.29	14.20 ± 1.71
1992	7.34 ± 2.15	9.93 ± 1.58	9.13 ± 2.84	8.92 ± 1.18
1993	5.51 ± 1.17	3.92 ± 0.91	1.05 ± 0.37	4.14 ± 0.64
1994	6.24 ± 1.35	4.59 ± 0.76	3.69 ± 0.94	5.06 ± 0.63
1995	4.02 ± 1.80	12.82 ± 3.55	4.19 ± 0.91	8.68 ± 1.98
1996	4.29 ± 0.93	4.94 ± 1.17	3.34 ± 1.00	4.52 ± 0.71
1997	13.67 ± 3.77	14.05 ± 4.20	2.15 ± 0.79	12.48 ± 2.58
1998	6.39 ± 1.56	14.15 ± 2.83	3.64 ± 1.20	10.14 ± 1.60
1999	2.12 ± 0.64	1.95 ± 0.40	5.94 ± 2.21	2.49 ± 0.41
2000	8.88 ± 1.95	2.59 ± 0.53	3.09 ± 2.70	4.87 ± 0.82
2001	9.26 ± 1.66	9.58 ± 4.46	5.59 ± 2.96	8.99 ± 2.44
2002	3.52 ± 0.55	5.86 ± 1.76	0.80 ± 0.41	4.43 ± 0.95
2003	0.67 ± 0.22	2.00 ± 0.57	1.20 ± 0.38	1.43 ± 0.31
2004	0.95 ± 0.25	4.09 ± 1.30	1.85 ± 0.62	2.71 ± 0.70
White Shrimp				
1984	38.08 ± 6.63	23.68 ± 7.32	10.13 ± 3.15	27.14 ± 4.53
1985	17.47 ± 4.57	21.58 ± 5.75	6.00 ± 3.11	18.26 ± 3.45
1986	12.82 ± 2.82	19.31 ± 8.17	3.49 ± 1.09	15.12 ± 4.42
1987	9.71 ± 2.11	15.29 ± 3.36	2.05 ± 0.47	11.73 ± 1.93
1988	16.07 ± 2.86	12.57 ± 2.93	3.24 ± 0.91	12.69 ± 1.85
1989	7.31 ± 1.34	9.46 ± 1.76	2.64 ± 0.77	7.88 ± 1.05
1990	13.72 ± 2.24	22.03 ± 6.20	21.66 ± 4.74	19.05 ± 3.41
1991	30.81 ± 5.23	24.83 ± 10.49	13.92 ± 6.89	25.63 ± 5.88
1992	53.64 ± 6.92	5.51 ± 1.46	5.64 ± 1.43	22.52 ± 2.73
1993	19.81 ± 3.14	10.18 ± 4.70	14.62 ± 3.84	14.11 ± 2.75
1994	6.31 ± 1.41	34.51 ± 11.89	10.48 ± 2.20	21.66 ± 6.30
1995	9.21 ± 2.24	5.86 ± 1.73	7.34 ± 1.28	7.22 ± 1.21
1996	4.77 ± 1.36	3.27 ± 0.77	3.54 ± 0.96	3.83 ± 0.64
1997	28.09 ± 4.84	3.72 ± 1.14	1.90 ± 0.73	12.10 ± 1.87
1998	34.53 ± 4.75	8.63 ± 2.75	5.14 ± 1.16	17.35 ± 2.28
1999	20.86 ± 3.78	18.01 ± 10.45	6.69 ± 2.54	17.66 ± 5.67
2000	10.78 ± 1.82	2.89 ± 0.60	2.25 ± 0.50	5.60 ± 0.74
2001	17.79 ± 3.17	2.77 ± 0.72	9.63 ± 2.41	8.90 ± 1.25
2002	56.54 ± 7.11	9.13 ± 1.91	4.69 ± 0.89	25.33 ± 2.86
2003	69.44 ± 12.11	15.79 ± 8.42	5.59 ± 1.47	33.50 ± 6.24
2004	29.22 ± 6.00	2.42 ± 0.47	11.08 ± 2.75	12.92 ± 2.22

Table 7. Estimated annual and seasonal private sport-boat fish landings(no.) $\pm$ 1 SE, catch rates (no./man-h)$\pm$ 1 SE, and fishing pressure (man-h), and , in bays and passes in the Coastal Bend Bays and Estuary Program's area, by bay system, species and creel year (1984-2005).

	Landings (landings/SE)			Catch Rate (#/h/SE)			Man-Hours		
	High-Use	Low-Use	Annual	High-Use	Low-Use	Annual	High-Use	Low-Use	Total
Atlantic Croaker									
Aransas Bay									
1983-1984	14021 / 6041	0 / 0	14021 / 6041	0.04 / 0.02	0.00 / 0.00	0.03 / 0.02	327868	77640	405508
1984-1985	2350 / 1793	127 / 127	2477 / 1798	0.01 / 0.01	0.00 / 0.00	0.01 / 0.01	175336	76754	252090
1985-1986	1457 / 779	0 / 0	1457 / 779	0.01 / 0.00	0.00 / 0.00	0.00 / 0.00	276076	157483	433559
1986-1987	1121 / 731	0 / 0	1121 / 731	0.01 / 0.00	0.00 / 0.00	0.00 / 0.00	201301	173081	374382
1987-1988	6413 / 3023	0 / 0	6413 / 3023	0.02 / 0.01	0.00 / 0.00	0.01 / 0.01	396123	169760	565884
1988-1989	15302 / 14621	0 / 0	15302 / 14621	0.04 / 0.04	0.00 / 0.00	0.03 / 0.03	373126	132999	506125
1989-1990	103 / 86	0 / 0	103 / 86	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	317709	118675	436384
1990-1991	489 / 311	85 / 85	574 / 322	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	281163	118299	399461
1991-1992	1225 / 1027	0 / 0	1225 / 1027	0.01 / 0.00	0.00 / 0.00	0.00 / 0.00	241887	175435	417322
1992-1993	2343 / 1298	0 / 0	2343 / 1298	0.01 / 0.00	0.00 / 0.00	0.00 / 0.00	361124	181188	542312
1993-1994	551 / 276	0 / 0	551 / 276	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	452478	254753	707232
1994-1995	3186 / 2460	0 / 0	3186 / 2460	0.01 / 0.01	0.00 / 0.00	0.00 / 0.00	449480	237611	687090
1995-1996	346 / 202	0 / 0	346 / 202	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	454956	213413	668370
1996-1997	419 / 196	0 / 0	419 / 196	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	433775	109476	543252
1997-1998	84 / 48	0 / 0	84 / 48	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	485701	166670	652371
1998-1999	385 / 233	0 / 0	385 / 233	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	463840	258660	722500
1999-2000	698 / 410	0 / 0	698 / 410	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	514852	309242	824093
2000-2001	21 / 21	0 / 0	21 / 21	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	423619	255553	679172
2001-2002	158 / 124	3937 / 3937	4095 / 3939	0.00 / 0.00	0.02 / 0.02	0.01 / 0.01	455543	200168	655710
2002-2003	622 / 423	0 / 0	622 / 423	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	432706	222943	655649
2003-2004	130 / 94	0 / 0	130 / 94	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	452030	232563	684593
2004-2005	385 / 348	0 / 0	385 / 348	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	488701	181974	670674
Corpus Christi Bay									
1983-1984	48331 / 19490	23726 / 23726	72056 / 30705	0.14 / 0.06	0.34 / 0.34	0.18 / 0.08	340533	69262	409795
1984-1985	7333 / 2807	746 / 618	8079 / 2875	0.04 / 0.02	0.01 / 0.01	0.03 / 0.01	167494	118670	286164
1985-1986	12946 / 6958	44 / 44	12991 / 6958	0.06 / 0.03	0.00 / 0.00	0.03 / 0.02	213144	166187	379331
1986-1987	7614 / 2401	80 / 56	7694 / 2402	0.04 / 0.01	0.00 / 0.00	0.02 / 0.01	213381	107337	320717
1987-1988	29141 / 9620	15424 / 14794	44565 / 17647	0.11 / 0.04	0.06 / 0.06	0.08 / 0.04	264650	262484	527133
1988-1989	10839 / 7777	3233 / 2898	14072 / 8299	0.04 / 0.03	0.02 / 0.02	0.03 / 0.02	265713	154235	419948
1989-1990	4447 / 3310	117 / 117	4564 / 3312	0.02 / 0.01	0.00 / 0.00	0.01 / 0.01	223372	158969	382342
1990-1991	1393 / 557	0 / 0	1393 / 557	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	397315	154340	551655
1991-1992	10134 / 5853	356 / 286	10489 / 5860	0.04 / 0.02	0.00 / 0.00	0.02 / 0.01	263415	212769	476185
1992-1993	5595 / 1907	158 / 90	5753 / 1909	0.02 / 0.01	0.00 / 0.00	0.01 / 0.00	246155	254421	500576
1993-1994	4324 / 1308	211 / 128	4535 / 1314	0.01 / 0.00	0.00 / 0.00	0.01 / 0.00	302521	180763	483283
1994-1995	2489 / 769	430 / 222	2919 / 800	0.01 / 0.00	0.00 / 0.00	0.01 / 0.00	357224	209207	566431
1995-1996	3001 / 1538	2434 / 1172	5435 / 1933	0.01 / 0.00	0.01 / 0.01	0.01 / 0.00	328802	217603	546485
1996-1997	3404 / 1406	1316 / 805	4721 / 1620	0.01 / 0.01	0.01 / 0.00	0.01 / 0.00	248243	176641	424884
1997-1998	2590 / 1234	380 / 257	2970 / 1260	0.01 / 0.00	0.00 / 0.00	0.01 / 0.00	277504	148092	425596
1998-1999	3127 / 991	839 / 423	3966 / 1078	0.01 / 0.00	0.00 / 0.00	0.01 / 0.00	310363	188639	499002
1999-2000	3194 / 923	1308 / 669	4502 / 1140	0.01 / 0.00	0.01 / 0.00	0.01 / 0.00	296422	219082	515504
2000-2001	777 / 465	56 / 56	833 / 468	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	324127	180073	504200
2001-2002	1252 / 590	444 / 388	1696 / 706	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	272877	148280	421157
2002-2003	1437 / 628	0 / 0	1437 / 628	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	293063	185862	478924
2003-2004	628 / 397	41 / 41	668 / 399	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	264002	136862	400864
2004-2005	644 / 397	326 / 210	971 / 449	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	261285	216977	478262

CTable 7. (Cont'd.)

	Landings (landings/SE)			Catch Rate (#/h/SE)			Man-Hours		
	High-Use	Low-Use	Annual	High-Use	Low-Use	Annual	High-Use	Low-Use	Total
Atlantic Croaker (Cont'd.)									
Upper Laguna Madre									
1983-1984	22746 / 4491	0 / 0	22746 / 4491	0.07 / 0.01	0.00 / 0.00	0.06 / 0.01	321081	54562	375643
1984-1985	1700 / 545	580 / 511	2280 / 747	0.02 / 0.01	0.01 / 0.01	0.01 / 0.00	75991	98341	174332
1985-1986	11312 / 2221	1546 / 1333	12858 / 2590	0.05 / 0.01	0.01 / 0.01	0.03 / 0.01	218888	184679	403567
1986-1987	9103 / 2669	2357 / 1263	11460 / 2952	0.04 / 0.01	0.01 / 0.01	0.03 / 0.01	226078	210277	436355
1987-1988	12091 / 2882	360 / 360	12451 / 2904	0.04 / 0.01	0.00 / 0.00	0.02 / 0.01	306906	203741	510647
1988-1989	5537 / 1232	443 / 330	5980 / 1275	0.02 / 0.00	0.00 / 0.00	0.01 / 0.00	282048	157420	440276
1989-1990	6634 / 2111	0 / 0	6634 / 2111	0.02 / 0.01	0.00 / 0.00	0.02 / 0.01	277847	136404	414251
1990-1991	1758 / 1188	675 / 675	2433 / 1366	0.02 / 0.02	0.01 / 0.01	0.01 / 0.01	73879	90875	164755
1991-1992	3461 / 944	610 / 610	4071 / 1124	0.02 / 0.01	0.00 / 0.00	0.01 / 0.00	146996	142278	289274
1992-1993	6169 / 2587	286 / 247	6455 / 2599	0.03 / 0.01	0.00 / 0.00	0.02 / 0.01	188267	168045	356312
1993-1994	5163 / 1617	47 / 47	5210 / 1618	0.03 / 0.01	0.00 / 0.00	0.02 / 0.01	171242	177167	348409
1994-1995	1338 / 350	452 / 280	1790 / 448	0.01 / 0.00	0.00 / 0.00	0.00 / 0.00	186777	178841	365618
1995-1996	2556 / 1082	621 / 519	3177 / 1200	0.01 / 0.00	0.01 / 0.00	0.01 / 0.00	230833	113955	344788
1996-1997	2537 / 790	359 / 262	2896 / 832	0.01 / 0.00	0.00 / 0.00	0.01 / 0.00	190011	107176	297187
1997-1998	2231 / 462	42 / 42	2273 / 464	0.01 / 0.00	0.00 / 0.00	0.01 / 0.00	231559	133907	365466
1998-1999	3118 / 1190	135 / 85	3253 / 1193	0.01 / 0.01	0.00 / 0.00	0.01 / 0.00	223959	184654	408613
1999-2000	1576 / 466	224 / 98	1799 / 477	0.01 / 0.00	0.00 / 0.00	0.00 / 0.00	297226	180707	477934
2000-2001	537 / 181	293 / 162	830 / 243	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	302563	117139	419702
2001-2002	369 / 110	22 / 22	391 / 112	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	208172	148532	356704
2002-2003	370 / 154	77 / 77	447 / 172	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	226512	136302	362814
2003-2004	1178 / 949	194 / 194	1372 / 969	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	251224	167139	418363
2004-2005	540 / 259	0 / 0	540 / 259	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	284663	174039	458702
Black Drum									
Aransas Bay									
1983-1984	8411 / 3268	3000 / 2225	11411 / 3954	0.03 / 0.01	0.04 / 0.03	0.03 / 0.01	327868	77640	405508
1984-1985	27 / 27	2488 / 2408	2515 / 2408	0.00 / 0.00	0.03 / 0.03	0.01 / 0.01	175336	76754	252090
1985-1986	1250 / 759	173 / 137	1423 / 771	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	276076	157483	433559
1986-1987	349 / 167	1929 / 958	2278 / 972	0.00 / 0.00	0.01 / 0.01	0.01 / 0.00	201301	173081	374382
1987-1988	2643 / 1547	104 / 104	2747 / 1551	0.01 / 0.00	0.00 / 0.00	0.00 / 0.00	396123	169760	565884
1988-1989	1715 / 543	656 / 417	2371 / 685	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	373126	132999	506125
1989-1990	1682 / 735	1306 / 664	2988 / 991	0.01 / 0.00	0.01 / 0.01	0.01 / 0.00	317709	118675	436384
1990-1991	6635 / 6169	2752 / 2346	9387 / 6600	0.02 / 0.02	0.02 / 0.02	0.02 / 0.02	281163	118299	399461
1991-1992	1269 / 360	1478 / 614	2746 / 712	0.01 / 0.00	0.01 / 0.00	0.01 / 0.00	241887	175435	417322
1992-1993	4156 / 1194	2560 / 1008	6717 / 1563	0.01 / 0.00	0.01 / 0.01	0.01 / 0.00	361124	181188	542312
1993-1994	4696 / 1311	6926 / 1990	11622 / 2382	0.01 / 0.00	0.03 / 0.01	0.02 / 0.00	452478	254753	707232
1994-1995	4944 / 1662	4154 / 1184	9098 / 2041	0.01 / 0.00	0.02 / 0.01	0.01 / 0.00	449480	237611	687090
1995-1996	3533 / 1039	6082 / 1791	9616 / 2071	0.01 / 0.00	0.03 / 0.01	0.01 / 0.00	454956	213413	668370
1996-1997	4340 / 1306	2350 / 1149	6690 / 1739	0.01 / 0.00	0.02 / 0.01	0.01 / 0.00	433775	109476	543252
1997-1998	5079 / 1201	2172 / 822	7251 / 1456	0.01 / 0.00	0.01 / 0.01	0.01 / 0.00	485701	166670	652371
1998-1999	2793 / 595	4676 / 2150	7469 / 2231	0.01 / 0.00	0.02 / 0.01	0.01 / 0.00	463840	258660	722500
1999-2000	2478 / 767	4462 / 2295	6940 / 2420	0.00 / 0.00	0.01 / 0.01	0.01 / 0.00	514852	309242	824093
2000-2001	6318 / 2664	1956 / 643	8275 / 2740	0.01 / 0.01	0.01 / 0.00	0.01 / 0.00	423619	255553	679172
2001-2002	8888 / 1754	3345 / 1136	12233 / 2090	0.02 / 0.00	0.02 / 0.01	0.02 / 0.00	455543	200168	655710
2002-2003	3657 / 888	8673 / 4412	12330 / 4500	0.01 / 0.00	0.04 / 0.02	0.02 / 0.01	432706	222943	655649
2003-2004	9140 / 3706	4603 / 1795	13742 / 4118	0.02 / 0.01	0.02 / 0.01	0.02 / 0.01	452030	232563	684593
2004-2005	3382 / 1062	1148 / 612	4530 / 1226	0.01 / 0.00	0.01 / 0.00	0.01 / 0.00	488701	181974	670674

CTable 7. (Cont'd.)

	Landings (landings/SE)			Catch Rate (#/h/SE)			Man-Hours		
	High-Use	Low-Use	Annual	High-Use	Low-Use	Annual	High-Use	Low-Use	Total
Black Drum (Cont'd.)									
Corpus Christi Bay									
1983-1984	4648 / 1293	3296 / 1932	7944 / 2325	0.01 / 0.00	0.05 / 0.03	0.02 / 0.01	340533	69262	409795
1984-1985	1605 / 556	742 / 528	2347 / 767	0.01 / 0.00	0.01 / 0.00	0.01 / 0.00	167494	118670	286164
1985-1986	3106 / 1693	7769 / 6402	10955 / 6622	0.01 / 0.01	0.05 / 0.04	0.03 / 0.02	213144	166187	379331
1986-1987	695 / 251	274 / 155	969 / 295	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	213381	107337	320717
1987-1988	970 / 358	1176 / 606	2146 / 704	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	264650	262484	527133
1988-1989	1712 / 781	3043 / 1476	4755 / 1670	0.01 / 0.00	0.02 / 0.01	0.01 / 0.00	265713	154235	419948
1989-1990	3804 / 1480	2118 / 1201	5922 / 1906	0.02 / 0.01	0.01 / 0.01	0.02 / 0.01	223372	158969	382342
1990-1991	8835 / 4826	2300 / 1367	11135 / 5016	0.02 / 0.01	0.01 / 0.01	0.02 / 0.01	397315	154340	551655
1991-1992	1200 / 466	2852 / 1178	4052 / 1267	0.00 / 0.00	0.01 / 0.01	0.01 / 0.00	263415	212769	476185
1992-1993	3736 / 816	8027 / 2559	11763 / 2686	0.02 / 0.00	0.03 / 0.01	0.02 / 0.01	246155	254421	500576
1993-1994	7424 / 2031	3637 / 1287	11060 / 2404	0.02 / 0.01	0.02 / 0.01	0.02 / 0.01	302521	180763	483283
1994-1995	6326 / 1374	10526 / 2831	16852 / 3146	0.02 / 0.00	0.05 / 0.02	0.03 / 0.01	357224	209207	566431
1995-1996	4386 / 950	5980 / 1640	10366 / 1895	0.01 / 0.00	0.03 / 0.01	0.02 / 0.00	328802	217603	546485
1996-1997	3597 / 845	2956 / 805	6552 / 1167	0.01 / 0.00	0.02 / 0.01	0.02 / 0.00	248243	176641	424884
1997-1998	3284 / 1054	4691 / 3810	7975 / 3953	0.01 / 0.00	0.03 / 0.03	0.02 / 0.01	277504	148092	425596
1998-1999	2000 / 627	2009 / 780	4009 / 1001	0.01 / 0.00	0.01 / 0.00	0.01 / 0.00	310363	188639	499002
1999-2000	1665 / 496	1232 / 479	2897 / 690	0.01 / 0.00	0.01 / 0.00	0.01 / 0.00	296422	219082	515504
2000-2001	3170 / 1006	1351 / 602	4521 / 1172	0.01 / 0.00	0.01 / 0.00	0.01 / 0.00	324127	180073	504200
2001-2002	2469 / 593	915 / 401	3384 / 716	0.01 / 0.00	0.01 / 0.00	0.01 / 0.00	272877	148280	421157
2002-2003	2834 / 936	1291 / 544	4125 / 1083	0.01 / 0.00	0.01 / 0.00	0.01 / 0.00	293063	185862	478924
2003-2004	1638 / 1014	1272 / 586	2910 / 1171	0.01 / 0.00	0.01 / 0.00	0.01 / 0.00	264002	136862	400864
2004-2005	711 / 207	2365 / 1103	3076 / 1123	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	261285	216977	478262
Upper Laguna Madre									
1983-1984	1246 / 316	50 / 50	1296 / 320	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	321081	54562	375643
1984-1985	121 / 63	575 / 537	696 / 540	0.00 / 0.00	0.01 / 0.01	0.00 / 0.00	75991	98341	174332
1985-1986	2641 / 981	1984 / 1767	4625 / 2021	0.01 / 0.00	0.01 / 0.01	0.01 / 0.01	218888	184679	403567
1986-1987	436 / 127	1716 / 1134	2152 / 1141	0.00 / 0.00	0.01 / 0.01	0.00 / 0.00	226078	210277	436355
1987-1988	2950 / 1039	479 / 353	3429 / 1097	0.01 / 0.00	0.00 / 0.00	0.01 / 0.00	306906	203741	510647
1988-1989	7653 / 4274	582 / 274	8235 / 4283	0.03 / 0.02	0.00 / 0.00	0.02 / 0.01	282048	157420	440276
1989-1990	4145 / 1288	647 / 478	4792 / 1374	0.01 / 0.00	0.00 / 0.00	0.01 / 0.00	277847	136404	414251
1990-1991	287 / 137	1649 / 1130	1936 / 1138	0.00 / 0.00	0.01 / 0.01	0.01 / 0.01	73879	90875	164755
1991-1992	2682 / 1152	3889 / 1637	6570 / 2001	0.02 / 0.01	0.03 / 0.01	0.02 / 0.01	146996	142278	289274
1992-1993	5359 / 1991	1759 / 609	7118 / 2082	0.03 / 0.01	0.01 / 0.00	0.02 / 0.01	188267	168045	356312
1993-1994	10088 / 3011	8413 / 3337	18501 / 4495	0.06 / 0.02	0.05 / 0.02	0.05 / 0.01	171242	177167	348409
1994-1995	13748 / 2345	6426 / 1386	20174 / 2724	0.07 / 0.01	0.04 / 0.01	0.06 / 0.01	186777	178841	365618
1995-1996	5912 / 1408	5616 / 1841	11528 / 2318	0.03 / 0.01	0.05 / 0.02	0.03 / 0.01	230833	113955	344788
1996-1997	5955 / 905	12522 / 6587	18477 / 6649	0.03 / 0.01	0.12 / 0.06	0.06 / 0.02	190011	107176	297187
1997-1998	5009 / 1496	4901 / 3151	9910 / 3488	0.02 / 0.01	0.04 / 0.02	0.03 / 0.01	231559	133907	365466
1998-1999	2832 / 913	3463 / 1105	6295 / 1434	0.01 / 0.00	0.02 / 0.01	0.02 / 0.00	223959	184654	408613
1999-2000	2694 / 572	7409 / 2345	10103 / 2413	0.01 / 0.00	0.04 / 0.01	0.02 / 0.01	297226	180707	477934
2000-2001	5677 / 2182	2630 / 726	8307 / 2300	0.02 / 0.01	0.02 / 0.01	0.02 / 0.01	302563	117139	419702
2001-2002	4026 / 725	3165 / 1090	7191 / 1309	0.02 / 0.00	0.02 / 0.01	0.02 / 0.00	208172	148532	356704
2002-2003	1798 / 357	2802 / 1395	4600 / 1440	0.01 / 0.00	0.02 / 0.01	0.01 / 0.00	226512	136302	362814
2003-2004	2268 / 527	3224 / 1653	5492 / 1735	0.01 / 0.00	0.02 / 0.01	0.01 / 0.00	251224	167139	418363
2004-2005	3704 / 927	3850 / 1161	7554 / 1486	0.01 / 0.00	0.02 / 0.01	0.02 / 0.00	284663	174039	458702

CTable 7. (Cont'd.)

	Landings (landings/SE)			Catch Rate (#/h/SE)			Man-Hours		
	High-Use	Low-Use	Annual	High-Use	Low-Use	Annual	High-Use	Low-Use	Total
Red Drum									
Aransas Bay									
1983-1984	29212 / 9146	1721 / 1435	30933 / 9258	0.09 / 0.03	0.02 / 0.02	0.08 / 0.02	327868	77640	405508
1984-1985	5400 / 1537	2439 / 1331	7839 / 2033	0.03 / 0.01	0.03 / 0.02	0.03 / 0.01	175336	76754	252090
1985-1986	16203 / 3355	4577 / 1487	20779 / 3669	0.06 / 0.01	0.03 / 0.01	0.05 / 0.01	276076	157483	433559
1986-1987	11573 / 2349	12839 / 5524	24412 / 6003	0.06 / 0.01	0.07 / 0.04	0.07 / 0.02	201301	173081	374382
1987-1988	10104 / 2817	2269 / 994	20373 / 2988	0.05 / 0.01	0.01 / 0.01	0.04 / 0.01	396123	169760	565884
1988-1989	19953 / 3304	7195 / 2947	27147 / 4427	0.05 / 0.01	0.05 / 0.03	0.05 / 0.01	373126	132999	506125
1989-1990	9674 / 1668	3826 / 1991	13501 / 2597	0.03 / 0.01	0.03 / 0.02	0.03 / 0.01	317709	118675	436384
1990-1991	10211 / 3839	2656 / 1719	12868 / 4207	0.04 / 0.01	0.02 / 0.02	0.03 / 0.01	281163	118299	399461
1991-1992	10635 / 1926	10924 / 3029	21760 / 3589	0.04 / 0.01	0.06 / 0.02	0.05 / 0.01	241887	175435	417322
1992-1993	20321 / 3327	15547 / 4259	35868 / 5405	0.06 / 0.01	0.09 / 0.03	0.07 / 0.01	361124	181188	542312
1993-1994	45753 / 5178	23311 / 4135	69065 / 6626	0.10 / 0.01	0.09 / 0.02	0.10 / 0.01	452478	254753	707232
1994-1995	29836 / 3295	15253 / 3041	45089 / 4483	0.07 / 0.01	0.06 / 0.02	0.07 / 0.01	449480	237611	687090
1995-1996	22800 / 2544	14175 / 3216	36975 / 4100	0.05 / 0.01	0.07 / 0.02	0.06 / 0.01	454956	213413	668370
1996-1997	21810 / 2668	5432 / 1287	27243 / 2962	0.05 / 0.01	0.05 / 0.02	0.05 / 0.01	433775	109476	543252
1997-1998	26389 / 2940	8525 / 2006	34914 / 3559	0.05 / 0.01	0.05 / 0.02	0.05 / 0.01	485701	166670	652371
1998-1999	20130 / 2257	13671 / 3351	33802 / 4040	0.04 / 0.01	0.05 / 0.02	0.05 / 0.01	463840	258660	722500
1999-2000	27168 / 3812	19860 / 3691	47028 / 5306	0.05 / 0.01	0.06 / 0.02	0.06 / 0.01	514852	309242	824093
2000-2001	20407 / 2470	11990 / 2803	32397 / 3735	0.05 / 0.01	0.05 / 0.01	0.05 / 0.01	423619	255553	679172
2001-2002	23912 / 2566	8451 / 2029	32362 / 3271	0.05 / 0.01	0.04 / 0.01	0.05 / 0.01	455543	200168	655710
2002-2003	14573 / 1988	8387 / 2017	22960 / 2832	0.03 / 0.01	0.04 / 0.01	0.04 / 0.01	432706	222943	655649
2003-2004	25275 / 3555	15107 / 4440	40383 / 5688	0.06 / 0.01	0.07 / 0.02	0.06 / 0.01	452030	232563	684593
2004-2005	21464 / 2936	11753 / 3365	33217 / 4466	0.04 / 0.01	0.07 / 0.02	0.05 / 0.00	488701	181974	670674
Corpus Christi Bay									
1983-1984	7304 / 1557	2532 / 1314	9836 / 2037	0.02 / 0.01	0.04 / 0.02	0.02 / 0.01	340533	69262	409795
1984-1985	5765 / 1365	2241 / 1238	8006 / 1843	0.03 / 0.01	0.01 / 0.01	0.03 / 0.01	167494	118670	286164
1985-1986	10002 / 2746	2076 / 910	12078 / 2895	0.05 / 0.01	0.01 / 0.01	0.03 / 0.01	213144	166187	379331
1986-1987	11080 / 2509	4775 / 1679	15855 / 3019	0.05 / 0.01	0.04 / 0.02	0.05 / 0.01	213381	107337	320717
1987-1988	9344 / 2022	8178 / 4836	17521 / 5242	0.04 / 0.01	0.03 / 0.02	0.03 / 0.01	264650	262484	527133
1988-1989	9101 / 1906	3212 / 1412	12313 / 2372	0.03 / 0.01	0.02 / 0.01	0.03 / 0.01	265713	154235	419948
1989-1990	7964 / 2083	3893 / 1161	11857 / 2385	0.04 / 0.01	0.02 / 0.01	0.03 / 0.01	223372	158969	382342
1990-1991	15585 / 2956	2250 / 957	17835 / 3107	0.04 / 0.01	0.01 / 0.01	0.03 / 0.01	397315	154340	551655
1991-1992	12725 / 3537	6926 / 3038	19651 / 4663	0.05 / 0.01	0.03 / 0.02	0.04 / 0.01	263415	212769	476185
1992-1993	11915 / 1577	11527 / 2809	23442 / 3221	0.05 / 0.01	0.05 / 0.01	0.05 / 0.01	246155	254421	500576
1993-1994	23519 / 2944	6272 / 1608	29791 / 3354	0.08 / 0.01	0.03 / 0.01	0.06 / 0.01	302521	180763	483283
1994-1995	17004 / 1787	6659 / 1606	23663 / 2403	0.05 / 0.01	0.03 / 0.01	0.04 / 0.01	357224	209207	566431
1995-1996	12736 / 1675	11139 / 3930	23875 / 4272	0.04 / 0.01	0.05 / 0.02	0.04 / 0.01	328802	217603	546485
1996-1997	10637 / 1530	4069 / 1273	14706 / 1990	0.04 / 0.01	0.02 / 0.01	0.03 / 0.01	248243	176641	424884
1997-1998	12374 / 1589	4000 / 1178	16374 / 1978	0.04 / 0.01	0.03 / 0.01	0.04 / 0.01	277504	148092	425596
1998-1999	16129 / 1927	7788 / 1780	23917 / 2623	0.05 / 0.01	0.04 / 0.01	0.05 / 0.01	310363	188639	499002
1999-2000	13774 / 1586	7165 / 1591	20940 / 2247	0.05 / 0.01	0.03 / 0.01	0.04 / 0.01	296422	219082	515504
2000-2001	16722 / 2456	6419 / 1594	23141 / 2928	0.05 / 0.01	0.04 / 0.01	0.05 / 0.01	324127	180073	504200
2001-2002	13738 / 1858	4742 / 1723	18480 / 2534	0.05 / 0.01	0.03 / 0.01	0.04 / 0.01	272877	148280	421157
2002-2003	14074 / 4124	4745 / 1385	18819 / 4350	0.05 / 0.02	0.03 / 0.01	0.04 / 0.01	293063	185862	478924
2003-2004	14232 / 2232	4957 / 1460	19189 / 2667	0.05 / 0.01	0.04 / 0.01	0.05 / 0.01	264002	136862	400864
2004-2005	12291 / 1456	8545 / 2214	20836 / 2650	0.05 / 0.01	0.04 / 0.01	0.04 / 0.01	261285	216977	478262

CTable 7. (Cont'd.)

	Landings (landings/SE)			Catch Rate (#/h/SE)			Man-Hours		
	High-Use	Low-Use	Annual	High-Use	Low-Use	Annual	High-Use	Low-Use	Total
Red Drum (Cont'd.)									
Upper Laguna Madre									
1983-1984	10340 / 1245	273 / 143	10614 / 1254	0.03 / 0.00	0.01 / 0.00	0.03 / 0.00	321081	54562	375643
1984-1985	1438 / 337	2274 / 1673	3712 / 1707	0.02 / 0.01	0.02 / 0.02	0.02 / 0.01	75991	98341	174332
1985-1986	11213 / 1645	4617 / 4008	15830 / 4332	0.05 / 0.01	0.03 / 0.02	0.04 / 0.01	218888	184679	403567
1986-1987	7821 / 1334	5036 / 1562	12857 / 2053	0.03 / 0.01	0.02 / 0.01	0.03 / 0.01	226078	210277	436355
1987-1988	10011 / 1496	4741 / 1596	14751 / 2187	0.03 / 0.01	0.02 / 0.01	0.03 / 0.01	306906	203741	510647
1988-1989	8075 / 1142	1953 / 815	10027 / 1403	0.03 / 0.00	0.01 / 0.01	0.02 / 0.00	282048	157420	440276
1989-1990	6380 / 862	1895 / 916	8276 / 1258	0.02 / 0.00	0.01 / 0.01	0.02 / 0.00	277847	136404	414251
1990-1991	1206 / 394	1539 / 637	2745 / 749	0.02 / 0.01	0.02 / 0.01	0.02 / 0.01	73879	90875	164755
1991-1992	3819 / 620	884 / 282	4704 / 682	0.03 / 0.00	0.01 / 0.00	0.02 / 0.00	146996	142278	289274
1992-1993	7326 / 1767	5213 / 1406	12539 / 2258	0.04 / 0.01	0.03 / 0.01	0.04 / 0.01	188267	168045	356312
1993-1994	8219 / 1355	5307 / 1998	13526 / 2414	0.05 / 0.01	0.03 / 0.01	0.04 / 0.01	171242	177167	348409
1994-1995	9167 / 1201	4759 / 1364	13927 / 1817	0.05 / 0.01	0.03 / 0.01	0.04 / 0.01	186777	178841	365618
1995-1996	6715 / 1187	2337 / 1282	9052 / 1747	0.03 / 0.01	0.02 / 0.01	0.03 / 0.01	230833	113955	344788
1996-1997	4814 / 805	1862 / 614	6676 / 1012	0.03 / 0.00	0.02 / 0.01	0.02 / 0.00	190011	107176	297187
1997-1998	8643 / 1098	6211 / 1640	14854 / 1974	0.04 / 0.01	0.05 / 0.02	0.04 / 0.01	231559	133907	365466
1998-1999	6004 / 746	7207 / 2558	13211 / 2665	0.03 / 0.00	0.04 / 0.02	0.03 / 0.01	223959	184654	408613
1999-2000	15941 / 1548	8139 / 1576	24080 / 2209	0.05 / 0.01	0.05 / 0.01	0.05 / 0.01	297226	180707	477934
2000-2001	16614 / 1767	3046 / 860	19660 / 1965	0.05 / 0.01	0.03 / 0.01	0.05 / 0.01	302563	117139	419702
2001-2002	7975 / 930	3328 / 868	11303 / 1272	0.04 / 0.01	0.02 / 0.01	0.03 / 0.00	208172	148532	356704
2002-2003	6717 / 956	3438 / 791	10155 / 1241	0.03 / 0.00	0.03 / 0.01	0.03 / 0.00	226512	136302	362814
2003-2004	10960 / 1611	5041 / 1235	16000 / 2030	0.04 / 0.01	0.03 / 0.01	0.04 / 0.01	251224	167139	418363
2004-2005	11874 / 1295	7150 / 1579	19024 / 2042	0.04 / 0.01	0.04 / 0.01	0.04 / 0.01	284663	174039	458702
Sheepshead									
Aransas Bay									
1983-1984	6143 / 2576	10140 / 6450	16283 / 6945	0.02 / 0.01	0.13 / 0.09	0.04 / 0.02	327868	77640	405508
1984-1985	476 / 229	25834 / 20480	26311 / 20481	0.00 / 0.00	0.34 / 0.27	0.10 / 0.08	175336	76754	252090
1985-1986	455 / 180	5005 / 3095	5461 / 3100	0.00 / 0.00	0.03 / 0.02	0.01 / 0.01	276076	157483	433559
1986-1987	177 / 115	16752 / 9811	16929 / 9812	0.00 / 0.00	0.10 / 0.06	0.05 / 0.03	201301	173081	374382
1987-1988	2730 / 2335	1728 / 1618	4458 / 2841	0.01 / 0.01	0.01 / 0.01	0.01 / 0.01	396123	169760	565884
1988-1989	846 / 392	1451 / 827	2296 / 915	0.00 / 0.00	0.01 / 0.01	0.00 / 0.00	373126	132999	506125
1989-1990	1194 / 506	0 / 0	1194 / 506	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	317709	118675	436384
1990-1991	409 / 194	5571 / 3939	5981 / 3943	0.00 / 0.00	0.05 / 0.03	0.02 / 0.01	281163	118299	399461
1991-1992	133 / 76	2168 / 1965	2301 / 1966	0.00 / 0.00	0.01 / 0.01	0.01 / 0.00	241887	175435	417322
1992-1993	379 / 163	3012 / 1662	3390 / 1670	0.00 / 0.00	0.02 / 0.01	0.01 / 0.00	361124	181188	542312
1993-1994	553 / 194	6501 / 3810	7055 / 3815	0.00 / 0.00	0.03 / 0.02	0.01 / 0.01	452478	254753	707232
1994-1995	1192 / 418	1966 / 823	3157 / 923	0.00 / 0.00	0.01 / 0.00	0.00 / 0.00	449480	237611	687090
1995-1996	751 / 391	2688 / 824	3439 / 912	0.00 / 0.00	0.01 / 0.00	0.01 / 0.00	454956	213413	668370
1996-1997	1188 / 476	4977 / 4047	6166 / 4074	0.00 / 0.00	0.05 / 0.04	0.01 / 0.01	433775	109476	543252
1997-1998	1785 / 562	7403 / 3621	9188 / 3664	0.00 / 0.00	0.04 / 0.02	0.01 / 0.01	485701	166670	652371
1998-1999	1801 / 516	16932 / 13673	18732 / 13683	0.00 / 0.00	0.07 / 0.05	0.03 / 0.02	463840	258660	722500
1999-2000	1580 / 576	1105 / 446	2685 / 728	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	514852	309242	824093
2000-2001	1196 / 638	3361 / 1683	4557 / 1800	0.00 / 0.00	0.01 / 0.01	0.01 / 0.00	423619	255553	679172
2001-2002	1290 / 501	3960 / 3047	5250 / 3088	0.00 / 0.00	0.02 / 0.02	0.01 / 0.00	455543	200168	655710
2002-2003	638 / 285	4140 / 1490	4779 / 1517	0.00 / 0.00	0.02 / 0.01	0.01 / 0.00	432706	222943	655649
2003-2004	1054 / 338	1455 / 971	2510 / 1028	0.00 / 0.00	0.01 / 0.00	0.00 / 0.00	452030	232563	684593

2004-2005	764 / 422	741 / 437	1505 / 607	0.00 / 0.00	0.01 / 0.00	0.00 / 0.00	488701	181974	670674

CTable 7. (Cont'd.)

	Landings (landings/SE)			Catch Rate (#/h/SE)			Man-Hours		
	High-Use	Low-Use	Annual	High-Use	Low-Use	Annual	High-Use	Low-Use	Total
Sheepshead (Cont'd.)									
Corpus Christi Bay									
1983-1984	6122 / 2093	1039 / 577	7161 / 2171	0.02 / 0.01	0.02 / 0.01	0.02 / 0.01	340533	69262	409795
1984-1985	1522 / 611	3615 / 2596	5138 / 2667	0.01 / 0.00	0.03 / 0.02	0.02 / 0.01	167494	118670	286164
1985-1986	1927 / 913	4182 / 2622	6108 / 2776	0.01 / 0.00	0.03 / 0.02	0.02 / 0.01	213144	166187	379331
1986-1987	309 / 179	2131 / 1507	2439 / 1517	0.00 / 0.00	0.02 / 0.01	0.01 / 0.00	213381	107337	320717
1987-1988	683 / 246	34252 / 19015	34935 / 19016	0.00 / 0.00	0.13 / 0.08	0.07 / 0.04	264650	262484	527133
1988-1989	183 / 82	12457 / 9308	12640 / 9308	0.00 / 0.00	0.08 / 0.06	0.03 / 0.02	265713	154235	419948
1989-1990	380 / 189	5862 / 2479	6242 / 2486	0.00 / 0.00	0.04 / 0.02	0.02 / 0.01	223372	158969	382342
1990-1991	503 / 243	8485 / 5261	8987 / 5266	0.00 / 0.00	0.06 / 0.04	0.02 / 0.01	397315	154340	551655
1991-1992	1339 / 1021	12882 / 5542	14220 / 5635	0.01 / 0.00	0.06 / 0.03	0.03 / 0.01	263415	212769	476185
1992-1993	262 / 154	15087 / 5934	15349 / 5936	0.00 / 0.00	0.06 / 0.02	0.03 / 0.01	246155	254421	500576
1993-1994	295 / 117	16093 / 5347	16388 / 5349	0.00 / 0.00	0.09 / 0.03	0.03 / 0.01	302521	180763	483283
1994-1995	756 / 330	23437 / 8525	24192 / 8531	0.00 / 0.00	0.11 / 0.04	0.04 / 0.02	357224	209207	566431
1995-1996	700 / 250	27231 / 11980	27932 / 11983	0.00 / 0.00	0.13 / 0.06	0.05 / 0.02	328802	217603	546485
1996-1997	569 / 451	40692 / 19154	41261 / 19159	0.00 / 0.00	0.23 / 0.12	0.10 / 0.05	248243	176641	424884
1997-1998	1511 / 546	36217 / 12851	37727 / 12863	0.01 / 0.00	0.24 / 0.10	0.09 / 0.03	277504	148092	425596
1998-1999	1410 / 761	42843 / 15451	44253 / 15469	0.00 / 0.00	0.23 / 0.09	0.09 / 0.03	310363	188639	499002
1999-2000	1575 / 928	27404 / 11582	28979 / 11619	0.01 / 0.00	0.13 / 0.05	0.06 / 0.02	296422	219082	515504
2000-2001	660 / 257	45427 / 19792	46087 / 19794	0.00 / 0.00	0.25 / 0.12	0.09 / 0.04	324127	180073	504200
2001-2002	356 / 168	38533 / 14999	38889 / 15000	0.00 / 0.00	0.26 / 0.11	0.09 / 0.04	272877	148280	421157
2002-2003	2668 / 1669	23893 / 9336	26561 / 9484	0.01 / 0.01	0.13 / 0.06	0.06 / 0.02	293063	185862	478924
2003-2004	210 / 71	26621 / 11598	26830 / 11598	0.00 / 0.00	0.19 / 0.09	0.07 / 0.03	264002	136862	400864
2004-2005	383 / 170	41914 / 15375	42297 / 15376	0.00 / 0.00	0.19 / 0.08	0.09 / 0.03	261285	216977	478262
Upper Laguna Madre									
1983-1984	1940 / 410	149 / 149	2089 / 436	0.01 / 0.00	0.00 / 0.00	0.01 / 0.00	321081	54562	375643
1984-1985	58 / 34	258 / 231	315 / 234	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	75991	98341	174332
1985-1986	139 / 55	228 / 131	367 / 142	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	218888	184679	403567
1986-1987	43 / 26	159 / 78	203 / 82	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	226078	210277	436355
1987-1988	62 / 32	181 / 147	244 / 151	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	306906	203741	510647
1988-1989	133 / 52	0 / 0	133 / 52	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	282048	157420	440276
1989-1990	75 / 38	50 / 50	125 / 63	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	277847	136404	414251
1990-1991	39 / 27	831 / 349	870 / 350	0.00 / 0.00	0.01 / 0.00	0.01 / 0.00	73879	90875	164755
1991-1992	106 / 47	87 / 65	193 / 80	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	146996	142278	289274
1992-1993	57 / 25	49 / 35	106 / 43	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	188267	168045	356312
1993-1994	22 / 22	429 / 298	450 / 299	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	171242	177167	348409
1994-1995	28 / 17	330 / 165	358 / 166	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	186777	178841	365618
1995-1996	48 / 22	68 / 50	116 / 54	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	230833	113955	344788
1996-1997	212 / 94	807 / 679	1019 / 686	0.00 / 0.00	0.01 / 0.01	0.00 / 0.00	190011	107176	297187
1997-1998	400 / 139	544 / 325	943 / 353	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	231559	133907	365466
1998-1999	159 / 46	498 / 207	657 / 212	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	223959	184654	408613
1999-2000	253 / 86	593 / 279	846 / 292	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	297226	180707	477934
2000-2001	68 / 28	195 / 104	263 / 108	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	302563	117139	419702
2001-2002	32 / 20	405 / 342	437 / 342	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	208172	148532	356704
2002-2003	268 / 141	171 / 141	439 / 199	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	226512	136302	362814
2003-2004	200 / 107	119 / 69	318 / 127	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	251224	167139	418363
2004-2005	94 / 50	274 / 114	368 / 124	0.00 / 0.00	0.01 / 0.00	0.00 / 0.00	284663	174039	458702

Table 7. (Cont'd.)

	Landings (landings/SE)			Catch Rate (#/h/SE)			Man-Hours		
	High-Use	Low-Use	Annual	High-Use	Low-Use	Annual	High-Use	Low-Use	Total
Southern Flounder									
Aransas Bay									
1983-1984	5271 / 1086	750 / 434	6021 / 1169	0.02 / 0.00	0.01 / 0.01	0.01 / 0.00	327868	77640	405508
1984-1985	1837 / 775	1087 / 667	2925 / 1023	0.01 / 0.00	0.01 / 0.01	0.01 / 0.00	175336	76754	252090
1985-1986	6697 / 2184	3458 / 1650	10155 / 2737	0.02 / 0.01	0.02 / 0.01	0.02 / 0.01	276076	157483	433559
1986-1987	1690 / 581	1062 / 385	2752 / 697	0.01 / 0.00	0.01 / 0.00	0.01 / 0.00	201301	173081	374382
1987-1988	3997 / 996	727 / 446	4723 / 1091	0.01 / 0.00	0.00 / 0.00	0.01 / 0.00	396123	169760	565884
1988-1989	3593 / 895	1275 / 622	4867 / 1090	0.01 / 0.00	0.01 / 0.01	0.01 / 0.00	373126	132999	506125
1989-1990	2644 / 676	48 / 35	2893 / 676	0.01 / 0.00	0.00 / 0.00	0.01 / 0.00	317709	118675	436384
1990-1991	1177 / 641	20 / 380	1997 / 745	0.00 / 0.00	0.01 / 0.00	0.01 / 0.00	281163	118299	399461
1991-1992	2789 / 756	2628 / 1483	5417 / 1665	0.01 / 0.00	0.02 / 0.01	0.01 / 0.00	241887	175435	417322
1992-1993	5207 / 1490	2552 / 600	7759 / 1609	0.01 / 0.00	0.01 / 0.00	0.01 / 0.00	361124	181188	542312
1993-1994	6372 / 1945	1374 / 443	7746 / 1995	0.01 / 0.00	0.01 / 0.00	0.01 / 0.00	452478	254753	707232
1994-1995	4429 / 1074	1302 / 330	5731 / 1124	0.01 / 0.00	0.01 / 0.00	0.01 / 0.00	449480	237611	687090
1995-1996	1931 / 412	1466 / 782	3396 / 884	0.00 / 0.00	0.01 / 0.00	0.01 / 0.00	454956	213413	668370
1996-1997	2370 / 472	118 / 83	2488 / 480	0.01 / 0.00	0.00 / 0.00	0.00 / 0.00	433775	109476	543252
1997-1998	1526 / 332	499 / 216	2025 / 396	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	485701	166670	652371
1998-1999	2758 / 445	1938 / 592	4696 / 740	0.01 / 0.00	0.01 / 0.00	0.01 / 0.00	463840	258660	722500
1999-2000	3141 / 738	2698 / 2026	5838 / 2156	0.01 / 0.00	0.01 / 0.01	0.01 / 0.00	514852	309242	824093
2000-2001	1878 / 316	1119 / 337	2996 / 462	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	423619	255553	679172
2001-2002	2358 / 493	547 / 260	2905 / 557	0.01 / 0.00	0.00 / 0.00	0.00 / 0.00	455543	200168	655710
2002-2003	1236 / 289	1542 / 501	2778 / 578	0.00 / 0.00	0.01 / 0.00	0.00 / 0.00	432706	222943	655649
2003-2004	2028 / 363	1345 / 531	3373 / 643	0.00 / 0.00	0.01 / 0.00	0.00 / 0.00	452030	232563	684593
2004-2005	4746 / 1513	437 / 161	5183 / 1521	0.01 / 0.00	0.00 / 0.00	0.01 / 0.00	488701	181974	670674
Corpus Christi Bay									
1983-1984	10547 / 4083	131 / 76	10678 / 4084	0.03 / 0.01	0.00 / 0.00	0.03 / 0.01	340533	69262	409795
1984-1985	13552 / 5047	3497 / 1875	17049 / 5384	0.08 / 0.03	0.03 / 0.02	0.06 / 0.02	167494	118670	286164
1985-1986	6753 / 1710	5897 / 2712	12649 / 3206	0.03 / 0.01	0.04 / 0.02	0.03 / 0.01	213144	166187	379331
1986-1987	6923 / 2130	3703 / 2733	10626 / 3465	0.03 / 0.01	0.03 / 0.03	0.03 / 0.01	213381	107337	320717
1987-1988	4010 / 1618	1684 / 843	5695 / 1824	0.02 / 0.01	0.01 / 0.00	0.01 / 0.00	264650	262484	527133
1988-1989	2436 / 698	2527 / 1319	4963 / 1492	0.01 / 0.00	0.02 / 0.01	0.01 / 0.00	265713	154235	419948
1989-1990	1681 / 444	7791 / 6964	9473 / 6978	0.01 / 0.00	0.05 / 0.04	0.02 / 0.02	223372	158969	382342
1990-1991	2325 / 570	4868 / 2916	7193 / 2972	0.01 / 0.00	0.03 / 0.02	0.01 / 0.01	397315	154340	551655
1991-1992	6397 / 1423	1894 / 1182	8291 / 1850	0.02 / 0.01	0.01 / 0.01	0.02 / 0.00	263415	212769	476185
1992-1993	3626 / 871	4935 / 1609	8561 / 1830	0.01 / 0.00	0.02 / 0.01	0.02 / 0.00	246155	254421	500576
1993-1994	2595 / 416	1559 / 521	4154 / 667	0.01 / 0.00	0.01 / 0.00	0.01 / 0.00	302521	180763	483283
1994-1995	3736 / 848	1281 / 405	5017 / 940	0.01 / 0.00	0.01 / 0.00	0.01 / 0.00	357224	209207	566431
1995-1996	991 / 259	1241 / 295	2232 / 393	0.00 / 0.00	0.01 / 0.00	0.00 / 0.00	328802	217603	546485
1996-1997	966 / 275	595 / 247	1560 / 370	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	248243	176641	424884
1997-1998	742 / 209	372 / 120	1115 / 241	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	277504	148092	425596
1998-1999	1673 / 526	639 / 230	2312 / 574	0.01 / 0.00	0.00 / 0.00	0.00 / 0.00	310363	188639	499002
1999-2000	1123 / 260	525 / 264	1648 / 370	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	296422	219082	515504
2000-2001	1346 / 259	564 / 238	1910 / 352	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	324127	180073	504200
2001-2002	1164 / 385	936 / 464	2100 / 603	0.00 / 0.00	0.01 / 0.00	0.01 / 0.00	272877	148280	421157
2002-2003	1494 / 513	346 / 182	1840 / 544	0.01 / 0.00	0.00 / 0.00	0.00 / 0.00	293063	185862	478924
2003-2004	587 / 169	441 / 169	1028 / 239	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	264002	136862	400864
2004-2005	1184 / 217	1219 / 396	2403 / 451	0.01 / 0.00	0.01 / 0.00	0.01 / 0.00	261285	216977	478262

CTable 7. (Cont'd.)

	Landings (landings/SE)			Catch Rate (#/h/SE)			Man-Hours		
	High-Use	Low-Use	Annual	High-Use	Low-Use	Annual	High-Use	Low-Use	Total
Southern Flounder (Cont'd.)									
Upper Laguna Madre									
1983-1984	4389 / 688	1193 / 766	5583 / 1030	0.01 / 0.00	0.02 / 0.02	0.01 / 0.00	321081	54562	375643
1984-1985	863 / 295	2012 / 867	2876 / 916	0.01 / 0.00	0.02 / 0.01	0.02 / 0.01	75991	98341	174332
1985-1986	6976 / 1349	5935 / 2347	12912 / 2707	0.03 / 0.01	0.03 / 0.01	0.03 / 0.01	218888	184679	403567
1986-1987	7464 / 1195	4816 / 1130	12279 / 1645	0.03 / 0.01	0.02 / 0.01	0.03 / 0.00	226078	210277	436355
1987-1988	3563 / 709	3301 / 1345	6864 / 1521	0.01 / 0.00	0.02 / 0.01	0.01 / 0.00	306906	203741	510647
1988-1989	2312 / 454	1321 / 479	3632 / 660	0.01 / 0.00	0.01 / 0.00	0.01 / 0.00	282048	157420	440276
1989-1990	2863 / 824	3582 / 3237	6445 / 3340	0.01 / 0.00	0.03 / 0.02	0.02 / 0.01	277847	136404	414251
1990-1991	729 / 226	938 / 414	1667 / 472	0.01 / 0.00	0.01 / 0.01	0.01 / 0.00	73879	90875	164755
1991-1992	4866 / 849	6210 / 2042	11076 / 2211	0.03 / 0.01	0.04 / 0.02	0.04 / 0.01	146996	142278	289274
1992-1993	1589 / 374	358 / 207	1947 / 428	0.01 / 0.00	0.00 / 0.00	0.01 / 0.00	188267	168045	356312
1993-1994	403 / 136	702 / 319	1105 / 347	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	171242	177167	348409
1994-1995	594 / 156	201 / 179	795 / 238	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	186777	178841	365618
1995-1996	313 / 98	159 / 77	472 / 124	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	230833	113955	344788
1996-1997	218 / 68	94 / 72	312 / 99	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	190011	107176	297187
1997-1998	1379 / 322	177 / 88	1556 / 334	0.06 / 0.00	0.00 / 0.00	0.00 / 0.00	231559	133907	365466
1998-1999	1088 / 251	375 / 170	1463 / 303	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	223959	184654	408613
1999-2000	1158 / 260	372 / 121	1529 / 287	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	297226	180707	477934
2000-2001	865 / 175	203 / 136	1068 / 221	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	302563	117139	419702
2001-2002	416 / 111	944 / 294	1360 / 314	0.00 / 0.00	0.01 / 0.00	0.00 / 0.00	208172	148532	356704
2002-2003	1972 / 434	466 / 150	2438 / 460	0.01 / 0.00	0.00 / 0.00	0.01 / 0.00	226512	136302	362814
2003-2004	1033 / 210	185 / 90	1217 / 228	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	251224	167139	418363
2004-2005	701 / 229	0 / 0	701 / 229	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	284663	174039	458702
Spotted Seatrout									
Aransas Bay									
1983-1984	69173 / 13451	2558 / 1548	71731 / 13540	0.21 / 0.05	0.03 / 0.02	0.18 / 0.04	327868	77640	405508
1984-1985	3064 / 840	14563 / 10148	17627 / 10183	0.02 / 0.01	0.19 / 0.14	0.07 / 0.04	175336	76754	252090
1985-1986	26847 / 8120	20285 / 6260	47133 / 10253	0.10 / 0.03	0.13 / 0.05	0.11 / 0.03	276076	157483	433559
1986-1987	14916 / 2981	28821 / 8363	43738 / 8879	0.07 / 0.02	0.17 / 0.06	0.12 / 0.03	201301	173081	374382
1987-1988	51905 / 9128	16662 / 7524	68647 / 11829	0.13 / 0.03	0.10 / 0.05	0.12 / 0.02	396123	169760	565884
1988-1989	38840 / 5923	21130 / 7720	59970 / 9731	0.10 / 0.02	0.16 / 0.07	0.12 / 0.02	373126	132999	506125
1989-1990	23168 / 3927	1155 / 740	24323 / 3996	0.07 / 0.01	0.01 / 0.01	0.06 / 0.01	317709	118675	436384
1990-1991	8828 / 1963	6869 / 4248	15697 / 4680	0.03 / 0.01	0.06 / 0.04	0.04 / 0.01	281163	118299	399461
1991-1992	12762 / 2494	24634 / 11681	37396 / 11945	0.05 / 0.01	0.14 / 0.08	0.09 / 0.03	241887	175435	417322
1992-1993	48376 / 8693	22196 / 5593	70572 / 10337	0.13 / 0.03	0.12 / 0.04	0.13 / 0.02	361124	181188	542312
1993-1994	58182 / 7862	36218 / 7738	94400 / 11031	0.13 / 0.02	0.14 / 0.04	0.13 / 0.02	452478	254753	707232
1994-1995	45921 / 4900	21736 / 4899	67657 / 6929	0.10 / 0.01	0.09 / 0.02	0.10 / 0.01	449480	237611	687090
1995-1996	47994 / 7317	17015 / 9873	65008 / 12288	0.11 / 0.02	0.08 / 0.05	0.10 / 0.02	454956	213413	668370
1996-1997	50828 / 8787	8449 / 2522	59277 / 9142	0.12 / 0.02	0.08 / 0.03	0.11 / 0.02	433775	109476	543252
1997-1998	63268 / 9164	21410 / 6389	84677 / 11171	0.13 / 0.02	0.13 / 0.05	0.13 / 0.02	485701	166670	652371
1998-1999	43248 / 4891	38022 / 8074	81270 / 9440	0.09 / 0.01	0.15 / 0.04	0.11 / 0.02	463840	258660	722500
1999-2000	66838 / 8642	30740 / 6606	97578 / 10877	0.13 / 0.02	0.10 / 0.03	0.12 / 0.02	514852	309242	824093
2000-2001	37292 / 5592	41445 / 9336	78737 / 10882	0.09 / 0.02	0.16 / 0.05	0.12 / 0.02	423619	255553	679172
2001-2002	37140 / 4088	16353 / 6884	53493 / 8006	0.08 / 0.01	0.08 / 0.04	0.08 / 0.01	455543	200168	655710
2002-2003	49540 / 9045	41071 / 13093	90611 / 15914	0.11 / 0.02	0.18 / 0.07	0.14 / 0.03	432706	222943	655649
2003-2004	53313 / 6582	32409 / 6523	85721 / 9267	0.12 / 0.02	0.14 / 0.04	0.13 / 0.02	452030	232563	684593
2004-2005	70944 / 11602	23906 / 8290	94850 / 14260	0.15 / 0.03	0.13 / 0.05	0.14 / 0.02	488701	181974	670674

CTable 7. (Cont'd.)

	Landings (landings/SE)			Catch Rate (#/h/SE)			Man-Hours		
	High-Use	Low-Use	Annual	High-Use	Low-Use	Annual	High-Use	Low-Use	Total
Spotted Seatrout (Cont'd.)									
Corpus Christi Bay									
1983-1984	109197 / 36702	7655 / 6579	116852 / 37287	0.32 / 0.12	0.11 / 0.10	0.29 / 0.10	340533	69262	409795
1984-1985	7704 / 2643	8508 / 4305	16212 / 5051	0.05 / 0.02	0.07 / 0.04	0.06 / 0.02	167494	118670	286164
1985-1986	27147 / 6084	39341 / 18508	66488 / 19483	0.13 / 0.03	0.24 / 0.12	0.18 / 0.06	213144	166187	379331
1986-1987	31981 / 6675	12368 / 4440	44349 / 8016	0.15 / 0.04	0.12 / 0.05	0.14 / 0.03	213381	107337	320717
1987-1988	33557 / 10819	30072 / 9621	63628 / 14478	0.13 / 0.04	0.11 / 0.05	0.12 / 0.03	264650	262484	527133
1988-1989	34250 / 6918	16448 / 7244	50698 / 10017	0.13 / 0.03	0.11 / 0.05	0.12 / 0.03	265713	154235	419948
1989-1990	32558 / 7121	11743 / 4600	44301 / 8478	0.15 / 0.04	0.07 / 0.03	0.12 / 0.03	223372	158969	382342
1990-1991	26791 / 8704	12136 / 6346	38927 / 10772	0.07 / 0.02	0.08 / 0.05	0.07 / 0.02	397315	154340	551655
1991-1992	24565 / 4968	8878 / 3010	33443 / 5808	0.09 / 0.02	0.04 / 0.02	0.07 / 0.02	263415	212769	476185
1992-1993	35543 / 5239	44461 / 13723	80004 / 14689	0.14 / 0.03	0.17 / 0.06	0.16 / 0.03	246155	254421	500576
1993-1994	40302 / 5936	20336 / 4604	60638 / 7512	0.13 / 0.02	0.11 / 0.03	0.13 / 0.02	302521	180763	483283
1994-1995	43265 / 6187	18353 / 5433	61618 / 8234	0.12 / 0.02	0.09 / 0.03	0.11 / 0.02	357224	209207	566431
1995-1996	33736 / 4788	13556 / 4369	47293 / 6482	0.10 / 0.02	0.06 / 0.02	0.09 / 0.01	328802	217603	546485
1996-1997	25915 / 3976	10224 / 2753	36139 / 4836	0.10 / 0.02	0.06 / 0.02	0.09 / 0.01	248243	176641	424884
1997-1998	32364 / 4475	10993 / 2920	43357 / 5343	0.12 / 0.02	0.07 / 0.02	0.10 / 0.02	277504	148092	425596
1998-1999	42052 / 8392	21185 / 7241	63238 / 11084	0.14 / 0.03	0.11 / 0.04	0.13 / 0.02	310363	188639	499002
1999-2000	30139 / 4529	14571 / 3924	44710 / 5993	0.10 / 0.02	0.07 / 0.02	0.09 / 0.01	296422	219082	515504
2000-2001	34582 / 4557	11866 / 4154	46448 / 6166	0.11 / 0.02	0.07 / 0.03	0.09 / 0.01	324127	180073	504200
2001-2002	13940 / 2526	11324 / 5462	25264 / 6017	0.05 / 0.01	0.08 / 0.04	0.06 / 0.02	272877	148280	421157
2002-2003	25928 / 5021	12259 / 4460	38187 / 6716	0.09 / 0.02	0.07 / 0.03	0.08 / 0.02	293063	185862	478924
2003-2004	24331 / 4204	9166 / 3120	33497 / 5236	0.09 / 0.02	0.07 / 0.03	0.08 / 0.02	264002	136862	400864
2004-2005	28900 / 5113	11523 / 3346	40423 / 6110	0.11 / 0.02	0.05 / 0.02	0.09 / 0.02	261285	216977	478262
Upper Laguna Madre									
1983-1984	142436 / 19539	4081 / 2794	146517 / 19738	0.44 / 0.07	0.07 / 0.06	0.39 / 0.06	321081	54562	375643
1984-1985	1758 / 673	5488 / 2245	7246 / 2344	0.02 / 0.01	0.06 / 0.03	0.04 / 0.02	75991	98341	174332
1985-1986	27662 / 5185	35990 / 10272	63652 / 11506	0.13 / 0.03	0.19 / 0.07	0.16 / 0.03	218888	184679	403567
1986-1987	35317 / 6573	46400 / 10640	81717 / 12506	0.16 / 0.03	0.22 / 0.07	0.19 / 0.03	226078	210277	436355
1987-1988	51522 / 5901	54046 / 15726	105569 / 16796	0.17 / 0.02	0.27 / 0.09	0.21 / 0.04	306906	203741	510647
1988-1989	59839 / 7766	53995 / 17766	113835 / 19389	0.21 / 0.03	0.34 / 0.13	0.26 / 0.05	282048	157420	440276
1989-1990	40832 / 4982	11345 / 8686	52177 / 10014	0.15 / 0.02	0.08 / 0.07	0.13 / 0.03	277847	136404	414251
1990-1991	1386 / 441	8472 / 3115	9857 / 3146	0.02 / 0.01	0.09 / 0.04	0.06 / 0.02	73879	90875	164755
1991-1992	20138 / 3190	39711 / 9544	59849 / 10063	0.14 / 0.03	0.28 / 0.09	0.21 / 0.04	146996	142278	289274
1992-1993	46676 / 10221	46797 / 15393	93473 / 18477	0.25 / 0.06	0.28 / 0.11	0.26 / 0.06	188267	168045	356312
1993-1994	29600 / 6216	27779 / 6986	57379 / 9351	0.17 / 0.04	0.16 / 0.05	0.16 / 0.03	171242	177167	348409
1994-1995	24802 / 3155	32433 / 6277	57235 / 7025	0.13 / 0.02	0.18 / 0.04	0.16 / 0.02	186777	178841	365618
1995-1996	65286 / 10590	19212 / 6544	84498 / 12448	0.28 / 0.05	0.17 / 0.07	0.25 / 0.04	230833	113955	344788
1996-1997	23860 / 2820	12812 / 3730	36672 / 4676	0.13 / 0.02	0.12 / 0.04	0.12 / 0.02	190011	107176	297187
1997-1998	58759 / 6912	26474 / 5874	85233 / 9071	0.25 / 0.04	0.20 / 0.06	0.23 / 0.03	231559	133907	365466
1998-1999	43645 / 6248	55657 / 15907	99302 / 17090	0.19 / 0.03	0.30 / 0.10	0.24 / 0.05	223959	184654	408613
1999-2000	64296 / 7956	22324 / 4731	86621 / 9256	0.22 / 0.03	0.12 / 0.03	0.18 / 0.02	297226	180707	477934
2000-2001	53876 / 6807	13513 / 3550	67389 / 7677	0.18 / 0.03	0.12 / 0.04	0.16 / 0.02	302563	117139	419702
2001-2002	23263 / 2824	25384 / 6971	48647 / 7521	0.11 / 0.02	0.17 / 0.06	0.14 / 0.03	208172	148532	356704
2002-2003	35653 / 4122	26623 / 5721	62276 / 7052	0.16 / 0.02	0.20 / 0.06	0.17 / 0.03	226512	136302	362814
2003-2004	46543 / 6352	21784 / 4031	68327 / 7523	0.19 / 0.03	0.13 / 0.04	0.16 / 0.02	251224	167139	418363
2004-2005	60014 / 6273	39542 / 15063	99556 / 16317	0.21 / 0.03	0.23 / 0.09	0.22 / 0.04	284663	174039	458702

Table 8. Estimated annual and seasonal party sport-boat fish landings(no.) ± 1 SE, catch rates (no./man-h)± 1 SE, and fishing pressure (man-h), and , in bays and passes in the Coastal Bend Bays and Estuary Program's area, by bay system, species and creel year (1983-2005).

	Landings (landings/SE)			Catch Rate (#/h/SE)			Man-Hours		
	High-Use	Low-Use	Annual	High-Use	Low-Use	Annual	High-Use	Low-Use	Total
Atlantic Croaker									
Aransas Bay									
1983-1984	0 / 0	0 / 0	0 / 0	0.00 / 0.00		0.00 / 0.00	11668	0	11668
1984-1985	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	10639	1312	11951
1985-1986	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	16142	9215	25357
1986-1987	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	16546	1326	17872
1987-1988	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	28744	9768	38512
1988-1989	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	22439	10825	33264
1989-19900	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	47060	1728	48789
1990-1991	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	41131	6470	47600
1991-1992	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	37653	4678	42332
1992-1993	14 / 14	0 / 0	14 / 14	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	72500	22950	95450
1993-1994	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	83630	26086	109716
1994-1995	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	86577	38191	124768
1995-1996	27 / 27	0 / 0	27 / 27	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	125910	39468	165378
1996-1997	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	105309	21053	126362
1997-1998	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	137890	31361	169251
1998-1999	64 / 64	0 / 0	64 / 64	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	129196	54617	183813
1999-2000	18 / 18	0 / 0	18 / 18	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	84127	67471	151598
2000-2001	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	117116	66503	183619
2001-2002	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	156862	49642	206504
2002-2003	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	132997	57618	190615
2003-2004	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	129310	62478	191788
2004-2005	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	148808	46503	195310
Corpus Christi Bay									
1983-1984	4743 / 4743	0 / 0	4743 / 4743	0.34 / 0.34		0.34 / 0.34	13972	0	13972
1984-1985	124 / 124	0 / 0	124 / 124	0.01 / 0.01		0.01 / 0.01	10421	0	10421
1985-1986	0 / 0	0 / 0	0 / 0	0.00 / 0.00		0.00 / 0.00	14459	0	14459
1986-1987	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	13799	1087	14886
1987-1988	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	34227	2424	36651
1988-1989	22 / 22	0 / 0	22 / 22	0.00 / 0.00		0.00 / 0.00	29468	0	29468
1989-1990	19 / 19	0 / 0	19 / 19	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	56961	12833	69794
1990-1991	37 / 37	0 / 0	37 / 37	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	53953	7729	61682
1991-1992	17 / 17	0 / 0	17 / 17	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	44644	2782	47426
1992-1993	457 / 457	0 / 0	457 / 457	0.02 / 0.02	0.00 / 0.00	0.01 / 0.01	28347	6280	34627
1993-1994	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	34521	6471	40992
1994-1995	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	107830	27583	135414
1995-1996	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	69537	7306	76842
1996-1997	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	101451	10000	111450
1997-1998	27 / 27	0 / 0	27 / 27	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	57854	21259	79113
1998-1999	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	112034	6657	118691
1999-2000	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	75986	18904	94889
2000-2001	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	42357	32554	74911
2001-2002	19 / 19	0 / 0	19 / 19	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	99485	5230	104715
2002-2003	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	212717	7114	219830
2003-2004	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	113680	18647	132327
2004-2005	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	109657	7221	116878

CTable 8. (Cont).

	Landings (landings/SE)			Catch Rate (#/h/SE)			Man-Hours		
	High-Use	Low-Use	Annual	High-Use	Low-Use	Annual	High-Use	Low-Use	Total
Atlantic Croaker (Cont'd.)									
Upper Laguna Madre									
1983-1984	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	699	175	874
1984-1985	0 / 0	0 / 0	0 / 0	0.00 / 0.00		0.00 / 0.00	742	0	742
1985-1986	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	2489	2782	5271
1986-1987	22 / 22	0 / 0	22 / 22	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	7435	2561	9996
1987-1988	52 / 35	0 / 0	52 / 35	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	11524	6243	17767
1988-1989	96 / 50	0 / 0	96 / 50	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	21746	28657	50402
1989-1990	115 / 77	0 / 0	115 / 77	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	28360	2693	31053
1990-1991	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	7852	3531	11383
1991-1992	79 / 56	0 / 0	79 / 56	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	20749	49866	70615
1992-1993	121 / 45	0 / 0	121 / 45	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	27696	25476	53172
1993-1994	979 / 892	0 / 0	979 / 892	0.04 / 0.03	0.00 / 0.00	0.02 / 0.02	27718	28327	56045
1994-1995	34 / 21	0 / 0	34 / 21	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	60549	15519	76068
1995-1996	150 / 101	0 / 0	150 / 101	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	51290	27047	78338
1996-1997	168 / 68	22 / 22	190 / 71	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	54093	72269	126362
1997-1998	315 / 103	48 / 48	363 / 114	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	66383	44834	111217
1998-1999	112 / 74	20 / 20	131 / 77	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	74641	48073	122715
1999-2000	84 / 36	0 / 0	84 / 36	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	115229	70976	186205
2000-2001	46 / 37	0 / 0	46 / 37	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	140596	40518	181114
2001-2002	68 / 49	0 / 0	68 / 49	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	104651	28149	132800
2002-2003	22 / 16	0 / 0	22 / 16	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	103533	31785	135318
2003-2004	50 / 38	0 / 0	50 / 38	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	77350	19710	97060
2004-2005	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	72585	26089	98674
Black Drum									
Aransas Bay									
1983-1984	0 / 0	0 / 0	0 / 0	0.00 / 0.00		0.00 / 0.00	11668	0	11668
1984-1985	152 / 152	0 / 0	152 / 152	0.01 / 0.01	0.00 / 0.00	0.01 / 0.01	10639	1312	11951
1985-1986	43 / 43	0 / 0	43 / 43	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	16142	9215	25357
1986-1987	64 / 64	0 / 0	64 / 64	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	16546	1326	17872
1987-1988	67 / 67	0 / 0	67 / 67	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	28744	9768	38512
1988-1989	116 / 98	52 / 37	168 / 105	0.01 / 0.00	0.00 / 0.00	0.01 / 0.00	22439	10825	33264
1989-1990	444 / 318	190 / 190	634 / 370	0.01 / 0.01	0.11 / 0.11	0.01 / 0.01	47060	1728	48789
1990-1991	1169 / 696	310 / 237	1479 / 735	0.03 / 0.02	0.05 / 0.04	0.03 / 0.02	41131	6470	47600
1991-1992	15 / 15	312 / 243	327 / 244	0.00 / 0.00	0.07 / 0.06	0.01 / 0.01	37653	4678	42332
1992-1993	341 / 168	1396 / 1373	1737 / 1384	0.00 / 0.00	0.06 / 0.06	0.02 / 0.01	72500	22950	95450
1993-1994	3160 / 1567	816 / 371	3976 / 1610	0.04 / 0.02	0.03 / 0.02	0.04 / 0.02	83630	26086	109716
1994-1995	1341 / 571	838 / 412	2179 / 704	0.02 / 0.01	0.02 / 0.01	0.02 / 0.01	86577	38191	124768
1995-1996	1307 / 1028	1696 / 1092	3003 / 1500	0.01 / 0.01	0.04 / 0.03	0.02 / 0.01	125910	39468	165378
1996-1997	925 / 464	406 / 233	1331 / 519	0.01 / 0.00	0.02 / 0.01	0.01 / 0.00	105309	21053	126362
1997-1998	1171 / 548	378 / 248	1549 / 601	0.01 / 0.00	0.01 / 0.01	0.01 / 0.00	137890	31361	169251
1998-1999	796 / 348	640 / 343	1436 / 489	0.01 / 0.00	0.01 / 0.01	0.01 / 0.00	129196	54617	183813
1999-2000	270 / 158	358 / 219	629 / 270	0.00 / 0.00	0.01 / 0.00	0.00 / 0.00	84127	67471	151598
2000-2001	1895 / 787	347 / 204	2243 / 813	0.02 / 0.01	0.01 / 0.00	0.01 / 0.00	117116	66503	183619
2001-2002	1218 / 571	760 / 450	1978 / 727	0.01 / 0.00	0.02 / 0.01	0.01 / 0.00	156862	49642	206504
2002-2003	1841 / 707	3562 / 2020	5403 / 2140	0.01 / 0.01	0.06 / 0.04	0.03 / 0.00	132997	57618	190615
2003-2004	2099 / 945	3236 / 2255	5335 / 2445	0.02 / 0.01	0.05 / 0.04	0.03 / 0.01	129310	62478	191788
2004-2005	1862 / 940	1359 / 1038	3221 / 1400	0.01 / 0.01	0.03 / 0.02	0.02 / 0.01	148808	46503	195310

CTable 8. (Cont'd.)

	Landings (landings/SE)			Catch Rate (#/h/SE)			Man-Hours		
	High-Use	Low-Use	Annual	High-Use	Low-Use	Annual	High-Use	Low-Use	Total
Black Drum (Cont'd.)									
Corpus Christi Bay									
1983-1984	659 / 659	0 / 0	659 / 659	0.05 / 0.05		0.05 / 0.05	13972	0	13972
1984-1985	372 / 372	0 / 0	372 / 372	0.04 / 0.04		0.04 / 0.04	10421	0	10421
1985-1986	0 / 0	0 / 0	0 / 0	0.00 / 0.00		0.00 / 0.00	14459	0	14459
1986-1987	0 / 0	87 / 87	87 / 87	0.00 / 0.00	0.08 / 0.08	0.01 / 0.01	13799	1087	14886
1987-1988	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	34227	2424	36651
1988-1989	410 / 410	0 / 0	410 / 410	0.01 / 0.01		0.01 / 0.01	29468	0	29468
1989-1990	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	56961	12833	69794
1990-1991	1020 / 796	0 / 0	1020 / 796	0.02 / 0.02	0.00 / 0.00	0.02 / 0.01	53953	7729	61682
1991-1992	630 / 414	115 / 115	745 / 430	0.01 / 0.01	0.04 / 0.04	0.02 / 0.01	44644	2782	47426
1992-1993	332 / 306	356 / 252	688 / 396	0.01 / 0.01	0.06 / 0.05	0.02 / 0.01	28347	6280	34627
1993-1994	1212 / 774	491 / 491	1704 / 917	0.04 / 0.02	0.08 / 0.08	0.04 / 0.02	34521	6471	40992
1994-1995	5777 / 3362	487 / 487	6264 / 3397	0.05 / 0.04	0.02 / 0.02	0.05 / 0.03	107830	27583	135414
1995-1996	2765 / 1812	528 / 489	3293 / 1877	0.04 / 0.03	0.07 / 0.07	0.04 / 0.03	69537	7306	76842
1996-1997	3820 / 3461	689 / 689	4508 / 3528	0.04 / 0.03	0.07 / 0.07	0.04 / 0.03	101451	10000	111450
1997-1998	288 / 225	11024 / 11024	11312 / 11026	0.01 / 0.00	0.52 / 0.52	0.14 / 0.14	57854	21259	79113
1998-1999	30 / 30	0 / 0	30 / 30	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	112034	6657	118691
1999-2000	19 / 19	248 / 248	267 / 249	0.00 / 0.00	0.01 / 0.01	0.00 / 0.00	75986	18904	94889
2000-2001	0 / 0	3584 / 3584	3584 / 3584	0.00 / 0.00	0.11 / 0.11	0.05 / 0.05	42357	32554	74911
2001-2002	722 / 460	0 / 0	722 / 460	0.01 / 0.00	0.00 / 0.00	0.01 / 0.00	99485	5230	104715
2002-2003	4563 / 4000	54 / 54	4616 / 4001	0.02 / 0.02	0.01 / 0.01	0.02 / 0.00	212717	7114	219830
2003-2004	217 / 182	2224 / 2096	2442 / 2104	0.00 / 0.00	0.12 / 0.12	0.02 / 0.00	113680	18647	132327
2004-2005	23 / 23	583 / 583	606 / 583	0.00 / 0.00	0.08 / 0.08	0.01 / 0.01	109657	7221	116878
Upper Laguna Madre									
1983-1984	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	699	175	874
1984-1985	0 / 0	0 / 0	0 / 0	0.00 / 0.00		0.00 / 0.00	742	0	742
1985-1986	40/ 30	0 / 0	40 / 30	0.02 / 0.01	0.00 / 0.00	0.01 / 0.01	2489	2782	5271
1986-1987	11 / 11	0 / 0	11 / 11	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	7435	2561	9996
1987-1988	0 / 0	41 / 29	41 / 29	0.00 / 0.00	0.01 / 0.01	0.00 / 0.00	11524	6243	17767
1988-1989	8 / 8	192 / 158	200 / 158	0.00 / 0.00	0.01 / 0.01	0.00 / 0.00	21746	28657	50402
1989-1990	130 / 103	0 / 0	130 / 103	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	28360	2693	31053
1990-1991	217 / 112	113 / 113	330 / 159	0.03 / 0.02	0.03 / 0.03	0.03 / 0.02	7852	3531	11383
1991-1992	291 / 121	956 / 434	1247 / 450	0.01 / 0.01	0.02 / 0.02	0.00 / 0.01	20749	49866	70615
1992-1993	426 / 134	717 / 356	1143 / 381	0.02 / 0.01	0.03 / 0.02	0.02 / 0.01	27696	25476	53172
1993-1994	1424 / 529	749 / 485	2173 / 718	0.05 / 0.02	0.03 / 0.02	0.04 / 0.02	27718	28327	56045
1994-1995	9438 / 6302	336 / 216	9774 / 6306	0.16 / 0.12	0.02 / 0.02	0.13 / 0.09	60549	15519	76068
1995-1996	2878 / 1809	1509 / 818	4387 / 1985	0.06 / 0.04	0.06 / 0.04	0.06 / 0.03	51290	27047	78338
1996-1997	4470 / 1305	3635 / 1816	8105 / 2237	0.08 / 0.03	0.05 / 0.04	0.06 / 0.03	54093	72269	126362
1997-1998	1648 / 680	963 / 512	2611 / 851	0.02 / 0.01	0.02 / 0.01	0.02 / 0.01	66383	44834	111217
1998-1999	1382 / 513	1470 / 570	2852 / 767	0.02 / 0.01	0.03 / 0.01	0.02 / 0.01	74641	48073	122715
1999-2000	868 / 262	14587 / 10167	15455 / 10170	0.01 / 0.00	0.21 / 0.15	0.08 / 0.06	115229	70976	186205
2000-2001	804 / 276	2008 / 930	2811 / 970	0.01 / 0.00	0.05 / 0.03	0.01 / 0.01	140596	40518	181114
2001-2002	255 / 1303	1048 / 569	3606 / 1422	0.02 / 0.01	0.04 / 0.02	0.03 / 0.01	104651	28149	132800
2002-2003	355 / 153	3622 / 2606	3977 / 2611	0.00 / 0.00	0.12 / 0.09	0.03 / 0.00	103533	31785	135318
2003-2004	2037 / 485	222 / 222	2259 / 533	0.03 / 0.01	0.01 / 0.01	0.02 / 0.01	77350	19710	97060
2004-2005	1987 / 532	1159 /618	3147 / 815	0.03 / 0.02	0.04 / 0.02	0.03 / 0.01	72585	26089	98674

CTable 8. (Cont'd.).

	Landings (landings/SE)			Catch Rate (#/h/SE)			Man-Hours		
	High-Use	Low-Use	Annual	High-Use	Low-Use	Annual	High-Use	Low-Use	Total
Red Drum									
Aransas Bay									
1983-1984	473 / 339	0 / 0	473 / 339	0.04 / 0.03		0.04 / 0.03	11668	0	11668
1984-1985	845 / 495	470 / 470	1315 / 683	0.08 / 0.07	0.36 / 0.36	0.11 / 0.10	10639	1312	11951
1985-1986	4724 / 1702	392 / 392	5116 / 1747	0.29 / 0.14	0.04 / 0.04	0.20 / 0.09	16142	9215	25357
1986-1987	3878 / 2081	280 / 262	4185 / 2097	0.23 / 0.14	0.21 / 0.20	0.23 / 0.13	16546	1326	17872
1987-1988	6053 / 3025	105 / 105	6159 / 3027	0.21 / 0.12	0.01 / 0.01	0.16 / 0.09	28744	9768	38512
1988-1989	3615 / 1237	194 / 138	3809 / 1245	0.16 / 0.07	0.02 / 0.02	0.11 / 0.05	22439	10825	33264
1989-1990	5524 / 1390	281 / 247	5805 / 1412	0.12 / 0.04	0.16 / 0.15	0.12 / 0.04	47060	1728	48789
1990-1991	7087 / 3359	738 / 499	7825 / 3396	0.17 / 0.09	0.11 / 0.09	0.16 / 0.08	41131	6470	47600
1991-1992	6339 / 2053	351 / 330	6689 / 2080	0.17 / 0.07	0.08 / 0.07	0.16 / 0.06	37653	4678	42332
1992-1993	9549 / 2119	2240 / 853	11789 / 2284	0.13 / 0.04	0.10 / 0.05	0.12 / 0.03	72500	22950	95450
1993-1994	17089 / 3528	3740 / 1431	20829 / 3808	0.20 / 0.05	0.14 / 0.08	0.19 / 0.05	83630	26086	109716
1994-1995	10379 / 2340	5180 / 1830	15559 / 2970	0.12 / 0.03	0.14 / 0.06	0.12 / 0.03	86577	38191	124768
1995-1996	10716 / 2679	5633 / 2667	16349 / 3780	0.09 / 0.03	0.14 / 0.09	0.10 / 0.03	125910	39468	165378
1996-1997	11819 / 2447	1761 / 766	13580 / 2565	0.11 / 0.03	0.08 / 0.05	0.11 / 0.03	105309	21053	126362
1997-1998	9196 / 1662	5043 / 2023	14239 / 2618	0.07 / 0.02	0.16 / 0.08	0.08 / 0.02	137890	31361	169251
1998-1999	11276 / 2547	5574 / 2242	16850 / 3393	0.09 / 0.02	0.10 / 0.05	0.09 / 0.02	129196	54617	183813
1999-2000	7158 / 1284	4117 / 1454	11275 / 1940	0.09 / 0.02	0.06 / 0.03	0.07 / 0.02	84127	67471	151598
2000-2001	6436 / 1261	3084 / 902	9520 / 1550	0.06 / 0.01	0.05 / 0.02	0.05 / 0.01	117116	66503	183619
2001-2002	14686 / 2922	2764 / 1135	17450 / 3134	0.09 / 0.02	0.06 / 0.03	0.08 / 0.02	156862	49642	206504
2002-2003	13011 / 3202	3189 / 1261	16200 / 3442	0.10 / 0.03	0.06 / 0.03	0.09 / 0.00	132997	57618	190615
2003-2004	11157 / 1982	5268 / 2834	16425 / 3458	0.09 / 0.02	0.08 / 0.05	0.09 / 0.02	129310	62478	191788
2004-2005	14514 / 2915	4726 / 2175	19241 / 3636	0.10 / 0.03	0.10 / 0.06	0.10 / 0.02	148808	46503	195310
Corpus Christi Bay									
1983-1984	220 / 220	0 / 0	220 / 220	0.02 / 0.02		0.02 / 0.02	13972	0	13972
1984-1985	952 / 532	0 / 0	952 / 532	0.09 / 0.06		0.09 / 0.06	10421	0	10421
1985-1986	716 / 500	0 / 0	716 / 500	0.05 / 0.04		0.05 / 0.04	14459	0	14459
1986-1987	107 / 77	1087 / 1087	1194 / 1090	0.01 / 0.01	1.00 / 1.00	0.08 / 0.07	13799	1087	14886
1987-1988	4113 / 3671	40 / 40	4153 / 3672	0.12 / 0.11	0.02 / 0.02	0.11 / 0.10	34227	2424	36651
1988-1989	322 / 178	0 / 0	322 / 178	0.01 / 0.01		0.01 / 0.01	29468	0	29468
1989-1990	1955 / 1122	1609 / 1495	3563 / 1869	0.03 / 0.03	0.13 / 0.12	0.05 / 0.04	56961	12833	69794
1990-1991	2484 / 1244	0 / 0	2484 / 1244	0.05 / 0.03	0.00 / 0.00	0.04 / 0.03	53953	7729	61682
1991-1992	3455 / 1436	1669 / 1213	5124 / 1880	0.08 / 0.04	0.60 / 0.53	0.11 / 0.05	44644	2782	47426
1992-1993	898 / 448	1772 / 1181	2670 / 1263	0.03 / 0.02	0.28 / 0.22	0.08 / 0.04	28347	6280	34627
1993-1994	6929 / 2550	139 / 106	7067 / 2552	0.20 / 0.10	0.02 / 0.02	0.17 / 0.08	34521	6471	40992
1994-1995	6609 / 3893	6332 / 4244	12941 / 5759	0.06 / 0.04	0.23 / 0.17	0.10 / 0.05	107830	27583	135414
1995-1996	7205 / 3274	1907 / 1467	9112 / 3587	0.10 / 0.05	0.26 / 0.24	0.12 / 0.05	69537	7306	76842
1996-1997	8487 / 3694	608 / 434	9096 / 3719	0.08 / 0.05	0.06 / 0.05	0.08 / 0.05	101451	10000	111450
1997-1998	5060 / 2208	98 / 69	5159 / 2209	0.01 / 0.06	0.00 / 0.00	0.07 / 0.04	57854	21259	79113
1998-1999	9959 / 4835	0 / 0	9959 / 4835	0.09 / 0.06	0.00 / 0.00	0.08 / 0.05	112034	6657	118691
1999-2000	10692 / 6771	686 / 375	11379 / 6782	0.14 / 0.11	0.04 / 0.02	0.12 / 0.08	75986	18904	94889
2000-2001	4341 / 1420	3453 / 2437	7793 / 2821	0.10 / 0.05	0.11 / 0.08	0.10 / 0.05	42357	32554	74911
2001-2002	16616 / 4753	903 / 639	17520 / 4796	0.17 / 0.07	0.17 / 0.15	0.17 / 0.06	99485	5230	104715
2002-2003	38408 / 15836	2346 / 1767	40754 / 15935	0.18 / 0.10	0.33 / 0.27	0.19 / 0.00	212717	7114	219830
2003-2004	14521 / 5908	1241 / 1054	15762 / 6001	0.13 / 0.06	0.07 / 0.06	0.12 / 0.05	113680	18647	132327
2004-2005	4919 / 1598	604 / 1653	5523 / 1653	0.04 / 0.03	0.08 / 0.07	0.05 / 0.03	109657	7221	116878

CTable 8. (Cont).

	Landings (landings/SE)			Catch Rate (#/h/SE)			Man-Hours		
	High-Use	Low-Use	Annual	High-Use	Low-Use	Annual	High-Use	Low-Use	Total
Red Drum (Cont'd.)									
Upper Laguna Madre									
1983-1984	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	699	175	874
1984-1985	0 / 0	0 / 0	0 / 0	0.00 / 0.00		0.00 / 0.00	742	0	742
1985-1986	273 / 146	0 / 0	273 / 146	0.11 / 0.07	0.00 / 0.00	0.05 / 0.04	2489	2782	5271
1986-1987	219 / 106	494 / 494	713 / 505	0.03 / 0.02	0.19 / 0.19	0.07 / 0.05	7435	2561	9996
1987-1988	890 / 367	692 / 450	1583 / 580	0.08 / 0.04	0.11 / 0.09	0.09 / 0.04	11524	6243	17767
1988-1989	1848 / 1004	464 / 278	2312 / 1042	0.09 / 0.05	0.02 / 0.01	0.05 / 0.02	21746	28657	50402
1989-1990	2045 / 626	0 / 0	2045 / 626	0.07 / 0.03	0.00 / 0.00	0.07 / 0.02	28360	2693	31053
1990-1991	1740 / 831	114 / 85	1854 / 836	0.22 / 0.13	0.03 / 0.03	0.16 / 0.09	7852	3531	11383
1991-1992	1354 / 482	1005 / 771	2359 / 909	0.07 / 0.03	0.02 / 0.02	0.03 / 0.02	20749	49866	70615
1992-1993	812 / 240	2708 / 1884	3520 / 1899	0.03 / 0.01	0.11 / 0.08	0.07 / 0.04	27696	25476	53172
1993-1994	2025 / 887	329 / 207	2354 / 911	0.07 / 0.04	0.01 / 0.01	0.04 / 0.02	27718	28327	56045
1994-1995	5910 / 2761	821 / 335	6731 / 2782	0.10 / 0.06	0.05 / 0.03	0.09 / 0.05	60549	15519	76068
1995-1996	1568 / 569	559 / 357	2127 / 671	0.03 / 0.01	0.02 / 0.02	0.03 / 0.01	51290	27047	78338
1996-1997	2595 / 920	2726 / 2159	5322 / 2347	0.05 / 0.02	0.04 / 0.03	0.04 / 0.02	54093	72269	126362
1997-1998	2620 / 790	1592 / 570	4212 / 974	0.04 / 0.01	0.04 / 0.02	0.04 / 0.01	66383	44834	111217
1998-1999	3415 / 896	1493 / 739	4908 / 1161	0.05 / 0.01	0.03 / 0.02	0.04 / 0.01	74641	48073	122715
1999-2000	5652 / 982	6847 / 2614	12499 / 2792	0.05 / 0.01	0.10 / 0.05	0.07 / 0.02	115229	70976	186205
2000-2001	13934 / 3002	1999 / 904	15933 / 3135	0.10 / 0.02	0.05 / 0.03	0.09 / 0.02	140596	40518	181114
2001-2002	5825 / 902	392 / 267	6217 / 940	0.06 / 0.01	0.01 / 0.01	0.05 / 0.01	104651	28149	132800
2002-2003	2923 / 470	3081 / 1528	6003 / 1598	0.03 / 0.01	0.10 / 0.05	0.04 / 0.00	103533	31785	135318
2003-2004	4498 / 913	802 / 397	5300 / 996	0.06 / 0.01	0.04 / 0.02	0.05 / 0.01	77350	19710	97060
2004-2005	2902 / 532	1094 / 400	3997 / 666	0.04 / 0.01	0.04 / 0.01	0.04 / 0.02	72585	26089	98674
Sheepshead									
Aransas Bay									
1983-1984	0 / 0	0 / 0	0 / 0	0.00 / 0.00		0.00 / 0.00	11668	0	11668
1984-1985	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	10639	1312	11951
1985-1986	22 / 22	0 / 0	22 / 22	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	16142	9215	25357
1986-1987	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	16546	1326	17872
1987-1988	233 / 165	0 / 0	233 / 165	0.01 / 0.01	0.00 / 0.00	0.01 / 0.00	28744	9768	38512
1988-1989	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	22439	10825	33264
1989-1990	22 / 22	0 / 0	22 / 22	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	47060	1728	48789
1990-1991	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	41131	6470	47600
1991-1992	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	37653	4678	42332
1992-1993	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	72500	22950	95450
1993-1994	47 / 36	0 / 0	47 / 36	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	83630	26086	109716
1994-1995	0 / 0	43 / 43	43 / 43	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	86577	38191	124768
1995-1996	377 / 377	73 / 73	449 / 384	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	125910	39468	165378
1996-1997	63 / 63	67 / 48	130 / 79	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	105309	21053	126362
1997-1998	71 / 54	47 / 47	117 / 72	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	137890	31361	169251
1998-1999	22 / 22	261 / 156	283 / 158	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	129196	54617	183813
1999-2000	515 / 360	28 / 28	543 / 361	0.01 / 0.00	0.00 / 0.00	0.00 / 0.00	84127	67471	151598
2000-2001	318 / 318	25 / 25	343 / 319	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	117116	66503	183619
2001-2002	505 / 442	0 / 0	505 / 442	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	156862	49642	206504
2002-2003	267 / 144	189 / 131	456 / 195	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	132997	57618	190615
2003-2004	1624 / 1023	390 / 250	2013 / 1053	0.01 / 0.01	0.01 / 0.00	0.01 / 0.01	129310	62478	191788
2004-2005	1009 / 778	101 / 70	1110 / 781	0.01 / 0.01	0.00 / 0.00	0.01 / 0.00	148808	46503	195310

CTable 8. (Cont).

	Landings (landings/SE)			Catch Rate (#/h/SE)			Man-Hours		
	High-Use	Low-Use	Annual	High-Use	Low-Use	Annual	High-Use	Low-Use	Total
Sheepshead (Cont'd.)									
Corpus Christi Bay									
1983-1984	1106 / 727	0 / 0	1106 / 727	0.08 / 0.06		0.08 / 0.06	13972	0	13972
1984-1985	0 / 0	0 / 0	0 / 0	0.00 / 0.00		0.00 / 0.00	10421	0	10421
1985-1986	0 / 0	0 / 0	0 / 0	0.00 / 0.00		0.00 / 0.00	14459	0	14459
1986-1987	0 / 0	43 / 43	43 / 43	0.00 / 0.00	0.04 / 0.04	0.00 / 0.00	13799	1087	14886
1987-1988	119 / 83	40 / 40	159 / 93	0.00 / 0.00	0.02 / 0.02	0.00 / 0.00	34227	2424	36651
1988-1989	369 / 369	0 / 0	369 / 369	0.01 / 0.01		0.01 / 0.01	29468	0	29468
1989-1990	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	56961	12833	69794
1990-1991	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	53953	7729	61682
1991-1992	147 / 100	0 / 0	147 / 100	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	44644	2782	47426
1992-1993	0 / 0	166 / 166	166 / 166	0.00 / 0.00	0.03 / 0.03	0.00 / 0.00	28347	6280	34627
1993-1994	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	34521	6471	40992
1994-1995	23 / 23	122 / 122	145 / 124	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	107830	27583	135414
1995-1996	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	69537	7306	76842
1996-1997	0 / 0	516 / 516	516 / 516	0.00 / 0.00	0.05 / 0.05	0.00 / 0.00	101451	10000	111450
1997-1998	53 / 53	2661 / 2661	2714 / 2661	0.00 / 0.00	0.13 / 0.13	0.03 / 0.03	57854	21259	79113
1998-1999	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	112034	6657	118691
1999-2000	0 / 0	73 / 50	73 / 50	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	75986	18904	94889
2000-2001	36 / 36	0 / 0	36 / 36	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	42357	32554	74911
2001-2002	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	99485	5230	104715
2002-2003	94 / 94	0 / 0	94 / 94	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	212717	7114	219830
2003-2004	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	113680	18647	132327
2004-2005	23 / 23	106 / 93	130 / 96	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	109657	7221	116878
Upper Laguna Madre									
1983-1984	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	699	175	874
1984-1985	0 / 0	0 / 0	0 / 0	0.00 / 0.00		0.00 / 0.00	742	0	742
1985-1986	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	2489	2782	5271
1986-1987	11 / 11	0 / 0	11 / 11	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	7435	2561	9996
1987-1988	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	11524	6243	17767
1988-1989	8 / 8	0 / 0	8 / 8	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	21746	28657	50402
1989-1990	7 / 7	0 / 0	7 / 7	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	28360	2693	31053
1990-1991	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	7852	3531	11383
1991-1992	18 / 13	0 / 0	18 / 13	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	20749	49866	70615
1992-1993	41 / 20	27 / 27	68 / 34	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	27696	25476	53172
1993-1994	16 / 12	0 / 0	16 / 12	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	27718	28327	56045
1994-1995	212 / 181	0 / 0	212 / 181	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	60549	15519	76068
1995-1996	40 / 20	46 / 33	86 / 38	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	51290	27047	78338
1996-1997	64 / 47	35 / 35	99 / 59	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	54093	72269	126362
1997-1998	236 / 124	0 / 0	236 / 124	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	66383	44834	111217
1998-1999	122 / 64	99 / 66	221 / 92	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	74641	48073	122715
1999-2000	99 / 85	76 / 56	175 / 102	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	115229	70976	186205
2000-2001	0 / 0	85 / 85	85 / 85	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	140596	40518	181114
2001-2002	14 / 14	65 / 37	80 / 39	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	104651	28149	132800
2002-2003	34 / 20	65 / 65	99 / 68	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	103533	31785	135318
2003-2004	74 / 34	44 / 44	119 / 56	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	77350	19710	97060
2004-2005	108 / 37	0 / 0	108 / 37	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	72585	26089	98674

CTable 8. (Cont).

	Landings (landings/SE)			Catch Rate (#/h/SE)			Man-Hours		
	High-Use	Low-Use	Annual	High-Use	Low-Use	Annual	High-Use	Low-Use	Total
Southern Flounder									
Aransas Bay									
1983-1984	21 / 21	0 / 0	21 / 21	0.00 / 0.00		0.00 / 0.00	11668	0	11668
1984-1985	325 / 305	0 / 0	325 / 305	0.03 / 0.03	0.00 / 0.00	0.03 / 0.03	10639	1312	11951
1985-1986	428 / 231	0 / 0	428 / 231	0.03 / 0.02	0.00 / 0.00	0.02 / 0.01	16142	9215	25357
1986-1987	225 / 143	17 / 17	243 / 144	0.01 / 0.01	0.01 / 0.01	0.01 / 0.01	16546	1326	17872
1987-1988	118 / 102	0 / 0	118 / 102	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	28744	9768	38512
1988-1989	119 / 62	0 / 0	119 / 62	0.01 / 0.00	0.00 / 0.00	0.00 / 0.00	22439	10825	33264
1989-1990	143 / 75	0 / 0	143 / 75	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	47060	1728	48789
1990-1991	445 / 356	39 / 39	484 / 358	0.01 / 0.01	0.01 / 0.01	0.01 / 0.01	41131	6470	47600
1991-1992	417 / 157	71 / 53	487 / 166	0.01 / 0.01	0.02 / 0.01	0.01 / 0.00	37653	4678	42332
1992-1993	427 / 124	59 / 46	486 / 132	0.01 / 0.00	0.00 / 0.00	0.01 / 0.00	72500	22950	95450
1993-1994	926 / 476	54 / 30	980 / 477	0.01 / 0.01	0.00 / 0.00	0.01 / 0.00	83630	26086	109716
1994-1995	225 / 79	335 / 155	560 / 174	0.00 / 0.00	0.01 / 0.00	0.00 / 0.00	86577	38191	124768
1995-1996	1085 / 416	86 / 53	1171 / 419	0.01 / 0.00	0.00 / 0.00	0.01 / 0.00	125910	39468	165378
1996-1997	504 / 187	323 / 263	826 / 323	0.00 / 0.00	0.02 / 0.01	0.01 / 0.00	105309	21053	126362
1997-1998	185 / 60	192 / 152	378 / 163	0.00 / 0.00	0.01 / 0.01	0.00 / 0.00	137890	31361	169251
1998-1999	911 / 377	438 / 281	1349 / 471	0.01 / 0.00	0.01 / 0.01	0.01 / 0.00	129196	54617	183813
1999-2000	435 / 147	116 / 82	551 / 168	0.01 / 0.00	0.00 / 0.00	0.00 / 0.00	84127	67471	151598
2000-2001	294 / 108	250 / 133	544 / 172	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	117116	66503	183619
2001-2002	924 / 350	101 / 82	1025 / 359	0.01 / 0.00	0.00 / 0.00	0.01 / 0.00	156862	49642	206504
2002-2003	634 / 200	256 / 134	890 / 240	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	132997	57618	190615
2003-2004	925 / 409	252 / 149	1177 / 435	0.01 / 0.00	0.00 / 0.00	0.01 / 0.00	129310	62478	191788
2004-2005	504 / 161	234 / 141	738 / 214	0.00 / 0.00	0.01 / 0.00	0.00 / 0.00	148808	46503	195310
Corpus Christi Bay									
1983-1984	550 / 550	0 / 0	550 / 550	0.04 / 0.04		0.04 / 0.04	13972	0	13972
1984-1985	256 / 155	0 / 0	256 / 155	0.02 / 0.02		0.02 / 0.02	10421	0	10421
1985-1986	0 / 0	0 / 0	0 / 0	0.00 / 0.00		0.00 / 0.00	14459	0	14459
1986-1987	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	13799	1087	14886
1987-1988	119 / 119	0 / 0	119 / 119	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	34227	2424	36651
1988-1989	192 / 173	0 / 0	192 / 173	0.01 / 0.01		0.01 / 0.01	29468	0	29468
1989-1990	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	56961	12833	69794
1990-1991	75 / 53	0 / 0	75 / 53	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	53953	7729	61682
1991-1992	400 / 174	0 / 0	400 / 174	0.01 / 0.00	0.00 / 0.00	0.01 / 0.00	44644	2782	47426
1992-1993	45 / 32	0 / 0	45 / 32	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	28347	6280	34627
1993-1994	44 / 31	0 / 0	44 / 31	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	34521	6471	40992
1994-1995	238 / 212	61 / 61	299 / 221	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	107830	27583	135414
1995-1996	45 / 32	0 / 0	45 / 32	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	69537	7306	76842
1996-1997	488 / 337	0 / 0	408 / 337	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	101451	10000	111450
1997-1998	47 / 34	0 / 0	47 / 34	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	57854	21259	79113
1998-1999	116 / 82	0 / 0	116 / 82	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	112034	6657	118691
1999-2000	74 / 43	302 / 302	377 / 305	0.00 / 0.00	0.02 / 0.02	0.00 / 0.00	75986	18904	94889
2000-2001	0 / 0	656 / 537	656 / 537	0.00 / 0.00	0.02 / 0.02	0.01 / 0.01	42357	32554	74911
2001-2002	178 / 131	0 / 0	178 / 131	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	99485	5230	104715
2002-2003	550 / 518	107 / 107	657 / 529	0.00 / 0.00	0.02 / 0.02	0.00 / 0.00	212717	7114	219830
2003-2004	1286 / 968	1109 / 1045	2395 / 1425	0.01 / 0.01	0.06 / 0.06	0.02 / 0.00	113680	18647	132327
2004-2005	569 / 551	0 / 0	569 / 551	0.01 / 0.01	0.00 / 0.00	0.00 / 0.00	109657	7221	116878

CTable 8. (Cont).

	Landings (landings/SE)			Catch Rate (#/h/SE)			Man-Hours		
	High-Use	Low-Use	Annual	High-Use	Low-Use	Annual	High-Use	Low-Use	Total
Southern Flounder (Cont'd.)									
Upper Laguna Madre									
1983-1984	0 / 0	0 / 0	0 / 0	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	699	175	874
1984-1985	46 / 46	0 / 0	46 / 46	0.06 / 0.06		0.06 / 0.06	742	0	742
1985-1986	362 / 216	824 / 824	1186 / 852	0.15 / 0.10	0.30 / 0.30	0.23 / 0.18	2489	2782	5271
1986-1987	902 / 342	537 / 379	1439 / 510	0.12 / 0.05	0.21 / 0.17	0.14 / 0.06	7435	2561	9996
1987-1988	153 / 74	79 / 56	232 / 93	0.01 / 0.01	0.01 / 0.01	0.01 / 0.01	11524	6243	17767
1988-1989	394 / 155	386 / 262	781 / 304	0.02 / 0.01	0.01 / 0.01	0.02 / 0.01	21746	28657	50402
1989-1990	202 / 87	0 / 0	202 / 87	0.01 / 0.00	0.00 / 0.00	0.01 / 0.00	28360	2693	31053
1990-1991	24 / 24	75 / 75	99 / 79	0.00 / 0.00	0.02 / 0.02	0.01 / 0.01	7852	3531	11383
1991-1992	506 / 203	2069 / 1602	2575 / 1615	0.02 / 0.01	0.04 / 0.04	0.04 / 0.03	20749	49866	70615
1992-1993	361 / 121	100 / 75	462 / 142	0.01 / 0.01	0.00 / 0.00	0.01 / 0.00	27696	25476	53172
1993-1994	12 / 12	30 / 30	42 / 32	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	27718	28327	56045
1994-1995	59 / 31	0 / 0	59 / 31	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	60549	15519	76068
1995-1996	113 / 47	0 / 0	113 / 47	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	51290	27047	78338
1996-1997	209 / 98	0 / 0	209 / 98	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	54093	72269	126362
1997-1998	126 / 49	62 / 33	188 / 59	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	66383	44834	111217
1998-1999	613 / 209	309 / 162	922 / 264	0.01 / 0.00	0.01 / 0.00	0.01 / 0.00	74641	48073	122715
1999-2000	366 / 147	148 / 77	514 / 166	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	115229	70976	186205
2000-2001	380 / 148	24 / 24	403 / 150	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	140596	40518	181114
2001-2002	399 / 119	97 / 77	496 / 142	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	104651	28149	132800
2002-2003	857 / 187	366 / 183	1223 / 261	0.01 / 0.00	0.01 / 0.01	0.01 / 0.00	103533	31785	135318
2003-2004	816 / 289	22 / 22	838 / 289	0.01 / 0.00	0.00 / 0.00	0.01 / 0.00	77350	19710	97060
2004-2005	101 / 48	0 / 0	101 / 48	0.00 / 0.00	0.00 / 0.00	0.00 / 0.00	72585	26089	98674
Spotted Seatrout									
Aransas Bay									
1983-1984	11657 / 7516	0 / 0	11657 / 7516	1.00 / 0.74		1.00 / 0.74	11668	0	11668
1984-1985	622 / 471	0 / 0	622 / 471	0.06 / 0.05	0.00 / 0.00	0.05 / 0.05	10639	1312	11951
1985-1986	4387 / 2867	3594 / 2651	7981 / 3905	0.27 / 0.19	0.39 / 0.32	0.31 / 0.17	16142	9215	25357
1986-1987	7930 / 3302	717 / 717	8647 / 3379	0.48 / 0.23	0.54 / 0.54	0.48 / 0.22	16546	1326	17872
1987-1988	17572 / 6935	3987 / 3965	21559 / 7989	0.61 / 0.29	0.41 / 0.41	0.56 / 0.26	28744	9768	38512
1988-1989	8576 / 2675	5972 / 5299	14548 / 5936	0.38 / 0.15	0.55 / 0.52	0.44 / 0.21	22439	10825	33264
1989-1990	11363 / 3961	0 / 0	11363 / 3961	0.24 / 0.10	0.00 / 0.00	0.23 / 0.09	47060	1728	48789
1990-1991	1372 / 604	0 / 0	1372 / 604	0.03 / 0.02	0.00 / 0.00	0.03 / 0.01	41131	6470	47600
1991-1992	6148 / 3234	729 / 432	6877 / 3263	0.16 / 0.10	0.16 / 0.11	0.16 / 0.09	37653	4678	42332
1992-1993	28190 / 7253	7643 / 3788	35833 / 8183	0.39 / 0.12	0.33 / 0.20	0.38 / 0.11	72500	22950	95450
1993-1994	31099 / 6335	9039 / 4686	40138 / 7880	0.37 / 0.10	0.35 / 0.21	0.37 / 0.09	83630	26086	109716
1994-1995	32412 / 6760	13070 / 6441	45482 / 9337	0.37 / 0.09	0.34 / 0.19	0.36 / 0.09	86577	38191	124768
1995-1996	49863 / 11403	10438 / 4893	60301 / 12409	0.40 / 0.11	0.26 / 0.16	0.36 / 0.10	125910	39468	165378
1996-1997	40512 / 11133	9536 / 5471	50048 / 12405	0.38 / 0.12	0.45 / 0.30	0.40 / 0.11	105309	21053	126362
1997-1998	75063 / 13676	10571 / 4013	85634 / 14253	0.54 / 0.13	0.34 / 0.17	0.51 / 0.11	137890	31361	169251
1998-1999	49200 / 9470	15079 / 8119	64279 / 12474	0.38 / 0.09	0.28 / 0.17	0.35 / 0.09	129196	54617	183813
1999-2000	35647 / 8277	19737 / 13618	55384 / 15936	0.42 / 0.12	0.29 / 0.21	0.37 / 0.12	84127	67471	151598
2000-2001	51559 / 11321	37260 / 22448	88819 / 25141	0.44 / 0.12	0.56 / 0.38	0.48 / 0.16	117116	66503	183619
2001-2002	53456 / 12826	10929 / 5906	64385 / 14120	0.34 / 0.10	0.22 / 0.14	0.31 / 0.08	156862	49642	206504
2002-2003	73359 / 16392	22382 / 9419	95741 / 18906	0.55 / 0.15	0.39 / 0.19	0.50 / 0.12	132997	57618	190615
2003-2004	47950 / 16799	18244 / 8569	66194 / 18858	0.37 / 0.14	0.29 / 0.17	0.35 / 0.11	129310	62478	191788
2004-2005	64100 / 11096	10665 / 5909	74765 / 12572	0.43 / 0.10	0.23 / 0.15	0.38 / 0.09	148808	46503	195310

Table 8. (Cont).

	Landings (landings/SE)			Catch Rate (#/h/SE)			Man-Hours		
	High-Use	Low-Use	Annual	High-Use	Low-Use	Annual	High-Use	Low-Use	Total
Spotted Seatrout (Cont'd.)									
Corpus Christi Bay									
1983-1984	8244 / 6954	0 / 0	8244 / 6954	0.59 / 0.53		0.59 / 0.53	13972	0	13972
1984-1985	1964 / 814	0 / 0	1964 / 814	0.19 / 0.11		0.19 / 0.11	10421	0	10421
1985-1986	8712 / 5149	0 / 0	8712 / 5149	0.60 / 0.46		0.60 / 0.46	14459	0	14459
1986-1987	2991 / 2246	174 / 174	3165 / 2252	0.22 / 0.18	0.16 / 0.16	0.21 / 0.17	13799	1087	14886
1987-1988	32021 / 22134	323 / 323	32344 / 22137	0.94 / 0.71	0.13 / 0.13	0.88 / 0.66	34227	2424	36651
1988-1989	17241 / 7834	0 / 0	17241 / 7834	0.59 / 0.35	0.00 / 0.00	0.59 / 0.35	29468	0	29468
1989-1990	37314 / 24296	671 / 512	37985 / 24301	0.66 / 0.53	0.05 / 0.05	0.54 / 0.41	56961	12833	69794
1990-1991	4526 / 1842	2122 / 2122	6648 / 2809	0.08 / 0.05	0.27 / 0.27	0.11 / 0.06	53953	7729	61682
1991-1992	21608 / 9685	297 / 211	21905 / 9687	0.48 / 0.26	0.11 / 0.09	0.46 / 0.24	44644	2782	47426
1992-1993	25428 / 13956	652 / 575	26080 / 13968	0.90 / 0.57	0.10 / 0.10	0.75 / 0.46	28347	6280	34627
1993-1994	22859 / 8360	363 / 363	23222 / 8368	0.66 / 0.32	0.06 / 0.06	0.57 / 0.26	34521	6471	40992
1994-1995	56103 / 22615	3054 / 2267	59157 / 22728	0.52 / 0.28	0.11 / 0.09	0.44 / 0.21	107830	27583	135414
1995-1996	39117 / 12350	599 / 599	39716 / 12364	0.56 / 0.23	0.08 / 0.08	0.52 / 0.20	69537	7306	76842
1996-1997	62654 / 21009	8270 / 7790	70924 / 22407	0.62 / 0.34	0.83 / 0.80	0.64 / 0.33	101451	10000	111450
1997-1998	23695 / 8418	1089 / 1089	24784 / 8488	0.41 / 0.25	0.05 / 0.05	0.31 / 0.17	57854	21259	79113
1998-1999	89779 / 51818	1122 / 1122	90901 / 51830	0.80 / 0.58	0.17 / 0.17	0.77 / 0.54	112034	6657	118691
1999-2000	53839 / 28266	5372 / 2868	59211 / 28411	0.71 / 0.51	0.28 / 0.18	0.62 / 0.40	75986	18904	94889
2000-2001	33426 / 15251	3694 / 2598	37120 / 15471	0.79 / 0.43	0.11 / 0.09	0.50 / 0.24	42357	32554	74911
2001-2002	21097 / 5184	62 / 62	21159 / 5184	0.21 / 0.08	0.01 / 0.01	0.20 / 0.07	99485	5230	104715
2002-2003	46293 / 22749	989 / 706	47282 / 22760	0.22 / 0.13	0.14 / 0.11	0.22 / 0.13	212717	7114	219830
2003-2004	53462 / 27088	3971 / 2970	57433 / 27251	0.47 / 0.26	0.21 / 0.19	0.43 / 0.23	113680	18647	132327
2004-2005	29081 / 13639	83 / 83	29164 / 13639	0.27 / 0.19	0.01 / 0.01	0.25 / 0.17	109657	7221	116878
Upper Laguna Madre									
1983-1984	645 / 645	0 / 0	645 / 645	0.92 / 0.92	0.00 / 0.00	0.74 / 0.74	699	175	874
1984-1985	0 / 0	0 / 0	0 / 0	0.00 / 0.00		0.00 / 0.00	742	0	742
1985-1986	913 / 389	1855 / 1855	2768 / 1895	0.37 / 0.20	0.67 / 0.67	0.53 / 0.42	2489	2782	5271
1986-1987	3028 / 1005	1588 / 1110	4616 / 1497	0.41 / 0.17	0.62 / 0.51	0.46 / 0.19	7435	2561	9996
1987-1988	4469 / 1255	2285 / 1415	6754 / 1892	0.39 / 0.16	0.37 / 0.30	0.38 / 0.15	11524	6243	17767
1988-1989	6314 / 1452	17396 / 10484	23710 / 10585	0.29 / 0.09	0.61 / 0.46	0.47 / 0.25	21746	28657	50402
1989-1990	6552 / 1686	0 / 0	6552 / 1686	0.23 / 0.07	0.00 / 0.00	0.21 / 0.06	28360	2693	31053
1990-1991	143 / 94	1458 / 933	1601 / 938	0.02 / 0.01	0.41 / 0.31	0.14 / 0.09	7852	3531	11383
1991-1992	5694 / 1226	18417 / 9778	24111 / 9855	0.27 / 0.08	0.37 / 0.30	0.34 / 0.21	20749	49866	70615
1992-1993	10442 / 1981	11377 / 4534	21819 / 4948	0.38 / 0.11	0.45 / 0.24	0.41 / 0.13	27696	25476	53172
1993-1994	12347 / 3768	13437 / 10418	25783 / 11079	0.45 / 0.20	0.47 / 0.40	0.46 / 0.24	27718	28327	56045
1994-1995	12619 / 3968	7322 / 3923	19941 / 5580	0.21 / 0.11	0.47 / 0.29	0.26 / 0.11	60549	15519	76068
1995-1996	24963 / 6212	9417 / 4967	34380 / 7953	0.49 / 0.16	0.35 / 0.25	0.44 / 0.15	51290	27047	78338
1996-1997	18075 / 4224	27817 / 20528	45892 / 20958	0.33 / 0.10	0.38 / 0.32	0.36 / 0.20	54093	72269	126362
1997-1998	41814 / 8718	24681 / 9862	66495 / 13162	0.63 / 0.20	0.55 / 0.27	0.60 / 0.16	66383	44834	111217
1998-1999	47422 / 10049	23861 / 8647	71284 / 13257	0.64 / 0.17	0.50 / 0.21	0.58 / 0.14	74641	48073	122715
1999-2000	82241 / 14317	17110 / 4949	99351 / 15149	0.71 / 0.17	0.24 / 0.10	0.53 / 0.11	115229	70976	186205
2000-2001	86918 / 14357	8912 / 3319	95830 / 14736	0.62 / 0.13	0.22 / 0.10	0.53 / 0.10	140596	40518	181114
2001-2002	55108 / 10409	7438 / 3332	62546 / 10929	0.53 / 0.12	0.26 / 0.16	0.47 / 0.10	104651	28149	132800
2002-2003	56480 / 8528	10031 / 3071	66511 / 9064	0.55 / 0.12	0.32 / 0.13	0.49 / 0.10	103533	31785	135318
2003-2004	40351 / 6126	8885 / 3013	49236 / 6827	0.52 / 0.10	0.45 / 0.20	0.51 / 0.09	77350	19710	97060
2004-2005	53477 / 7983	5294 / 2118	58771 / 8259	0.74 / 0.14	0.20 / 0.09	0.60 / 0.10	72585	26089	98674

Table 9. Weight (lbX1000) and Ex-vessel value ($X1000) of selected species landed commercially in the CBBEP area, between 1984-2004.

Year	Black Drum		Flounder		Sheepshead		Grooved Shrimp		White Shrimp		Blue Crab		Total	
Aransas Bay														
1984	16.8	$10	75.2	$58	5.5	$1	1733.4	$2,144	1135.0	$2,404	2129.7	$609	5095.6	$5,226
1985	15.7	$13	44.6	$45	11.3	$2	1582.7	$1,418	527.9	$1,238	2231.5	$744	4413.6	$3,460
1986	47.6	$33	90.5	$86	16.0	$4	1469.2	$2,208	1033.2	$2,866	936.0	$342	3592.4	$5,538
1987	46.4	$35	70.1	$68	29.9	$7	2054.7	$3,714	738.6	$1,761	1683.6	$604	4623.2	$6,190
1988	37.4	$28	27.9	$41	3.9	$1	1732.7	$2,335	677.3	$1,540	2571.9	$964	5051.1	$4,908
1989	2.6	$2	15.3	$25	0.2	$0	1220.6	$1,590	141.8	$341	405.5	$210	1786.0	$2,168
1990	26.2	$23	9.7	$18	1.9	$1	2211.8	$3,140	1245.2	$3,595	766.1	$278	4260.8	$7,055
1991	24.0	$17	34.0	$44	0.5	$0	3058.1	$5,291	1454.2	$3,877	868.2	$268	5438.9	$9,497
1992	25.6	$17	40.1	$63	4.0	$2	979.5	$1,781	1771.1	$4,245	997.6	$398	3817.8	$6,506
1993	64.9	$42	41.3	$74	8.8	$4	1425.5	$1,885	955.8	$2,053	1487.4	$686	3983.7	$4,745
1994	119.5	$108	43.0	$79	11.5	$6	2118.3	$4,277	259.2	$1,005	387.1	$239	2938.6	$5,714
1995	243.0	$222	74.6	$147	16.7	$9	1867.9	$3,004	119.8	$368	492.4	$355	2814.5	$4,104
1996	148.4	$130	50.3	$107	18.0	$10	1401.5	$1,988	179.6	$637	298.1	$192	2096.0	$3,063
1997	193.7	$180	63.2	$115	26.6	$15	1927.5	$4,045	2.2	$10	340.6	$213	2553.7	$4,578
1998	184.1	$203	59.8	$116	32.2	$16	1170.5	$1,581	158.3	$498	238.4	$154	1843.3	$2,566
1999	152.5	$126	120.8	$253	34.9	$16	584.4	$850	31.7	$118	181.8	$112	1106.1	$1,476
2000	75.4	$58	62.7	$128	27.0	$10	555.0	$1,118	117.6	$489	123.0	$89	960.6	$1,892
2001	96.2	$56	50.4	$105	17.3	$6	785.4	$1,425	114.2	$449	679.4	$477	1742.8	$2,519
2002	165.8	$129	68.2	$150	19.6	$8	268.0	$265	23.2	$66	1182.9	$745	1727.8	$1,363
2003	220.0	$184	79.5	$174	29.3	$12	326.6	$482	41.3	$115	1340.3	$847	2036.8	$1,815
2004	150.8	$122	84.5	$174	29.4	$15	186.5	$234	19.2	$40	1019.4	$699	1489.9	$1,283
Corpus Christi Bay														
1984	64.6	$40	32.2	$31	31.2	$6	1209.2	$1,543	882.2	$1,832	76.1	$27	2295.6	$3,479
1985	29.3	$24	86.8	$83	39.3	$8	871.0	$1,004	178.4	$366	132.8	$45	1337.5	$1,529
1986	59.0	$37	120.6	$109	20.4	$5	596.2	$1,123	396.8	$904	877.2	$274	2070.1	$2,451
1987	105.5	$61	65.4	$62	21.4	$5	822.3	$1,730	496.5	$1,193	267.6	$102	1778.7	$3,154
1988	137.0	$119	33.1	$41	59.7	$18	609.8	$1,023	301.0	$631	202.8	$81	1343.3	$1,912
1989	72.8	$80	10.0	$15	4.2	$2	541.8	$868	56.5	$131	979.1	$399	1664.3	$1,495
1990	151.6	$214	9.6	$16	0.5	$0	1217.3	$1,777	873.6	$2,481	665.5	$310	2918.3	$4,799
1991	112.8	$129	44.8	$62	4.5	$2	1494.5	$2,694	640.7	$1,789	112.2	$47	2409.5	$4,723
1992	300.7	$292	93.8	$119	11.5	$6	1537.3	$3,137	810.9	$2,200	508.4	$252	3262.6	$6,006
1993	282.1	$250	52.2	$94	13.0	$6	946.6	$1,518	439.4	$982	973.6	$566	2707.0	$3,416
1994	375.6	$339	66.7	$129	9.4	$4	1229.3	$2,971	261.6	$979	153.6	$125	2096.1	$4,548
1995	598.4	$573	48.3	$93	17.5	$9	1202.6	$2,272	92.8	$297	50.5	$46	2010.1	$3,290
1996	946.5	$910	64.2	$131	33.1	$15	626.2	$1,579	60.4	$230	20.3	$14	1750.7	$2,881
1997	519.2	$521	30.8	$57	20.4	$10	1051.1	$2,589	8.2	$38	18.9	$11	1648.6	$3,226
1998	316.3	$354	28.4	$64	10.5	$5	1216.1	$2,050	52.8	$169	56.8	$42	1680.8	$2,683
1999	134.9	$137	1.8	$4	2.9	$2	318.6	$568	30.2	$155	8.0	$4	496.5	$870
2000	194.0	$174	13.4	$28	2.9	$1	282.9	$595	24.3	$102	3.0	$1	520.5	$902
2001	207.0	$152	14.2	$34	2.8	$1	421.2	$888	31.3	$117	5.9	$3	682.4	$1,196
2002	168.9	$134	15.8	$39	5.2	$3	835.1	$913	110.3	$364	54.1	$28	1189.5	$1,480
2003	128.0	$109	9.7	$20	6.5	$3	320.7	$519	56.9	$173	115.8	$82	637.6	$907
2004	140.3	$126	9.0	$20	0.9	$0	151.1	$193	34.8	$66	53.5	$49	389.7	$454
Upper Laguna Madre														
1984	373.8	$196	28.3	$28	43.6	$8	277.9	$398	99.8	$156	19.7	$8	843.1	$793
1985	284.8	$164	18.0	$18	36.4	$7	157.4	$252	1.9	$7	92.5	$31	590.9	$480
1986	293.3	$218	24.6	$24	27.4	$8	72.1	$121	0.1	$0	76.3	$26	493.8	$398

CTable 9. (Cont'd.)

Year	Black Drum		Flounder		Sheepshead		Grooved Shrimp		White Shrimp		Blue Crab		Total	
Upper Laguna Madre (Cont'd.)														
1987	335.4	$283	10.8	$10	5.2	$2	148.8	$349	0.8	$3	179.4	$75	680.4	$721
1988	207.4	$181	5.0	$8	4.8	$2	170.0	$306	1.7	$3	102.8	$43	491.8	$542
1989	303.4	$314	0.5	$1	0.3	$0	41.8	$73	0.0	$0	10.3	$6	356.3	$394
1990	218.1	$242	0.9	$2	0.5	$0	4.4	$12	13.0	$28	25.8	$13	262.6	$297
1991	181.9	$194	4.3	$8	0.3	$0	22.5	$43	0.0	$0	3.7	$3	212.7	$248
1992	197.5	$175	2.3	$4	0.0	$0	114.2	$260	1.4	$4	472.6	$236	788.2	$680
1993	230.2	$170	0.9	$2	0.0	$0	46.1	$92	3.9	$9	63.2	$41	344.3	$314
1994	587.8	$479	0.5	$1	0.3	$0	160.8	$430	7.5	$30	69.4	$36	826.4	$976
1995	1326.7	$1,133	1.1	$3	0.6	$0	0.0	$0	0.0	$0	7.4	$6	1335.9	$1,142
1996	2016.5	$1,921	0.4	$1	4.9	$3	33.7	$48	0.8	$2	23.4	$17	2079.6	$1,991
1997	1586.0	$1,313	2.1	$3	0.5	$0	5.5	$15	0.2	$1	2.1	$1	1596.4	$1,334
1998	1363.4	$1,442	0.5	$1	1.3	$1	39.2	$70	1.2	$4	3.9	$2	1409.5	$1,521
1999	1463.0	$1,502	1.4	$2	0.5	$0	0.2	$0	0.0	$0	3.9	$2	1469.0	$1,506
2000	1569.1	$1,351	0.2	$0	4.4	$2	2.4	$5	0.0	$0	0.0	$0	1576.1	$1,359
2001	1380.4	$1,033	0.8	$1	2.8	$1	1.5	$6	0.6	$2	0.0	$0	1386.1	$1,043
2002	1370.9	$1,088	0.0	$0	0.9	$0	0.0	$0	0.0	$0	0.0	$0	1371.8	$1,089
2003	1077.8	$875	11.7	$22	0.6	$0	0.1	$0	0.0	$0	94.8	$64	1185.0	$962
2004	1157.6	$992	11.9	$30	0.1	$0	0.4	$1	0.1	$0	0.6	$0	1170.9	$1,023
CBBEP														
1984	455.2	$246	135.8	$116	80.3	$15	3220.5	$4,084	2117.0	$4,392	2225.5	$644	8234.3	$9,497
1985	329.7	$201	149.4	$146	86.9	$17	2611.0	$2,674	708.2	$1,612	2456.8	$820	6342.0	$5,469
1986	399.9	$288	235.7	$218	63.8	$16	2137.5	$3,451	1430.0	$3,771	1889.5	$642	6156.4	$8,386
1987	487.3	$378	146.3	$140	56.4	$14	3025.8	$5,793	1235.9	$2,958	2130.6	$781	7082.3	$10,065
1988	381.8	$328	66.0	$89	68.4	$21	2512.4	$3,663	980.1	$2,174	2877.4	$1,087	6886.2	$7,362
1989	378.8	$396	25.9	$41	4.6	$2	1804.2	$2,531	198.2	$472	1394.9	$614	3806.6	$4,057
1990	395.8	$479	20.3	$36	2.9	$1	3433.5	$4,929	2131.8	$6,103	1457.4	$601	7441.7	$12,150
1991	318.7	$340	83.1	$115	5.3	$2	4575.2	$8,028	2094.9	$5,666	984.0	$317	8061.2	$14,469
1992	523.9	$484	136.2	$186	15.5	$8	2631.0	$5,179	2583.4	$6,450	1978.6	$887	7868.6	$13,193
1993	577.2	$462	94.4	$170	21.8	$10	2418.3	$3,494	1399.1	$3,044	2524.2	$1,294	7035.0	$8,475
1994	1082.9	$926	110.2	$209	21.2	$10	3508.4	$7,678	528.3	$2,014	610.1	$400	5861.2	$11,237
1995	2168.1	$1,928	124.0	$243	34.8	$19	3070.6	$5,276	212.6	$666	550.3	$406	6160.5	$8,537
1996	3111.5	$2,961	114.9	$238	55.9	$28	2061.4	$3,615	240.8	$870	341.8	$222	5926.2	$7,935
1997	2298.8	$2,014	96.0	$176	47.5	$25	2984.1	$6,649	10.6	$49	361.6	$225	5798.6	$9,139
1998	1863.8	$1,999	88.8	$180	44.0	$22	2425.7	$3,700	212.3	$671	299.1	$198	4933.6	$6,770
1999	1750.5	$1,764	124.0	$259	38.2	$18	903.1	$1,419	62.0	$273	193.8	$118	3071.6	$3,852
2000	1838.4	$1,584	76.3	$157	34.3	$14	840.3	$1,717	141.9	$591	126.0	$90	3057.2	$4,153
2001	1683.6	$1,240	65.4	$141	22.9	$9	1208.0	$2,319	146.1	$569	685.2	$480	3811.3	$4,758
2002	1705.6	$1,351	84.0	$188	25.8	$11	1103.1	$1,177	133.5	$430	1237.0	$774	4289.1	$3,931
2003	1425.7	$1,169	100.9	$216	36.4	$15	647.3	$1,001	98.2	$289	1550.9	$993	3859.4	$3,684
2004	1448.8	$1,239	105.5	$224	30.4	$15	338.1	$428	54.1	$106	1073.6	$748	3050.5	$2,760

Table 10. Weight (lbX1000) and Ex-vessel value ($X1000) of dead and live bait shrimp landed in the CBBEP area, between 1984-2004.

Year	Aransas Bay		Corpus Christi Bay		Upper Laguna Madre		CBBEP	
Dead Bait Shrimp								
1995	16.4	$25.3	63.7	$100.4	32.9	$55.5	112.9	$181.1
1996	25.7	$40.7	91.2	$131.3	47.7	$55.8	164.7	$227.7
1997	22.3	$38.8	134.7	$220.4	34.8	$54.7	191.8	$313.9
1998	20.8	$30.0	144.8	$202.1	55.5	$77.0	221.1	$369.6
1999	12.6	$16.4	107.2	$154.1	48.1	$80.5	167.9	$251.0
2000	26.8	$43.3	87.3	$141.8	42.1	$74.0	156.2	$259.1
2001	26.7	$42.8	97.3	$151.6	39.8	$74.1	163.7	$268.6
2002	30.9	$50.2	115.1	$161.5	17.0	$31.7	162.9	$243.5
2003	28.1	$40.8	106.7	$167.1	9.5	$15.4	144.3	$223.3
2004	32.3	$42.4	113.5	$177.4	24.4	$46.6	170.2	$266.4
Live Bait Shrimp								
1995	53.0	$182.3	57.8	$187.3	27.6	$85.1	138.4	$454.6
1996	55.1	$182.6	113.6	$330.5	44.4	$137.4	213.0	$650.4
1997	56.5	$185.2	120.8	$391.1	34.3	$103.5	211.5	$679.7
1998	60.2	$188.5	128.3	$417.5	51.6	$151.1	240.0	$757.1
1999	35.5	$109.1	126.2	$403.6	43.2	$132.2	204.9	$644.9
2000	70.4	$230.7	116.2	$383.8	41.2	$132.5	227.8	$747.1
2001	68.7	$238.0	143.3	$502.8	33.0	$114.7	245.0	$855.5
2002	63.8	$225.5	157.4	$574.9	19.6	$74.2	240.8	$874.6
2003	66.4	$235.7	190.8	$716.1	15.1	$56.7	272.3	$1,008.5
2004	69.0	$226.1	197.3	$741.0	19.2	$73.9	285.5	$1,040.9

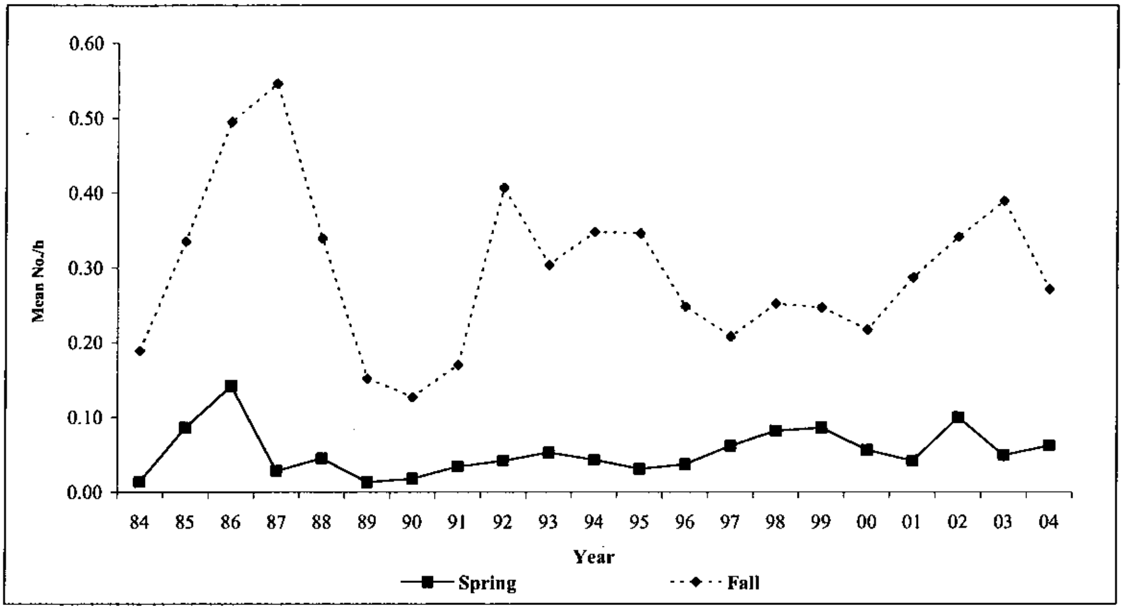

Figure 2. CBBEP area spring and fall mean catch rate (No./hr) for Atlantic croaker, 1984-2004.

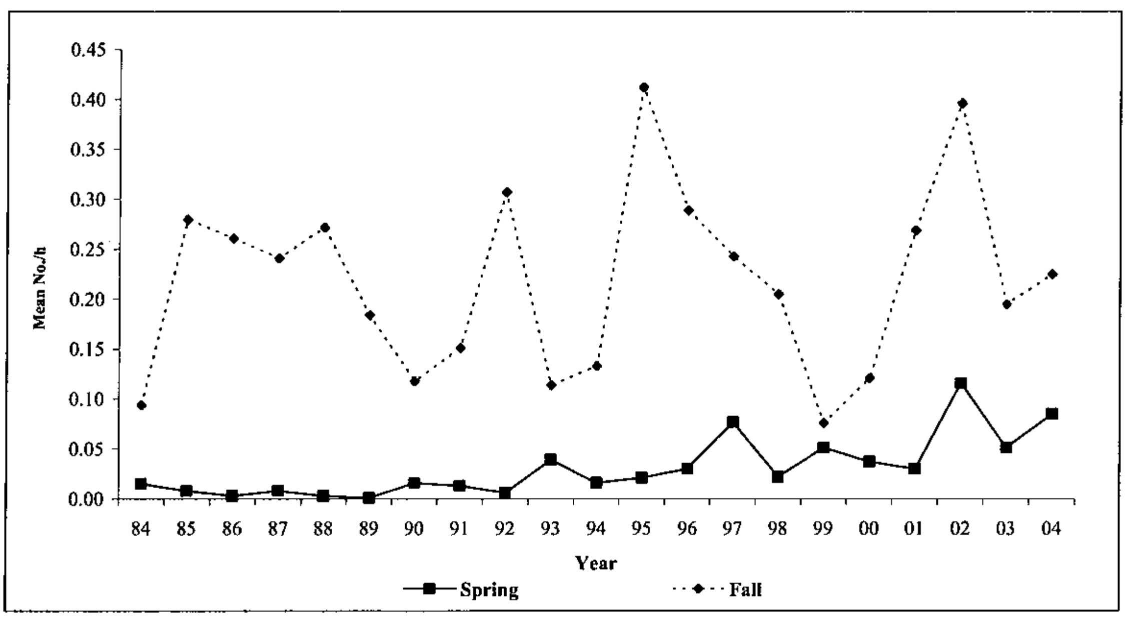

Figure 3. Aransas Bay spring and fall mean catch rate (No./hr) for Atlantic croaker, 1984-2004.

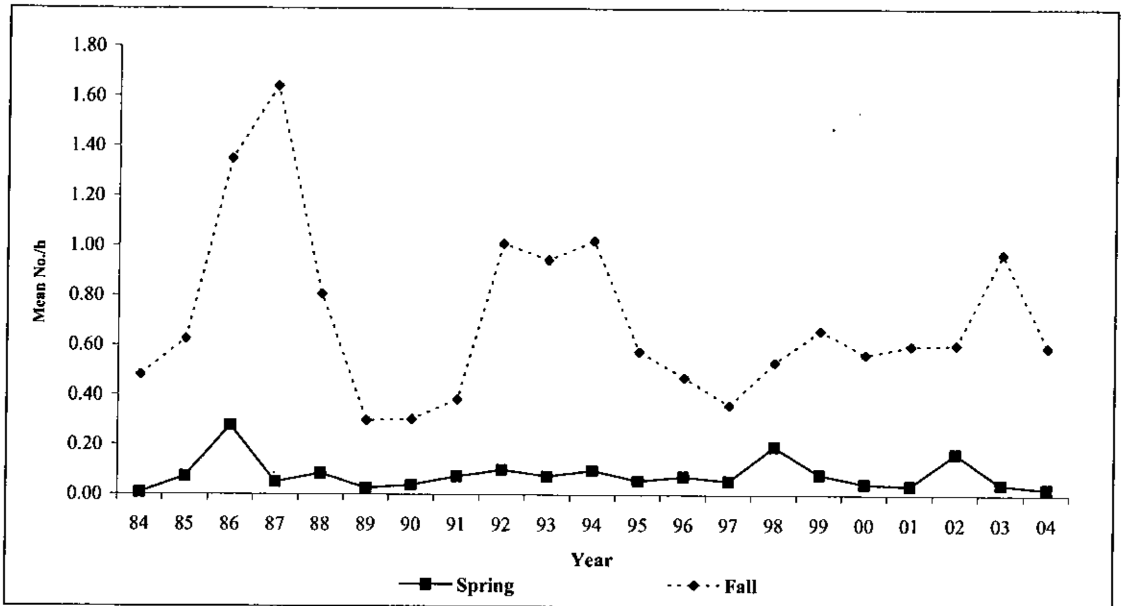

Figure 4. Corpus Christi Bay spring and fall mean catch rate (No./hr) for Atlantic croaker, 1984-2004.

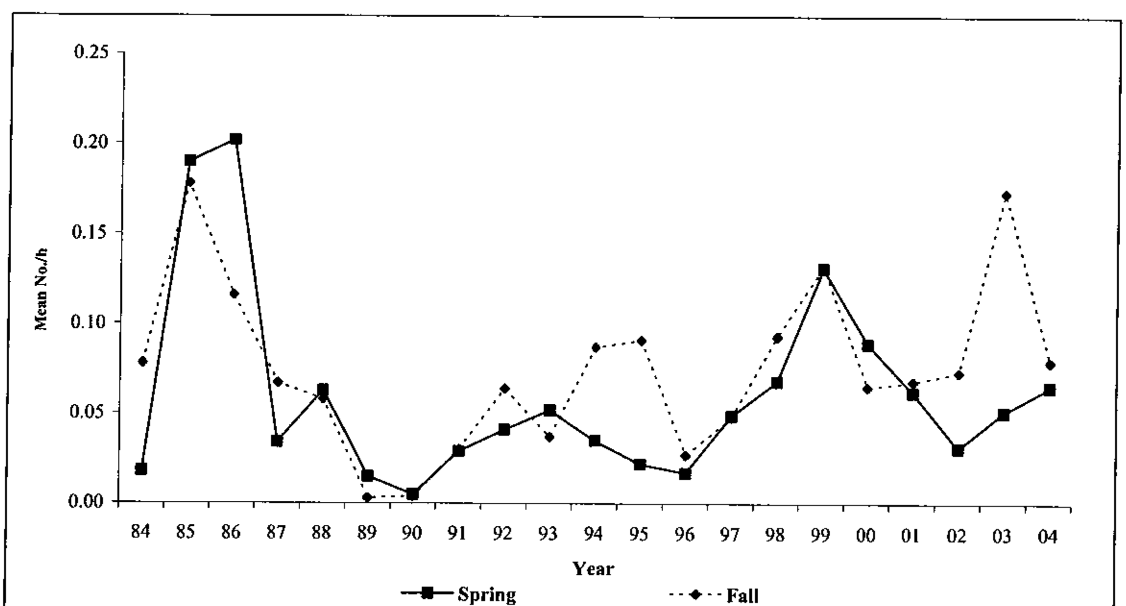

Figure 5. Upper Laguna Madre spring and fall mean catch rate (No./hr) for Atlantic croaker, 1984-2004.

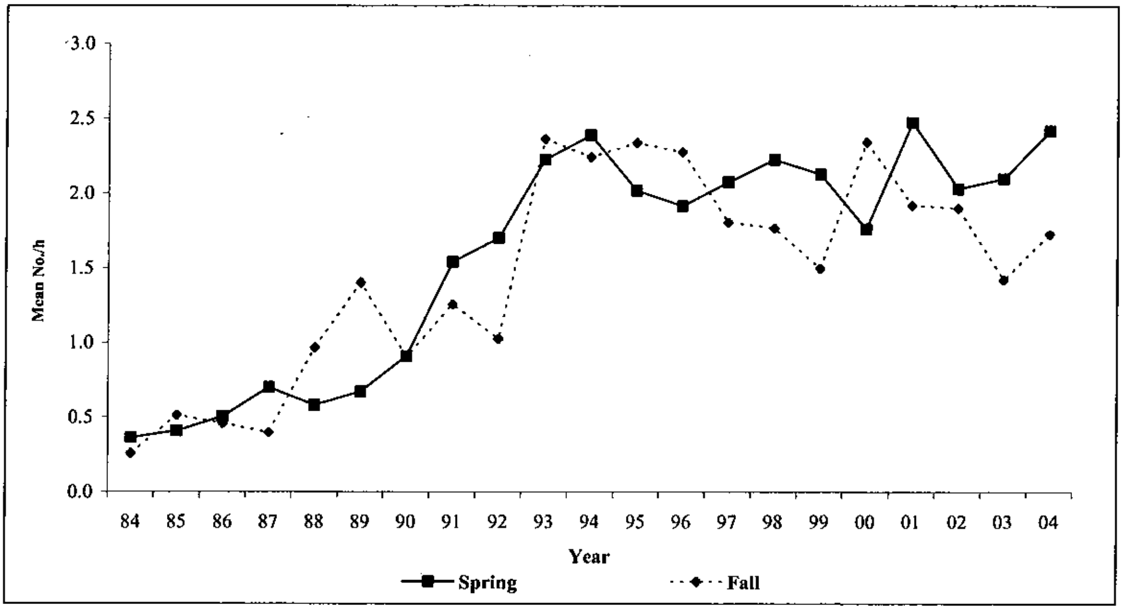

Figure 6. CBBEP area spring and fall mean catch rate (No./hr) for black drum, 1984-2004.

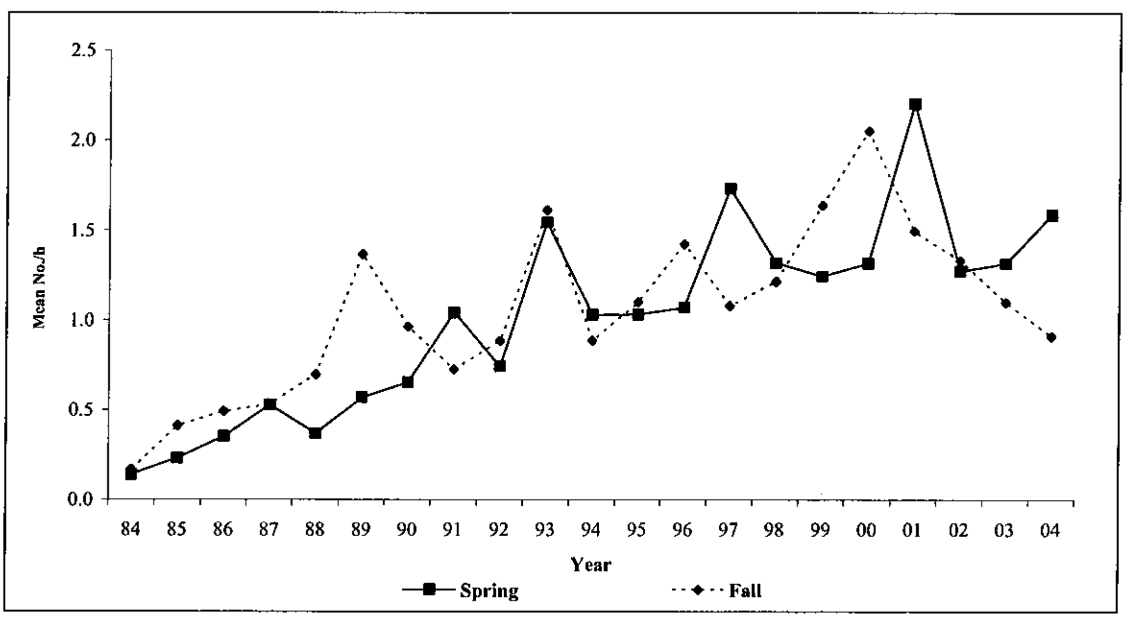

Figure 7. Aransas Bay spring and fall mean catch rate (No./hr) for black drum, 1984-2004.

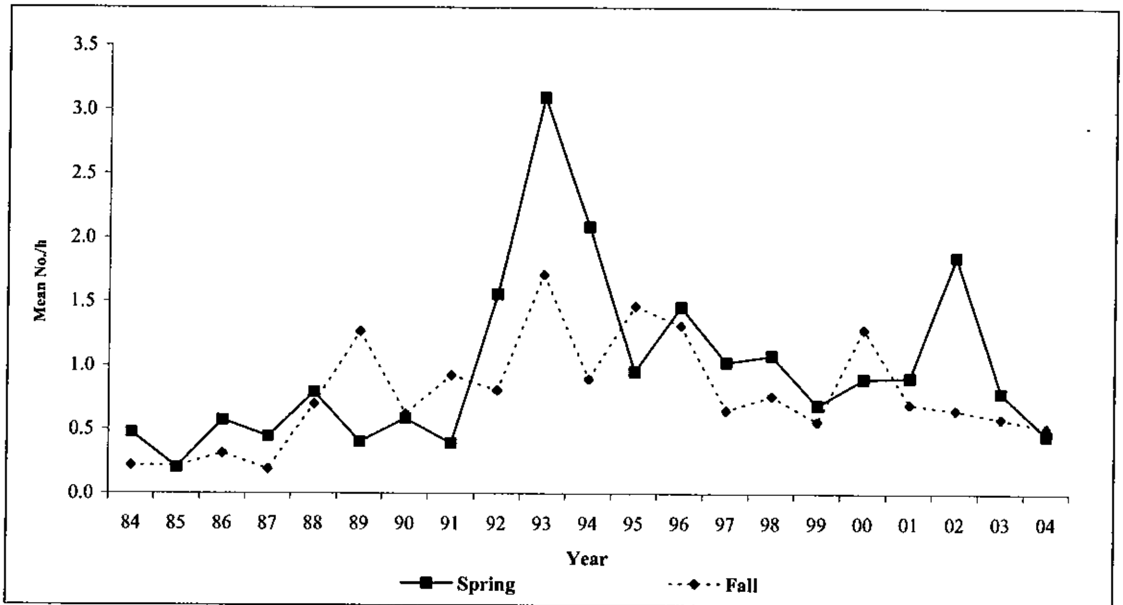

Figure 8. Corpus Christi Bay spring and fall mean catch rate (No./hr) for black drum, 1984-2004.

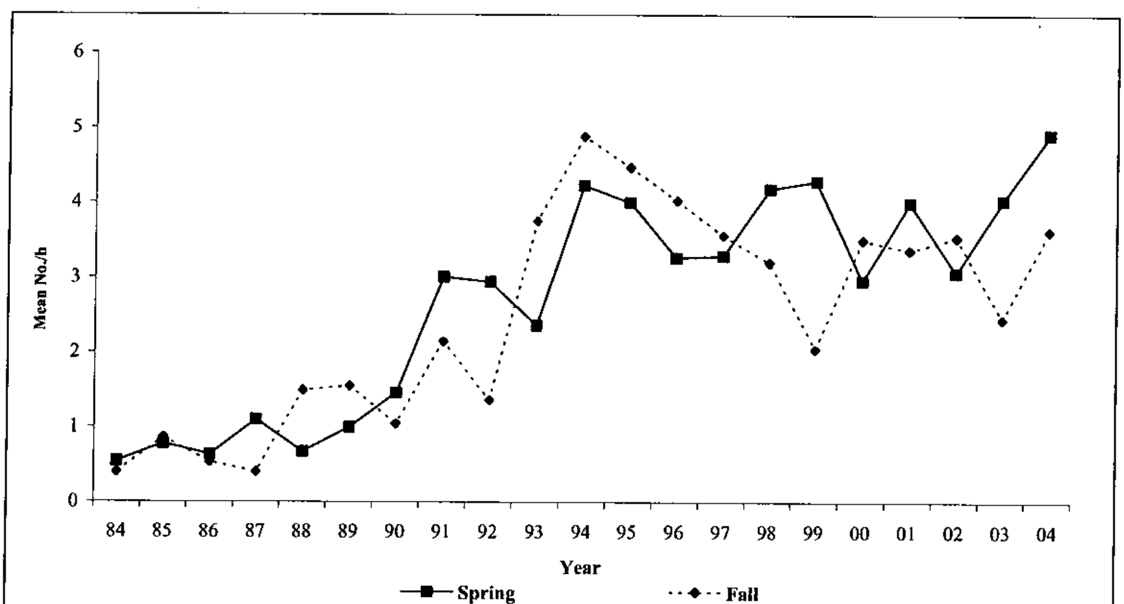

Figure 9. Upper Laguna Madre spring and fall mean catch rate (No./hr) for black drum, 1984-2004.

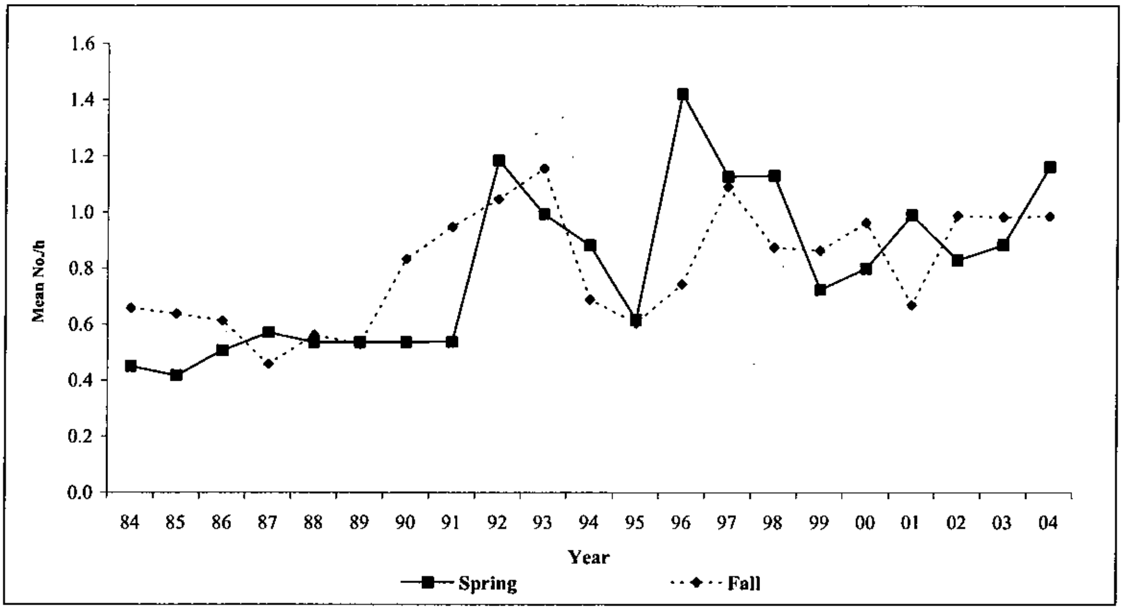

Figure 10. CBBEP area spring and fall mean catch rate (No./hr) for red drum, 1984-2004.

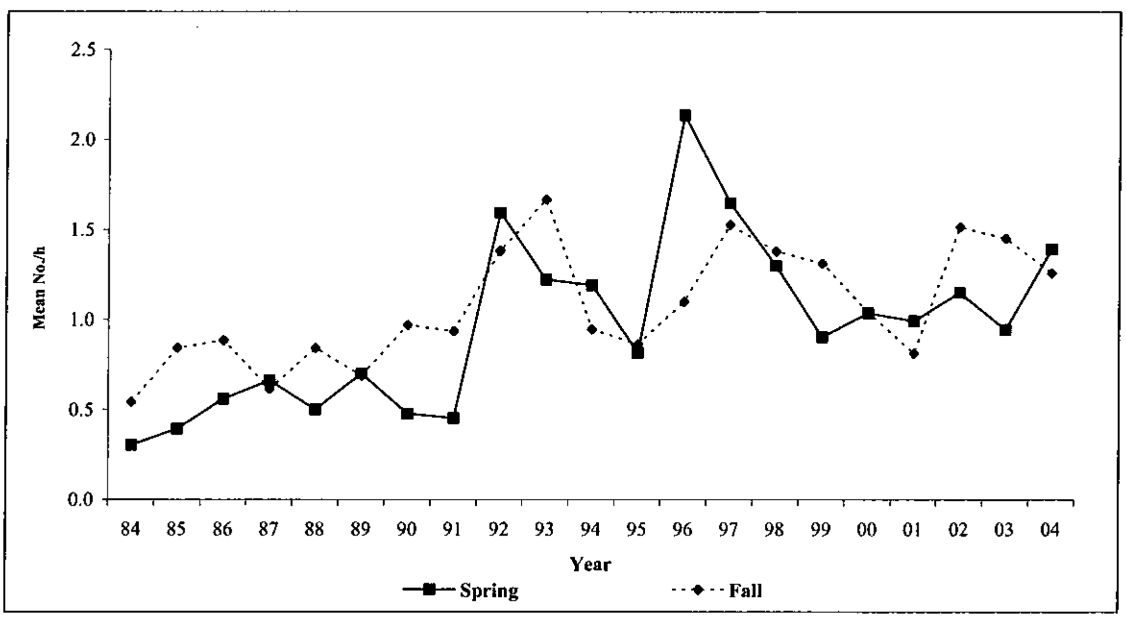

Figure 11. Aransas Bay spring and fall mean catch rate (No./hr) for red drum, 1984-2004.

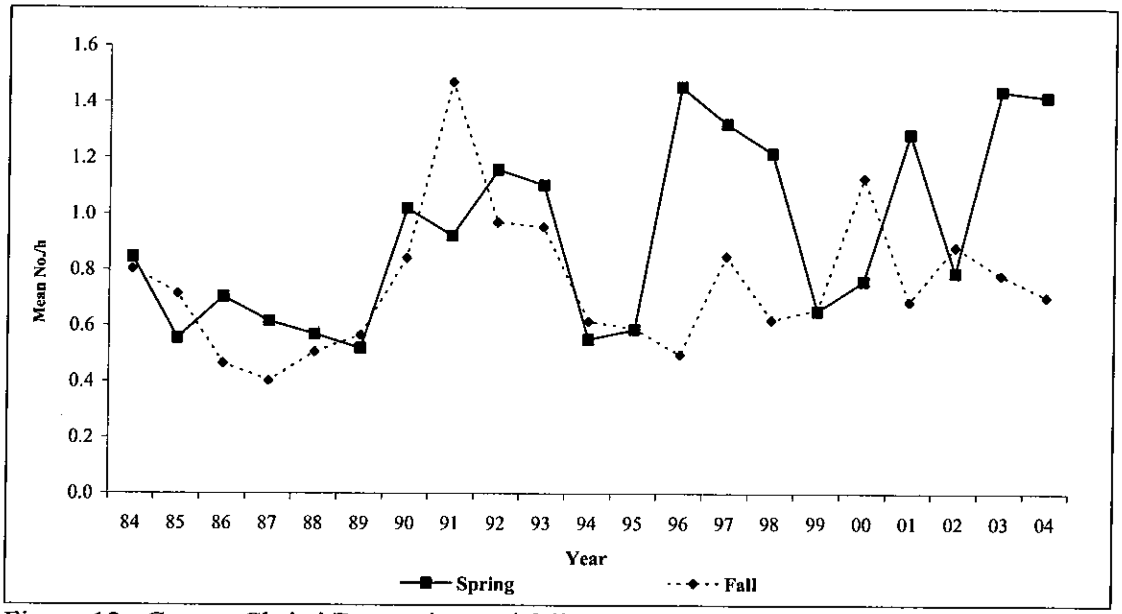

Figure 12. Corpus Christi Bay spring and fall mean catch rate (No./hr) for red drum, 1984-2004.

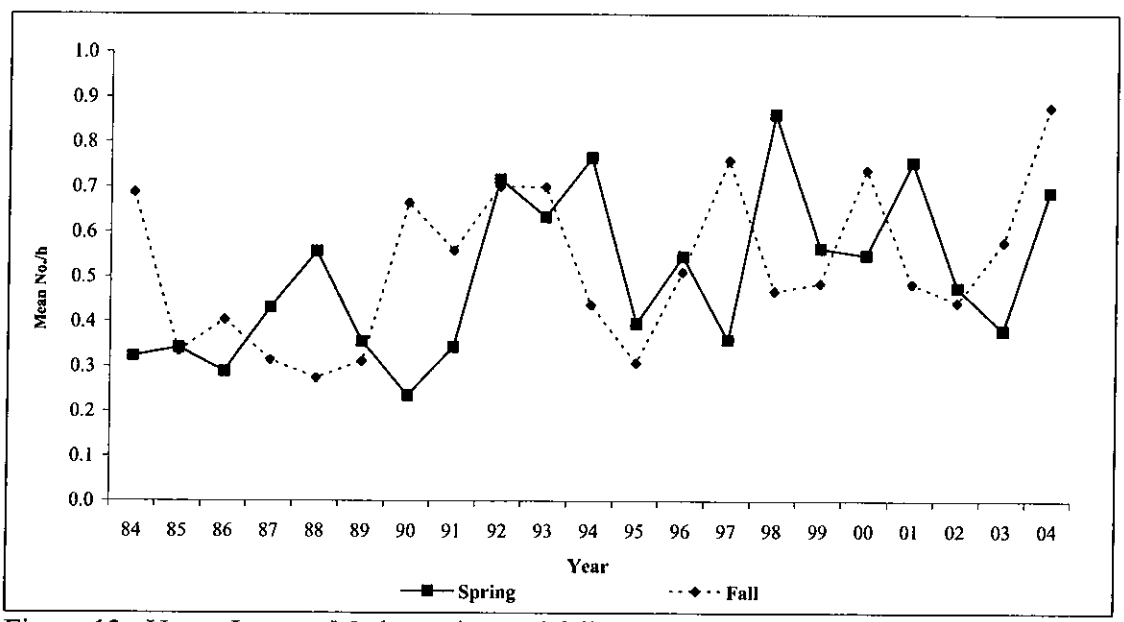

Figure 13. Upper Laguna Madre spring and fall mean catch rate (No./hr) for red drum, 1984-2004.

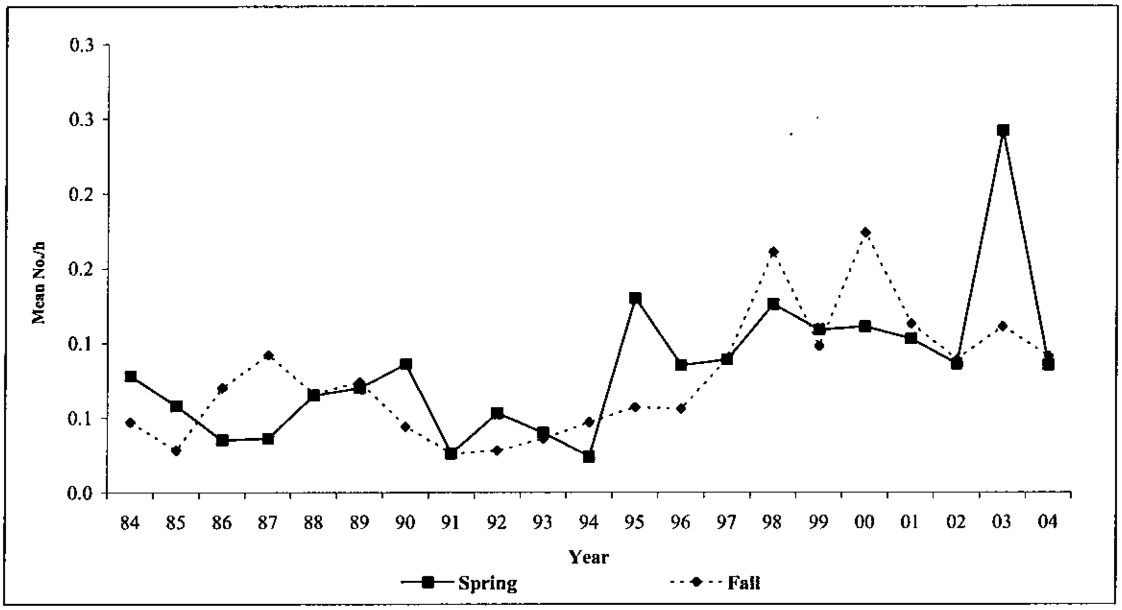

Figure 14. CBBEP area spring and fall mean catch rate (No./hr) for sheepshead, 1984-2004.

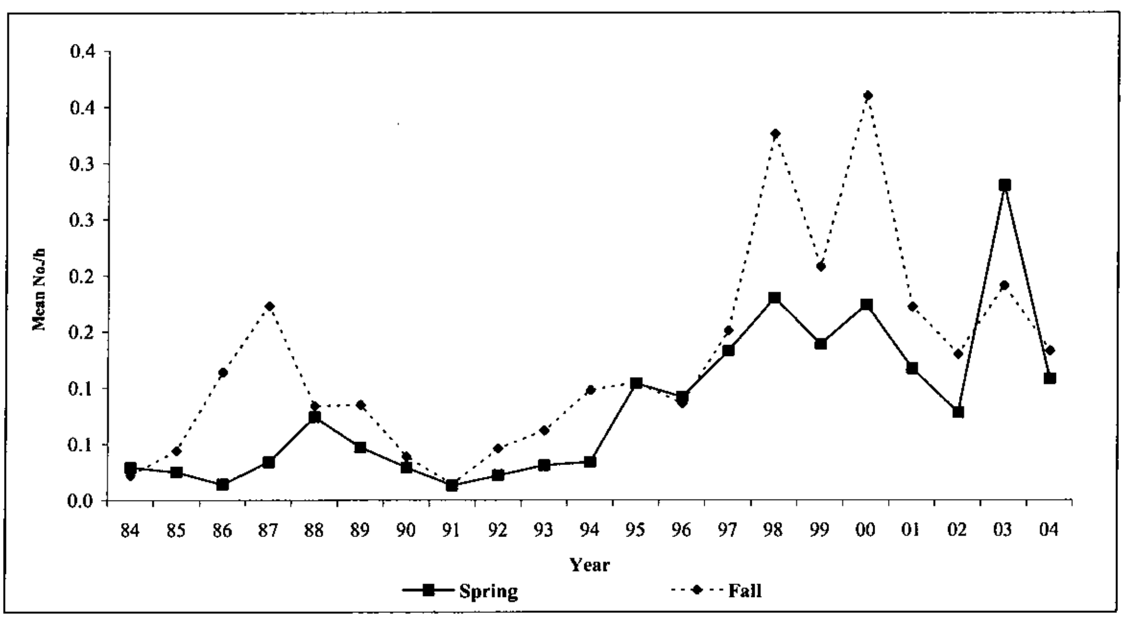

Figure 15. Aransas Bay spring and fall mean catch rate (No./hr) for sheepshead, 1984-2004.

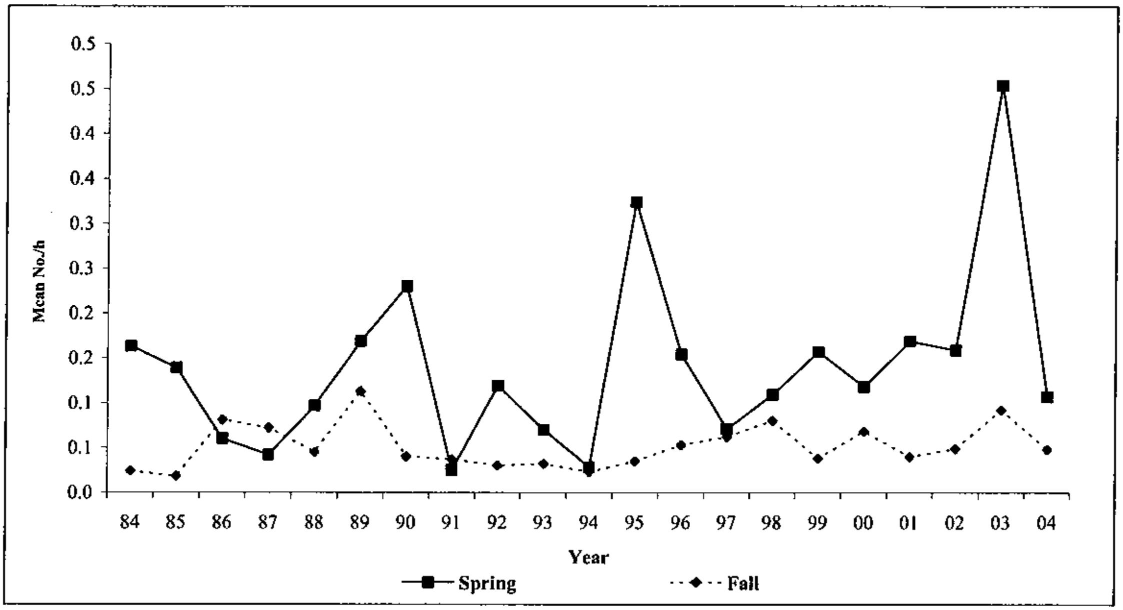

Figure 16. Corpus Christi Bay spring and fall mean catch rate (No./hr) for sheepshead, 1984-2004.

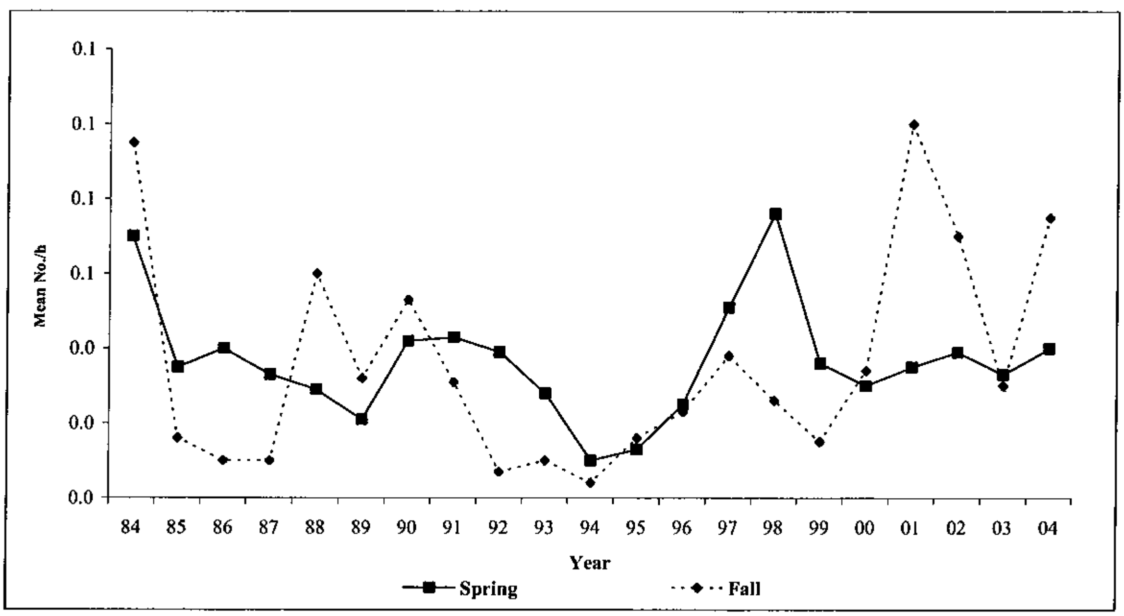

Figure 17. Upper Laguna Madre spring and fall mean catch rate (No./hr) for sheephead, 1984-2004.

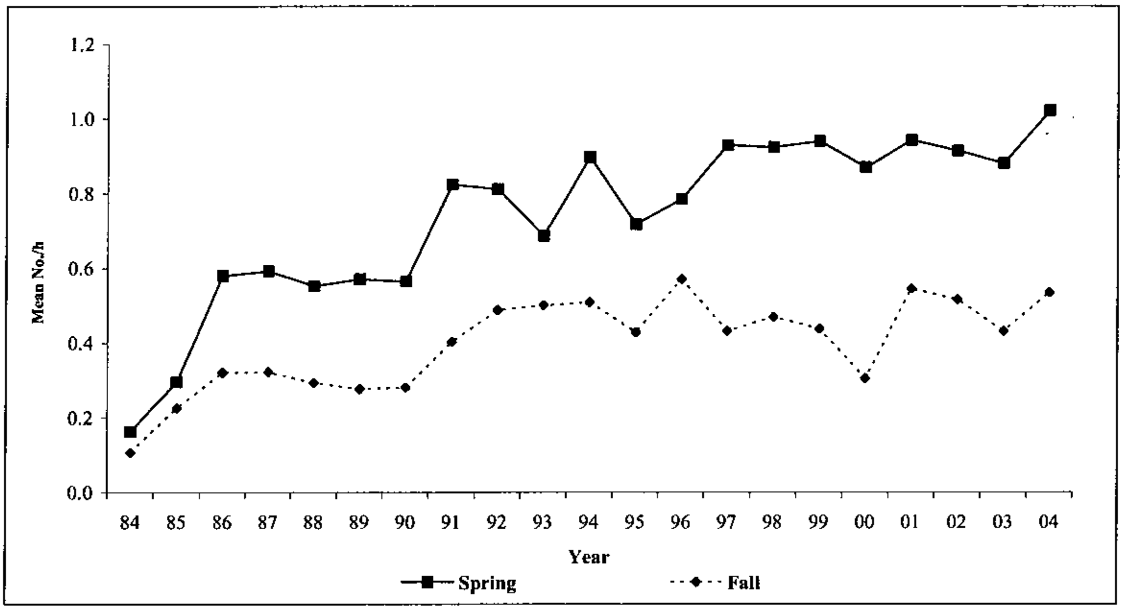

Figure 18. CBBEP area spring and fall mean catch rate (No./hr) for spotted seatrout, 1984-2004.

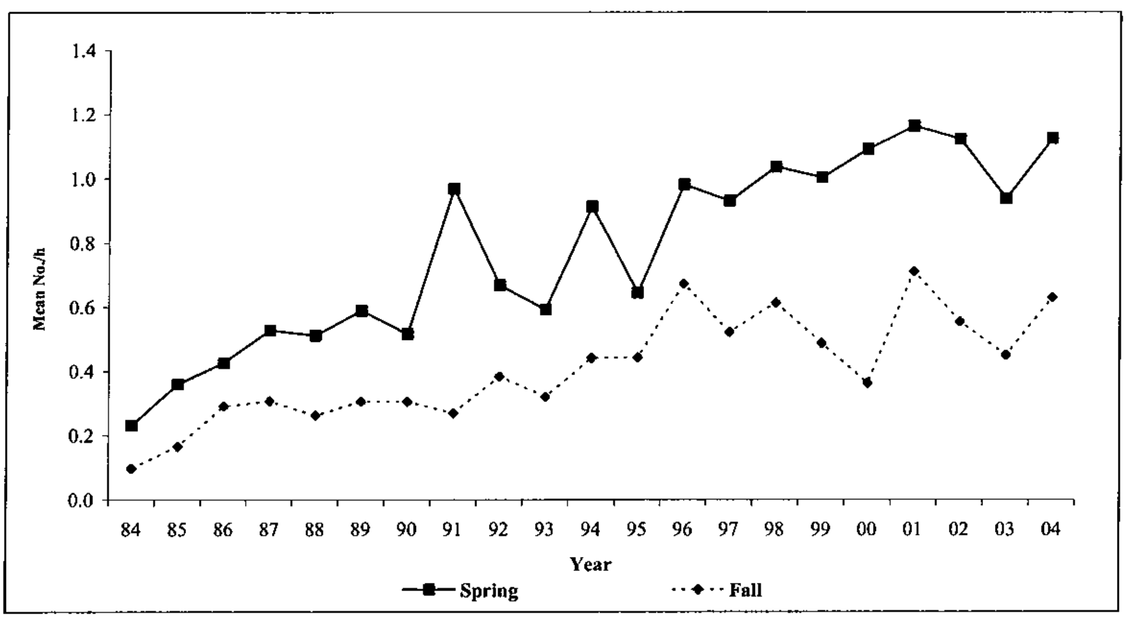

Figure 19. Aransas Bay spring and fall mean catch rate (No./hr) for spotted seatrout, 1984-2004.

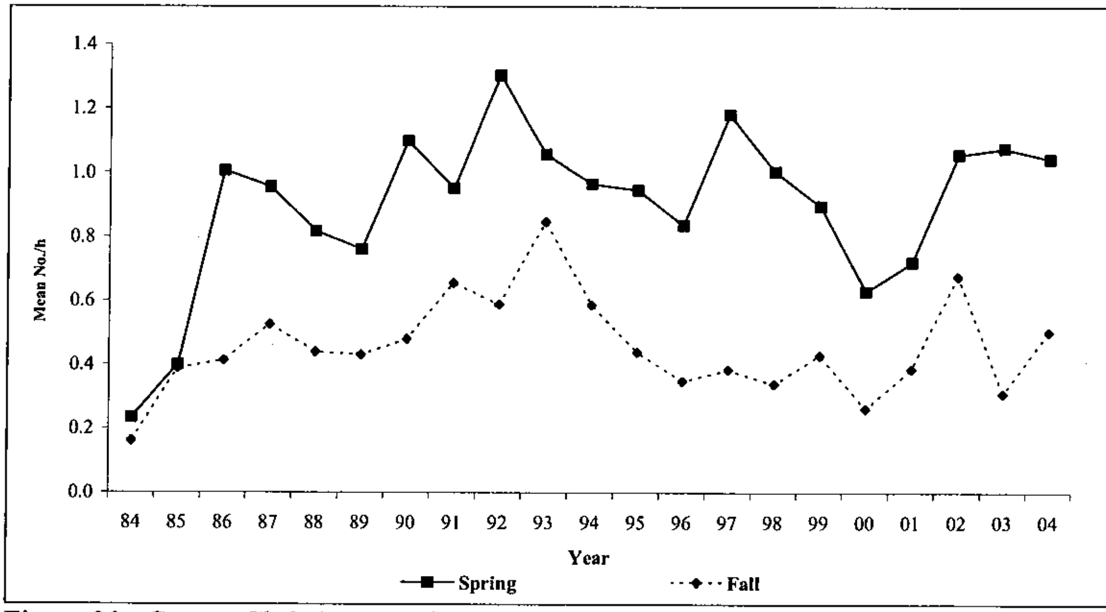

Figure 20. Corpus Christi Bay spring and fall mean catch rate (No./hr) for spotted seatrout, 1984-2004.

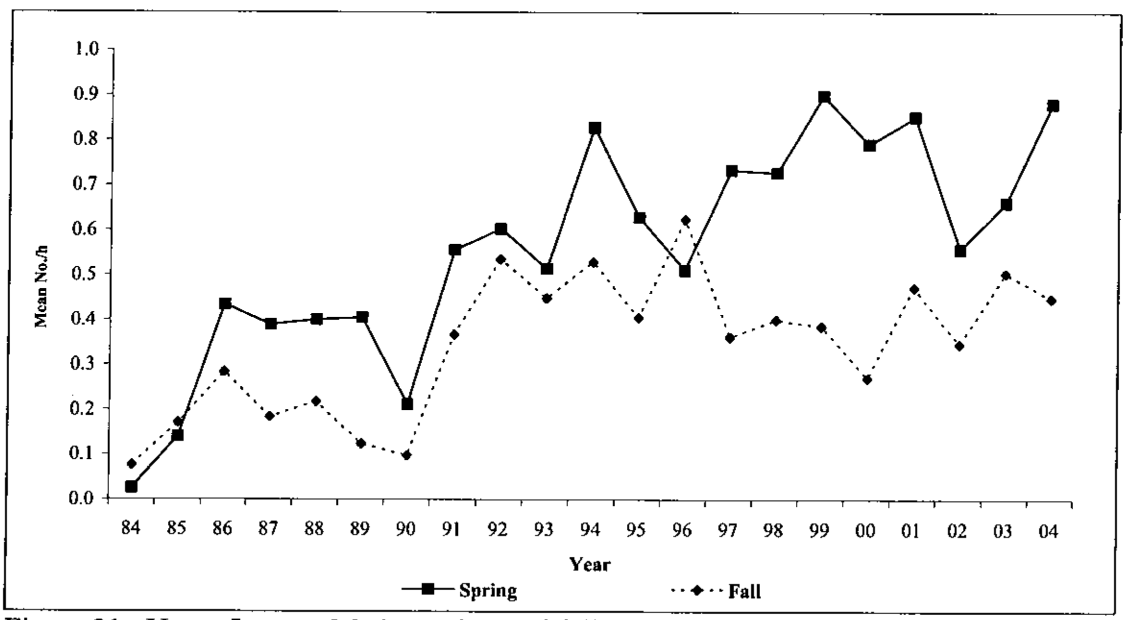

Figure 21. Upper Laguna Madre spring and fall mean catch rate (No./hr) for spotted seatrout, 1984-2004.

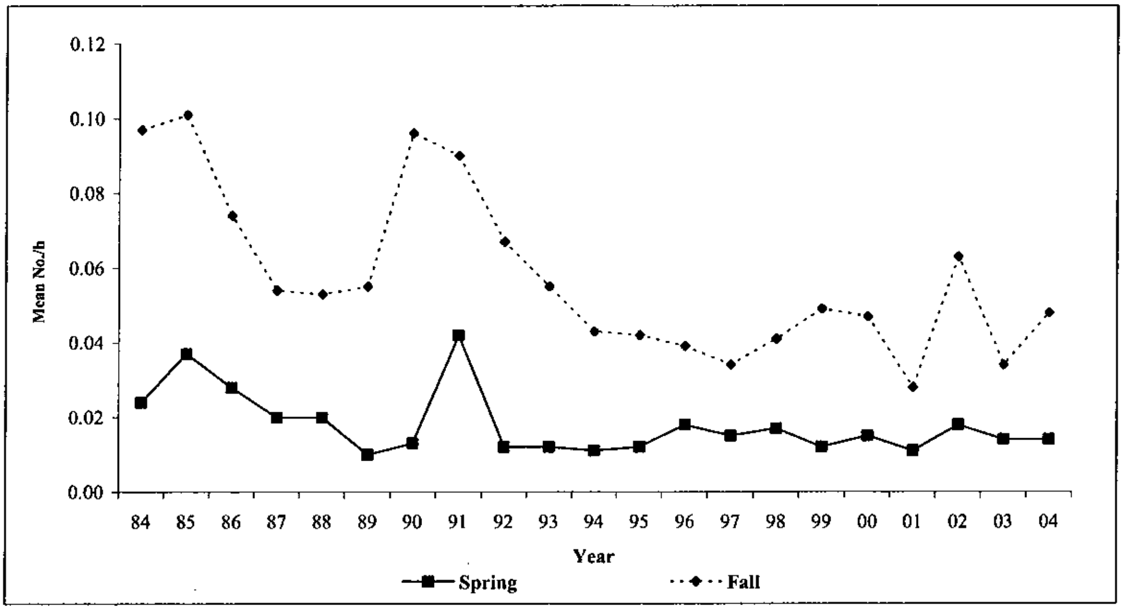

Figure 22. CBBEP area spring and fall mean catch rate (No./hr) for southern flounder, 1984-2004.

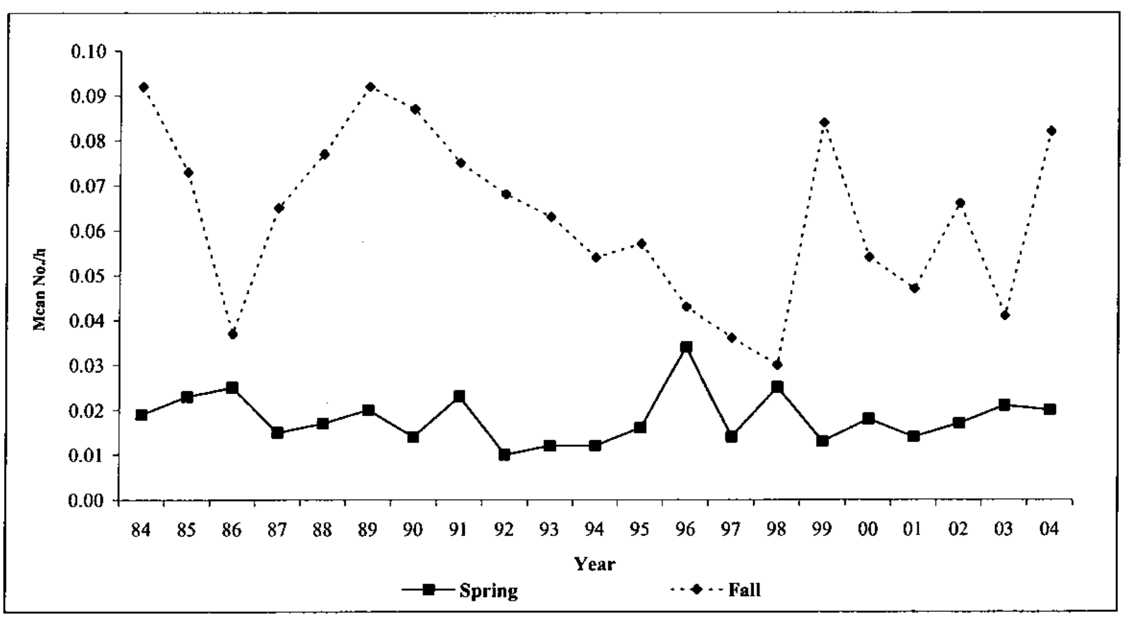

Figure 23. Aransas Bay spring and fall mean catch rate (No./hr) for southern flounder, 1984-2004.

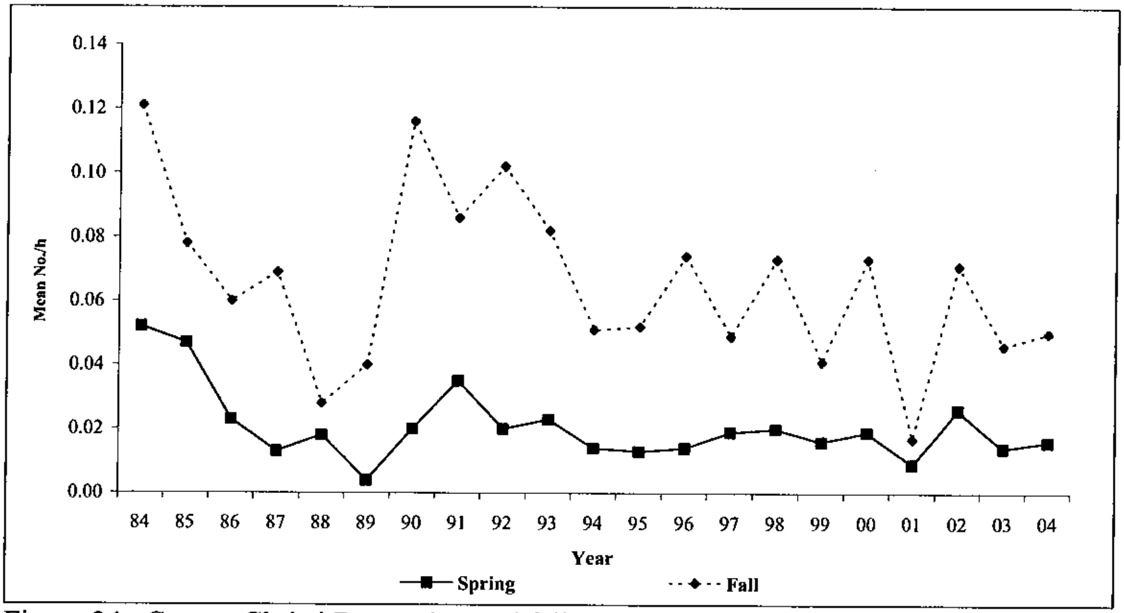

Figure 24. Corpus Christi Bay spring and fall mean catch rate (No./hr) for southern flounder, 1984-2004.

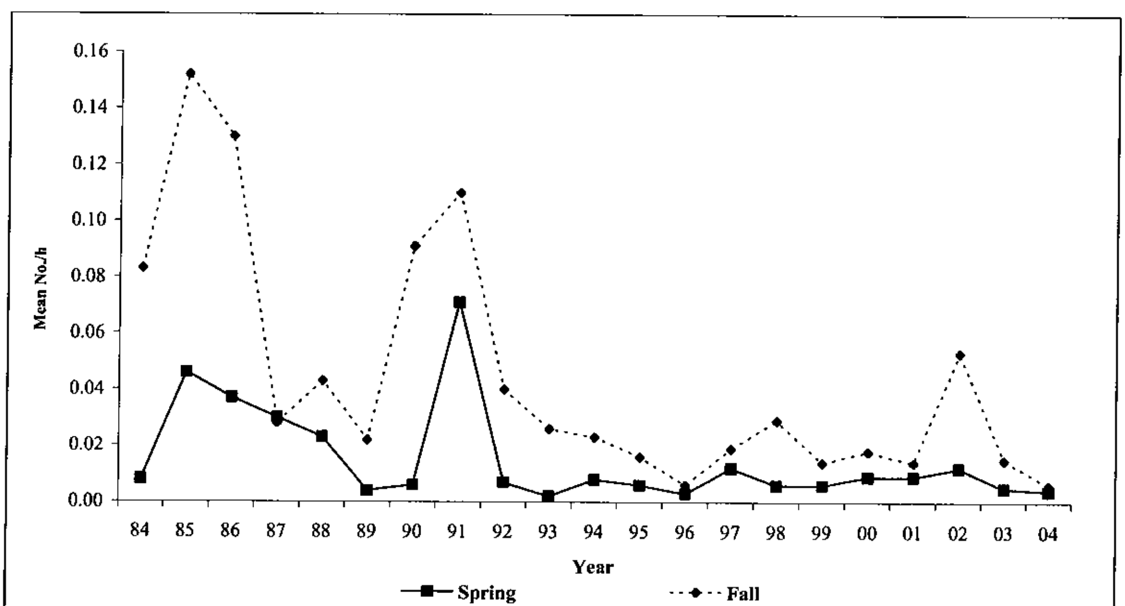

Figure 25. Upper Laguna Madre spring and fall mean catch rate (No./hr) for southern flounder, 1984-2004.

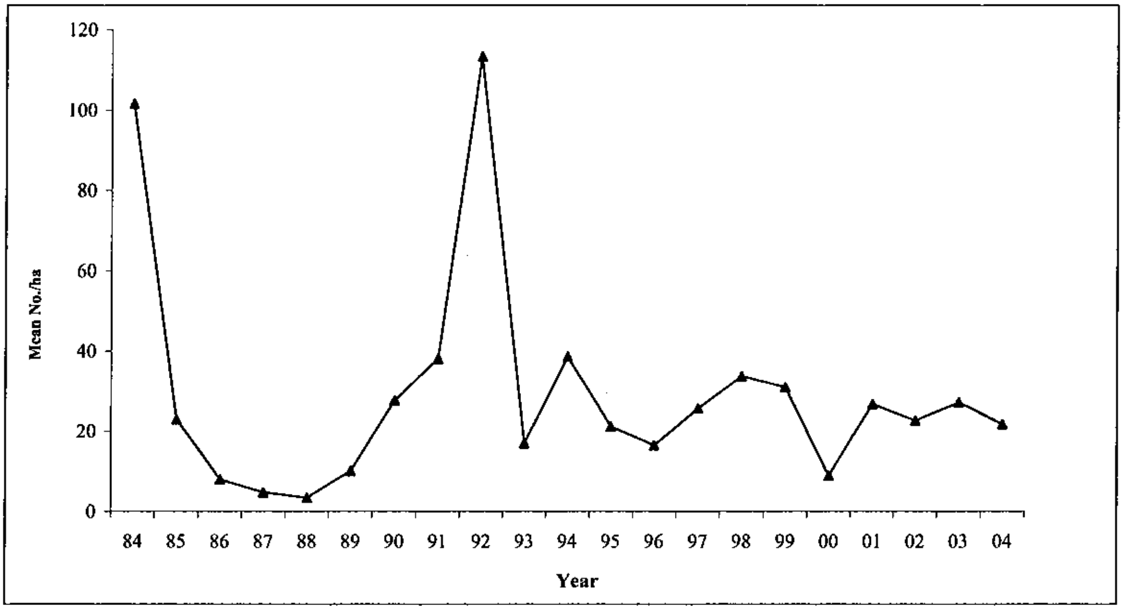

Figure 26. CBBEP area annual mean catch rate (No./ha) of Atlantic croaker caught with 18.3 meter bag seine during 1984-2004.

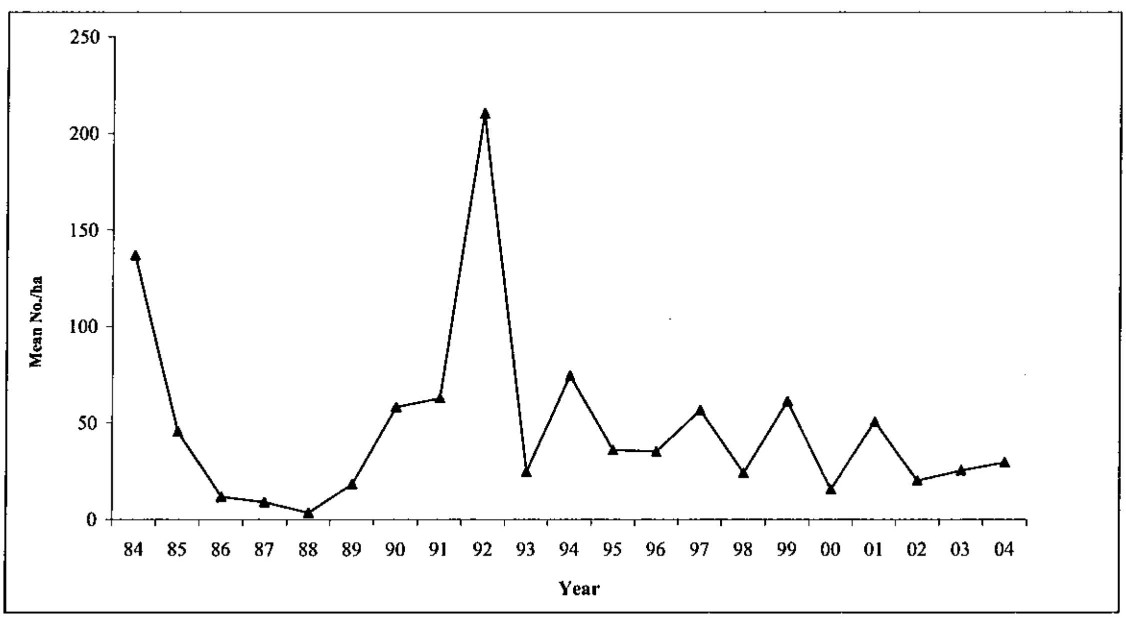

Figure 27. Aransas Bay annual mean catch rate (No./ha) of Atlantic croaker caught with 18.3 meter bag seine during 1984-2004.

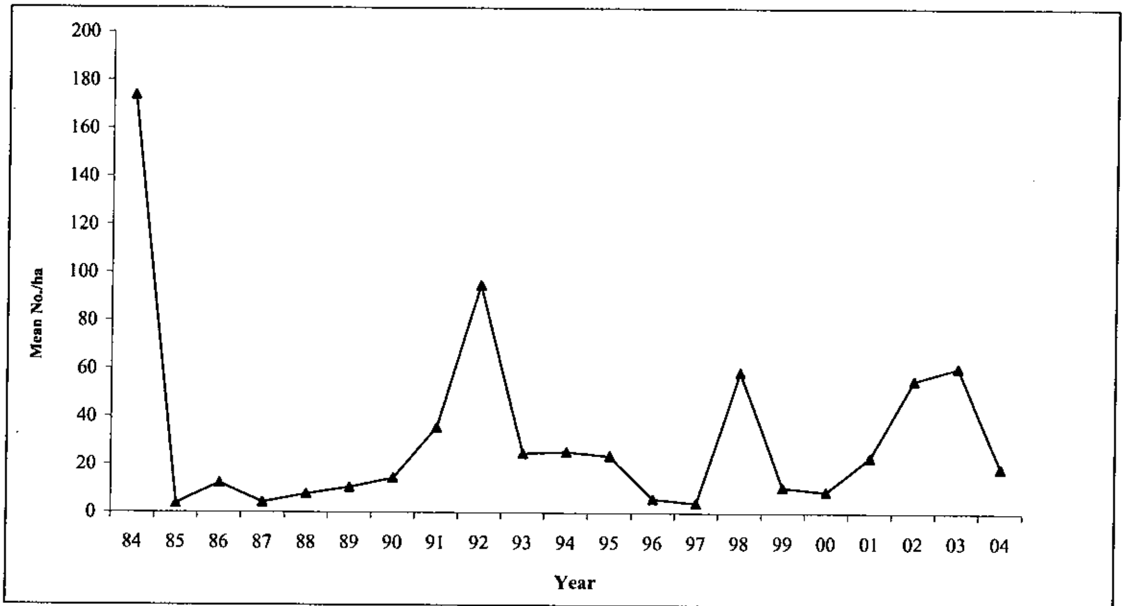

Figure 28. Corpus Christi Bay area annual mean catch rate (No./ha) of Atlantic croaker caught with 18.3 meter bag seine during 1984-2004.

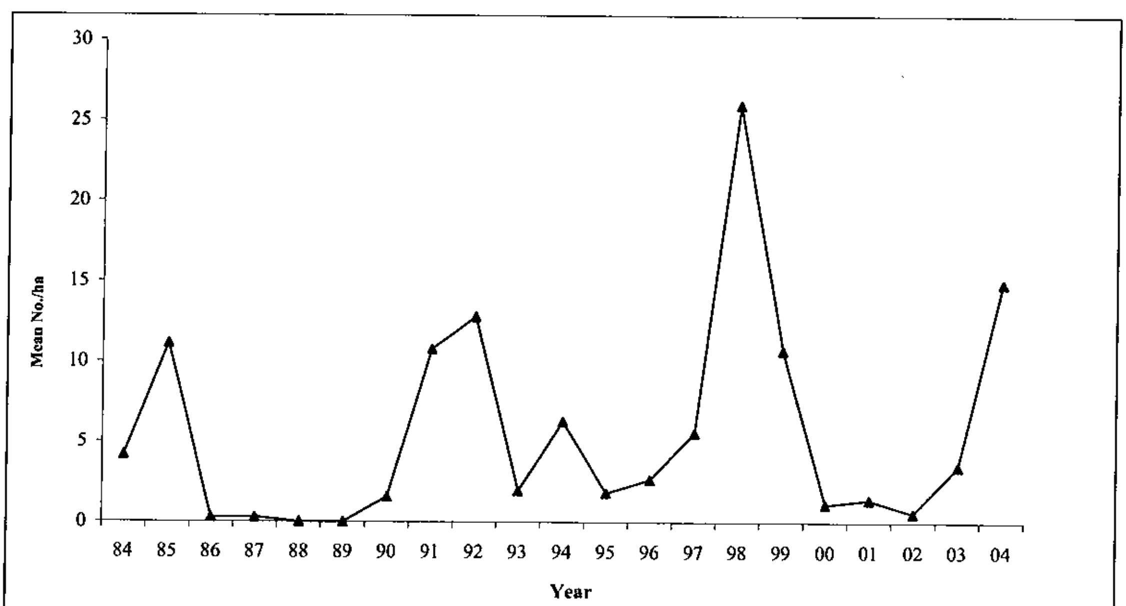

Figure 29. Upper Laguna Madre annual mean catch rate (No./ha) of Atlantic croaker caught with 18.3 meter bag seine during 1984-2004.

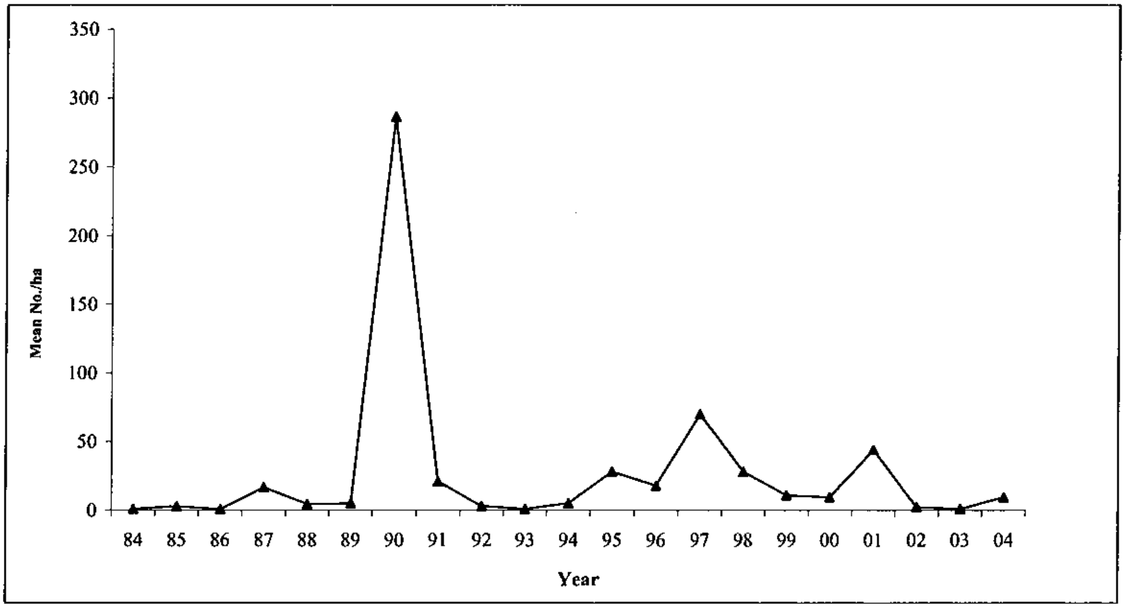

Figure 30. CBBEP area annual mean catch rate (No./ha) of black drum caught with 18.3 meter bag seine during 1984-2004.

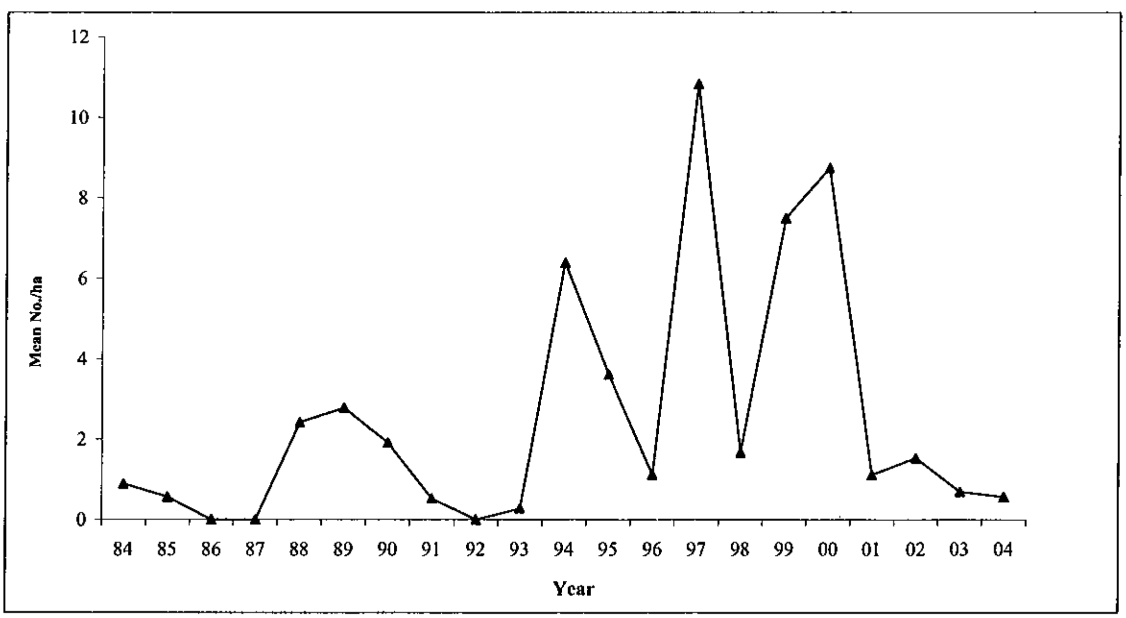

Figure 31. Aransas Bay annual mean catch rate (No./ha) of black drum caught with 18.3 meter bag seine during 1984-2004.

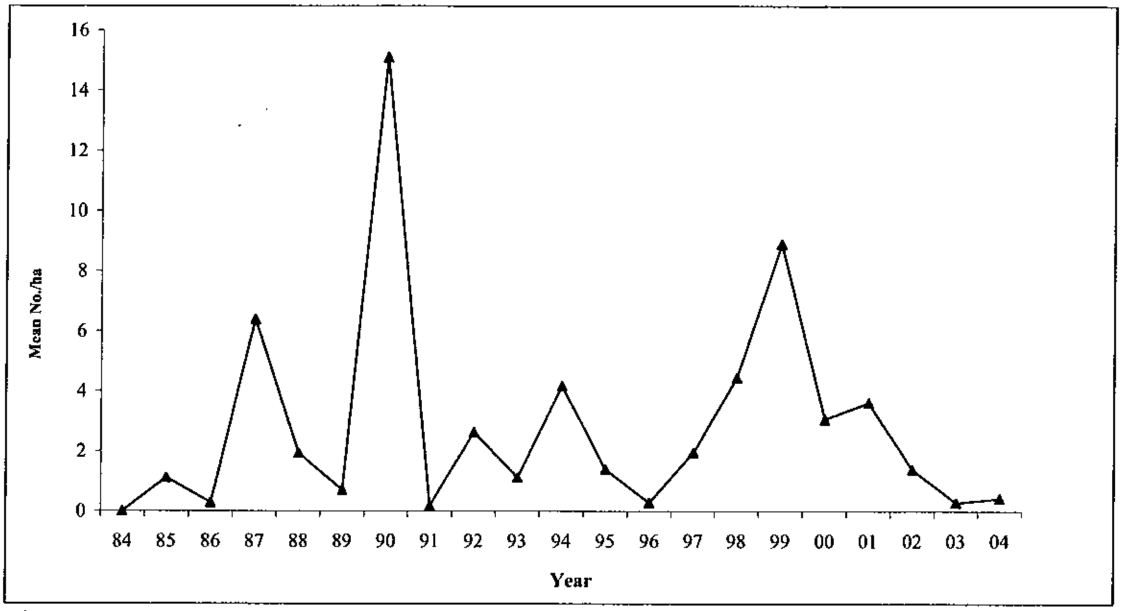

Figure 32. Annual mean catch rate (No./ha) of black drum caught with 18.3 meter bag seine in Corpus Christi Bay during 1984-2004.

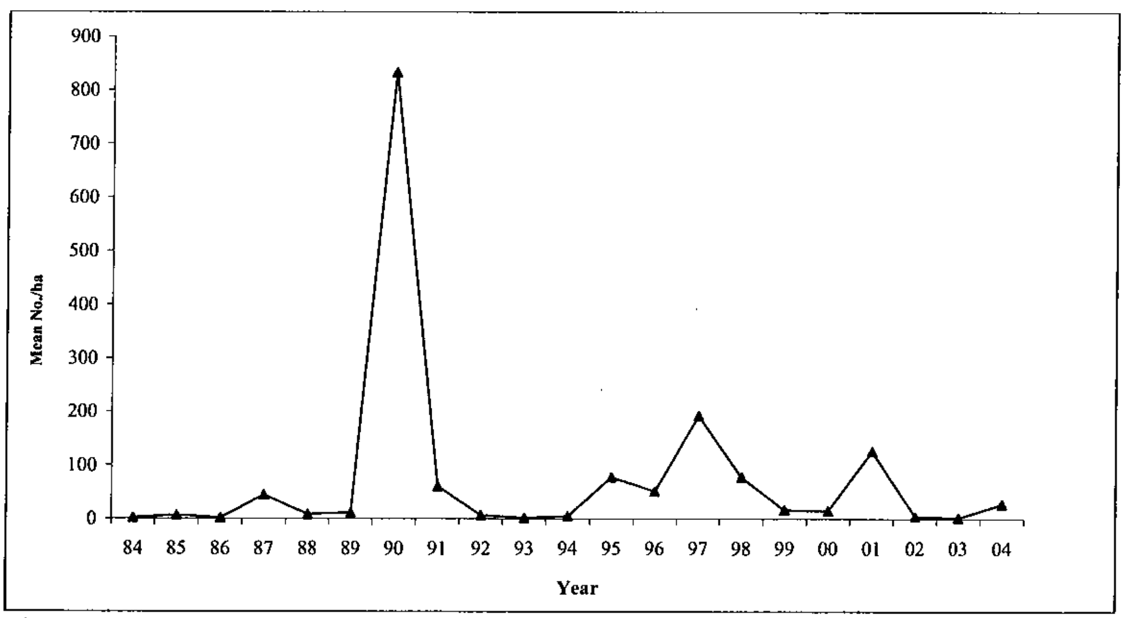

Figure 33. Upper Laguna Madre annual mean catch rate (No./ha) of black drum caught with 18.3 meter bag seine during 1984-2004.

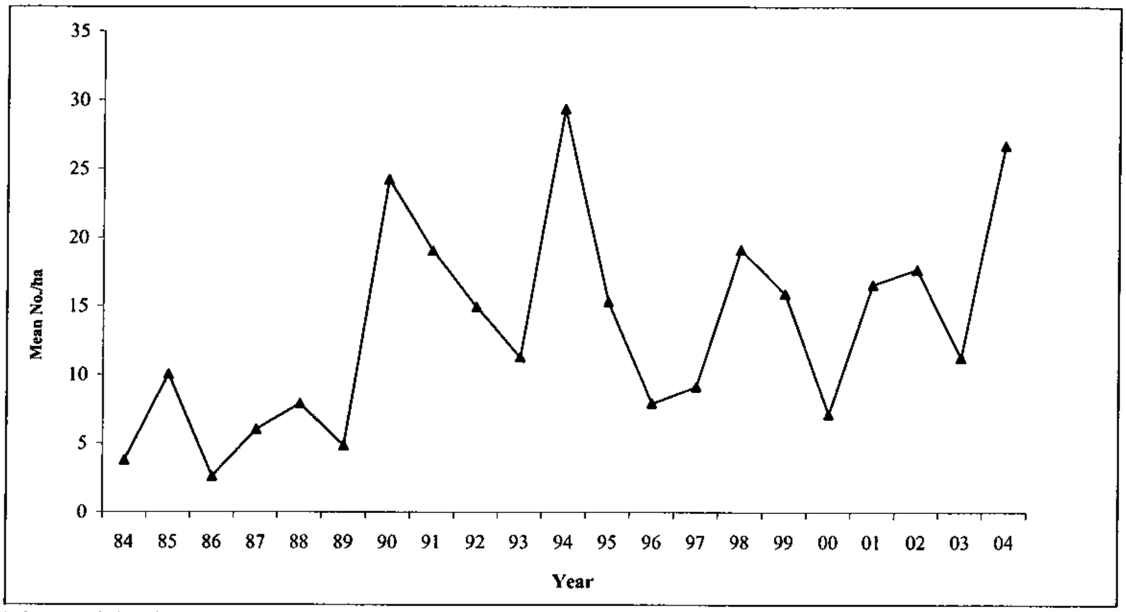

Figure 34. CBBEP area annual mean catch rate (No./ha) of red drum caught with 18.3 meter bag seine during 1984-2004.

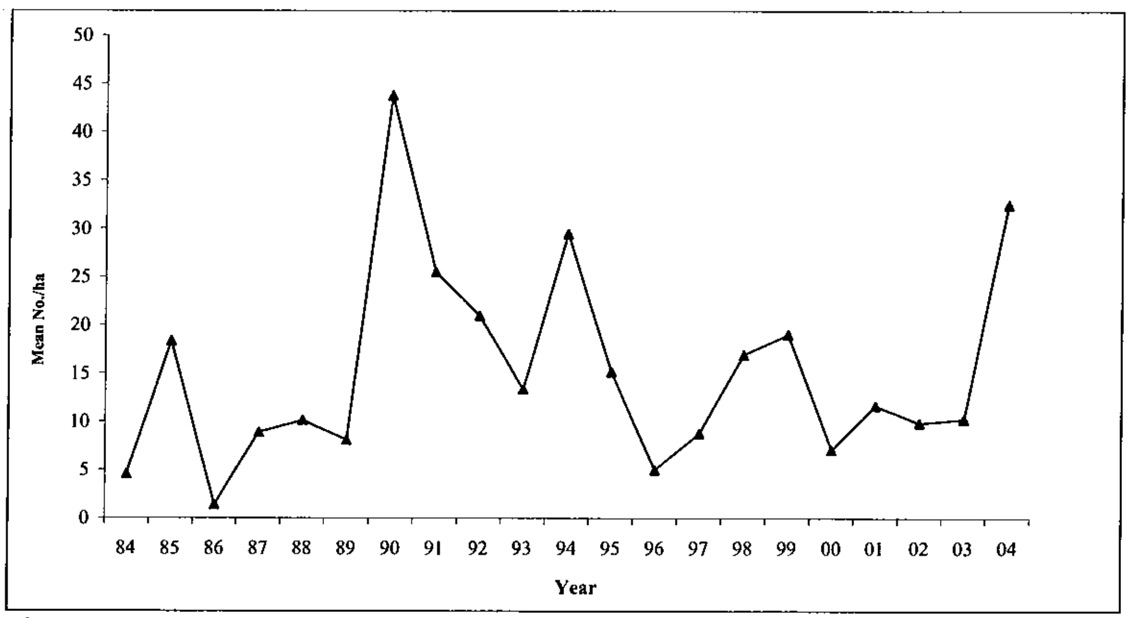

Figure 35. Aransas Bay annual mean catch rate (No./ha) of red drum caught with 18.3 meter bag seine during 1984-2004.

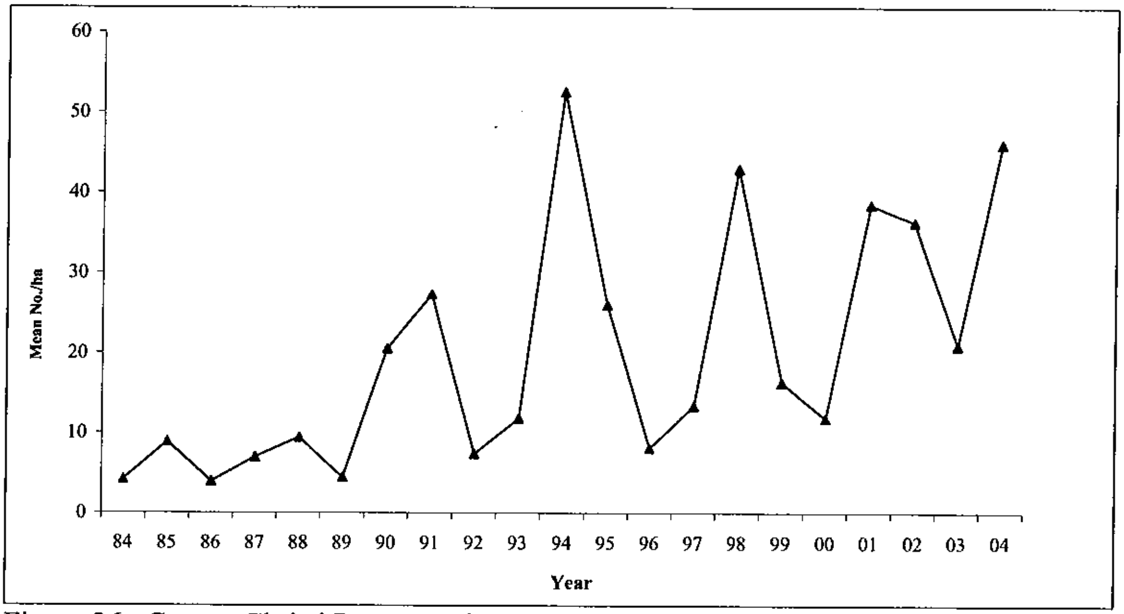

Figure 36. Corpus Christi Bay annual mean catch rate (No./ha) of red drum caught with 18.3 meter bag seine during 1984-2004.

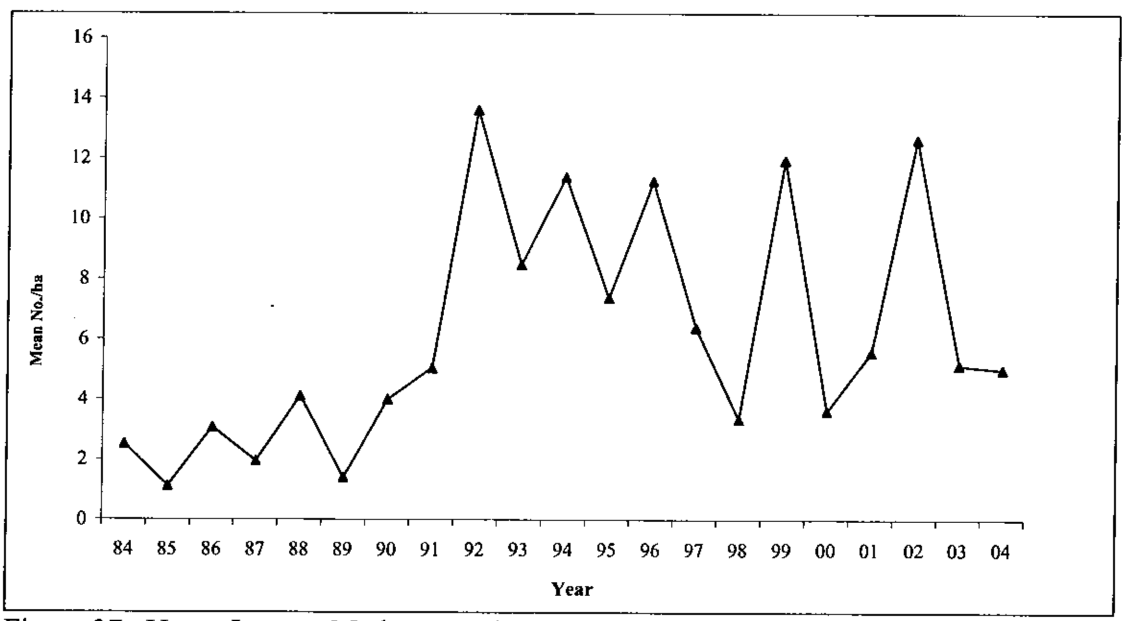

Figure 37. Upper Laguna Madre annual mean catch rate (No./ha) of red drum caught with 18.3 meter bag seine during 1984-2004.

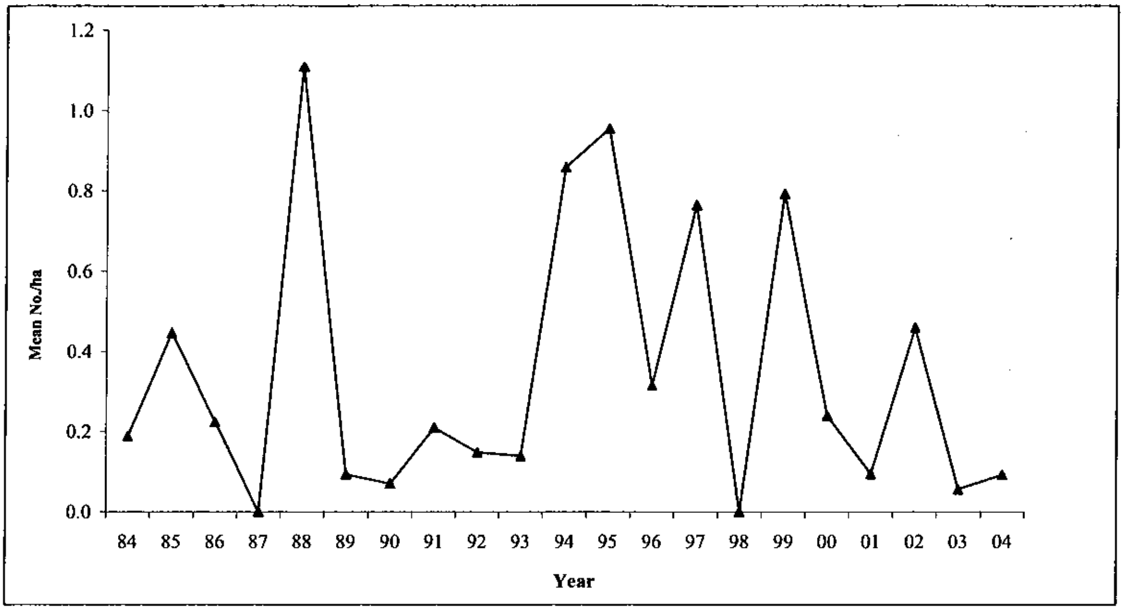

Figure 38. CBBEP area annual mean catch rate (No./ha) of sheepshead caught with 18.3 meter bag seine during 1984-2004.

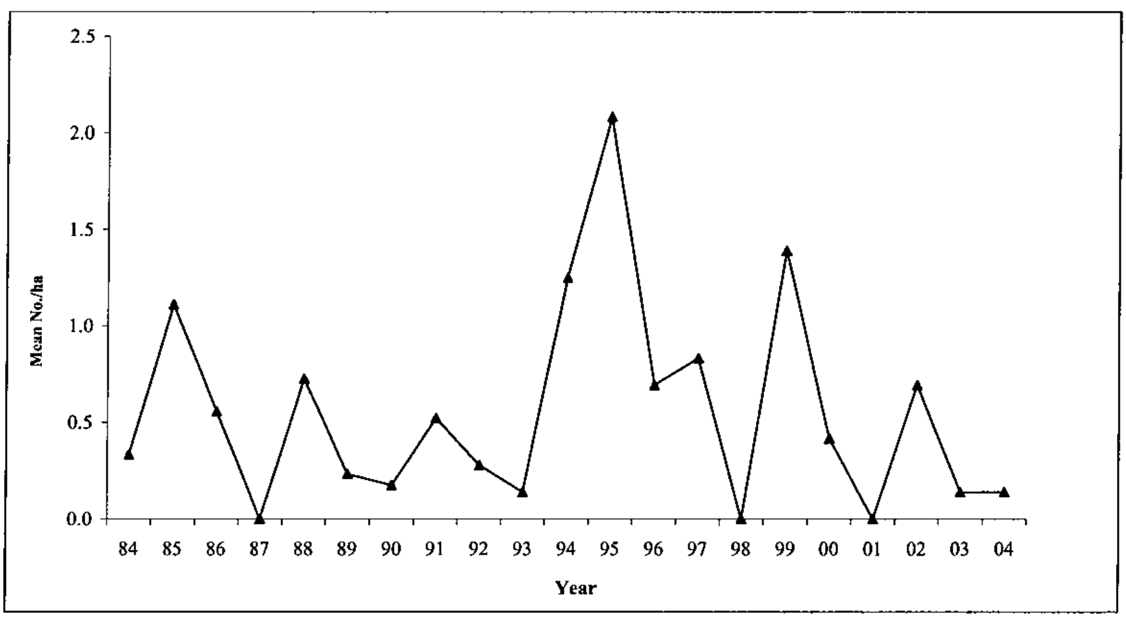

Figure 39. Aransas Bay annual mean catch rate (No./ha) of sheepshead caught with 18.3 meter bag seine during 1984-2004.

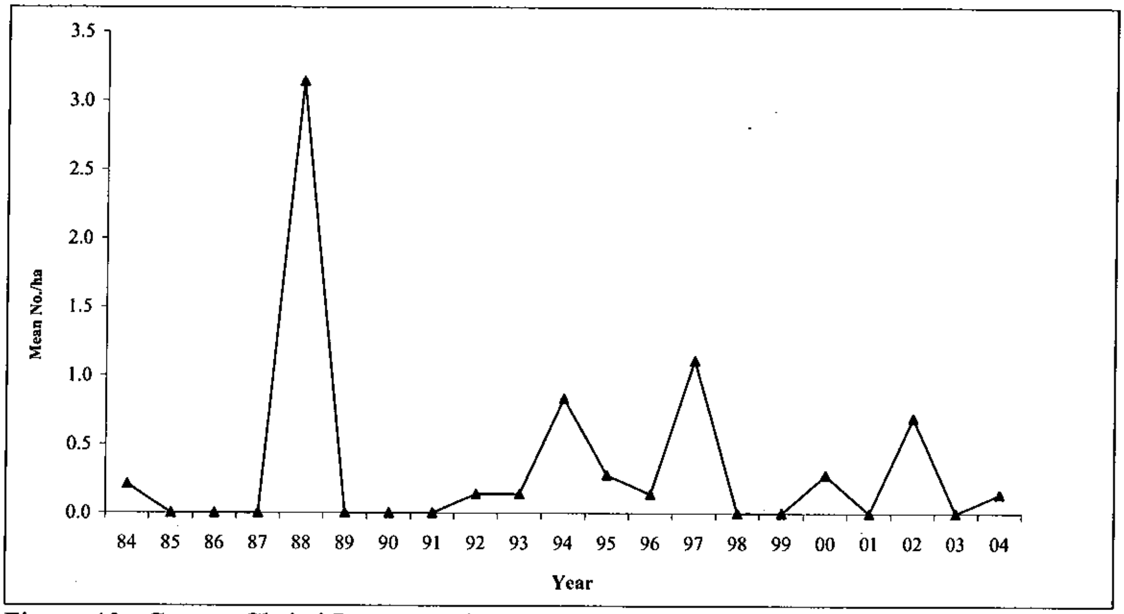

Figure 40. Corpus Christi Bay annual mean catch rate (No./ha) of sheepshead caught with 18.3 meter bag seine during 1984-2004.

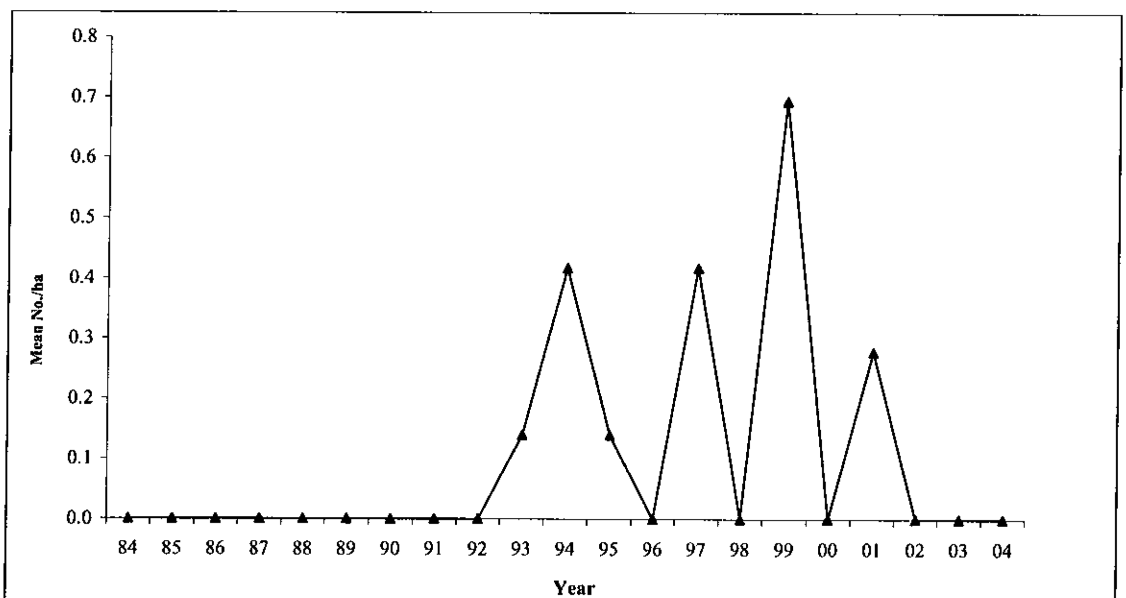

Figure 41. Upper Laguna Madre annual mean catch rate (No./ha) of sheepshead caught with 18.3 meter bag seine during 1984-2004.

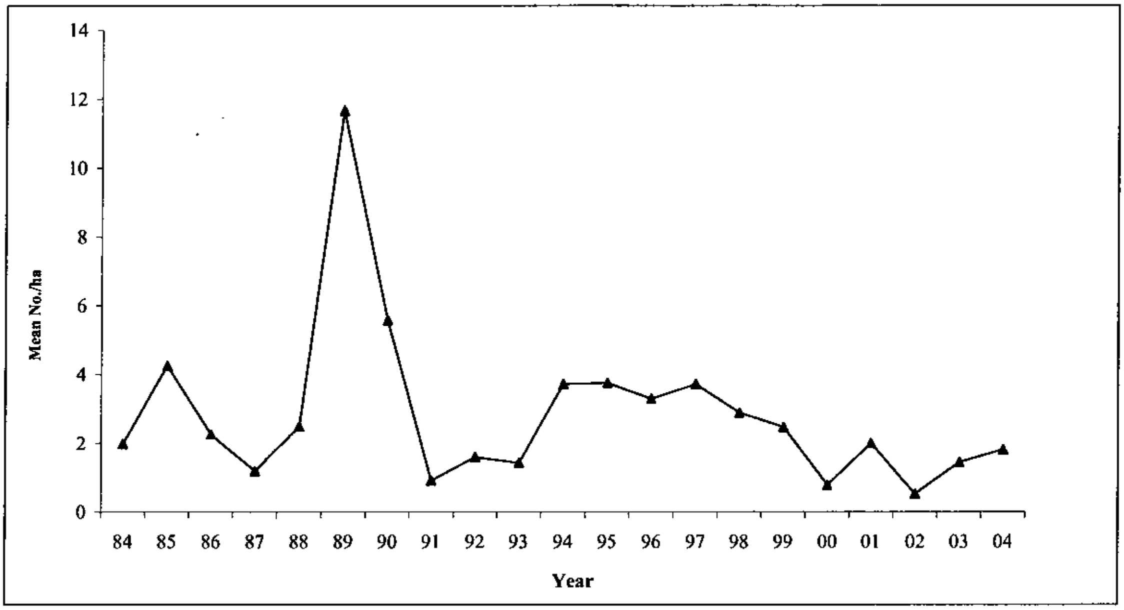

Figure 42. CBBEP area annual mean catch rate (No./ha) of southern flounder caught with 18.3 meter bag seine during 1984-2004.

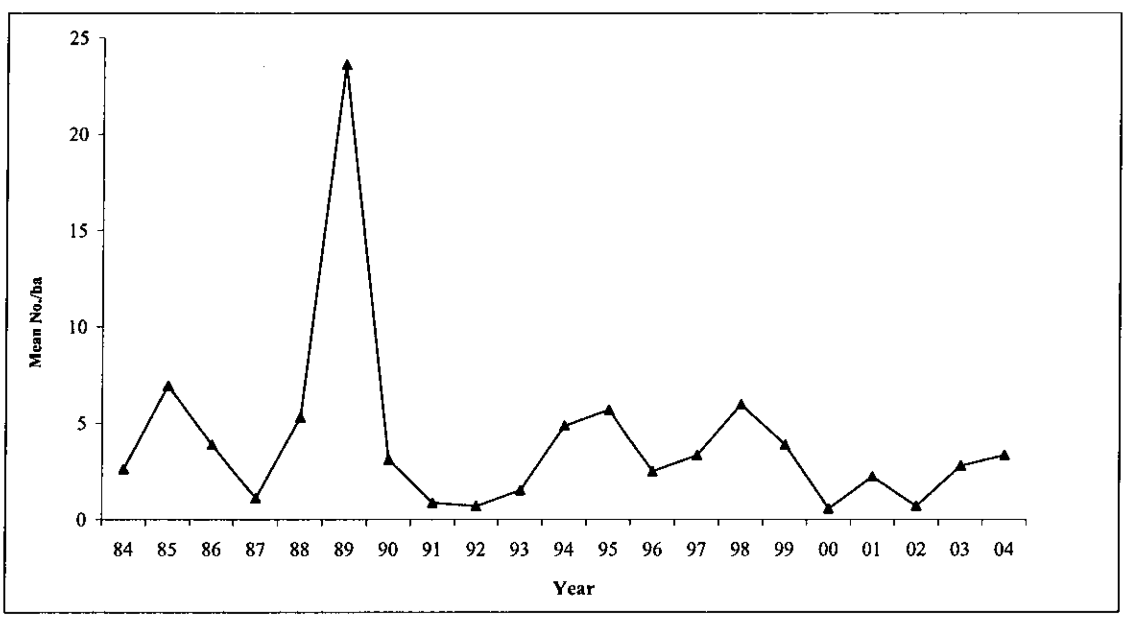

Figure 43. Aransas Bay annual mean catch rate (No./ha) of southern flounder caught with 18.3 meter bag seine during 1984-2004.

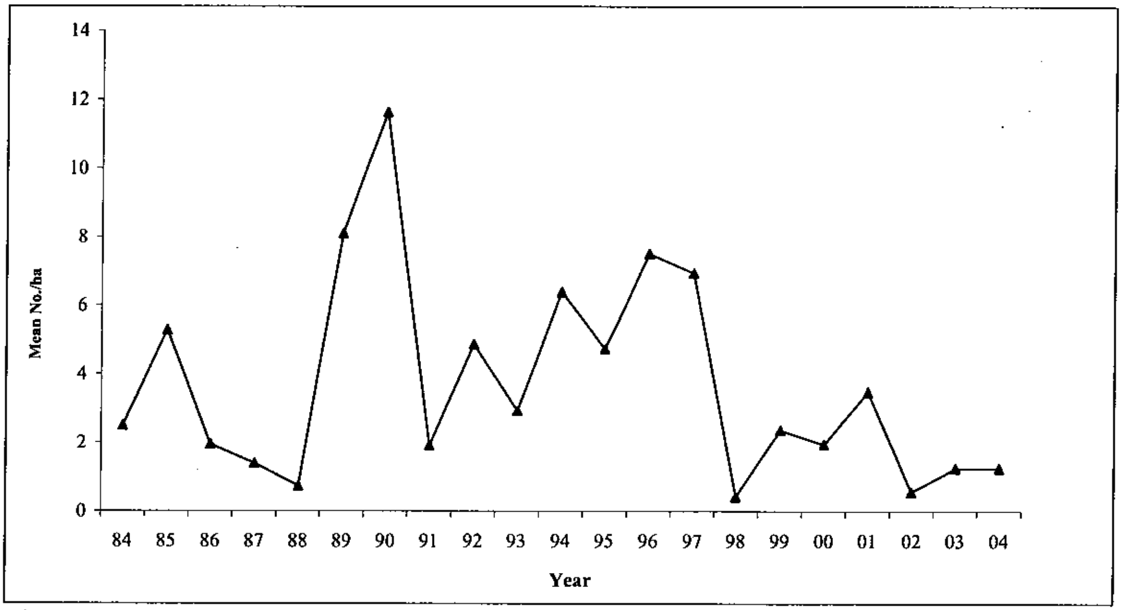

Figure 44. Corpus Christi Bay annual mean catch rate (No./ha) of southern flounder caught with 18.3 meter bag seine during 1984-2004.

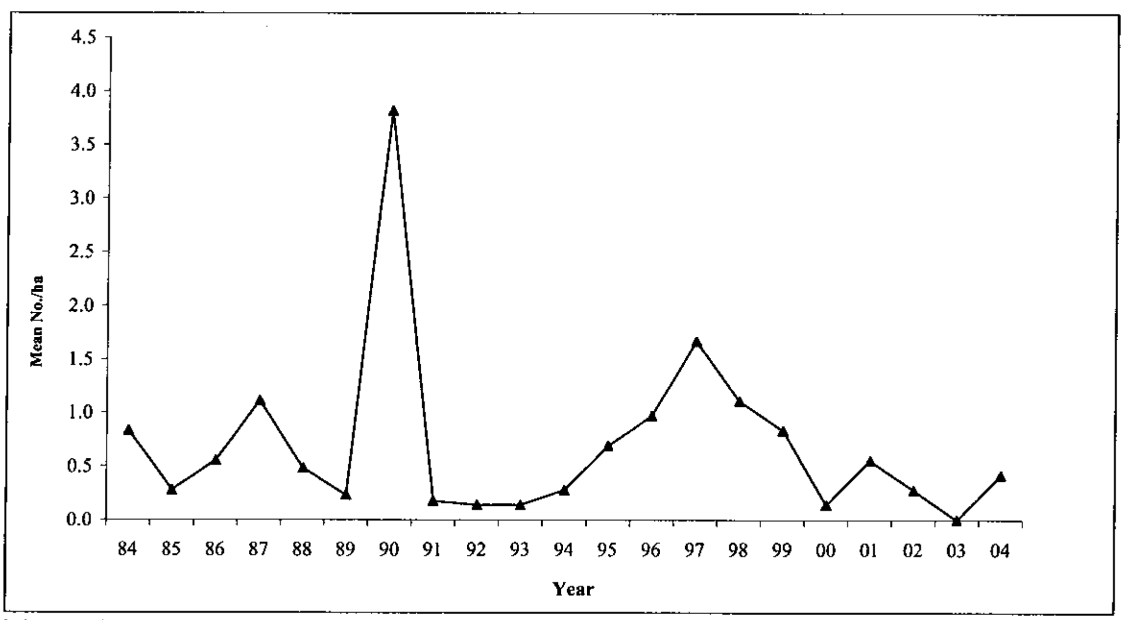

Figure 45. Upper Laguna Madre annual mean catch rate (No./ha) of southern flounder caught with 18.3 meter bag seine during 1984-2004.

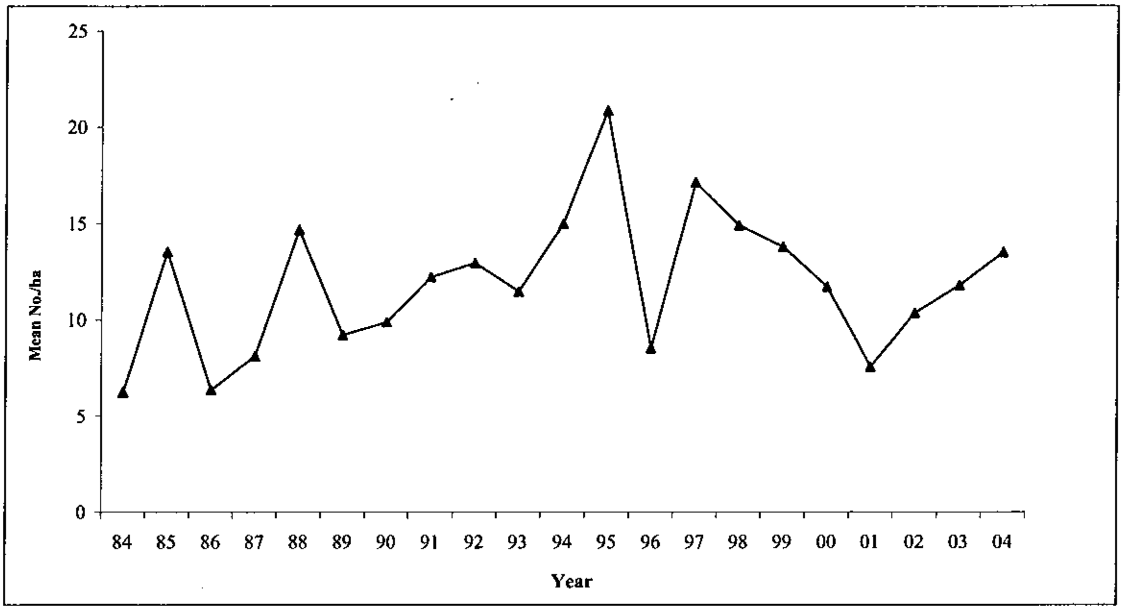

Figure 46. CBBEP area annual mean catch rate (No./ha) of spotted seatrout caught with 18.3 meter bag seine during 1984-2004.

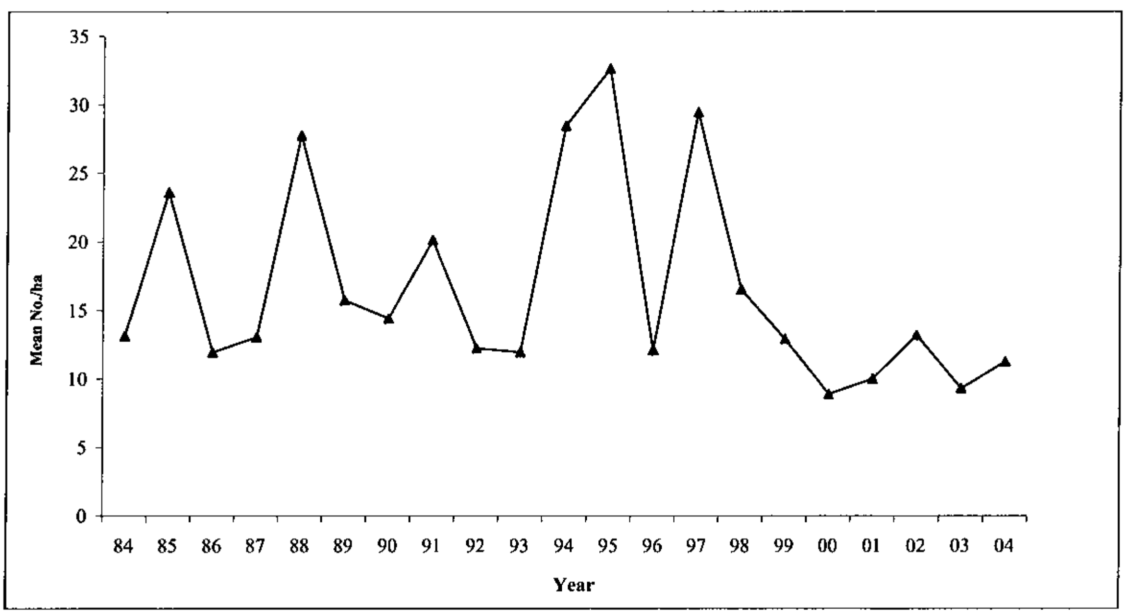

Figure 47. Aransas Bay annual mean catch rate (No./ha) of spotted seatrout caught with 18.3 meter bag seine during 1984-2004.

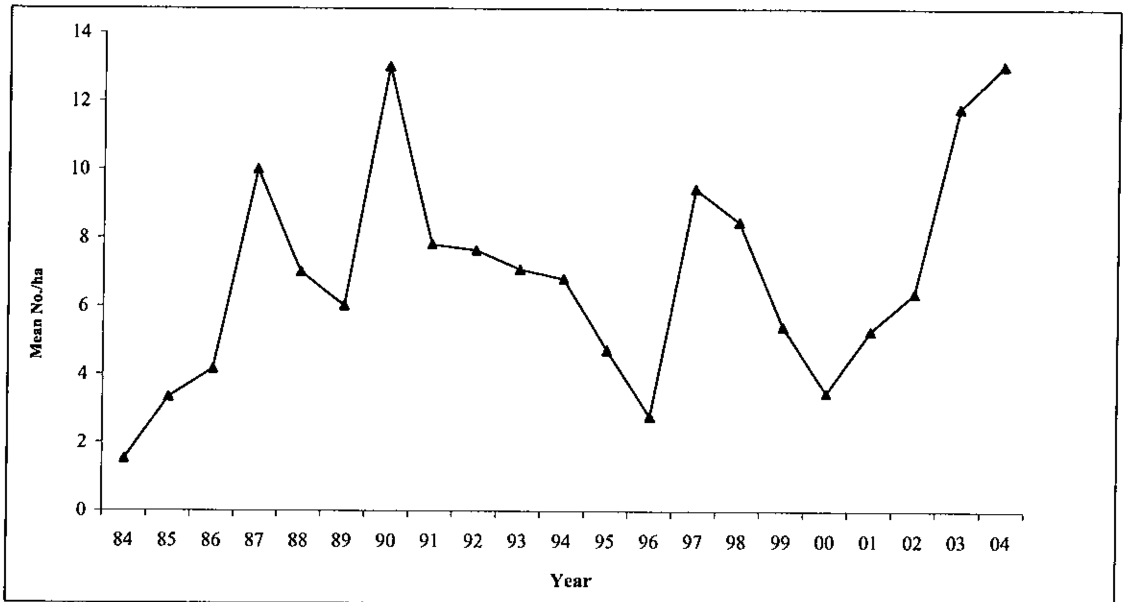

Figure 48. Corpus Christi Bay annual mean catch rate (No./ha) of spotted seatrout caught with 18.3 meter bag seine during 1984-2004.

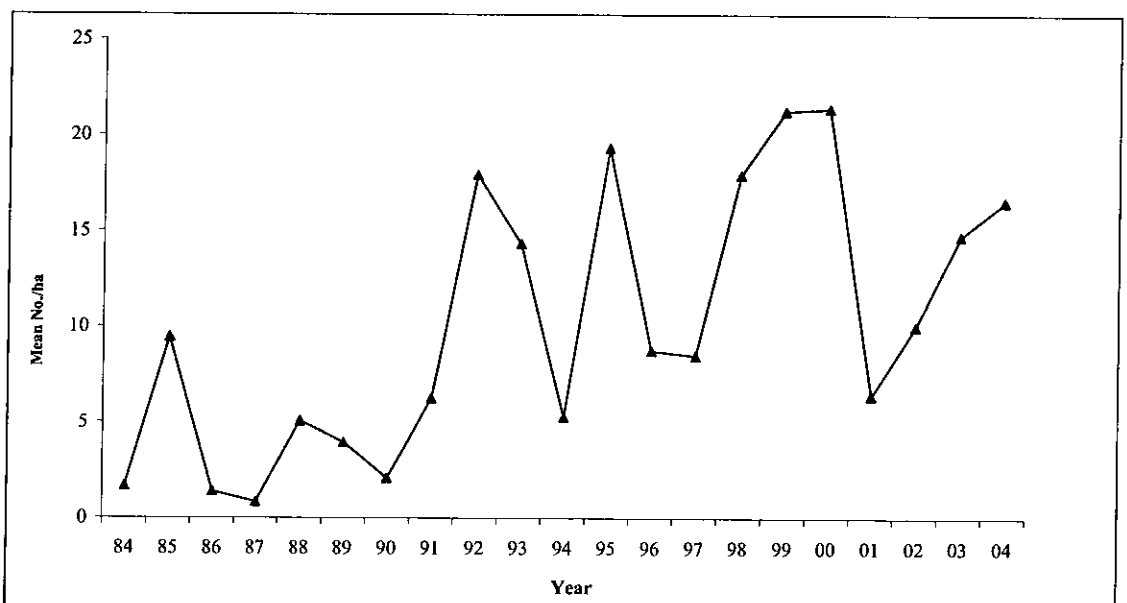

Figure 49. Upper Laguna Madre annual mean catch rate (No./ha) of spotted seatrout caught with 18.3 meter bag seine during 1984-2004.

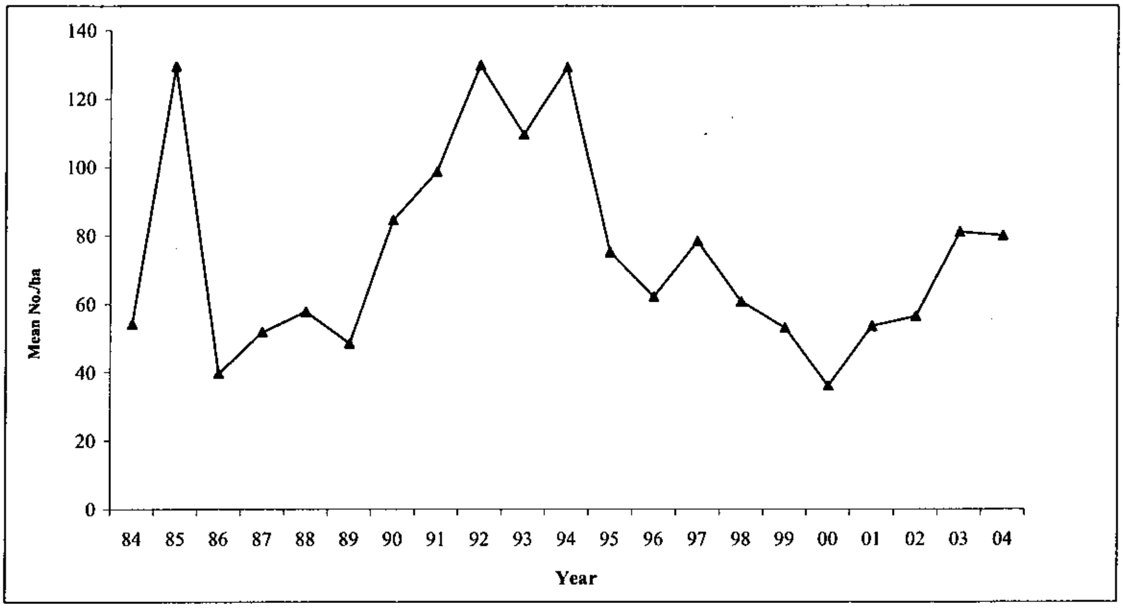

Figure 50. CBBEP area annual mean catch rate (No./ha) of blue crab caught with 18.3 meter bag seine during 1984-2004.

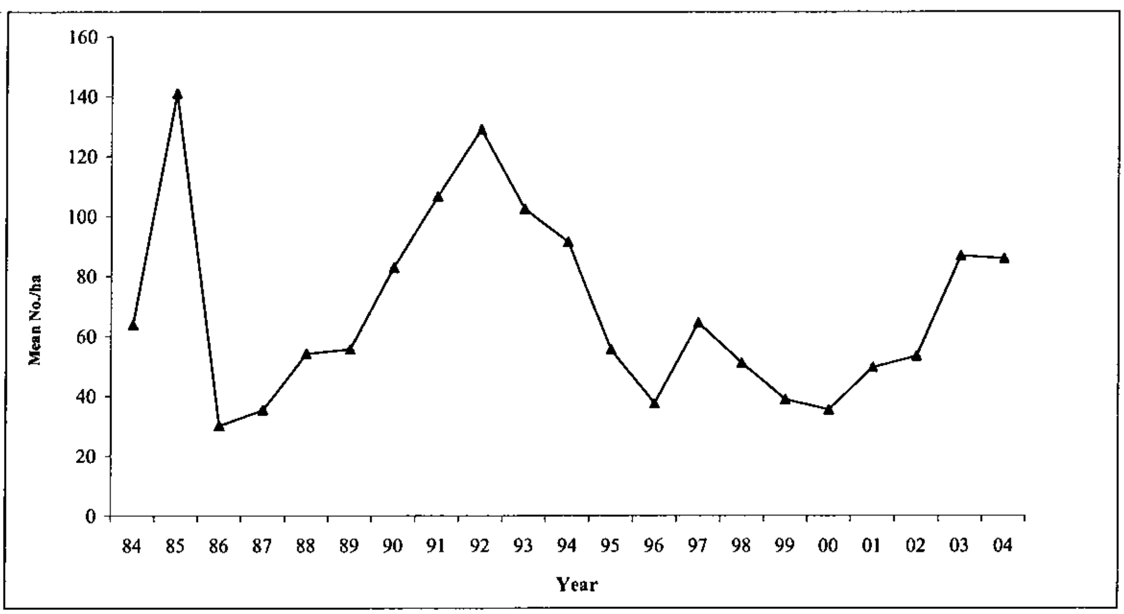

Figure 51. Aransas Bay annual mean catch rate (No./ha) of blue crab caught with 18.3 meter bag seine during 1984-2004.

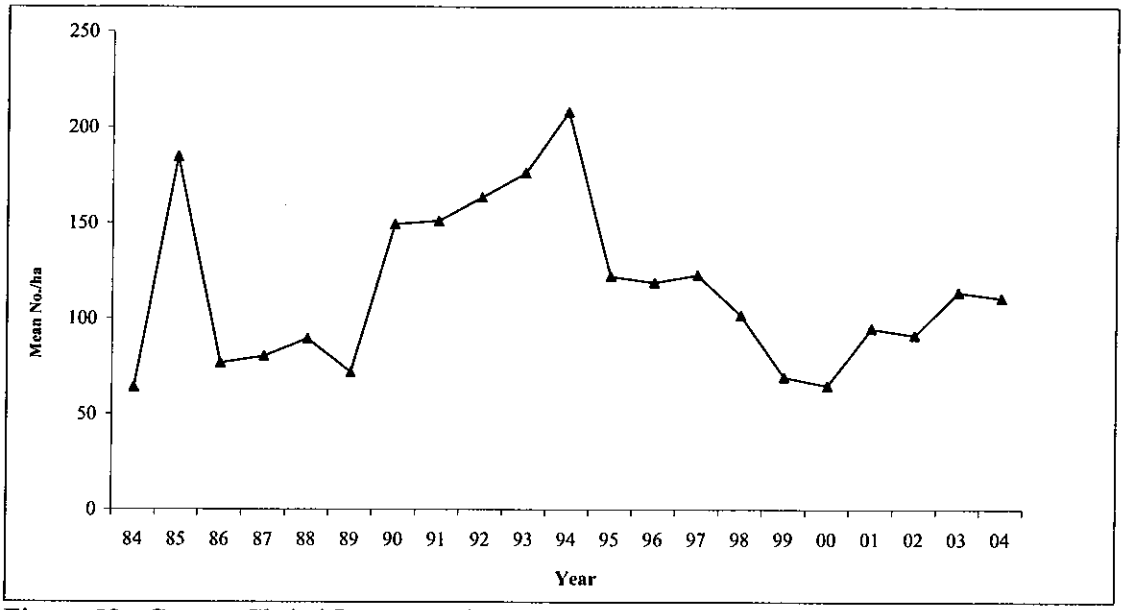

Figure 52. Corpus Christi Bay annual mean catch rate (No./ha) of blue crab caught with 18.3 meter bag seine during 1984-2004.

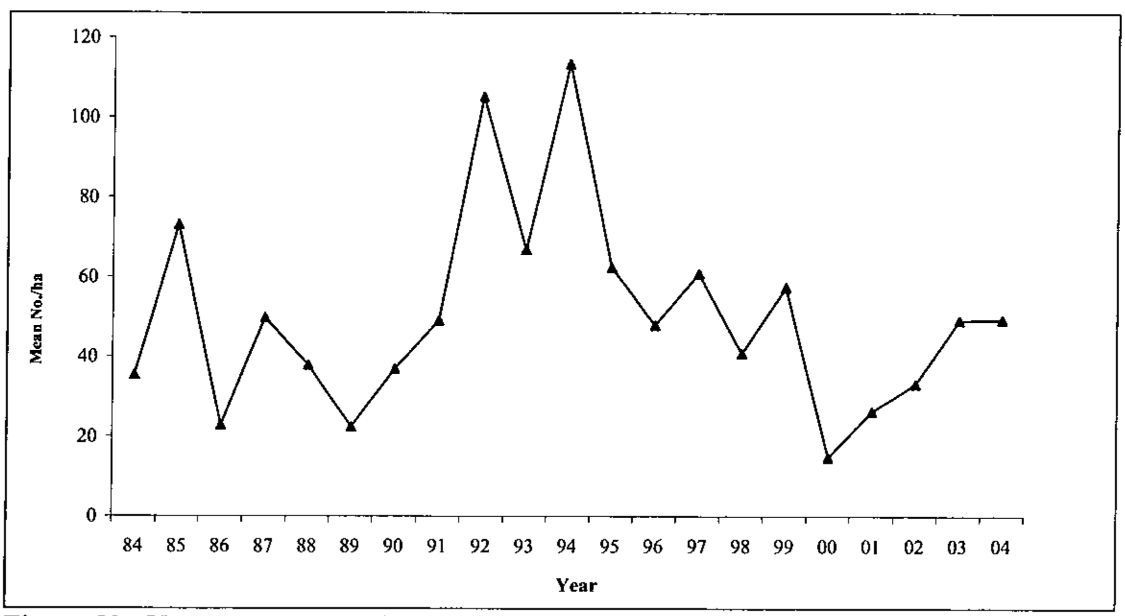

Figure 53. Upper Laguna Madre annual mean catch rate (No./ha) of blue crab caught with 18.3 meter bag seine during 1984-2004.

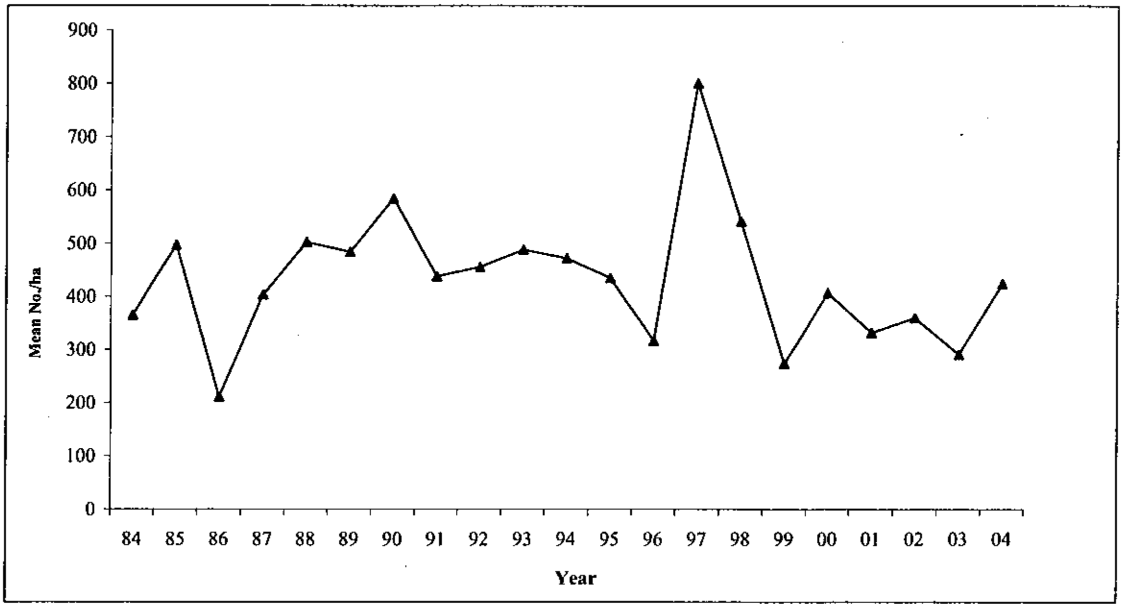

Figure 54. CBBEP area annual mean catch rate (No./ha) of brown shrimp caught with 18.3 meter bag seine during 1984-2004.

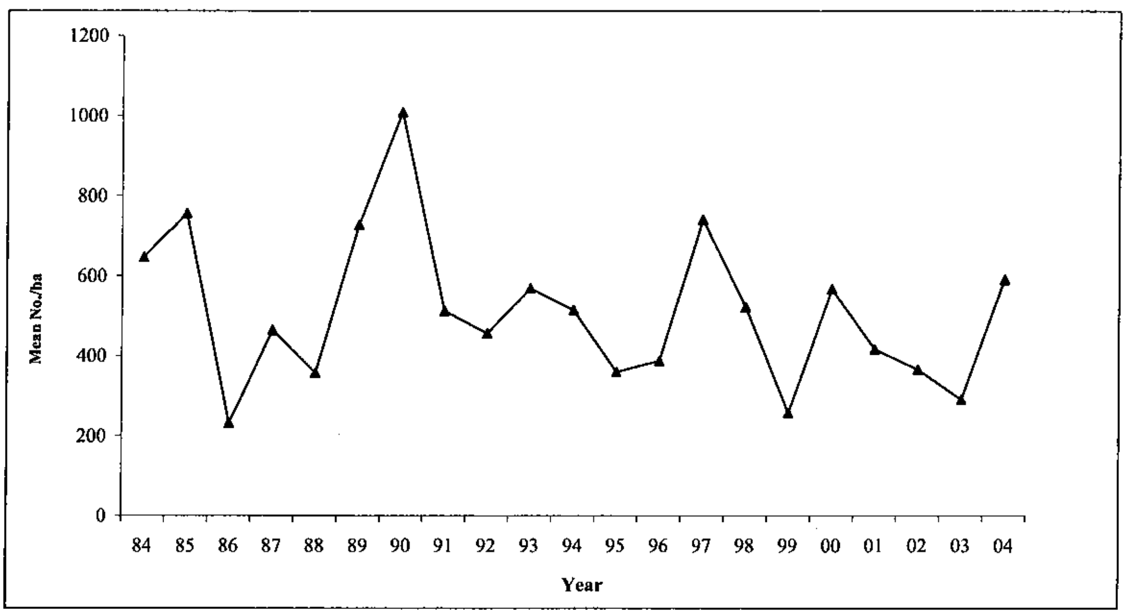

Figure 55. Aransas Bay annual mean catch rate (No./ha) of brown shrimp caught with 18.3 meter bag seine during 1984-2004.

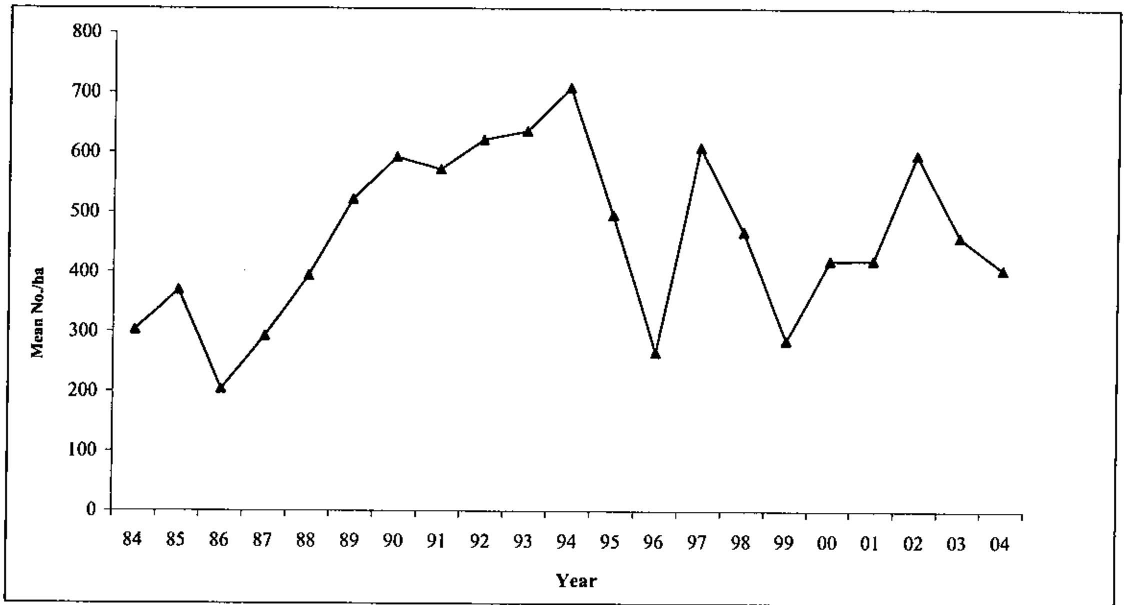

Figure 56. Corpus Christi Bay annual mean catch rate (No./ha) of brown shrimp caught with 18.3 meter bag seine during 1984-2004.

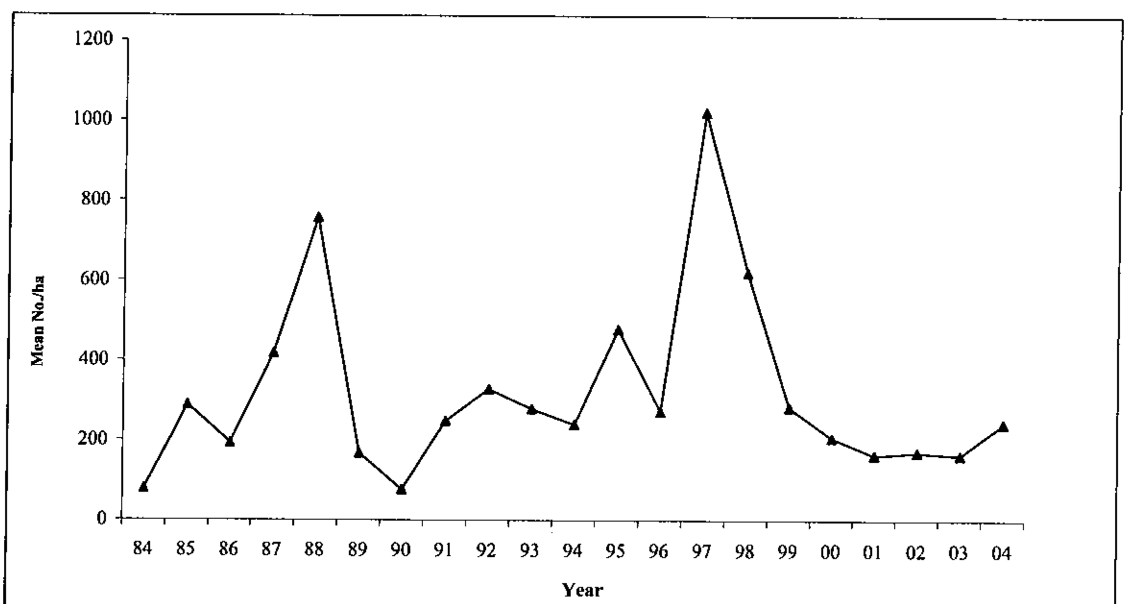

Figure 57. Upper Laguna Madre annual mean catch rate (No./ha) of brown shrimp caught with 18.3 meter bag seine during 1984-2004.

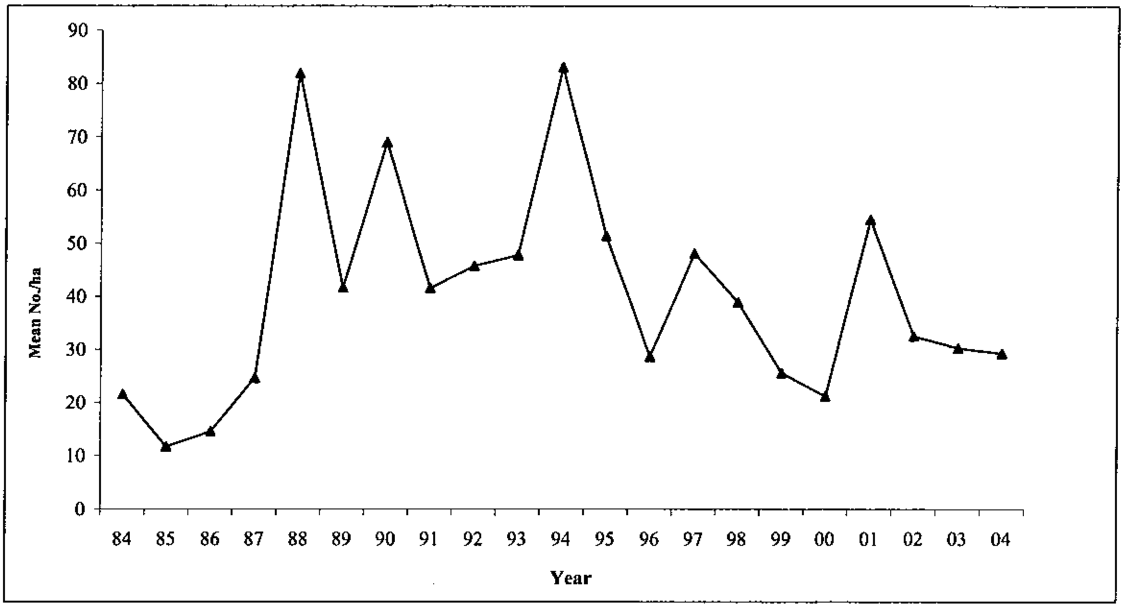

Figure 58. CBBEP area annual mean catch rate (No./ha) of pink shrimp caught with 18.3 meter bag seine during 1984-2004.

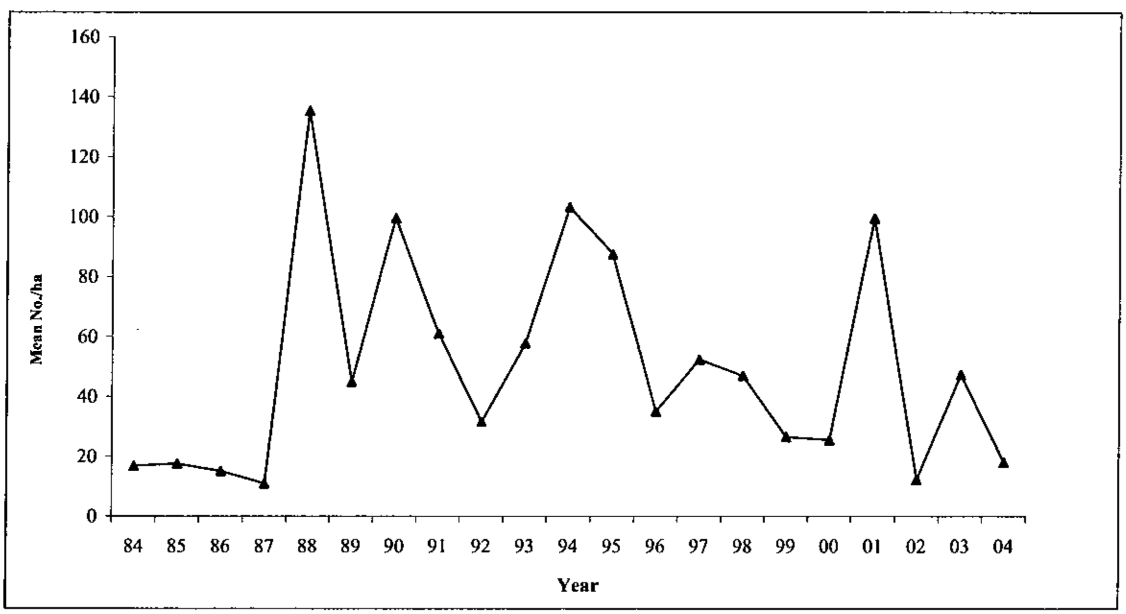

Figure 59. Aransas Bay annual mean catch rate (No./ha) of pink shrimp caught with 18.3 meter bag seine during 1984-2004.

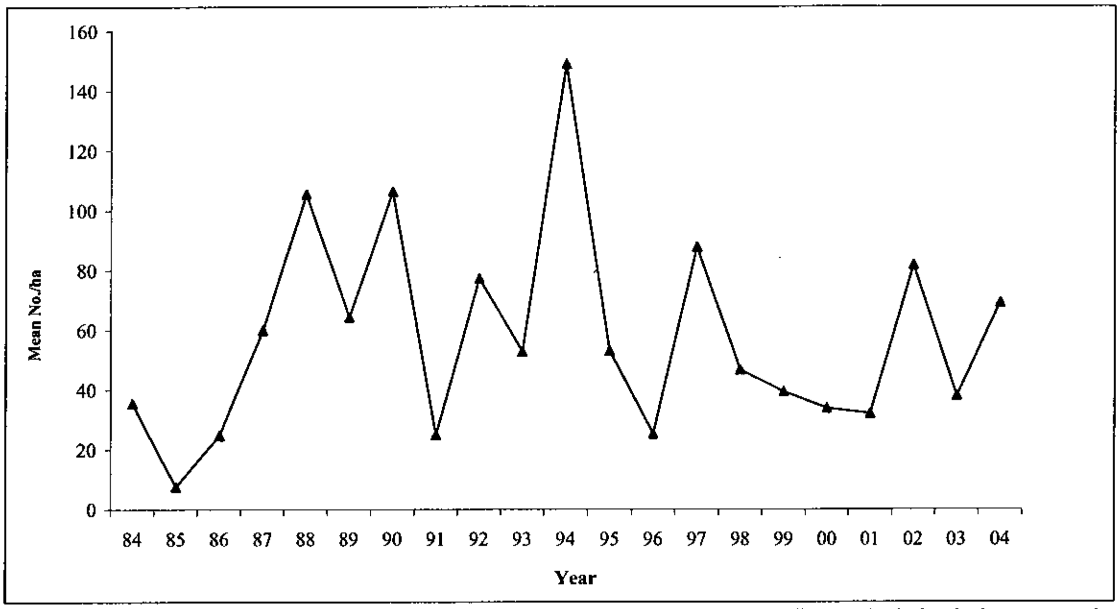

Figure 60. Corpus Christi Bay area annual mean catch rate (No./ha) of pink shrimp caught with 18.3 meter bag seine during 1984-2004.

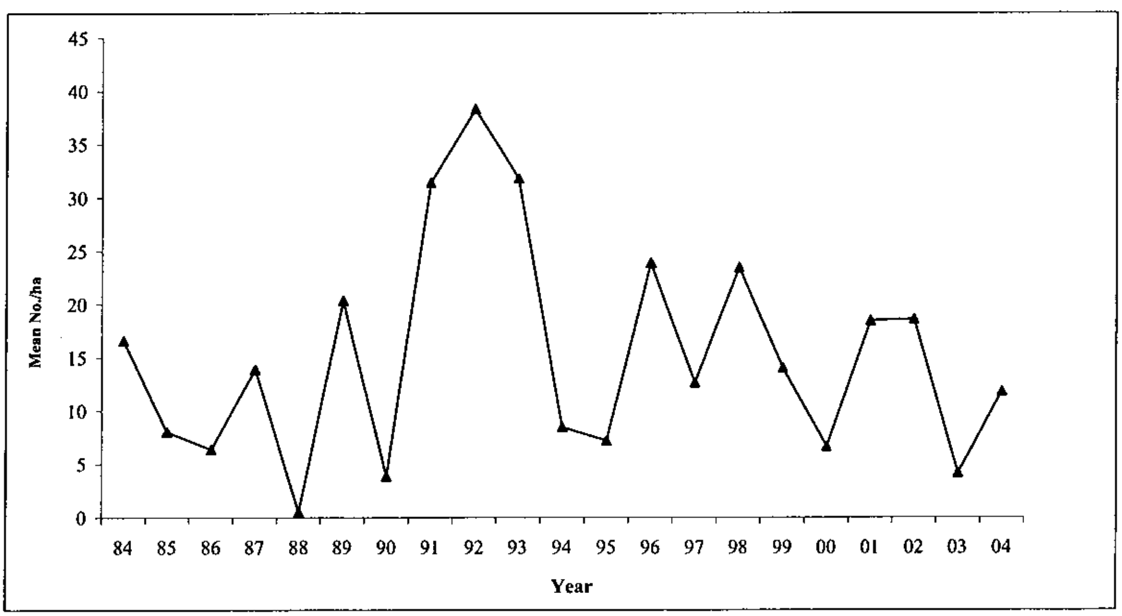

Figure 61. Upper Laguna Madre annual mean catch rate (No./ha) of pink shrimp caught with 18.3 meter bag seine during 1984-2004.

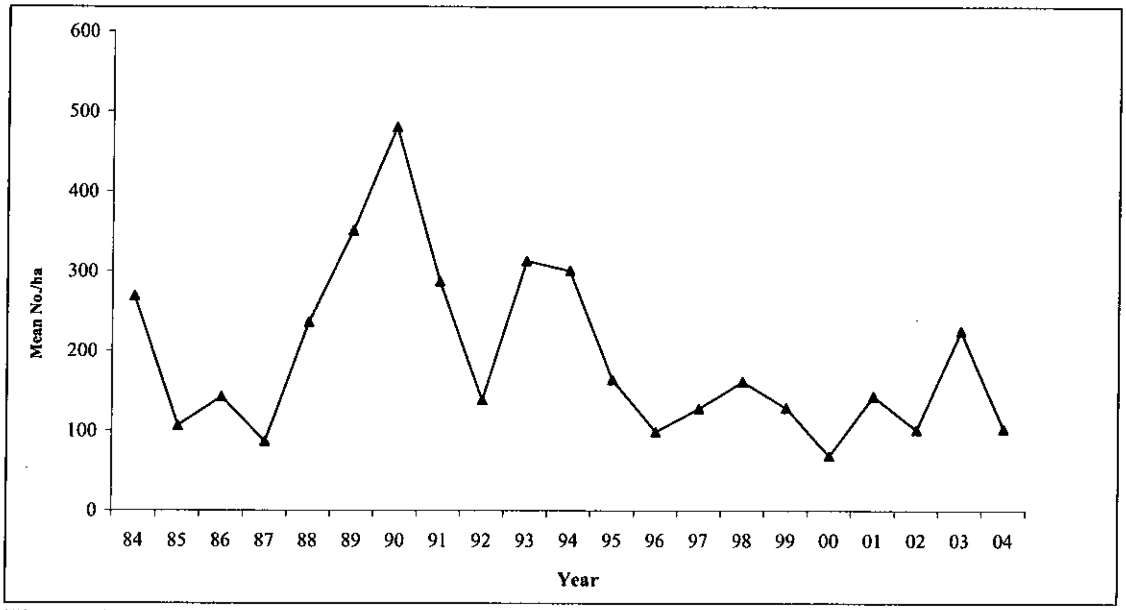

Figure 62. CBBEP area annual mean catch rate (No./ha) of white shrimp caught with 18.3 meter bag seine during 1984-2004.

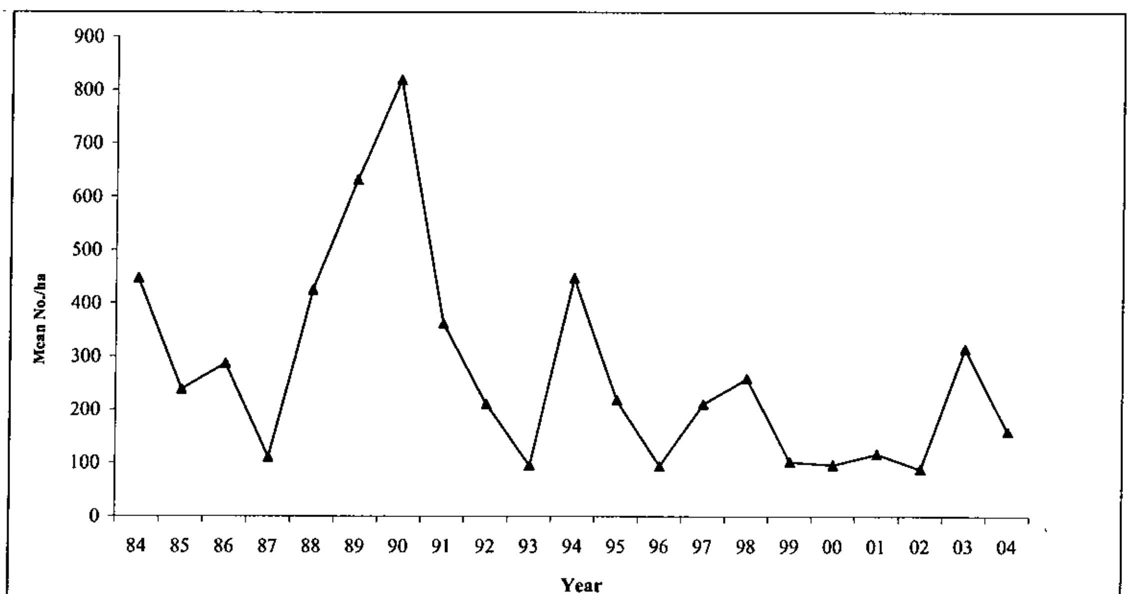

Figure 63. Aransas Bay annual mean catch rate (No./ha) of white shrimp caught with 18.3 meter bag seine during 1984-2004.

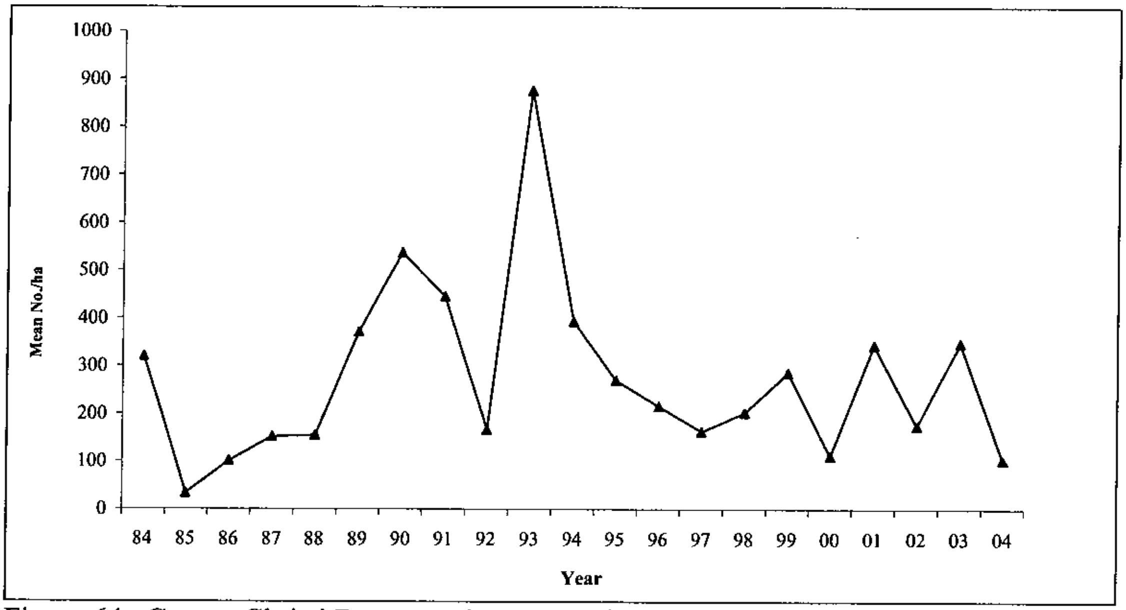

Figure 64. Corpus Christi Bay annual mean catch rate (No./ha) of white shrimp caught with 18.3 meter bag seine during 1984-2004.

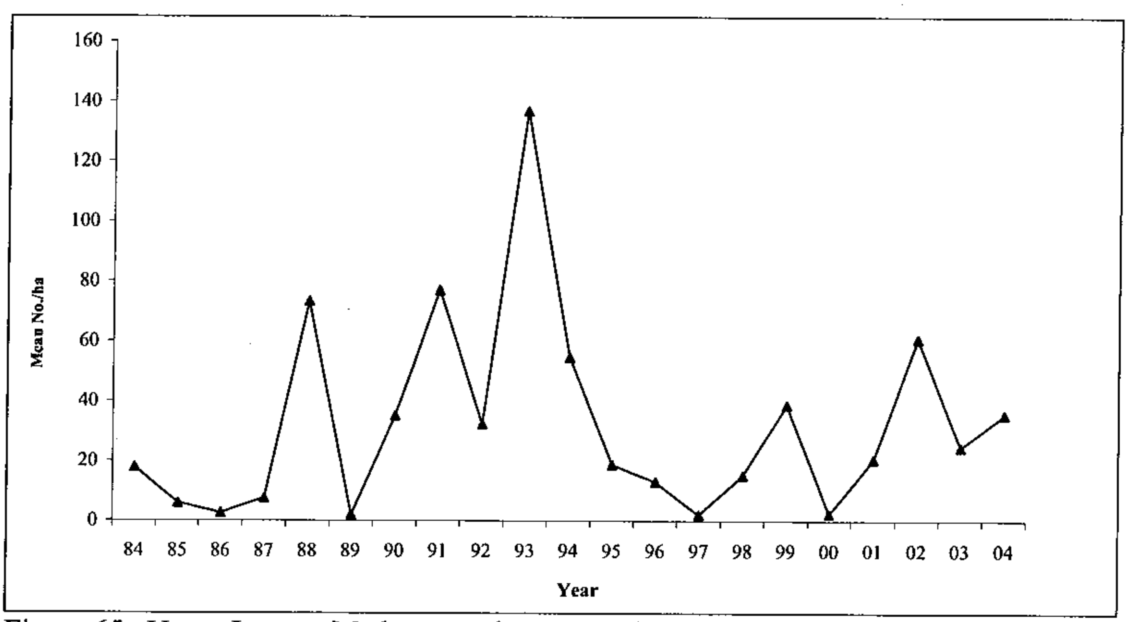

Figure 65. Upper Laguna Madre annual mean catch rate (No./ha) of white shrimp caught with 18.3 meter bag seine during 1984-2004.

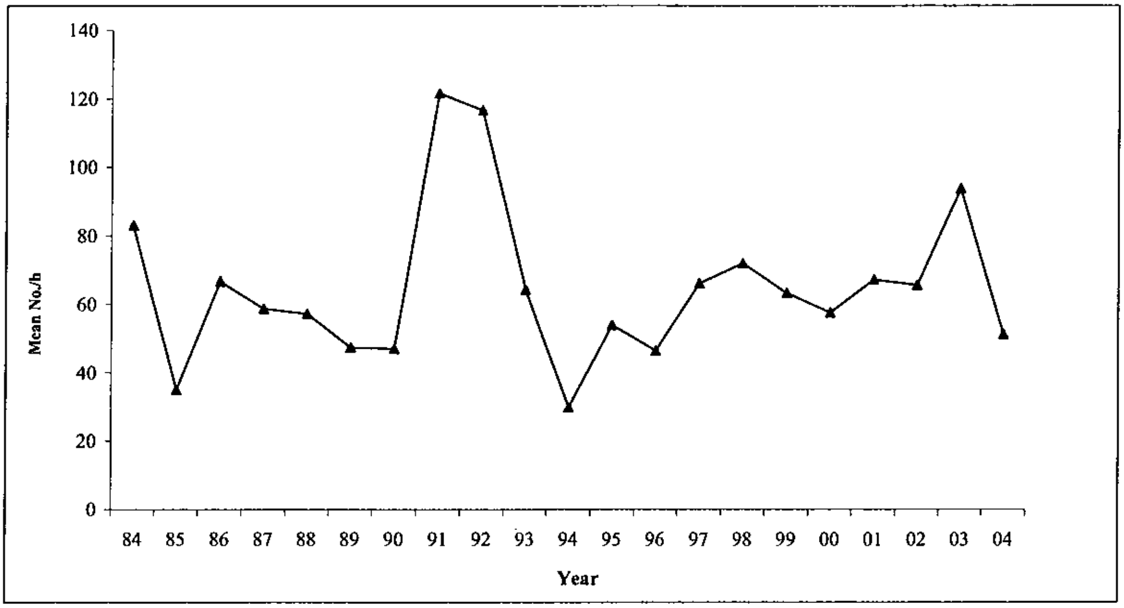

Figure 66. CBBEP area annual mean catch rate (No./h) of Atlantic croaker caught with 6.1 meter trawls during 1984-2004.

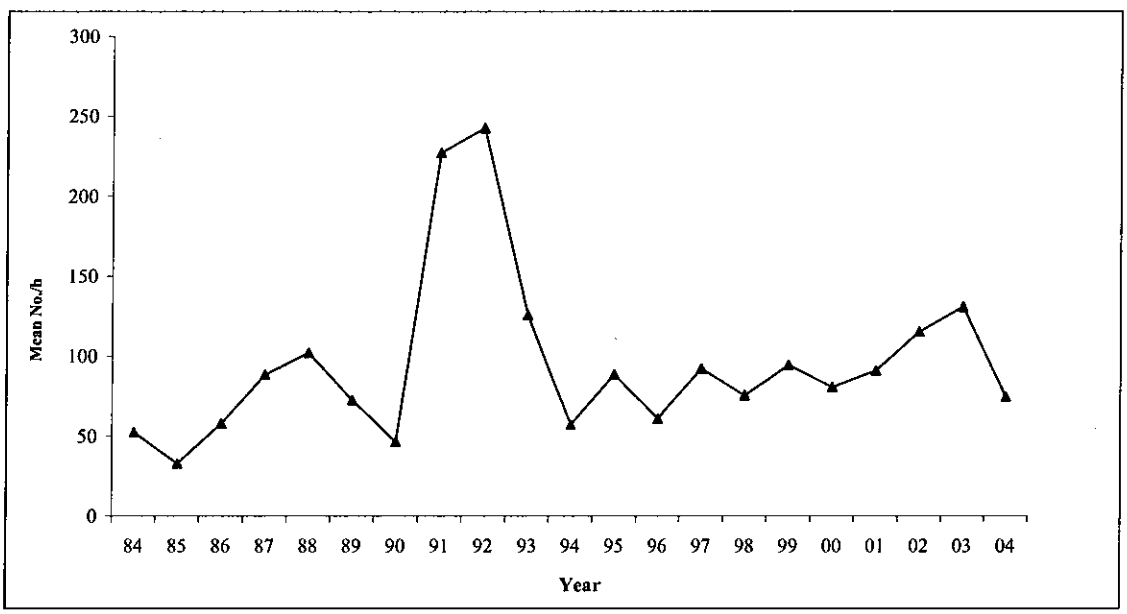

Figure 67. Aransas Bay annual mean catch rate (No./h) of Atlantic croaker caught with 6.1 meter trawls during 1984-2004..

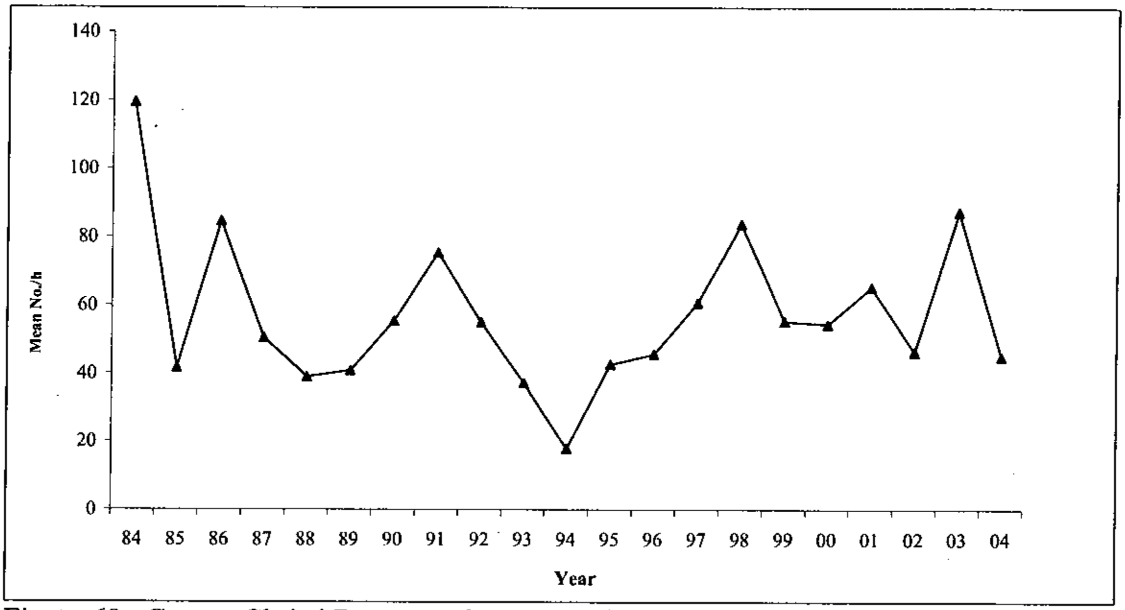

Figure 68. Corpus Christi Bay annual mean catch rate (No./h) of Atlantic croaker caught with 6.1 meter trawls during 1984-2004.

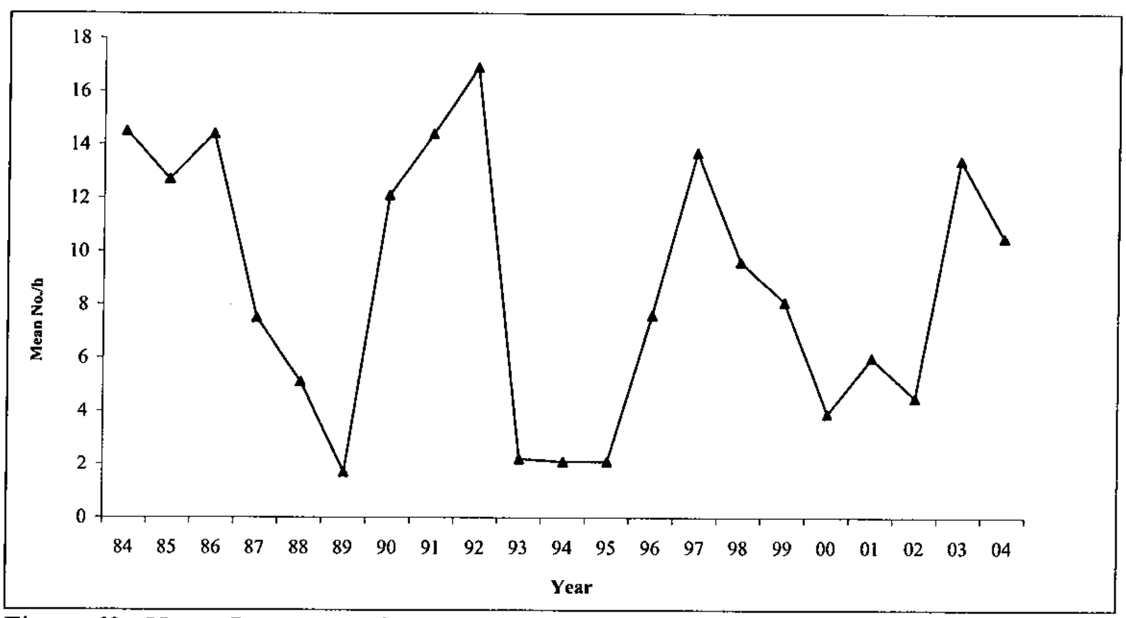

Figure 69. Upper Laguna Madre annual mean catch rate (No./h) of Atlantic croaker caught with 6.1 meter trawls during 1984-2004.

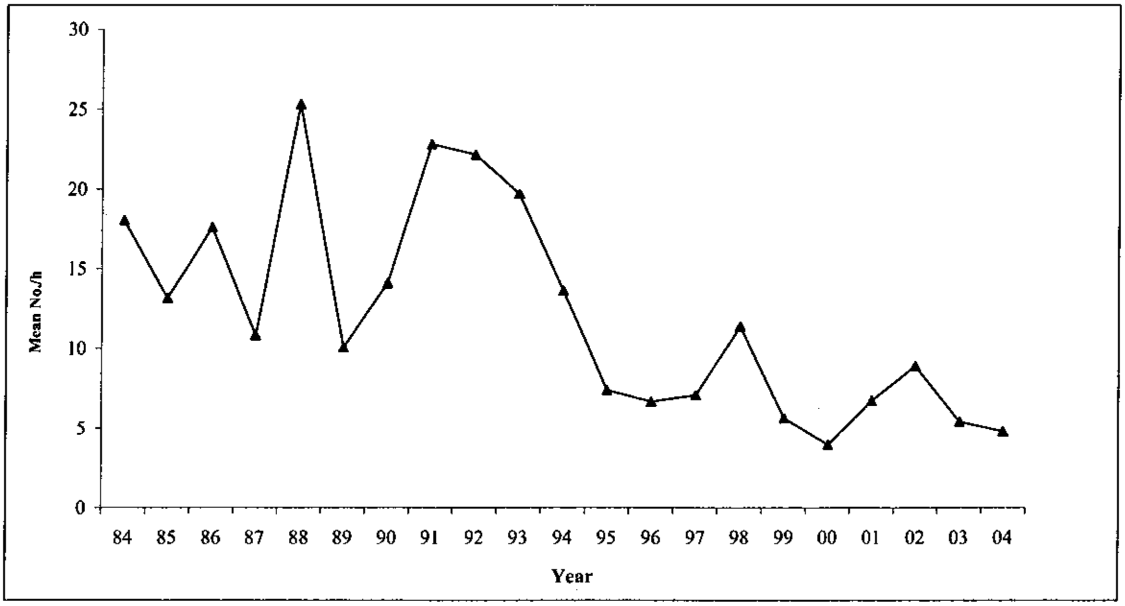

Figure 70. CBBEP area annual mean catch rate (No./h) of blue crab caught with 6.1 meter trawls during 1984-2004.

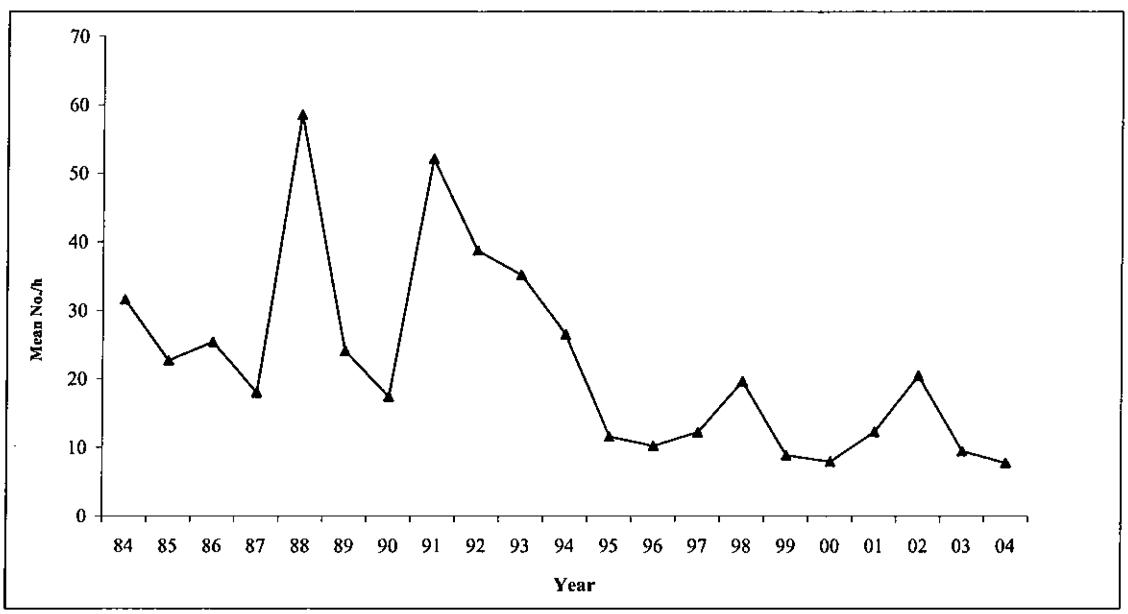

Figure 71. Aransas Bay annual mean catch rate (No./h) of blue crab caught with 6.1 meter trawls during 1984-2004.

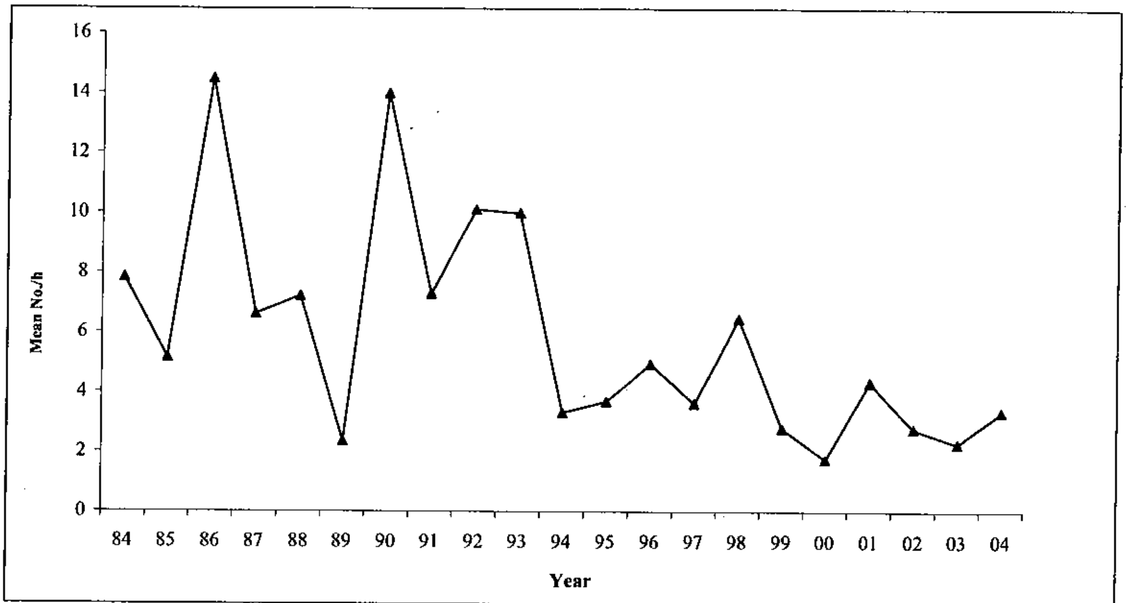

Figure 72. Corpus Christi Bay annual mean catch rate (No./h) of blue crab caught with 6.1 meter trawls during 1984-2004.

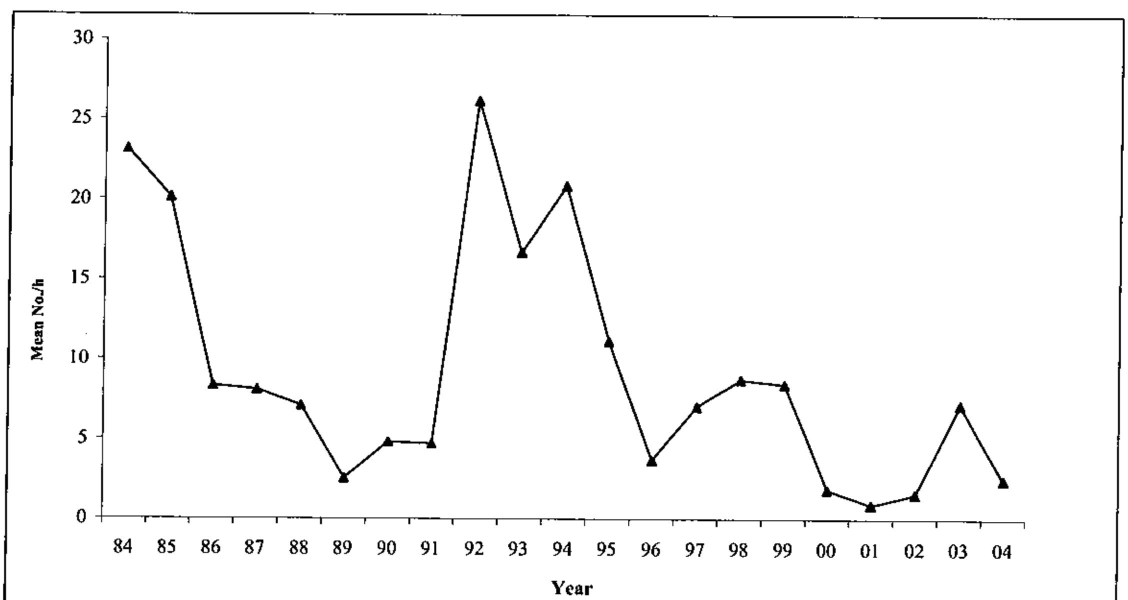

Figure 73. Upper Laguna Madre annual mean catch rate (No./h) of blue crab caught with 6.1 meter trawls during 1984-2004.

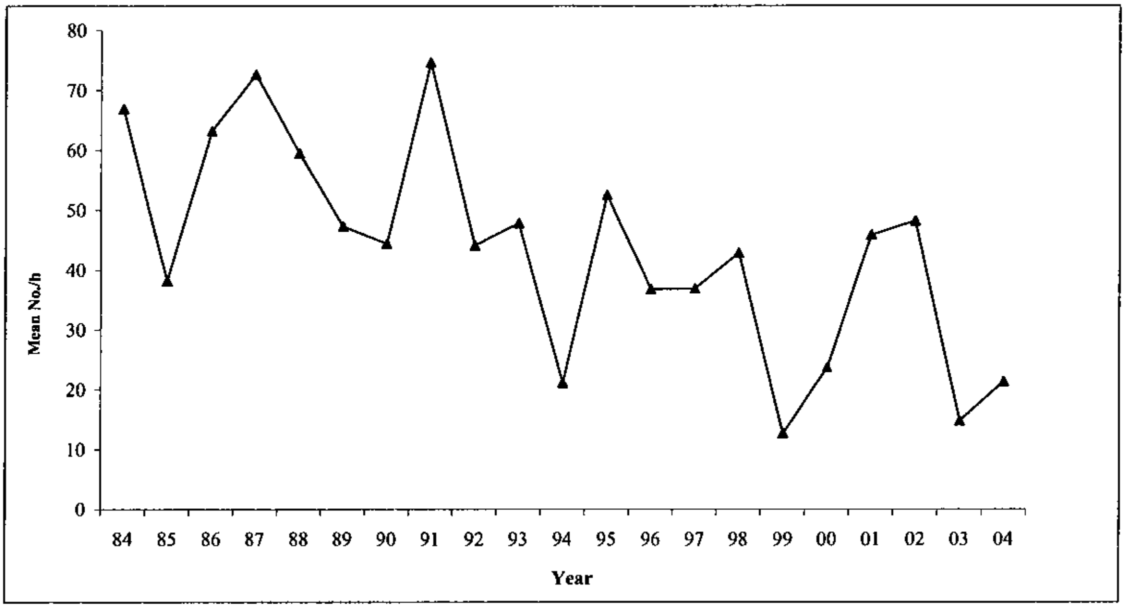

Figure 74. CBBEP area annual mean catch rate (No./h) of brown shrimp caught with 6.1 meter trawls during 1984-2004.

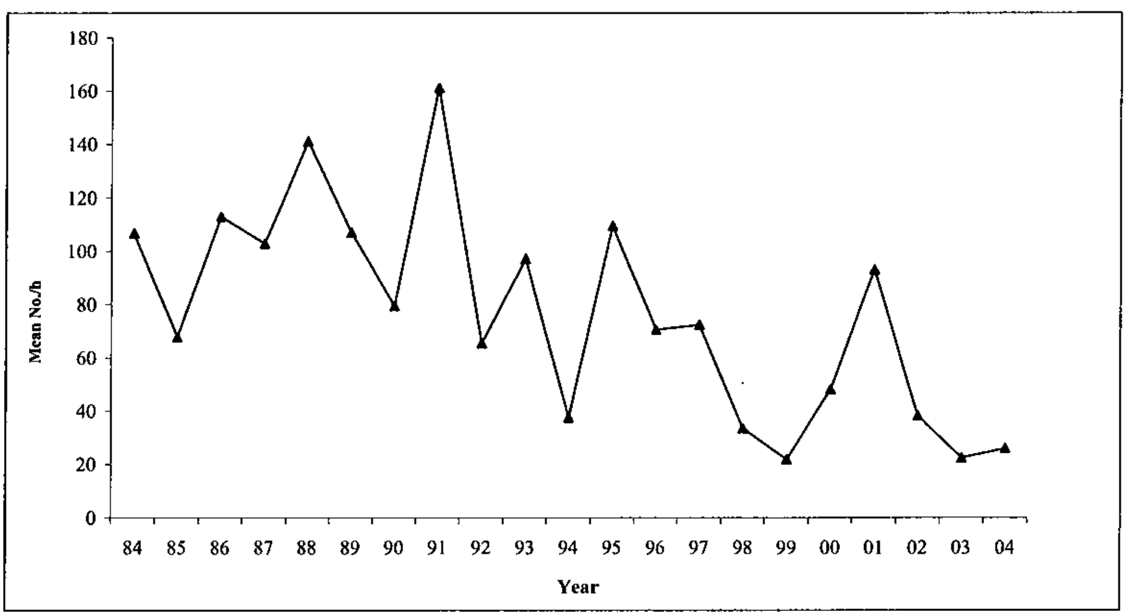

Figure 75. Aransas Bay annual mean catch rate (No./h) of brown shrimp caught with 6.1 meter trawls during 1984-2004.

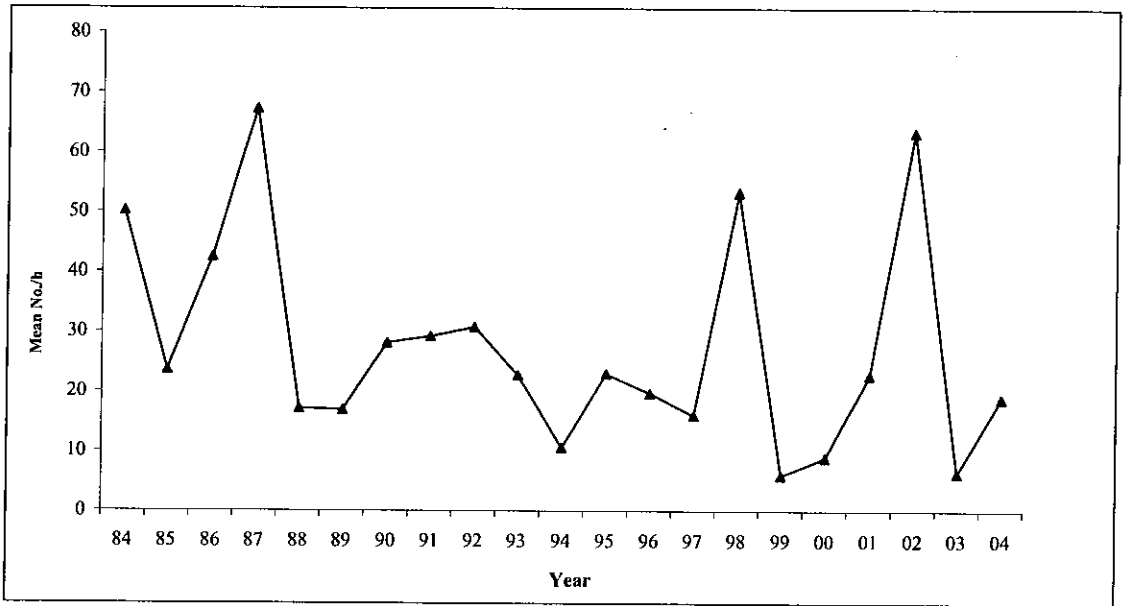

Figure 76. Corpus Christi Bay annual mean catch rate (No./h) of brown shrimp caught with 6.1 meter trawls during 1984-2004.

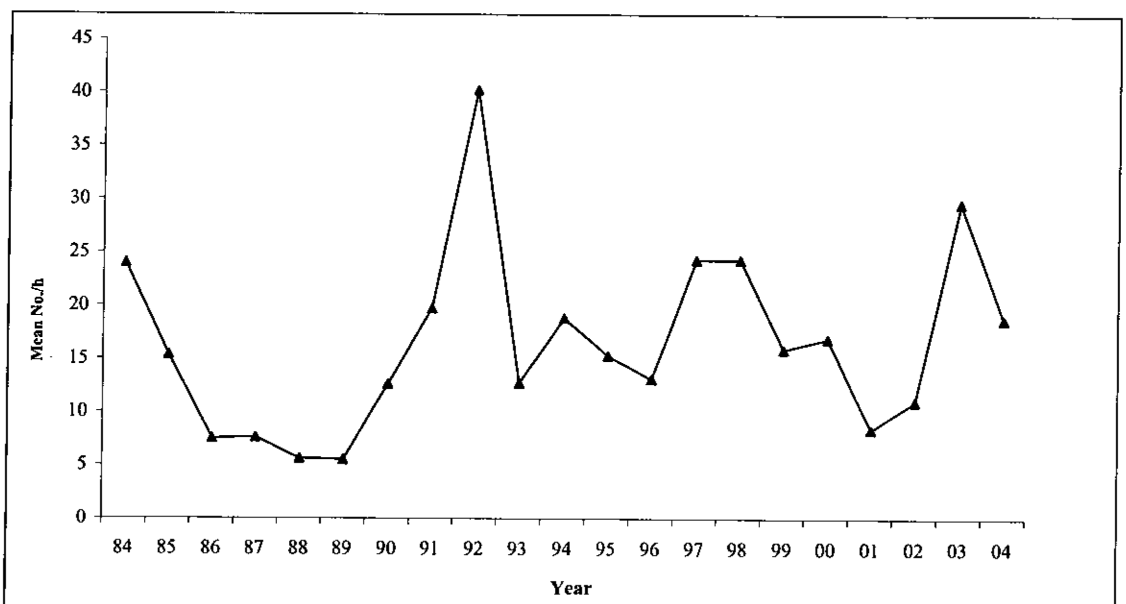

Figure 77. Upper Laguna Madre annual mean catch rate (No./h) of brown shrimp caught with 6.1 meter trawls during 1984-2004.

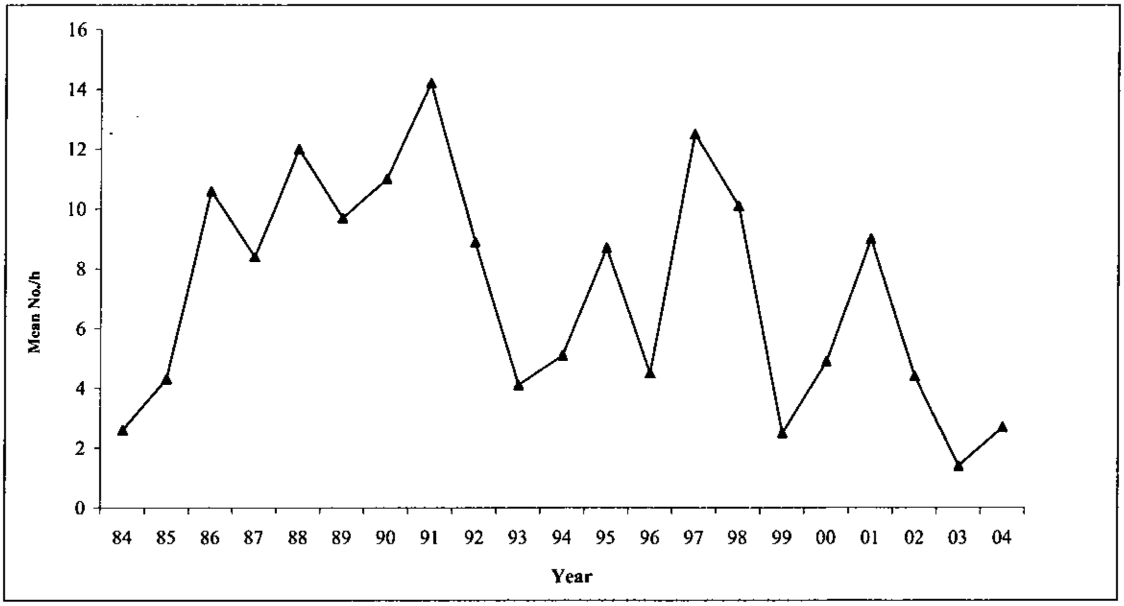

Figure 78. CBBEP area annual mean catch rate (No./h) of pink shrimp caught with 6.1 meter trawls during 1984-2004.

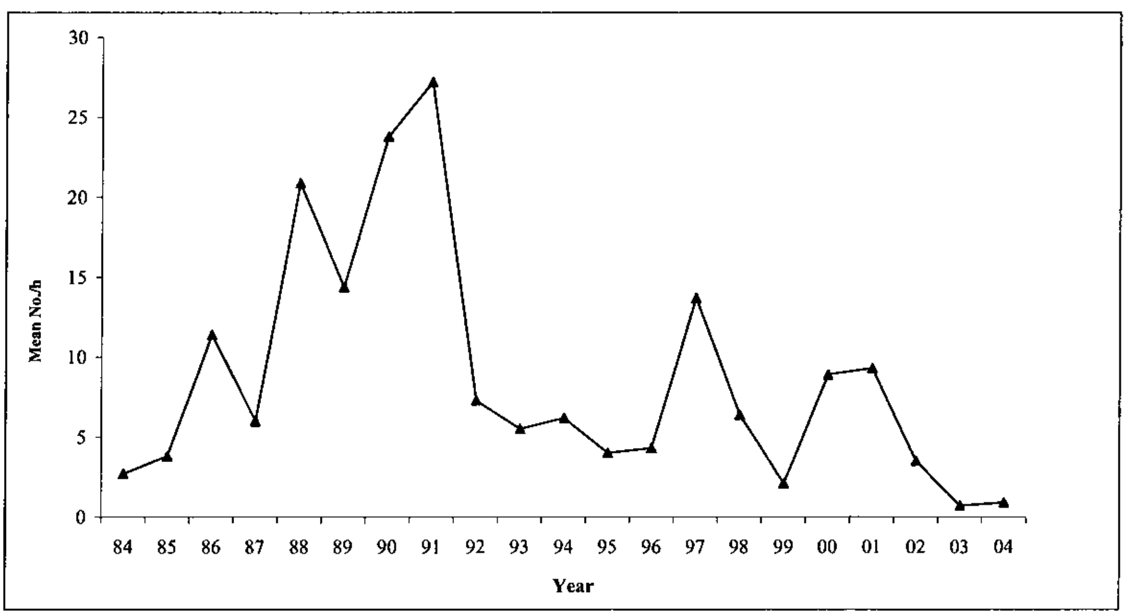

Figure 79. Aransas Bay annual mean catch rate (No./h) of pink shrimp caught with 6.1 meter trawls during 1984-2004..

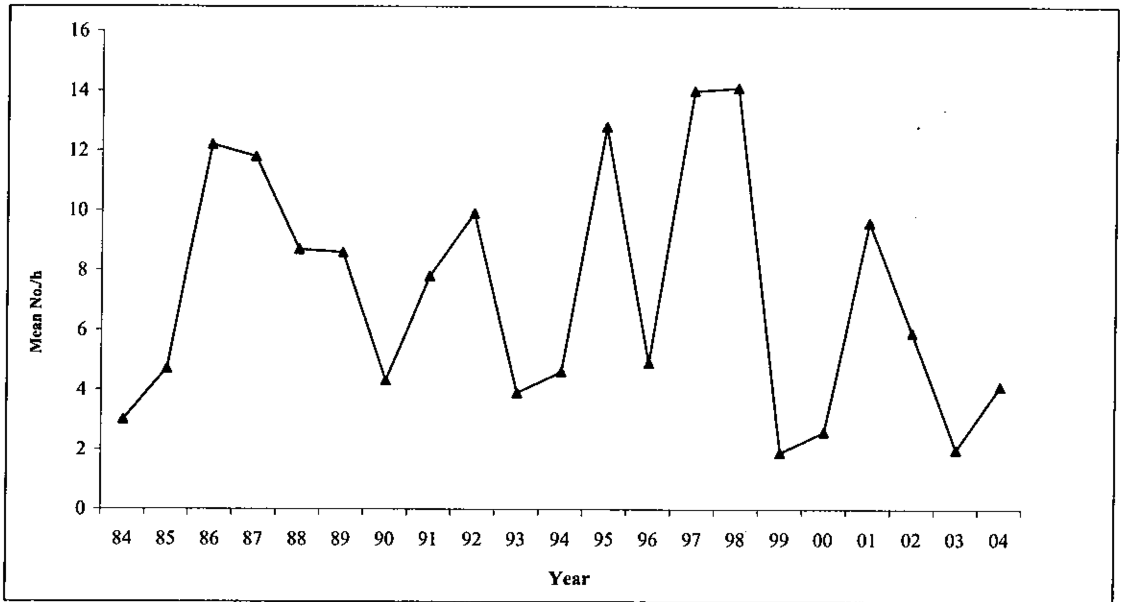

Figure 80. Corpus Christi Bay annual mean catch rate (No./h) of pink shrimp caught with 6.1 meter trawls during 1984-2004.

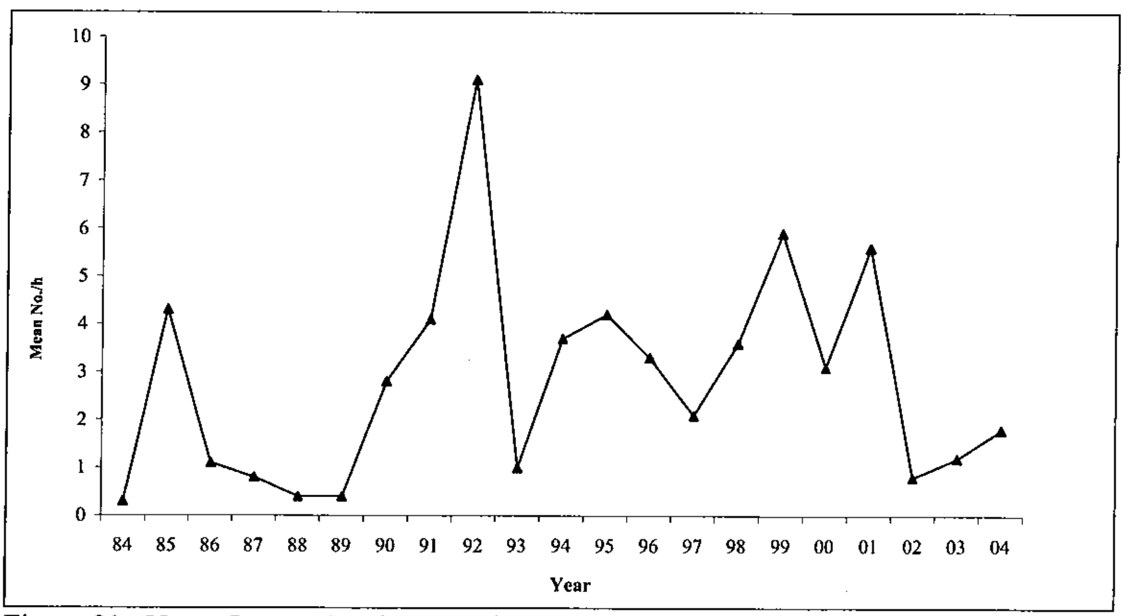

Figure 81. Upper Laguna Madre annual mean catch rate (No./h) of pink shrimp caught with 6.1 meter trawls during 1984-2004.

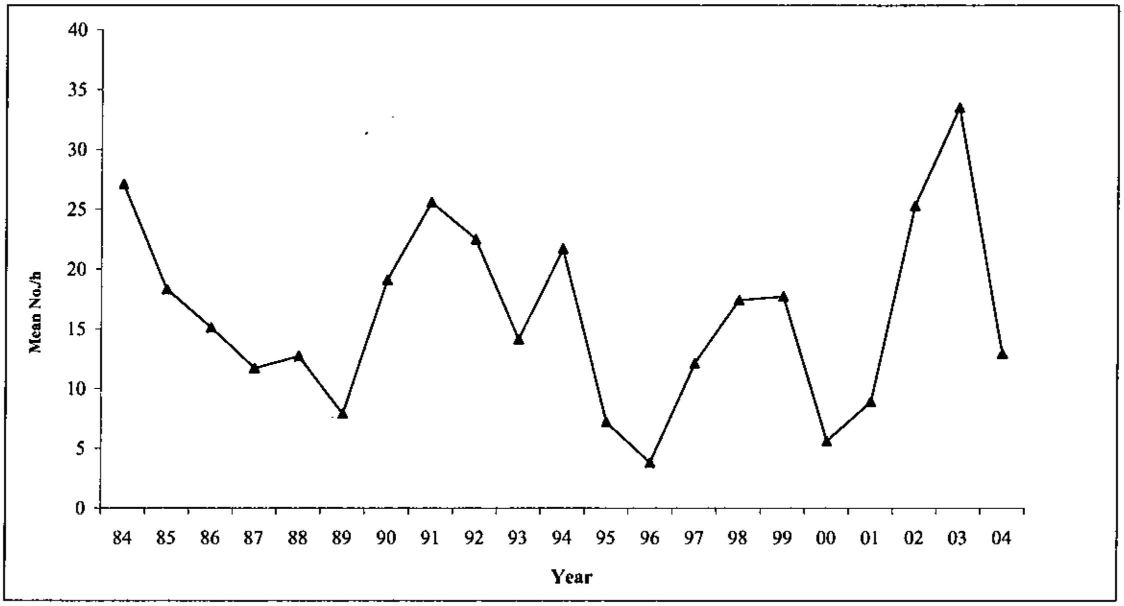

Figure 82. CBBEP area annual mean catch rate (No./h) of white shrimp caught with 6.1 meter trawls during 1984-2004.

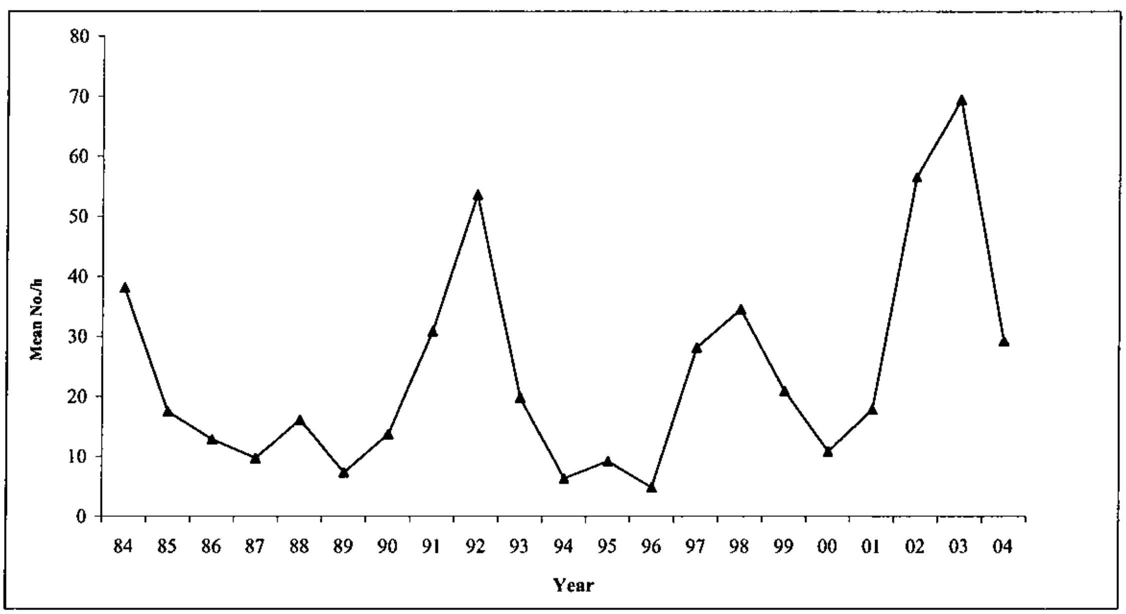

Figure 83. Aransas Bay annual mean catch rate (No./h) of white shrimp caught with 6.1 meter trawls during 1984-2004.

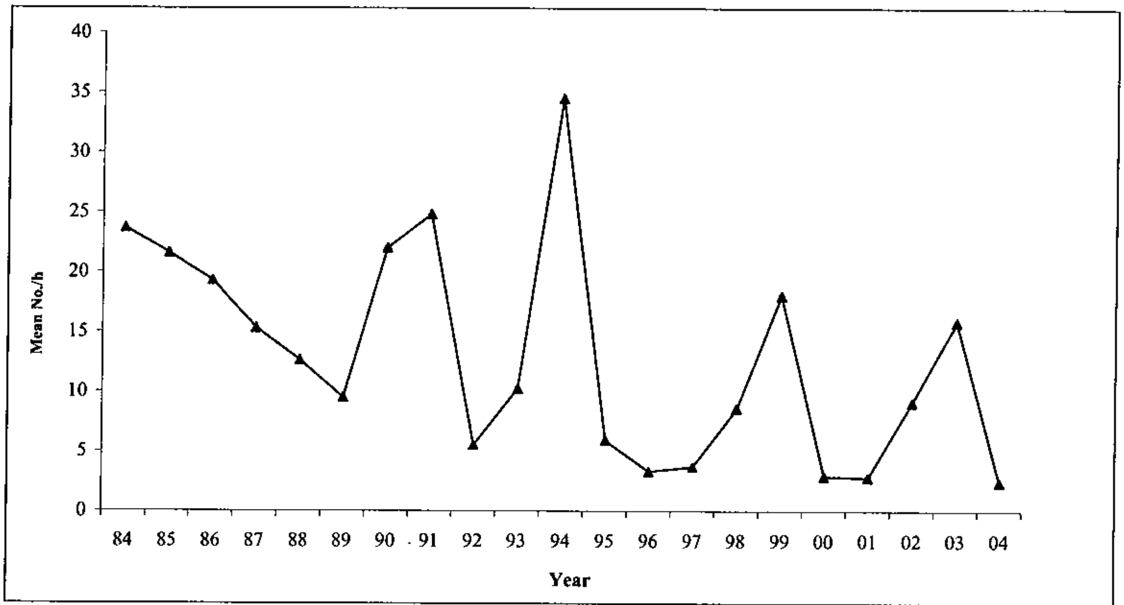

Figure 84. Corpus Christi Bay annual mean catch rate (No./h) of white shrimp caught with 6.1 meter trawls during 1984-2004.

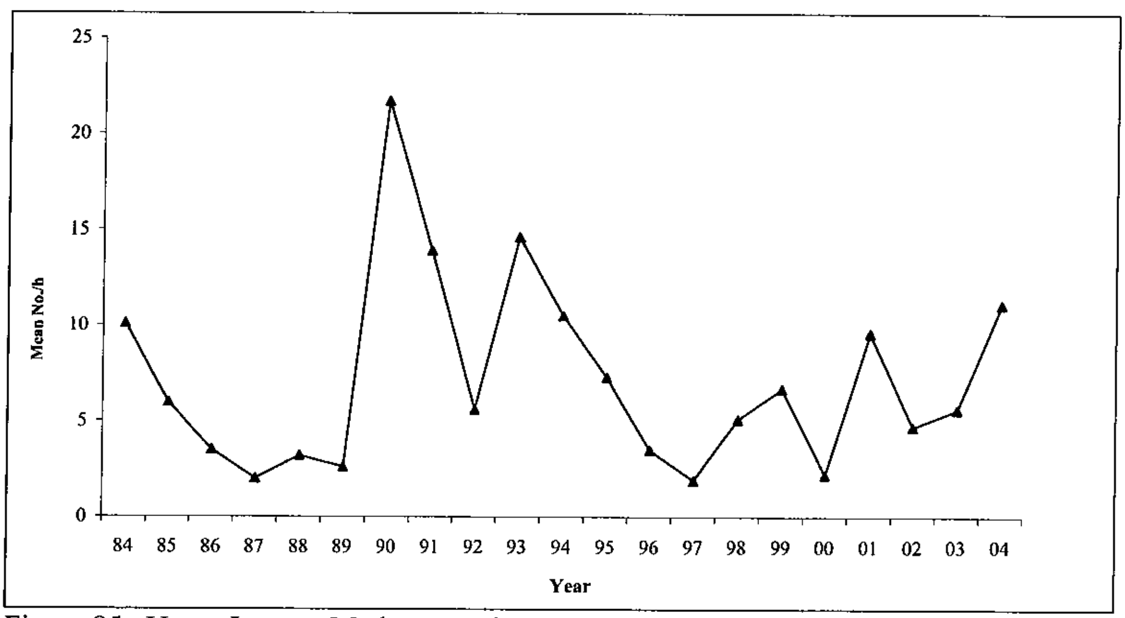

Figure 85. Upper Laguna Madre annual mean catch rate (No./h) of white shrimp caught with 6.1 meter trawls during 1984-2004.

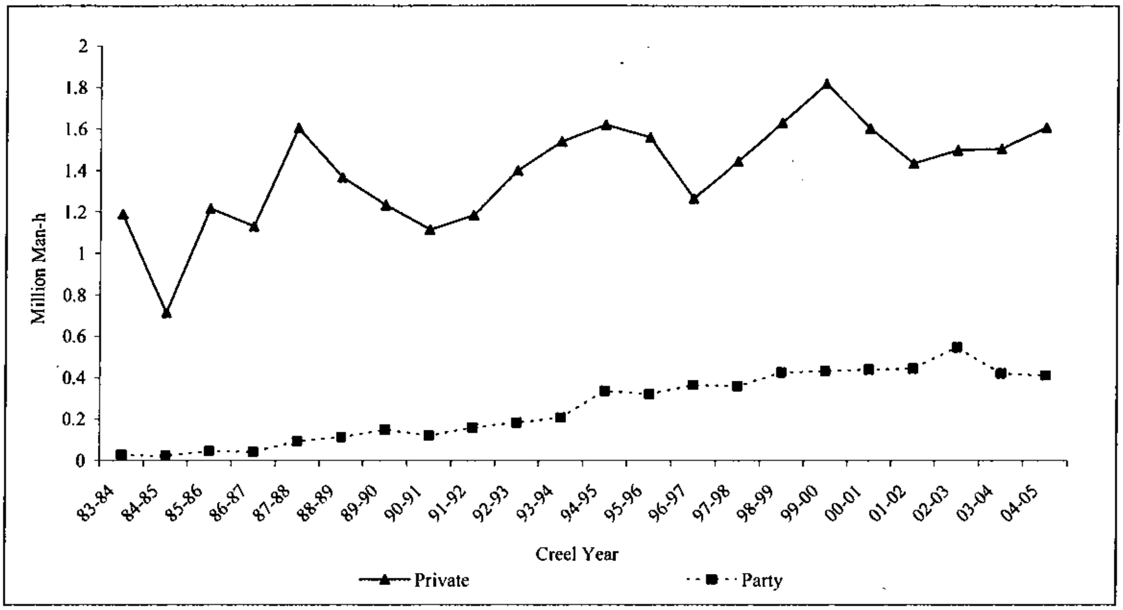

Figure 86. Estimated annual fishing pressure (million man-h) for private-boat and party-boat anglers in the CBBEP area bay and passes during the 1983-2005 creel years.

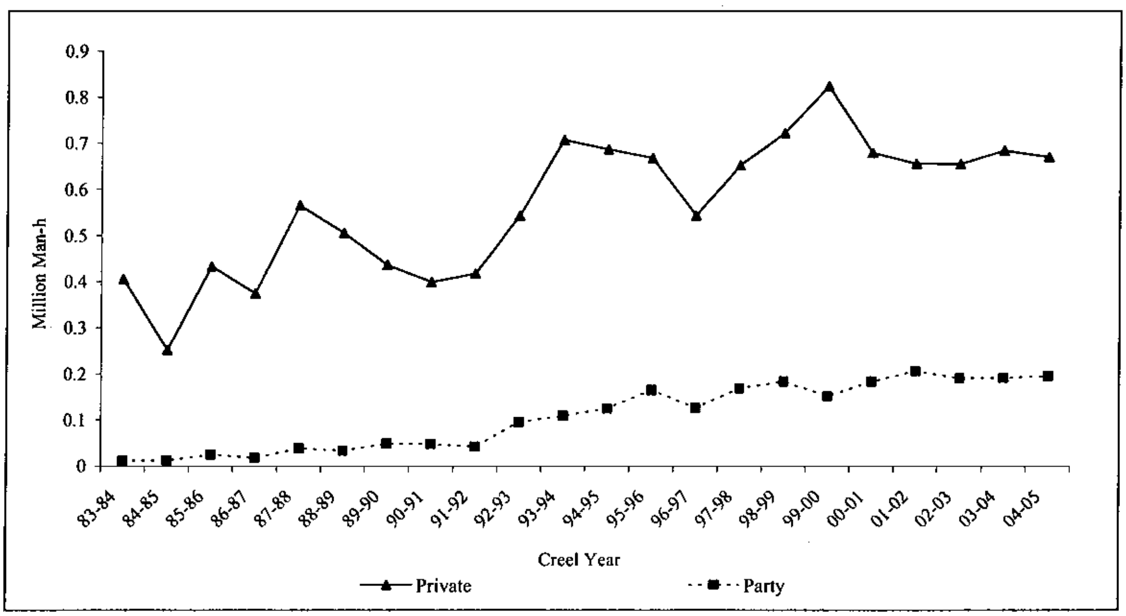

Figure 87. Estimated annual fishing pressure (million man-h) for private-boat and party-boat anglers in the Aransas Bay area bay and passes during the 1983-2005 creel years.

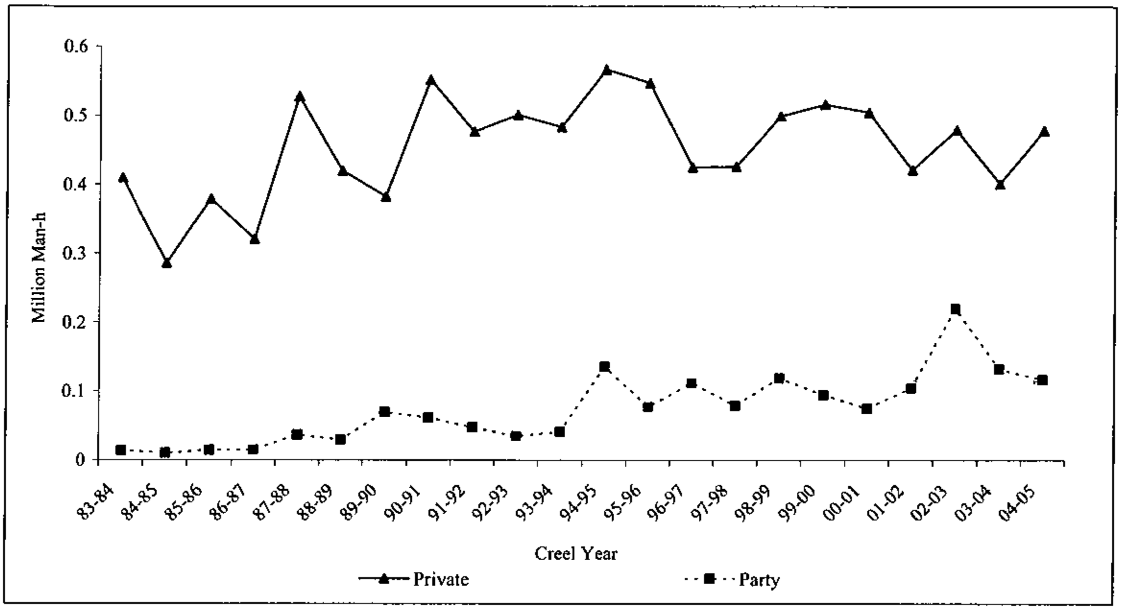

Figure 88. Estimated annual fishing pressure (million man-h) for private-boat and party-boat anglers in the Corpus Christi Bay area bay and passes during the 1983-2005 creel years.

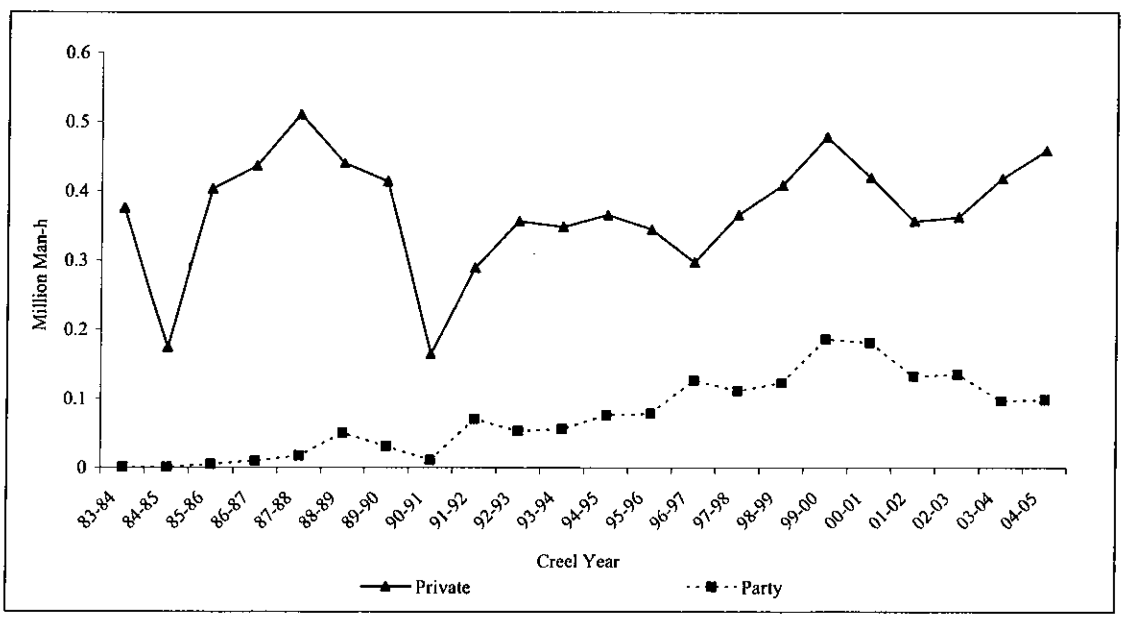

Figure 89. Estimated annual fishing pressure (million man-h) for private-boat and party-boat anglers in the upper Laguna Madre area bay and passes during the 1983-2005 creel years.

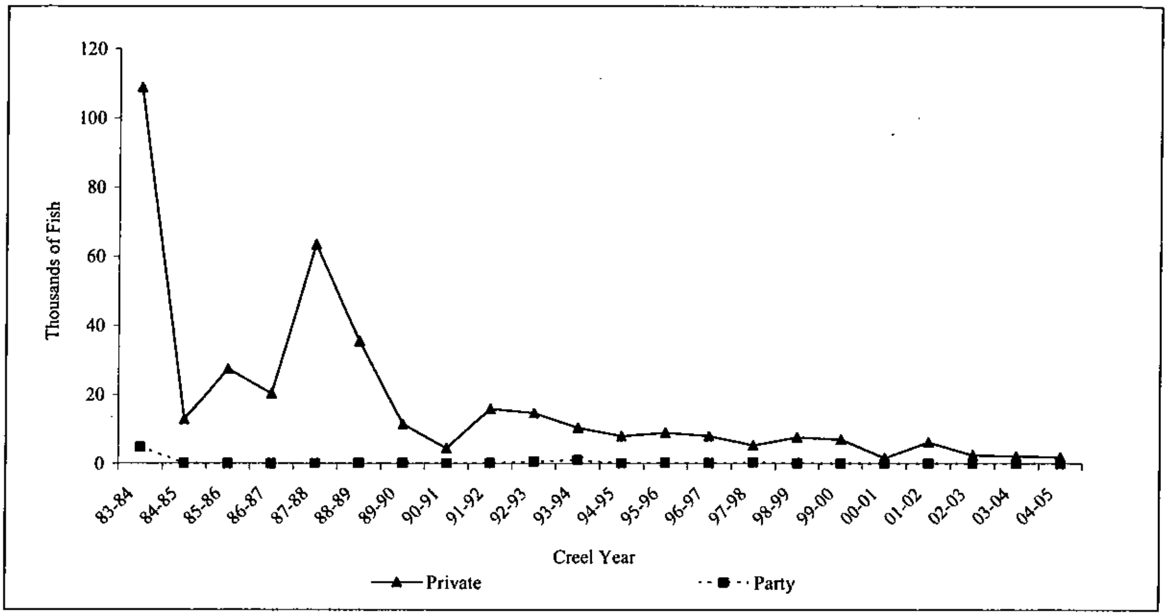

Figure 90. Estimated annual landings for Atlantic croaker by private-boat and party-boat anglers fishing bay and passes in the CBBEP area during the 1983-2005 creel years.

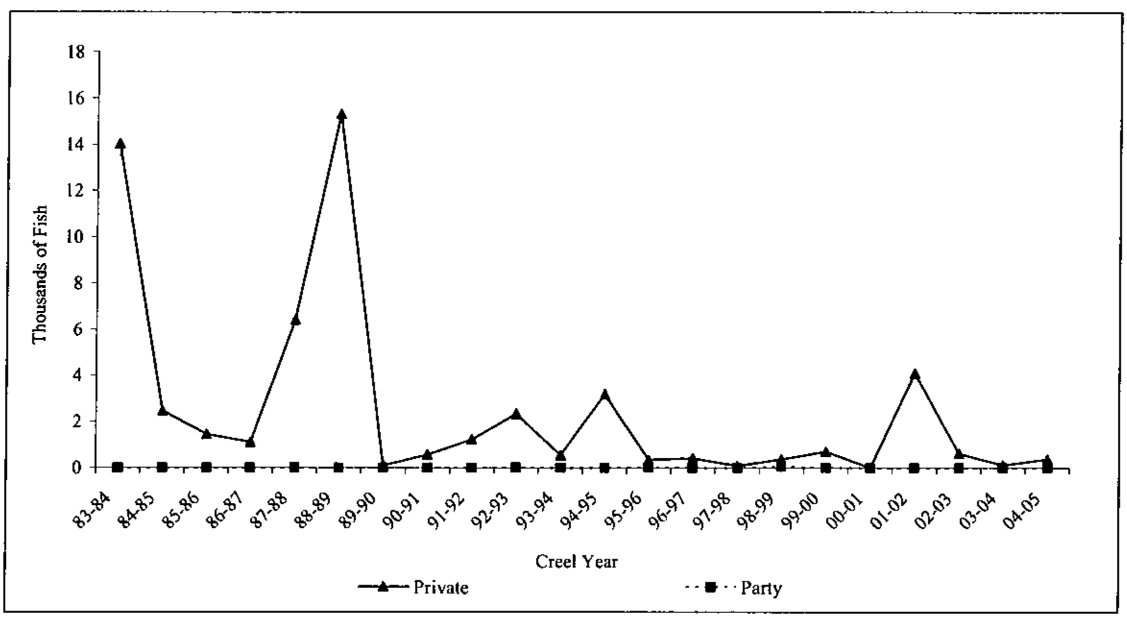

Figure 91. Estimated annual landings (No. x 1000) for Atlantic croaker by private-boat and party-boat anglers fishing bay and passes in Aransas Bay during the 1983-2005 creel years.

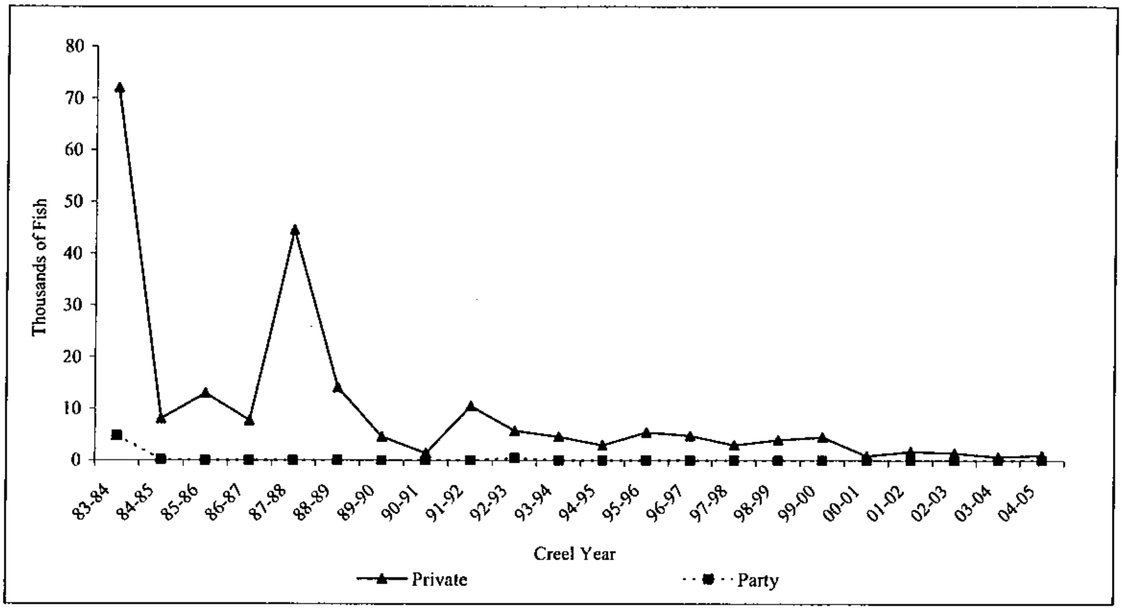

Figure 92. Estimated annual landings (No. x 1000) for Atlantic croaker by private-boat and party-boat anglers fishing bay and passes in Corpus Christi Bay during the 1983-2005 creel years.

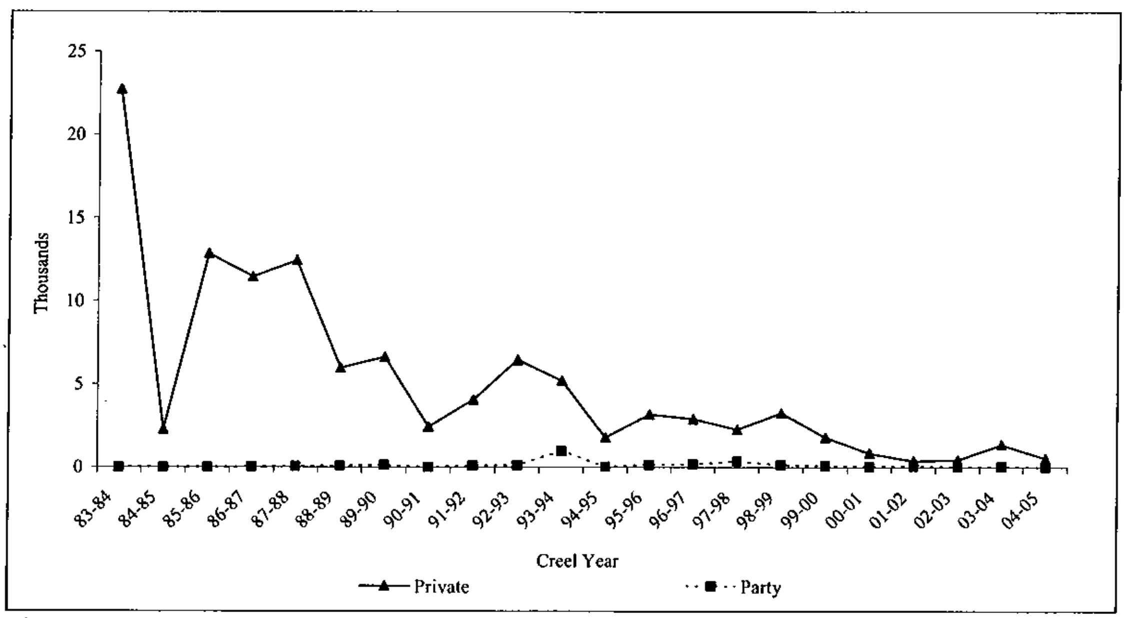

Figure 93. Estimated annual landings (No. x 1000) for Atlantic croaker by private-boat and party-boat anglers fishing bay and passes in the upper Laguna Madre during the 1983-2005 creel years.

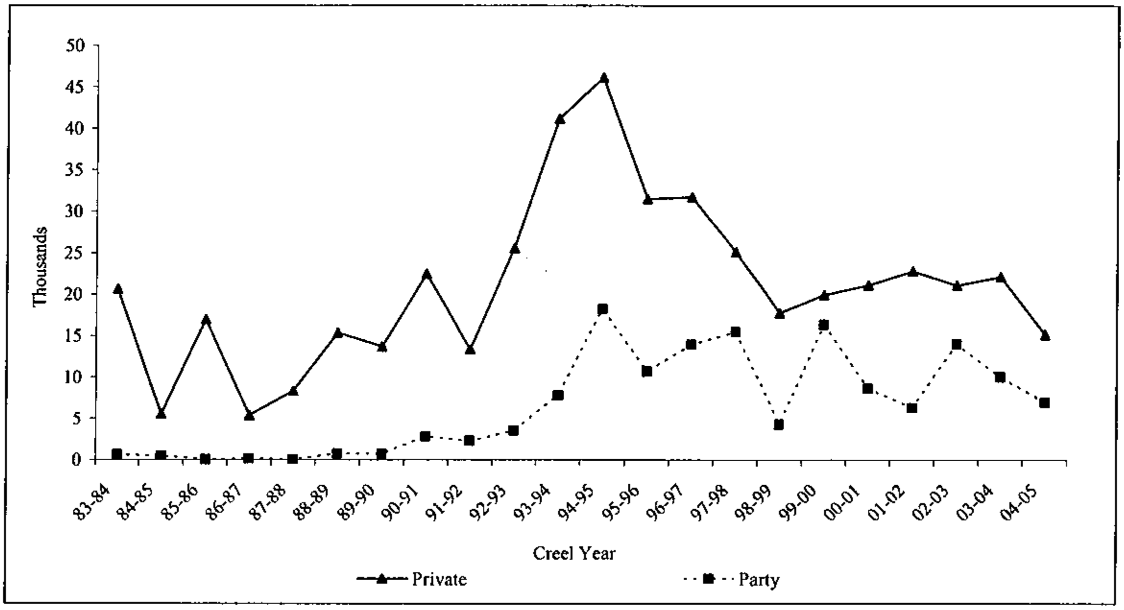

Figure 94. Estimated annual landings (No. x 1000) for black drum by private-boat and party-boat anglers fishing bay and passes in the CBBEP area during the 1983-2005 creel years.

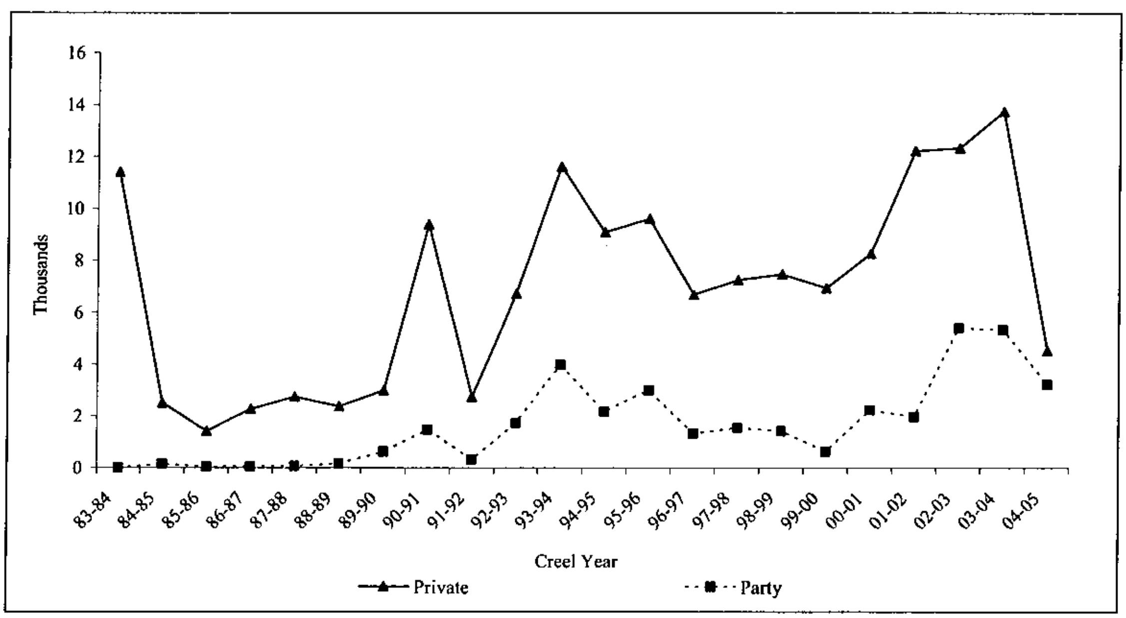

Figure 95. Estimated annual landings (No. x 1000) for black drum by private-boat and party-boat anglers fishing bay and passes in Aransas Bay during the 1983-2005 creel years.

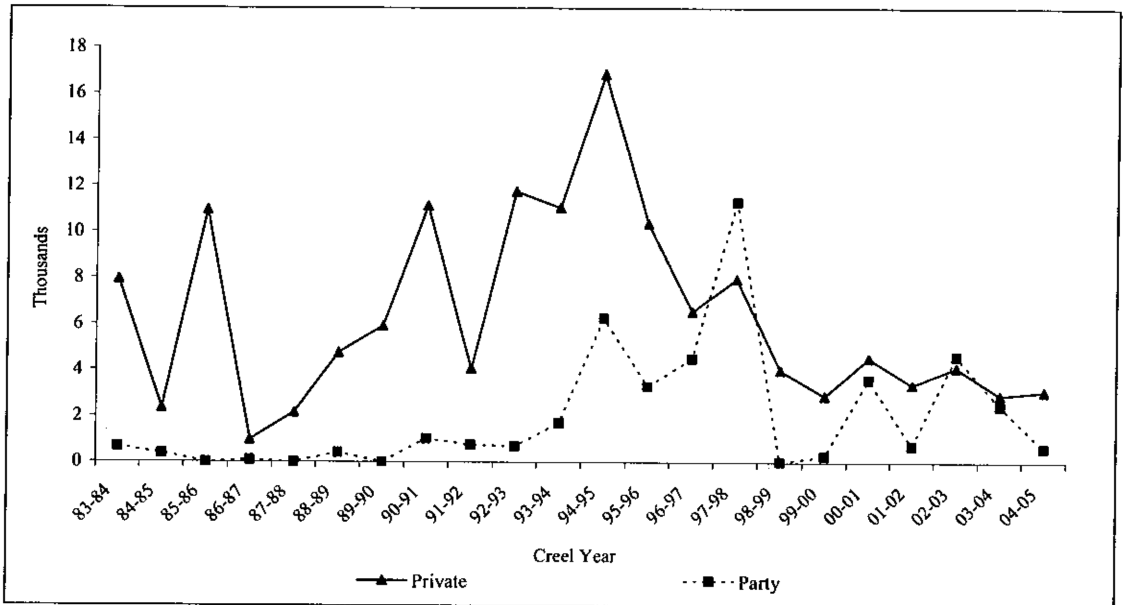

Figure 96. Estimated annual landings (No. x 1000) for black drum by private-boat and party-boat anglers fishing bay and passes in Corpus Christi Bay during the 1983-2005 creel years.

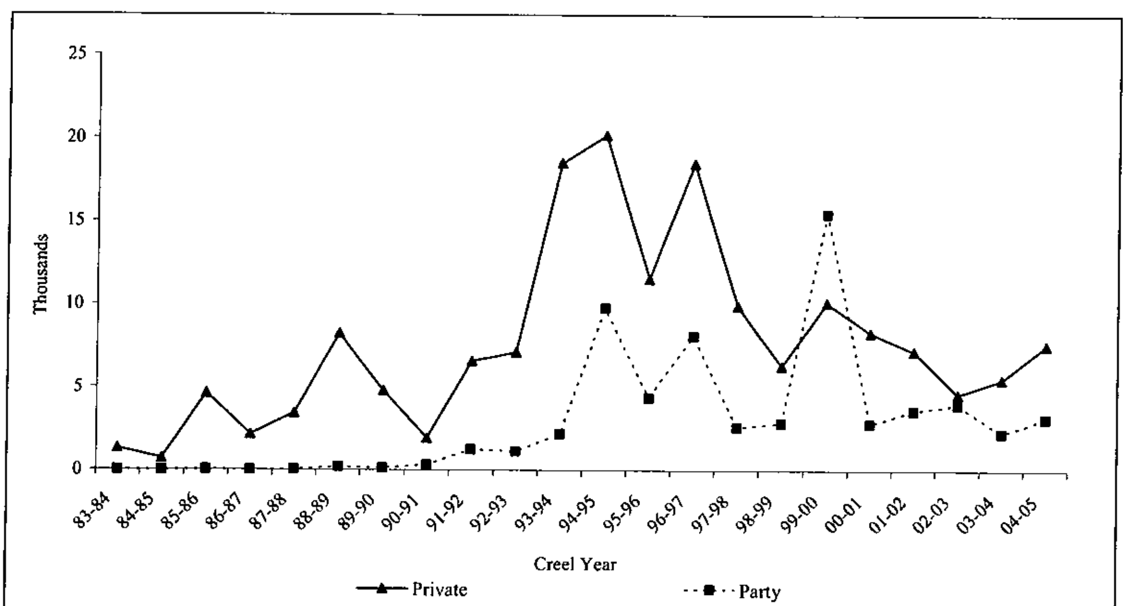

Figure 97. Estimated annual landings (No. x 1000) for black drum by private-boat and party-boat anglers fishing bay and passes in the upper Laguna Madre during the 1983-2005 creel years.

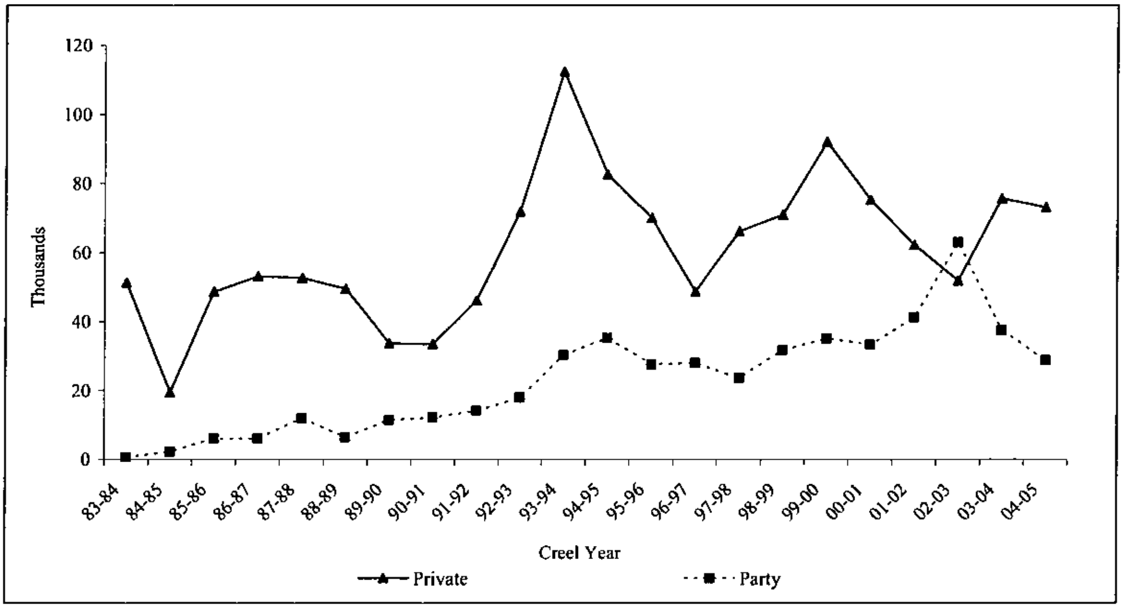

Figure 98. Estimated annual landings (No. x 1000) for red drum by private-boat and party-boat anglers fishing bay and passes in the CBBEP area during the 1983-2005 creel years.

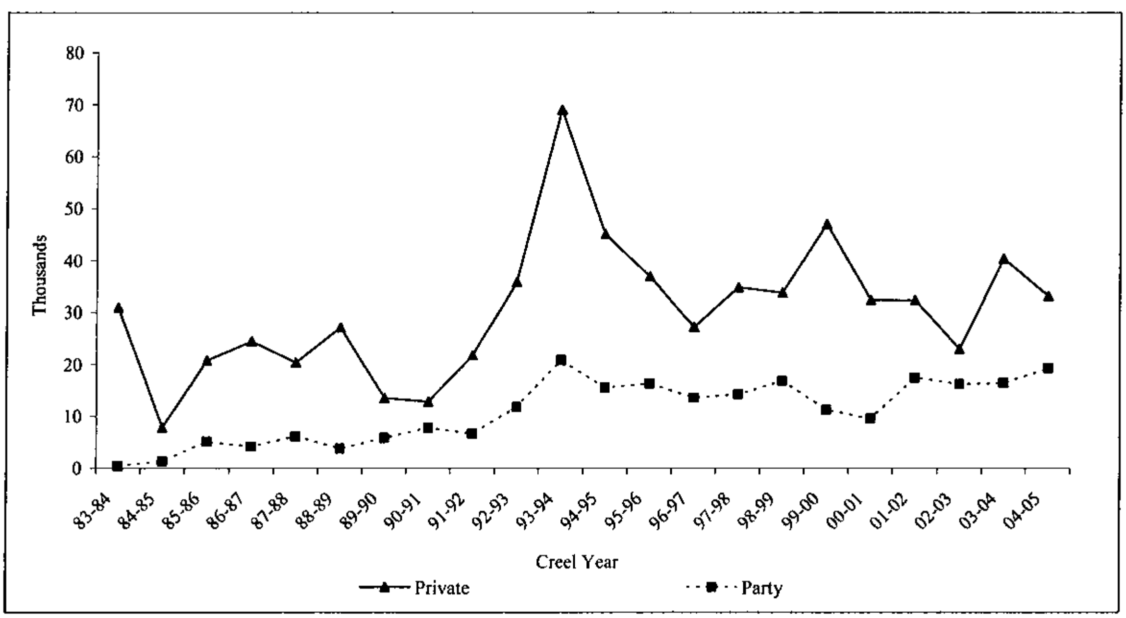

Figure 99. Estimated annual landings (No. x 1000) for red drum by private-boat and party-boat anglers fishing bay and passes in Aransas Bay during the 1983-2005 creel years.

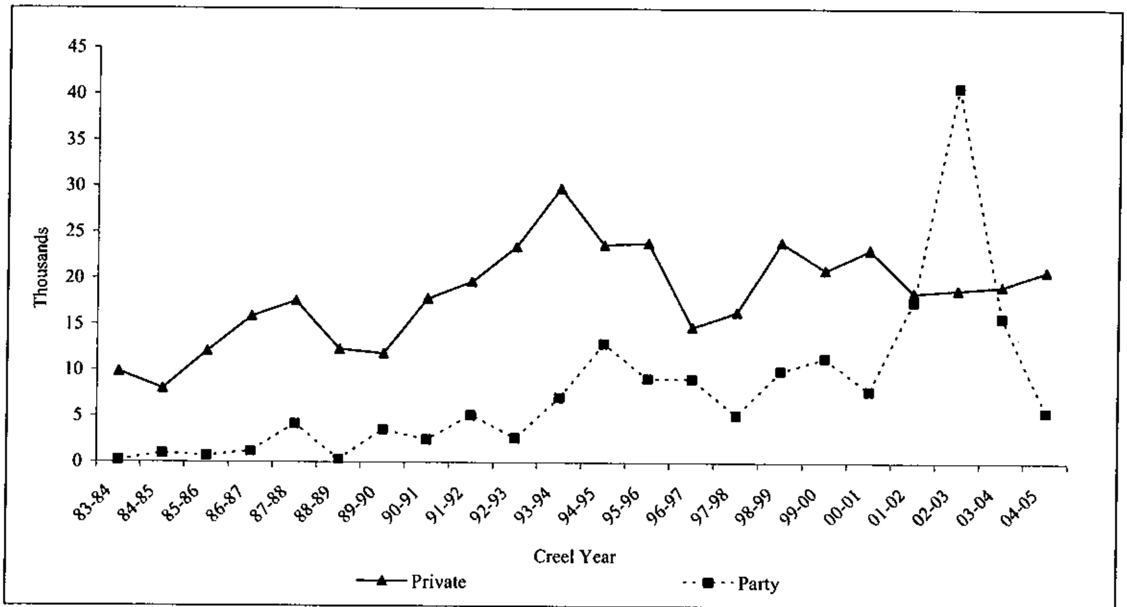

Figure 100. Estimated annual landings (No. x 1000) for red drum by private-boat and party-boat anglers fishing bay and passes in Corpus Christi Bay during the 1983-2005 creel years.

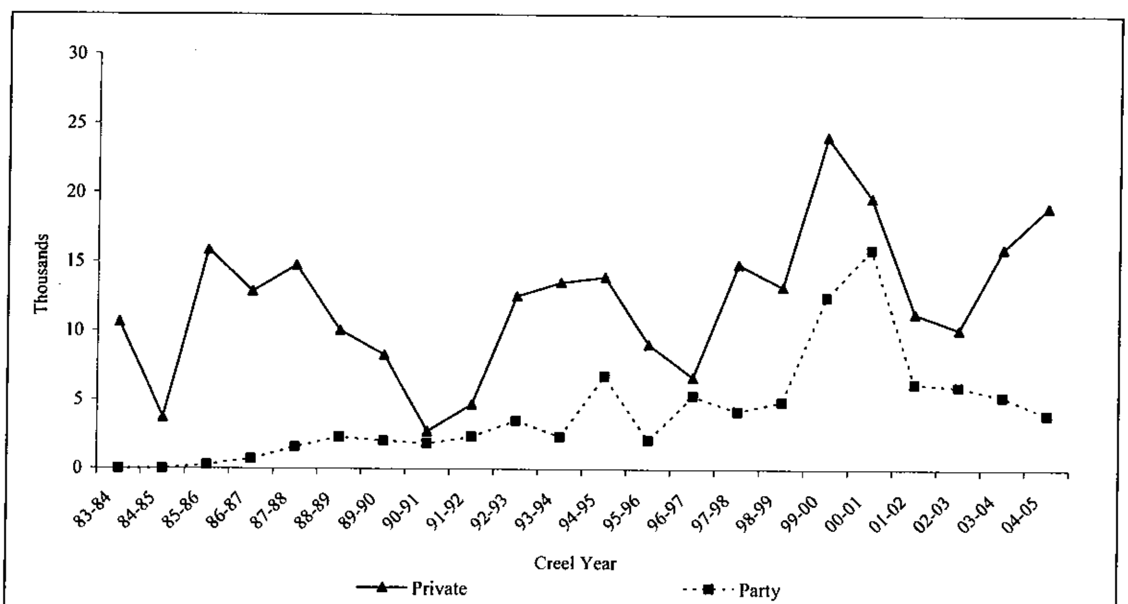

Figure 101. Estimated annual landings (No. x 1000) for black drum by private-boat and party-boat anglers fishing bay and passes in the upper Laguna Madre during the 1983-2005 creel years.

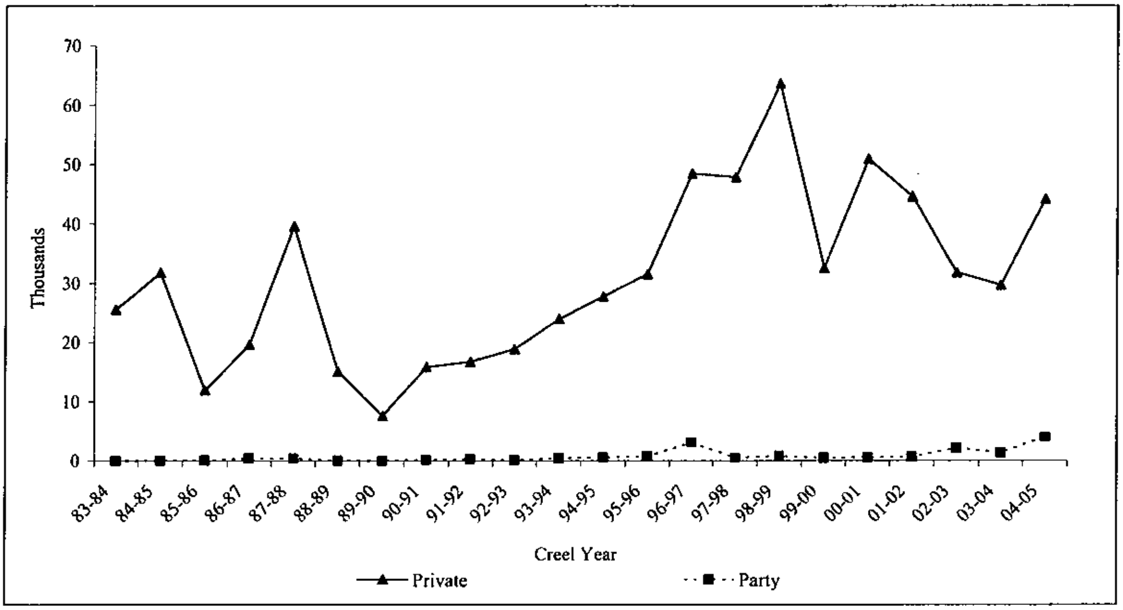

Figure 102. Estimated annual landings (No. x 1000) for sheepshead by private-boat and party-boat anglers fishing bay and passes in the CBBEP area during the 1983-2005 creel years.

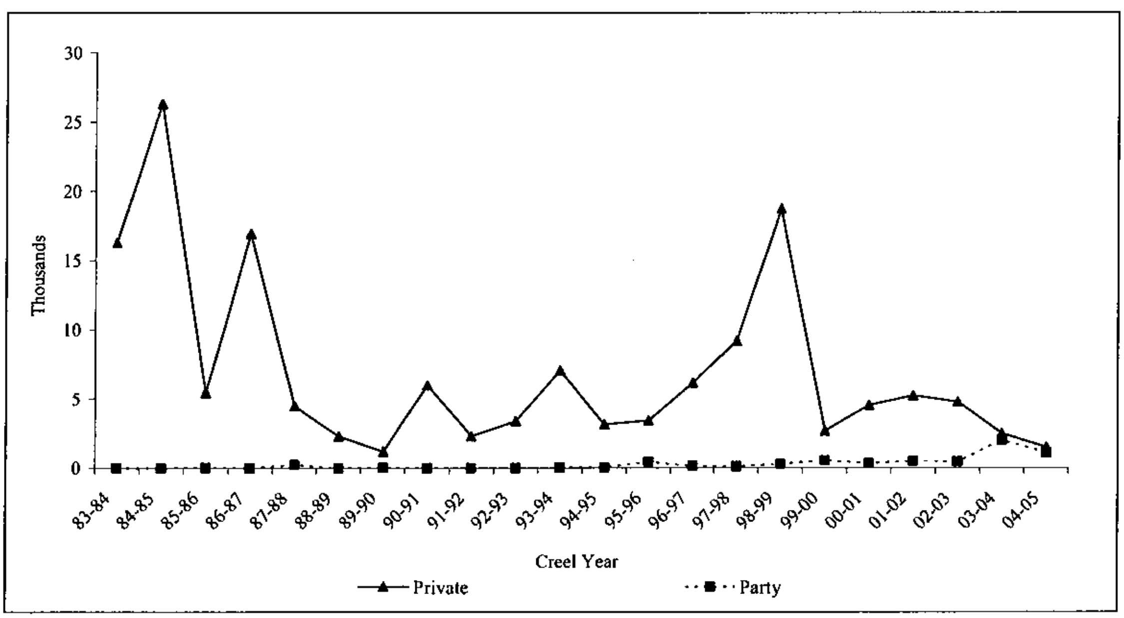

Figure 103. Estimated annual landings (No. x 1000) for sheepshead by private-boat and party-boat anglers fishing bay and passes in Aransas Bay during the 1983-2005 creel years.

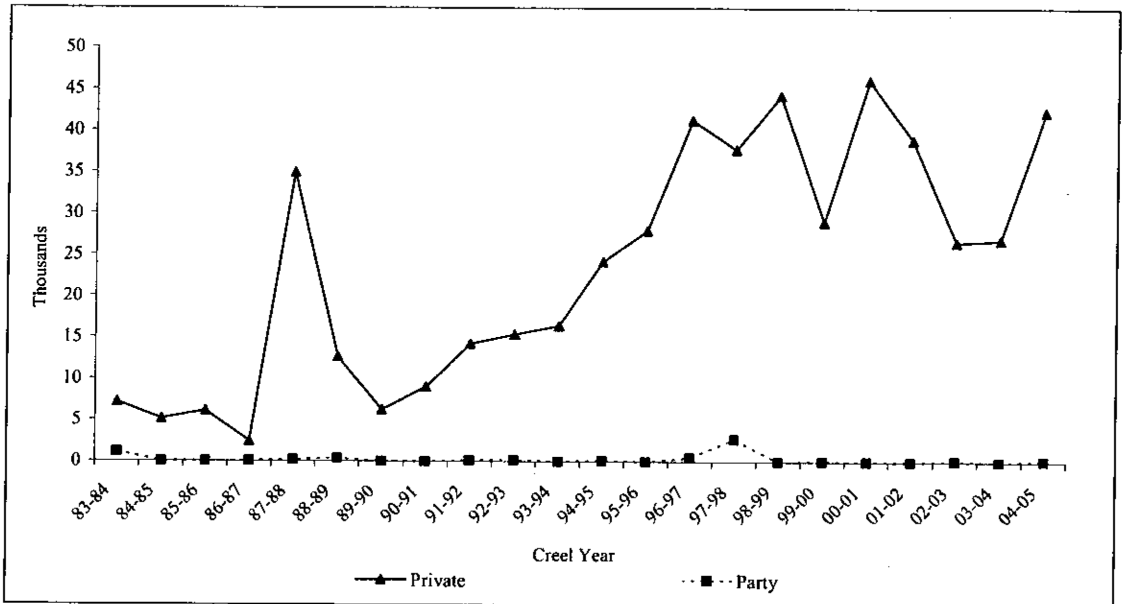

Figure 104. Estimated annual landings (No. x 1000) for sheepshead by private-boat and party-boat anglers fishing bay and passes in Corpus Christi Bay during the 1983-2005 creel years.

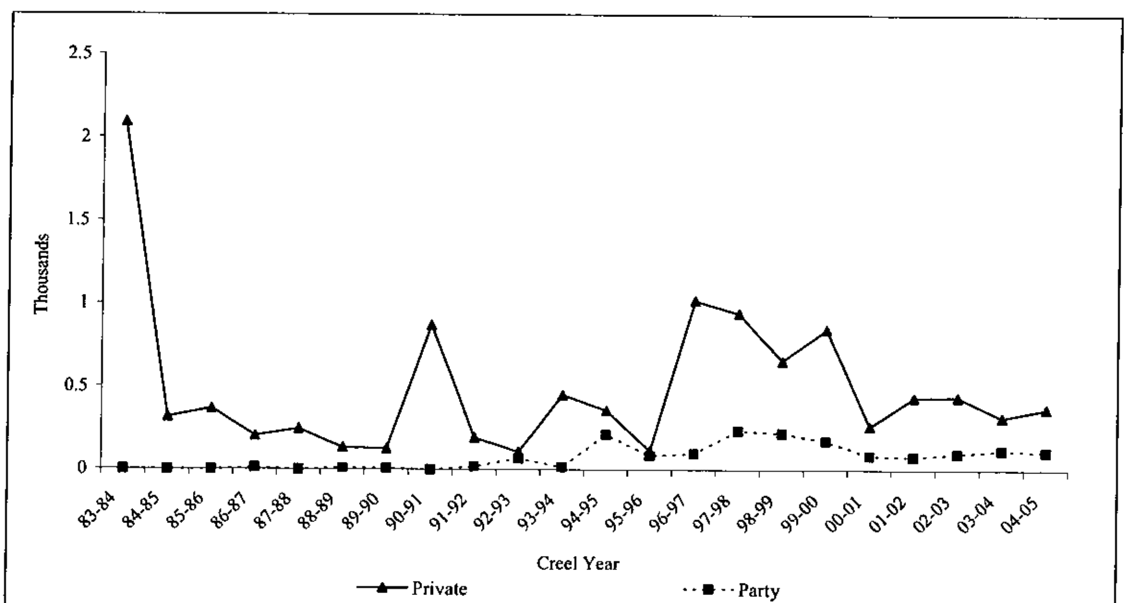

Figure 105. Estimated annual landings (No. x 1000) for sheepshead by private-boat and party-boat anglers fishing bay and passes in the upper Laguna Madre during the 1983-2005 creel years.

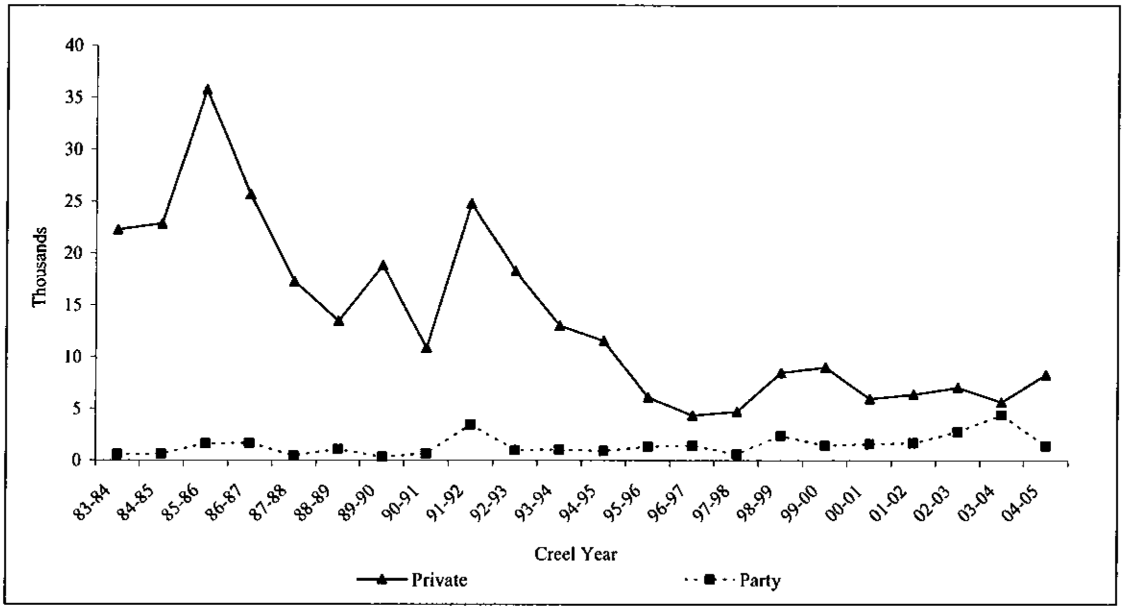

Figure 106. Estimated annual landings (No. x 1000) for southern flounder by private-boat and party-boat anglers fishing bay and passes in the CBBEP area during the 1983-2005 creel years.

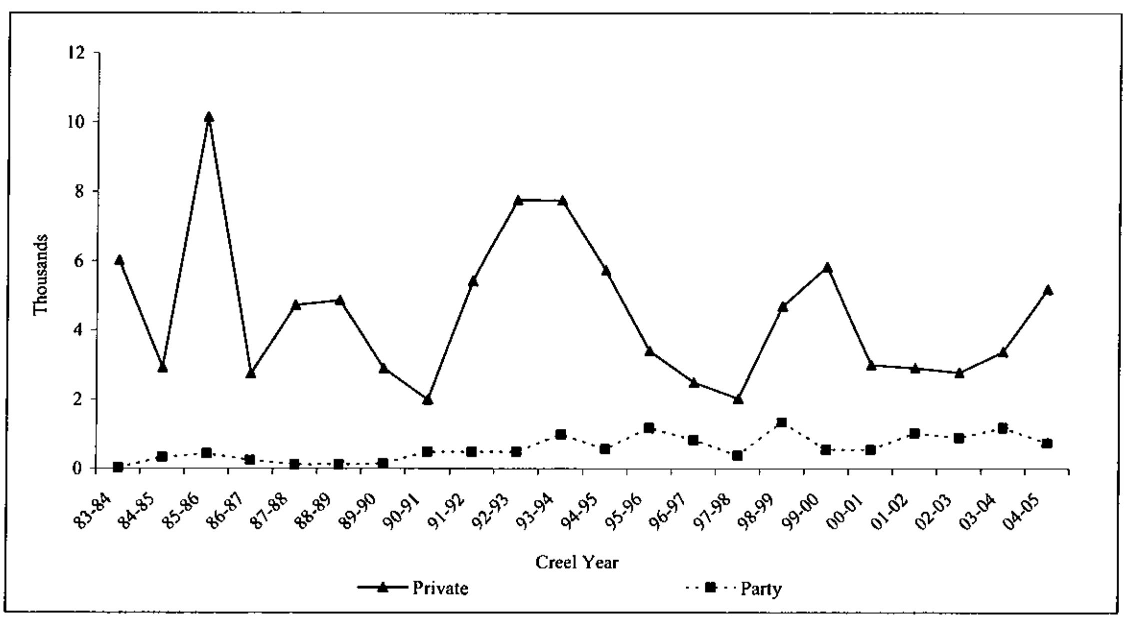

Figure 107. Estimated annual landings (No. x 1000) for southern flounder by private-boat and party-boat anglers fishing bay and passes in Aransas Bay during the 1983-2005 creel years.

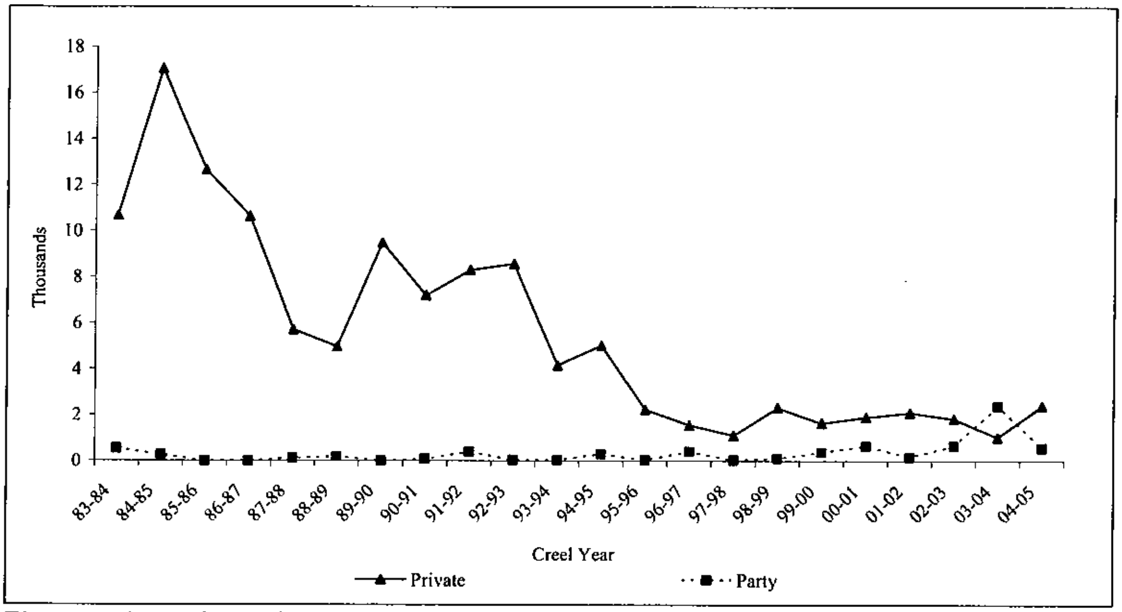

Figure 108. Estimated annual landings (No. x 1000) for southern flounder by private-boat and party-boat anglers fishing bay and passes in Corpus Christi Bay during the 1983-2005 creel years.

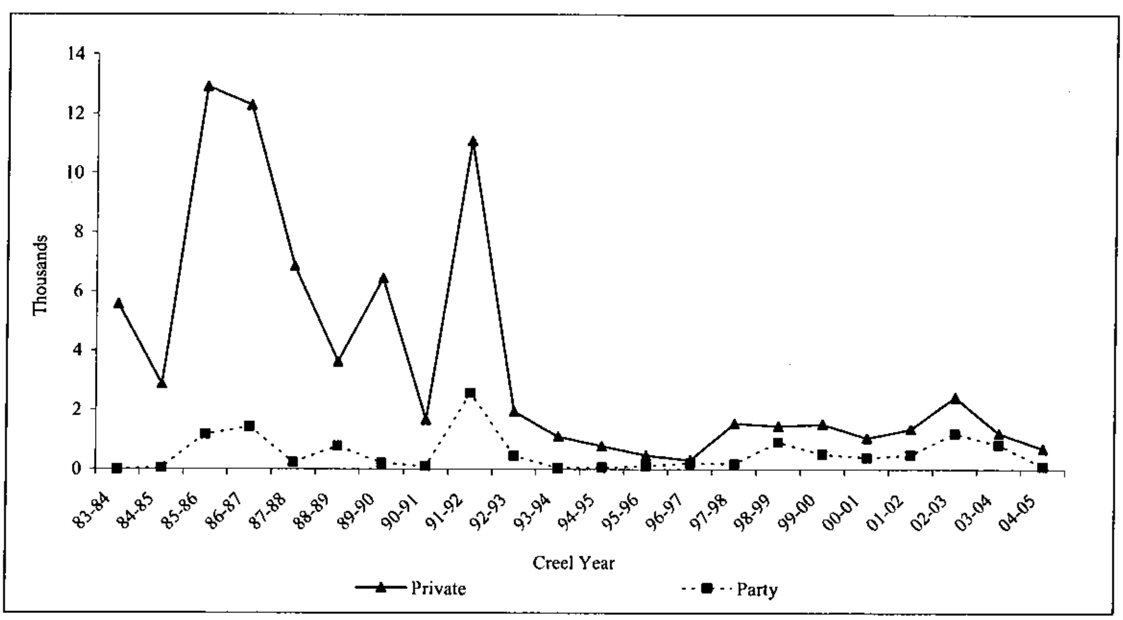

Figure 109. Estimated annual landings (No. x 1000) for southern flounder by private-boat and party-boat anglers fishing bay and passes in the upper Laguna Madre during the 1983-2005 creel years.

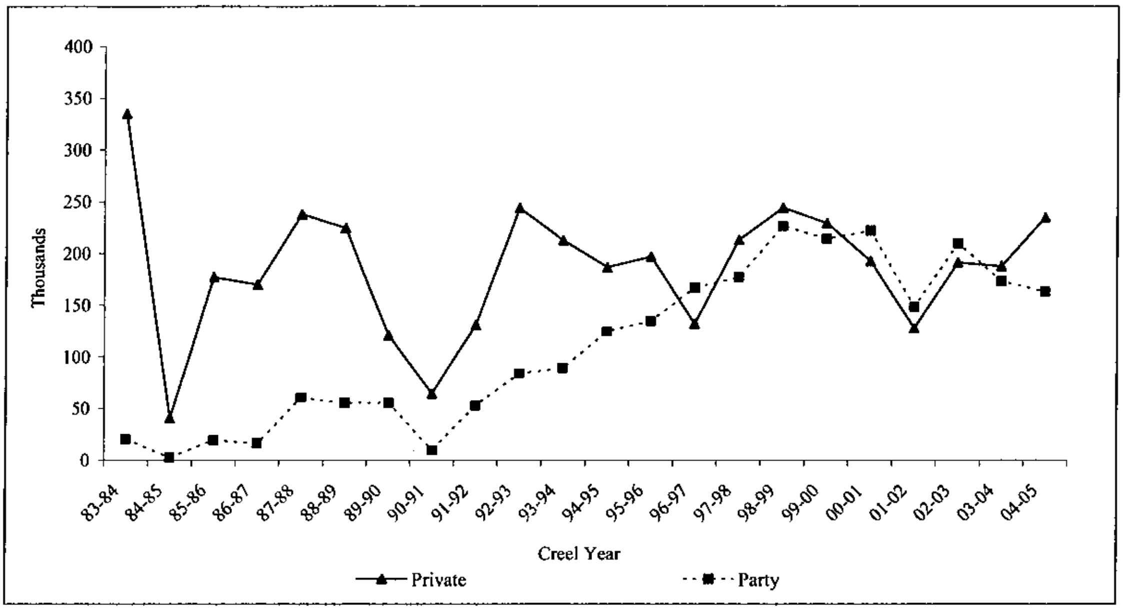

Figure 110. Estimated annual landings (No. x 1000) for spotted seatrout by private-boat and party-boat anglers fishing bay and passes in the CBBEP area during the 1983-2005 creel years.

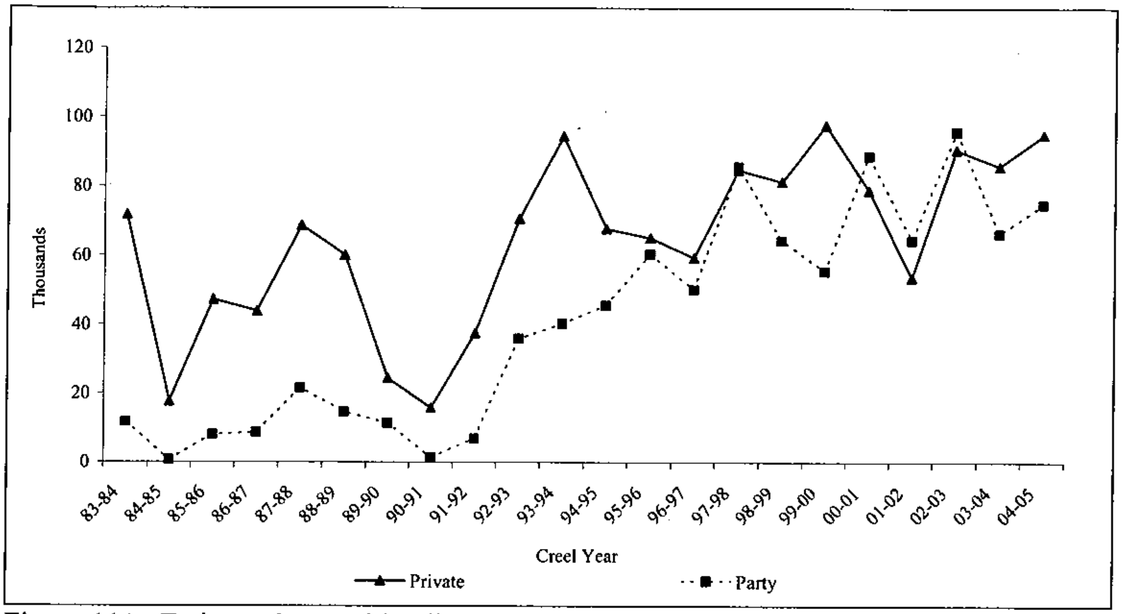

Figure 111. Estimated annual landings (No. x 1000) for spotted seatrout by private-boat and party-boat anglers fishing bay and passes in Aransas Bay during the 1983-2005 creel years.

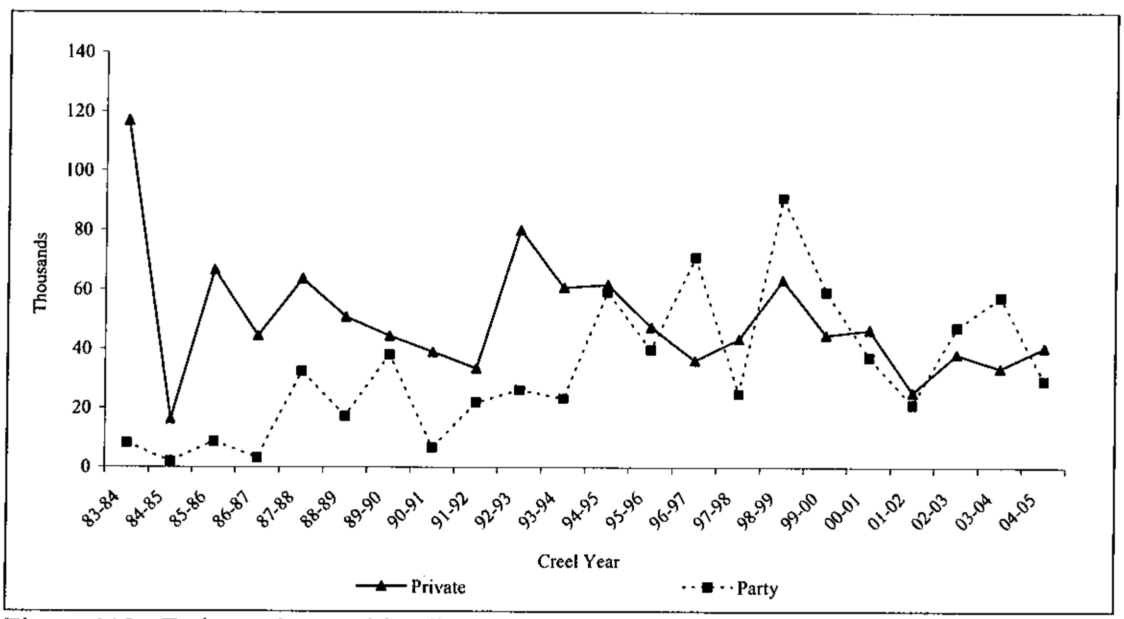

Figure 112. Estimated annual landings (No. x 1000) for spotted seatrout by private-boat and party-boat anglers fishing bay and passes in Corpus Christi Bay during the 1983-2005 creel years.

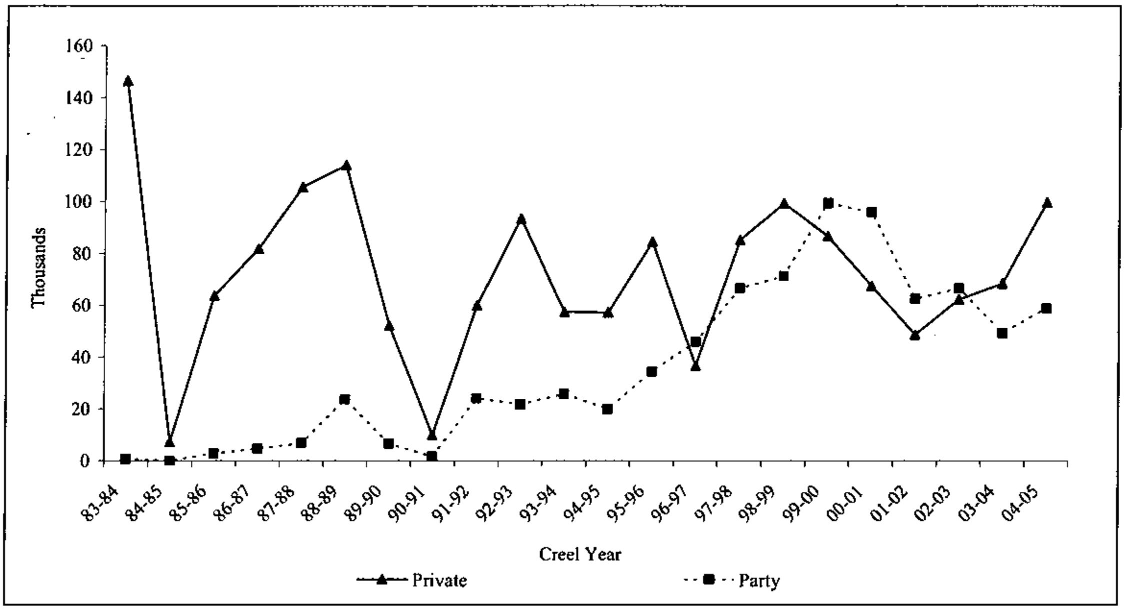

Figure 113. Estimated annual landings (No. x 1000) for spotted seatrout by private-boat and party-boat anglers fishing bay and passes in the upper Laguna Madre during the 1983-2005 creel years.

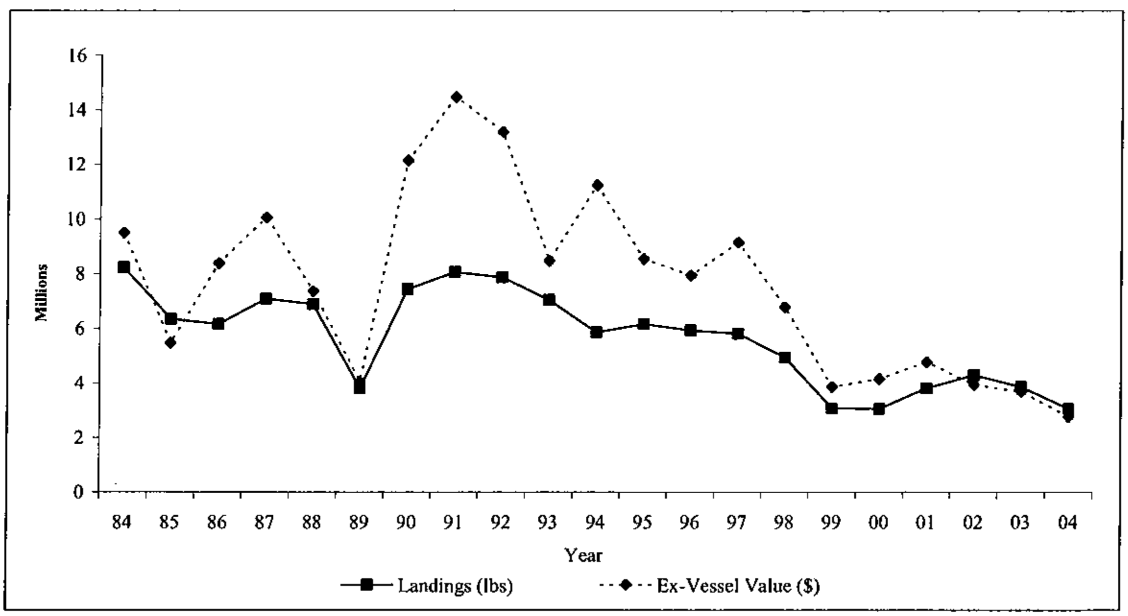

Figure 114. CBBEP area commercial landings (lbs) and ex-vessel value ($) landed during1984-2004.

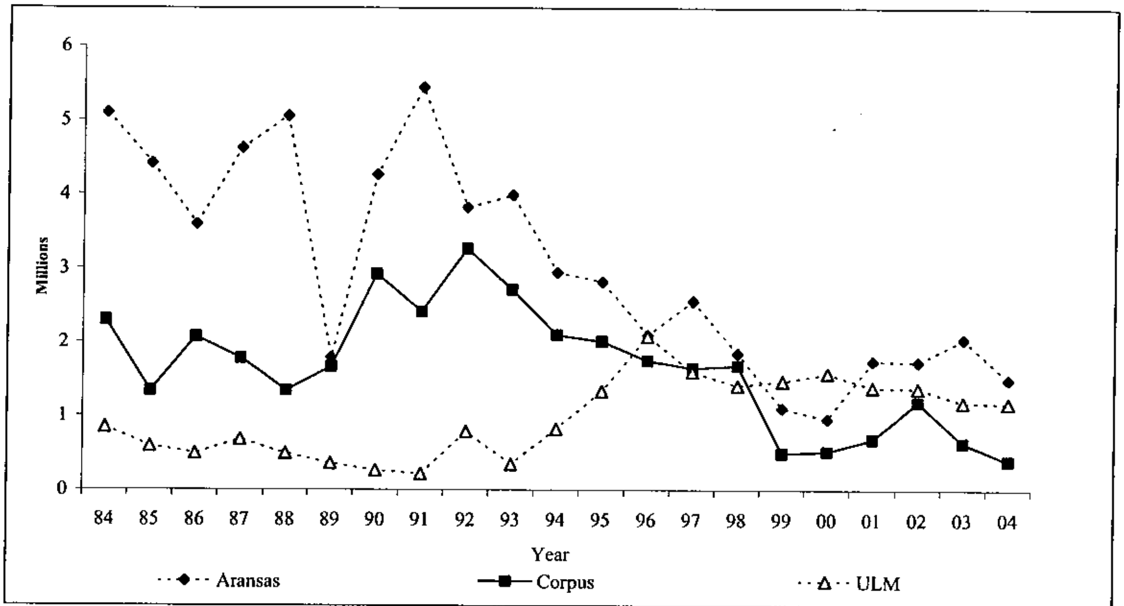

Figure 115. Commercial landings (lbs) by bay system landed during1984-2004.

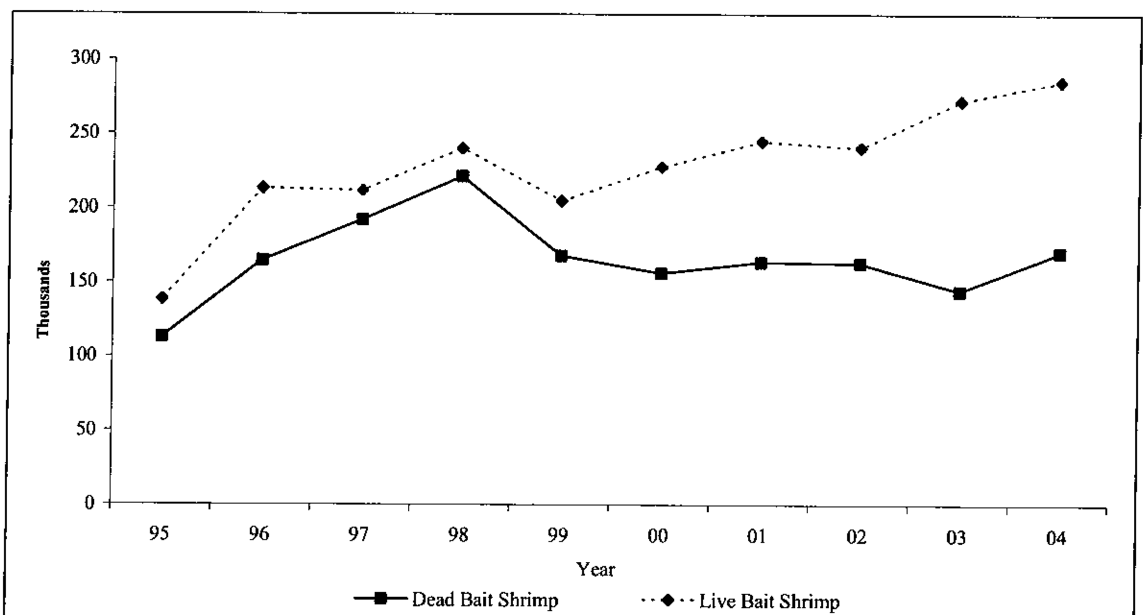

Figure 116. MAPR (Marine Aquatic Product Report) reported live and dead bait shrimp landings (lbs) from the CBBEP area between 1995-2004.

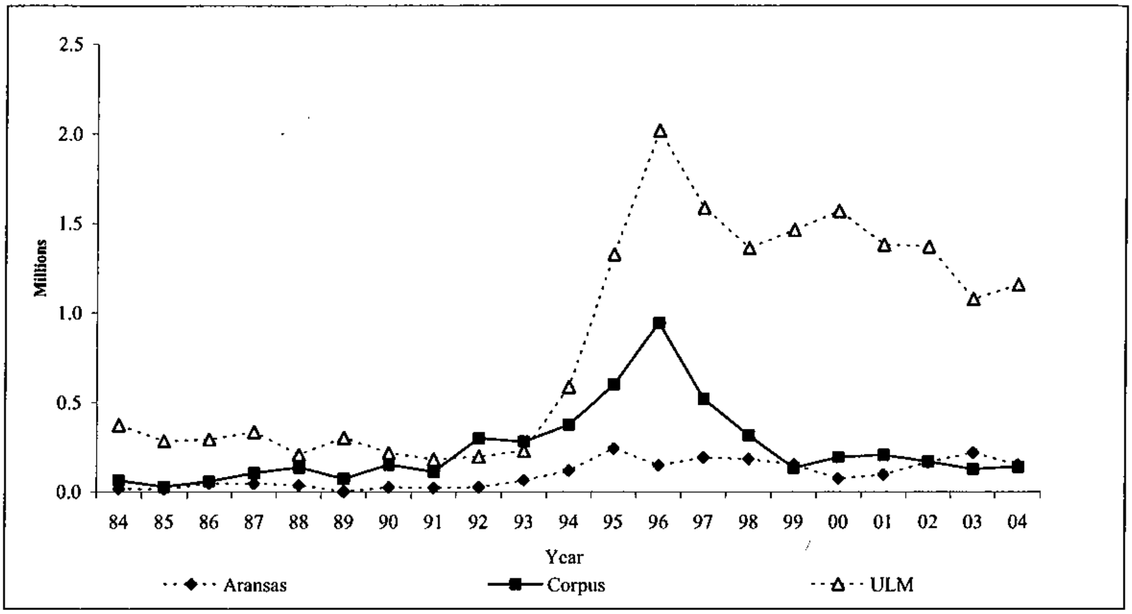

Figure 117. Commercial landings (lbs) of black drum by bay system landed during1984-2004.

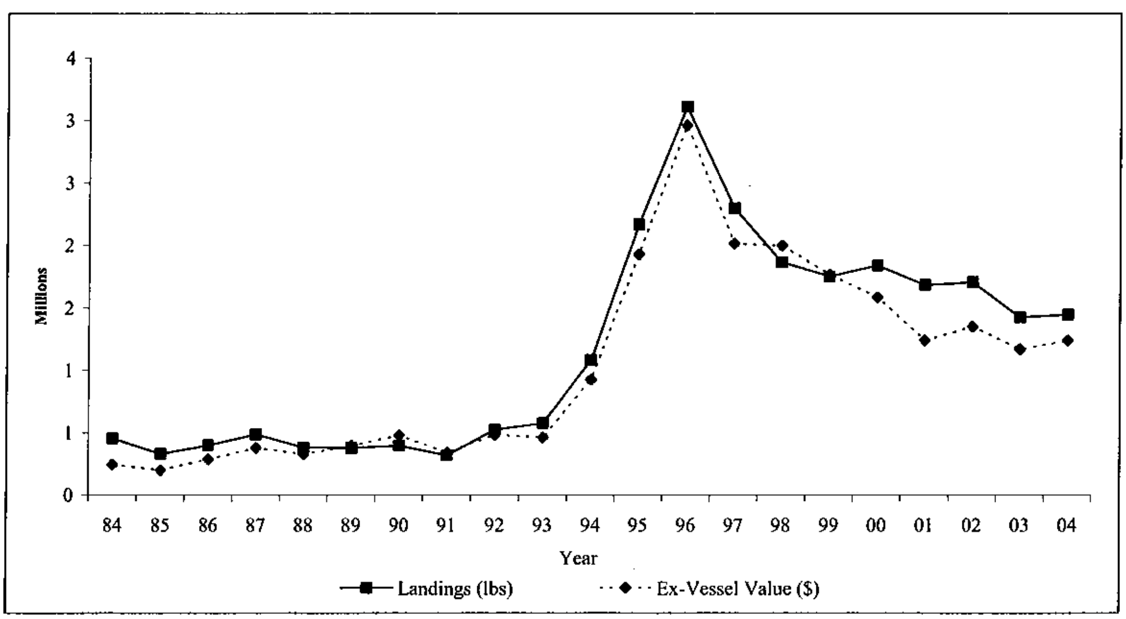

Figure 118. CBBEP area commercial landings (lbs) and ex-vessel value ($) for black drum landed during 1984-2004.

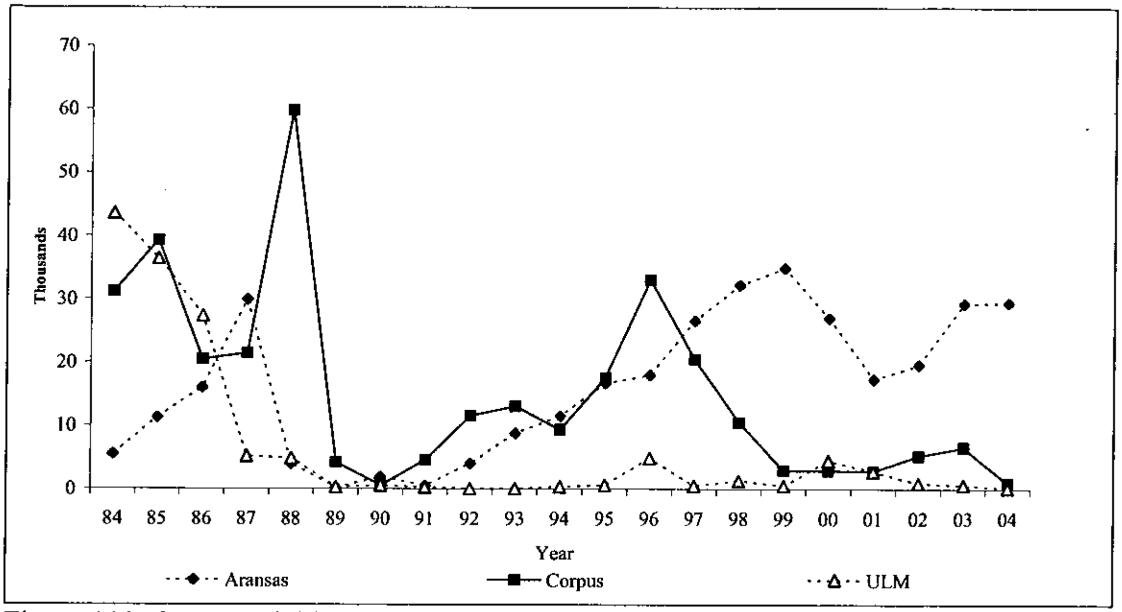

Figure 119. Commercial landings (lbs) by bay system for sheepshead landed during 1984-2004.

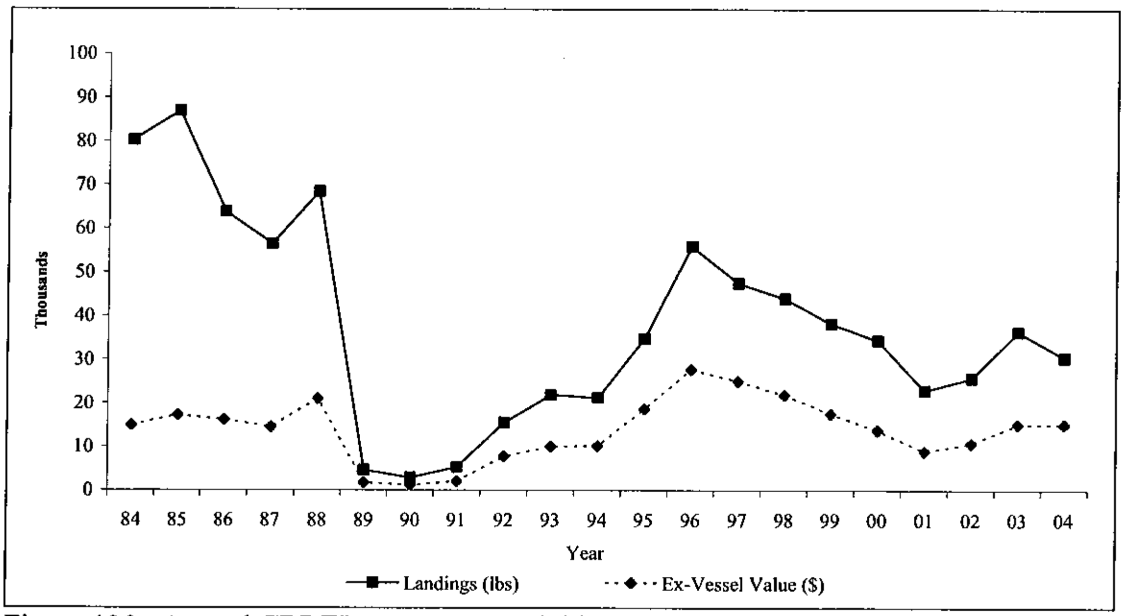

Figure 120. Annual CBBEP area commercial landings (lbs) and ex-vessel value ($) for sheepshead landed during 1984-2004.

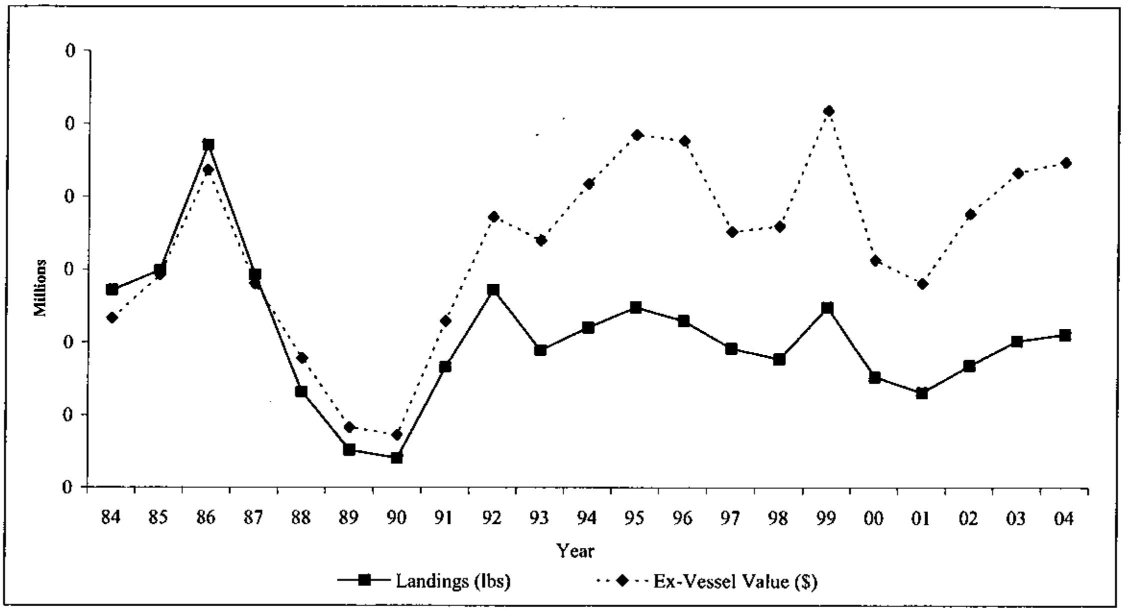

Figure 121. CBBEP area commercial landings (lbs) and ex-vessel value ($) for southern flounder landed during 1984-2004.

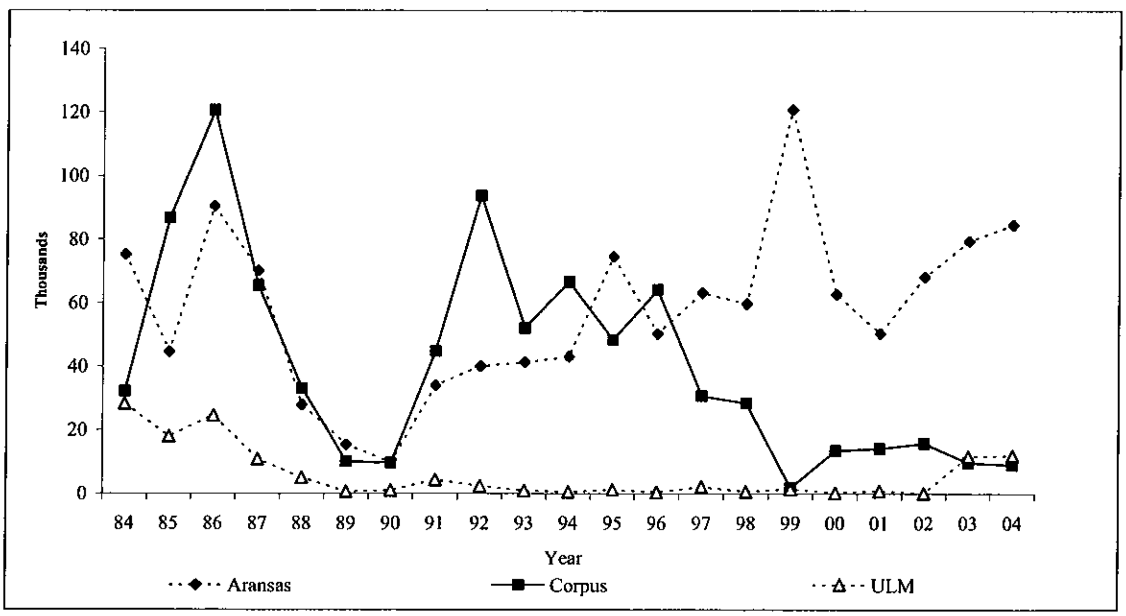

Figure 122. Commercial landings (lbs) by bay system for southern flounder landed during1984-2004.

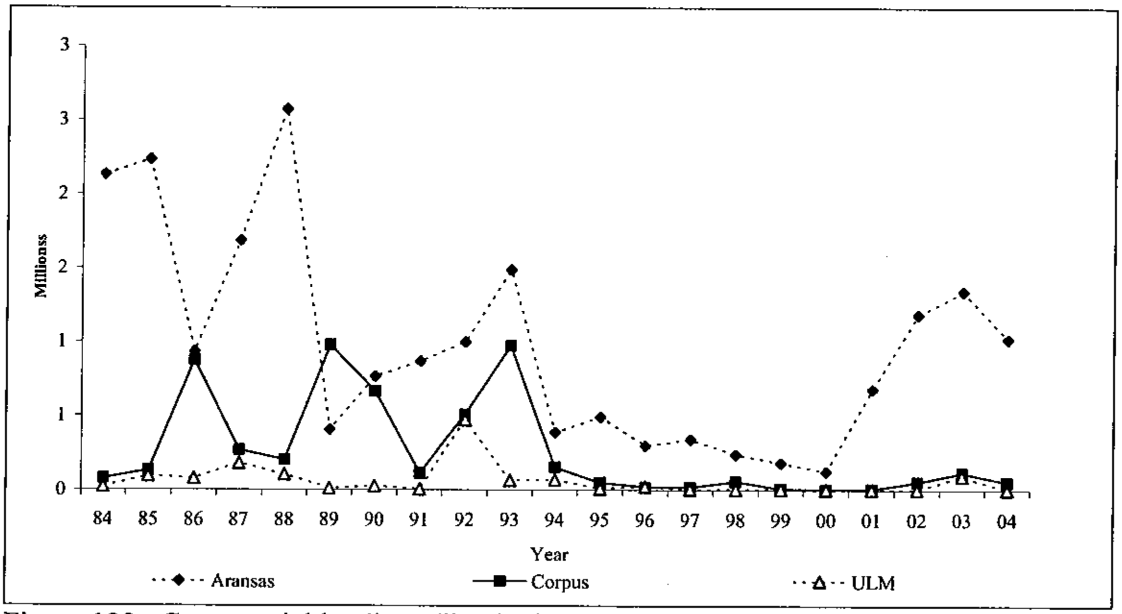

Figure 123. Commercial landings (lbs) by bay system for blue crab landed during 1984-2004.

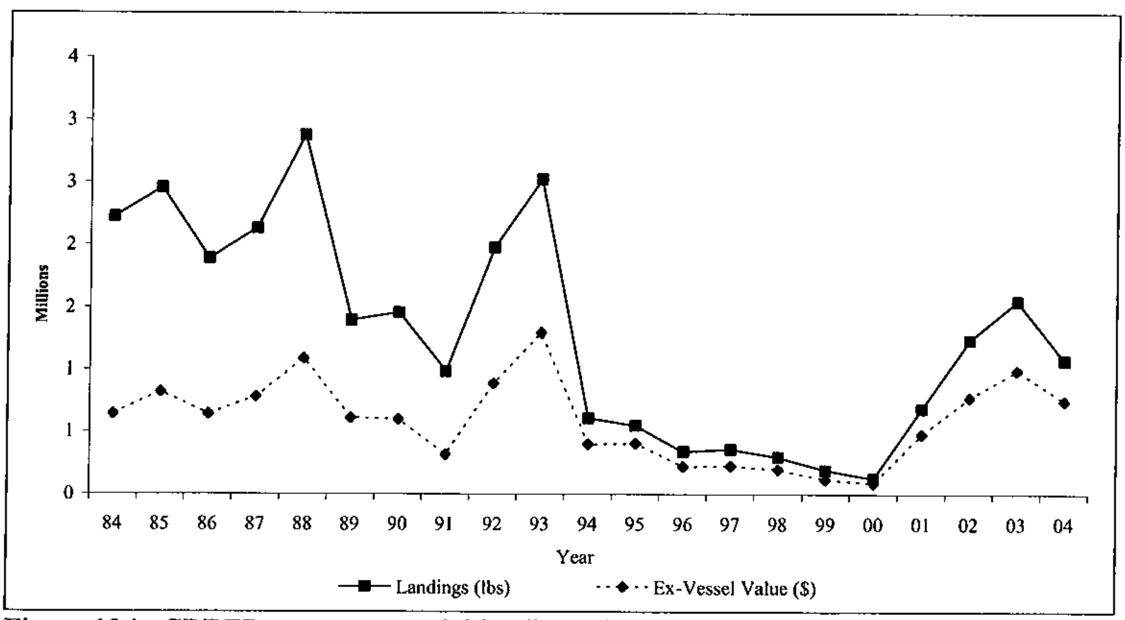

Figure 124. CBBEP area commercial landings (lbs) and ex-vessel value ($) for blue crab landed during 1984-2004.

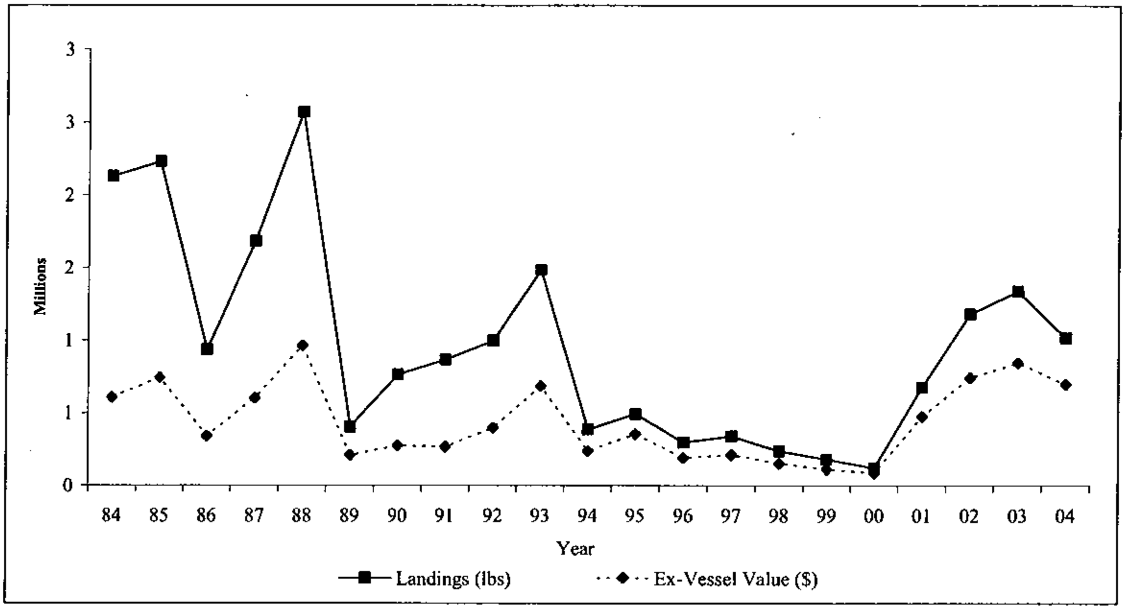

Figure 125. Aransas Bay commercial landings (lbs) and ex-vessel value ($) for blue crab landed during 1984-2004.

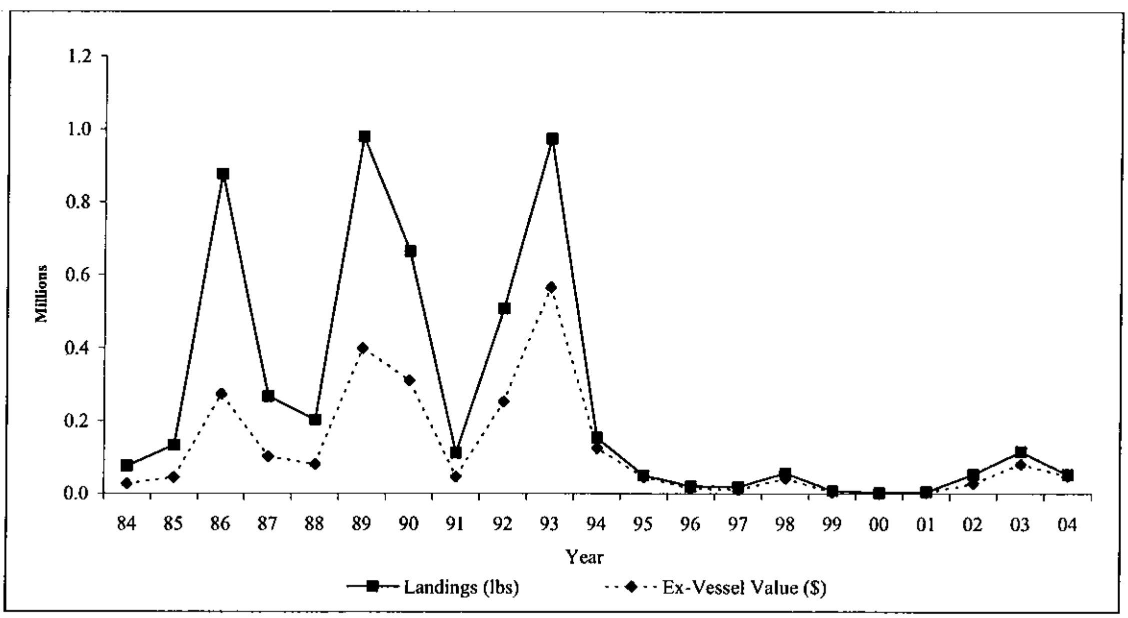

Figure 126. Corpus Christi Bay commercial landings (lbs) and ex-vessel value ($) for blue crab landed during 1984-2004.

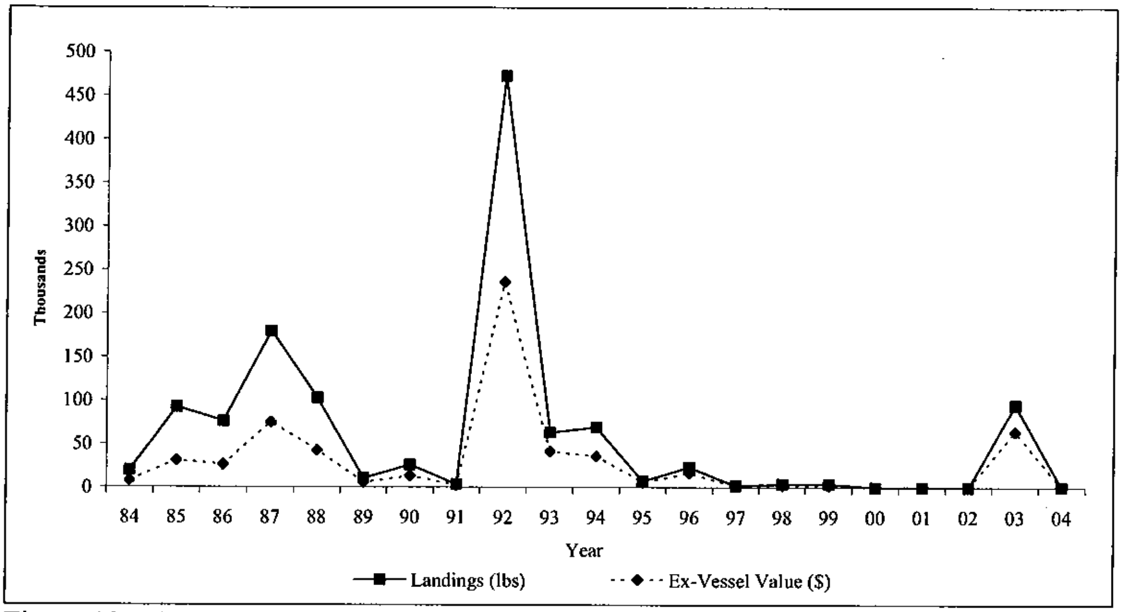

Figure 127. Upper Laguna Madre commercial landings (lbs) and ex-vessel value ($) for blue crab landed during 1984-2004.

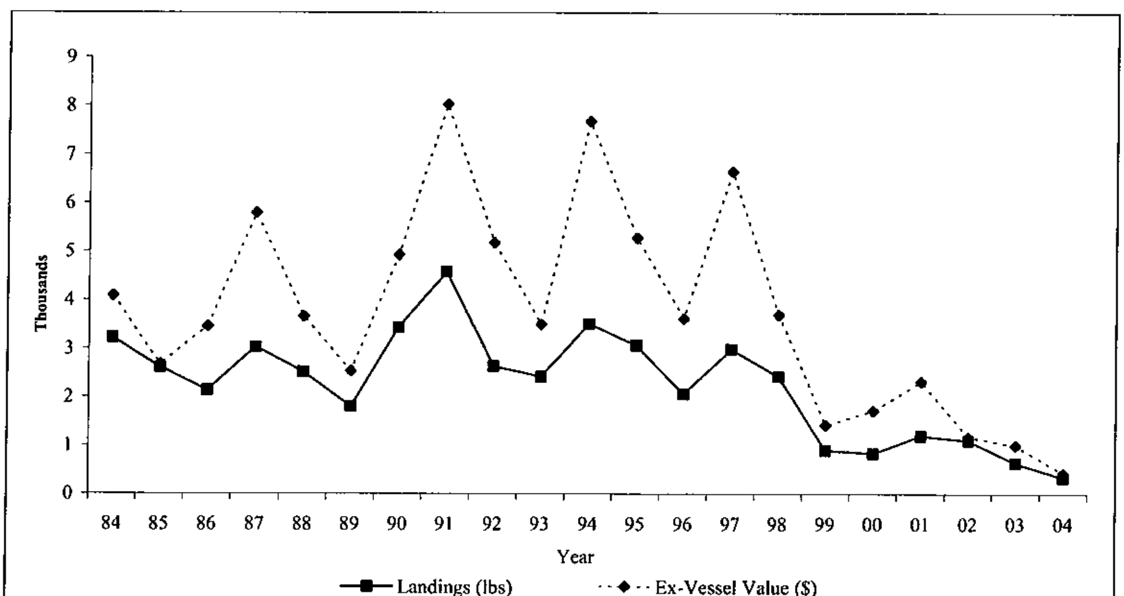

Figure 128. CBBEP area commercial landings (lbs) and ex-vessel value ($) for grooved shrimp (pink shrimp and brown shrimp) landed during 1984-2004.

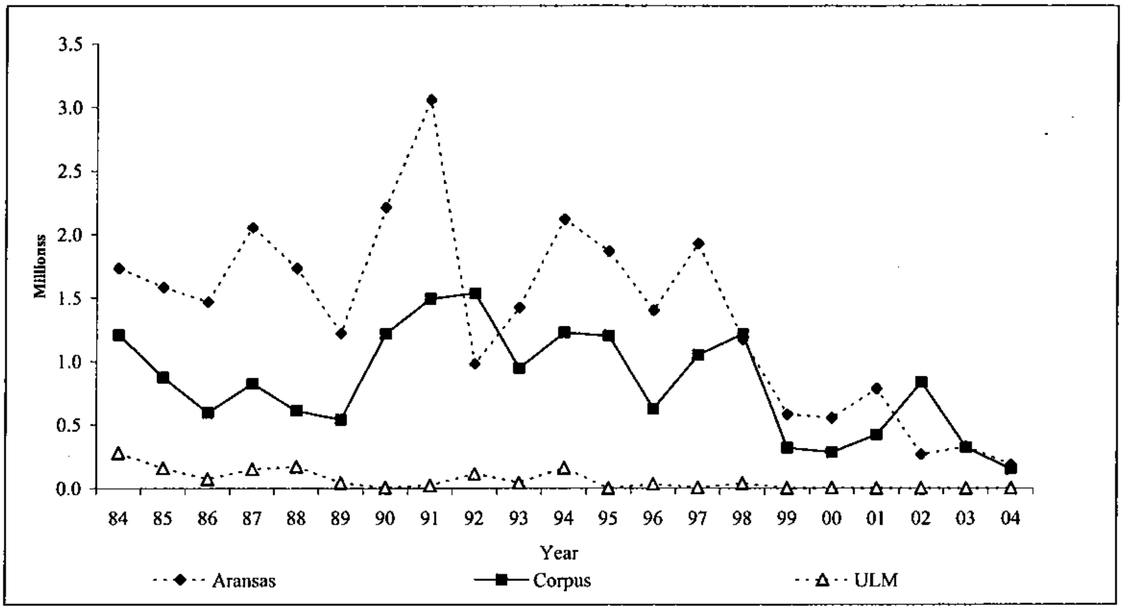

Figure 129. Commercial landings (lbs) by bay system for grooved shrimp (pink shrimp and brown shrimp)landed during 1984-2004.

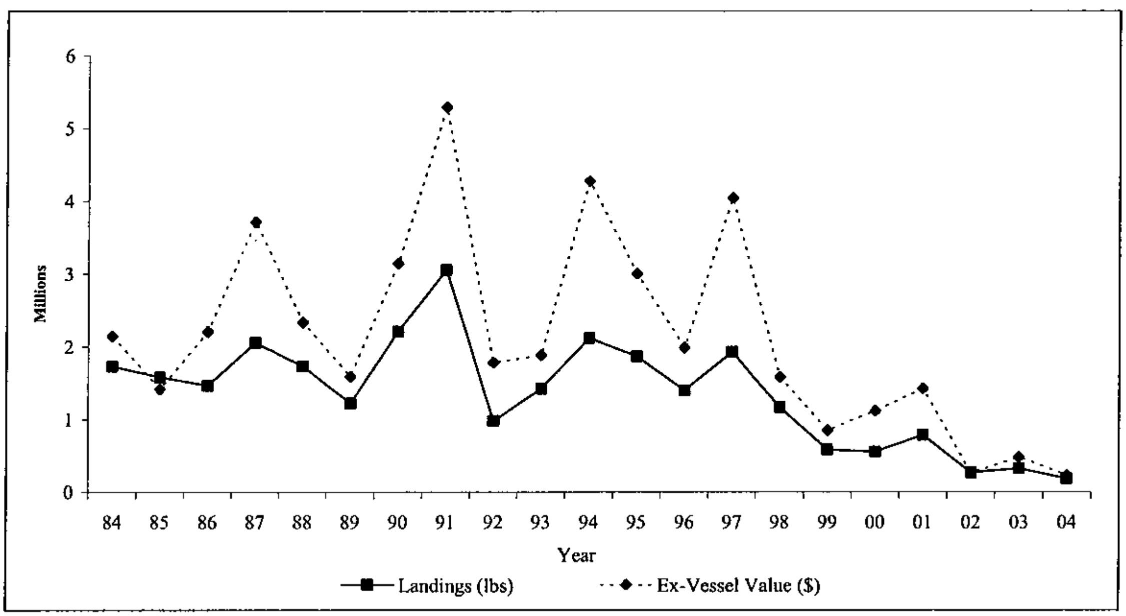

Figure 130. Aransas Bay commercial landings (lbs) and ex-vessel value ($) for grooved shrimp (brown shrimp and pink shrimp) landed during 1984-2004.

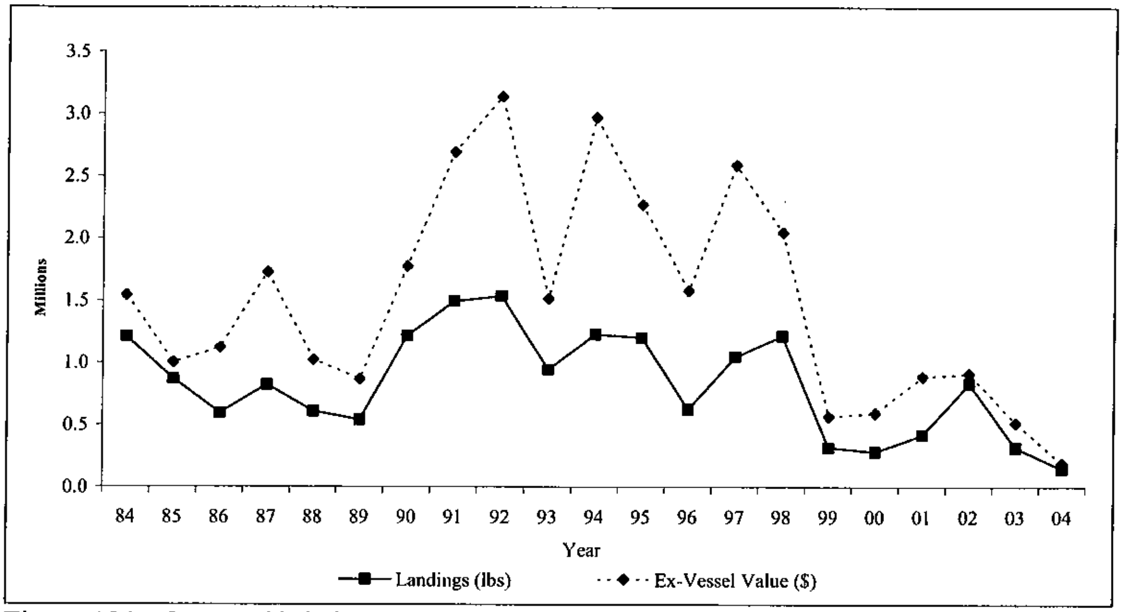

Figure 131. Corpus Christi Bay commercial landings (lbs) and ex-vessel value ($)for grooved shrimp (brown shrimp and pink shrimp) landed during 1984-2004.

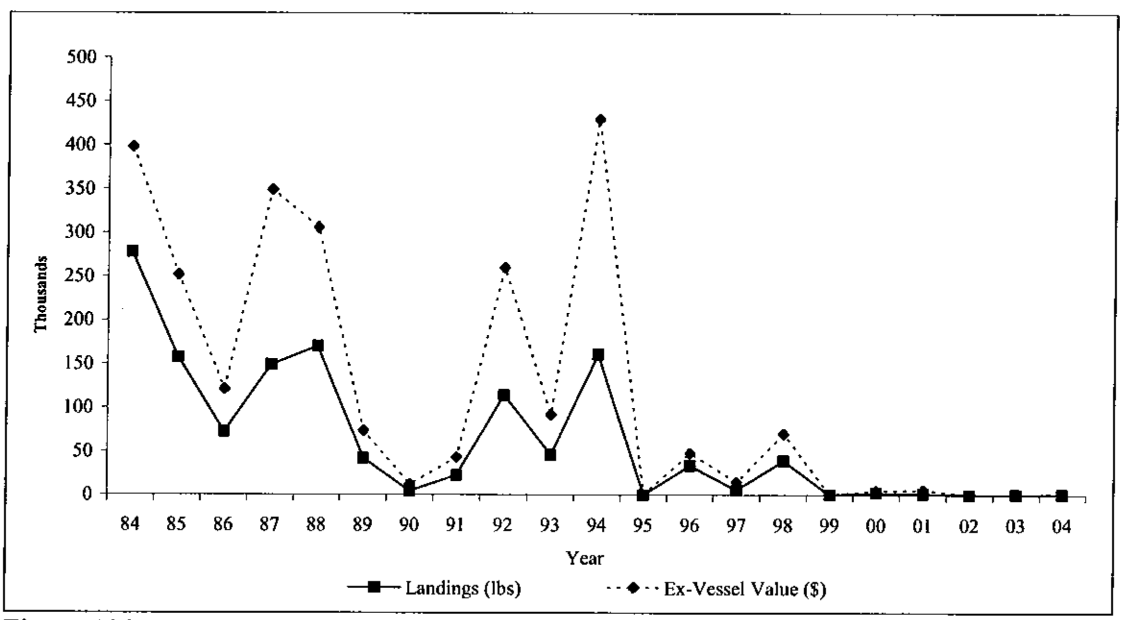

Figure 132. Upper Laguna Madre commercial landings (lbs) and ex-vessel value ($)for grooved shrimp (brown shrimp and pink shrimp) landed during 1984-2004.

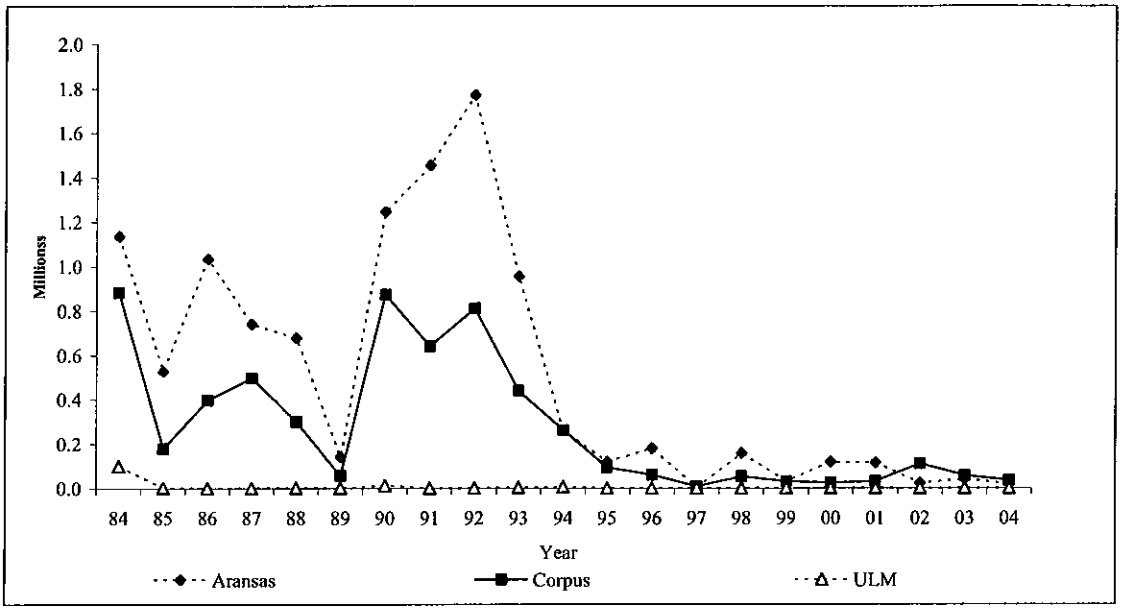

Figure 133. Commercial landings (lbs) by bay system white shrimp landed during 1984-2004.

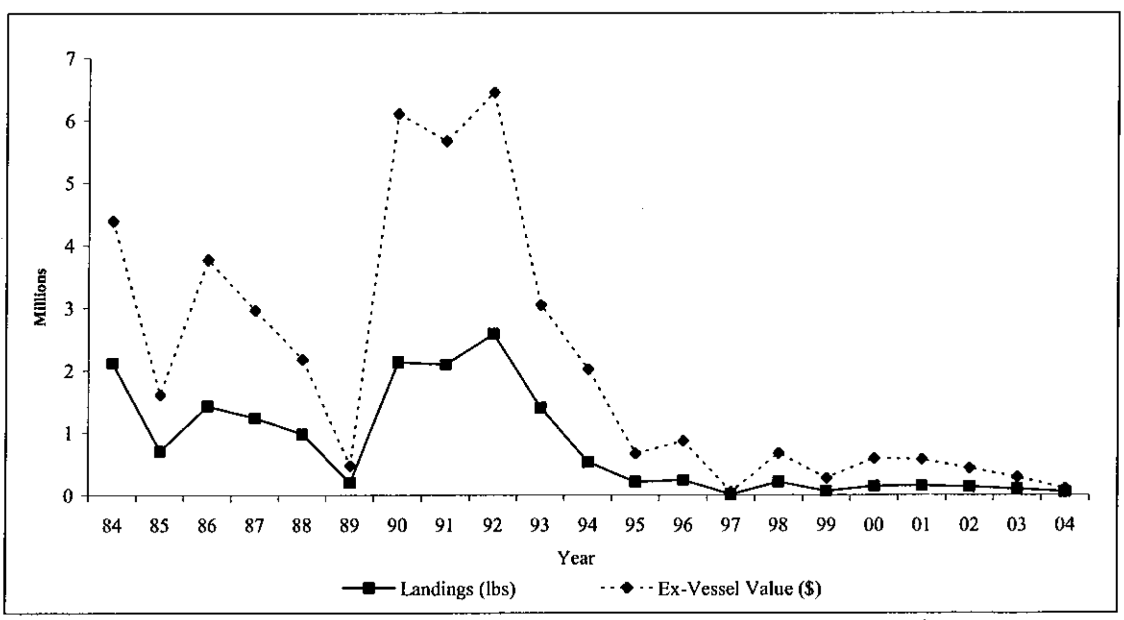

Figure 134. CBBEP area commercial landings (lbs) and ex-vessel value ($) for white shrimp landed during 1984-2004.

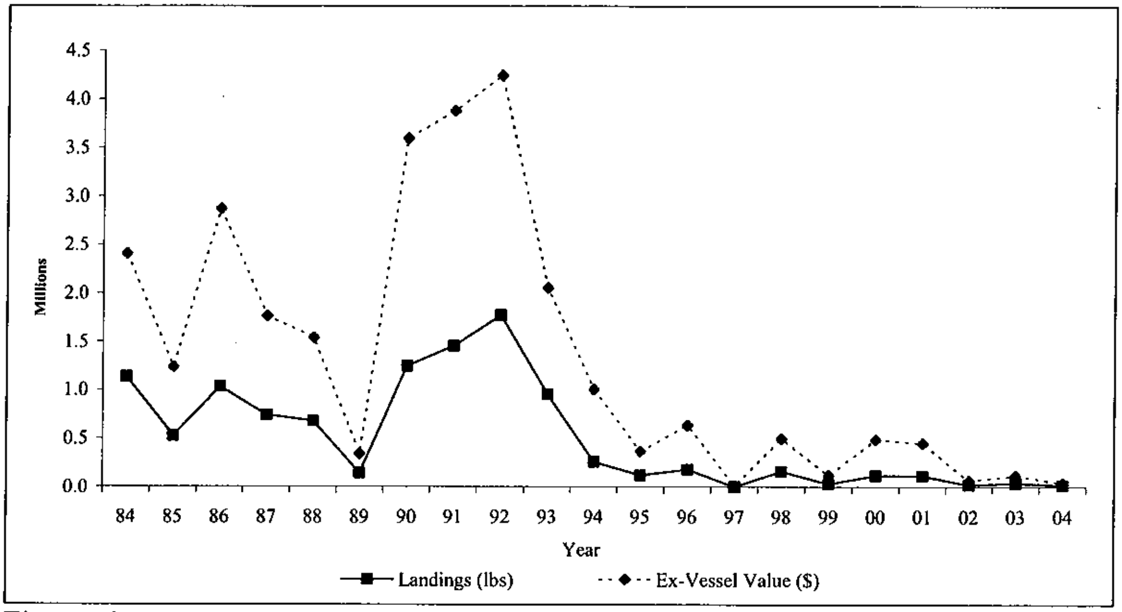

Figure 135. Aransas Bay commercial landings (lbs) and ex-vessel value ($) for white shrimp landed during 1984-2004.

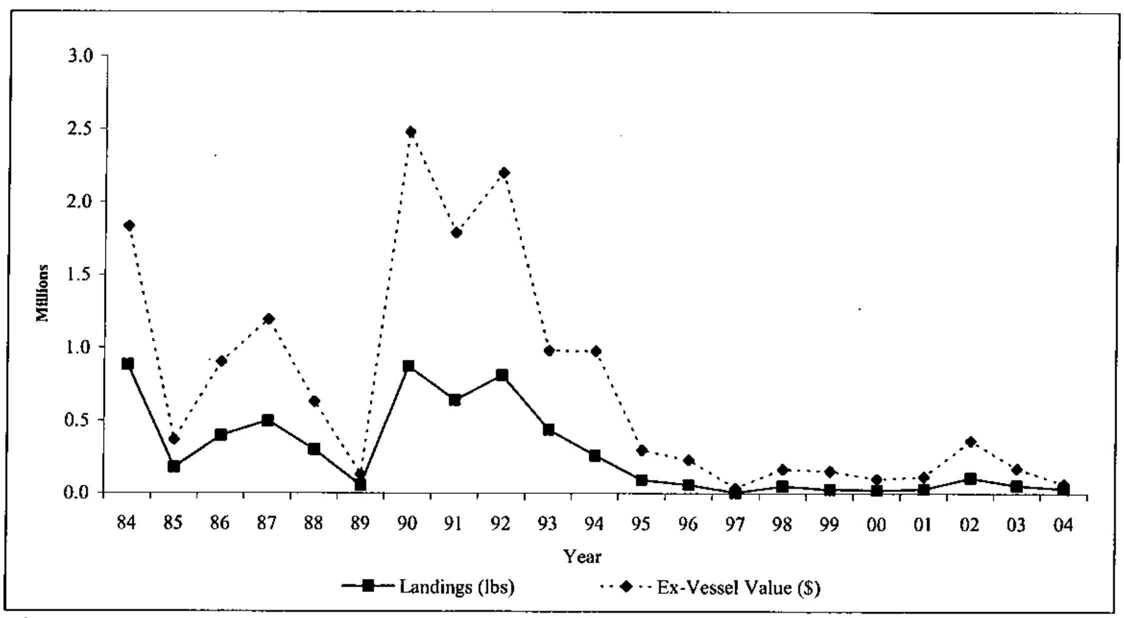

Figure 136. Corpus Christi Bay commercial landings (lbs) and ex-vessel value ($) for white shrimp landed during 1984-2004.

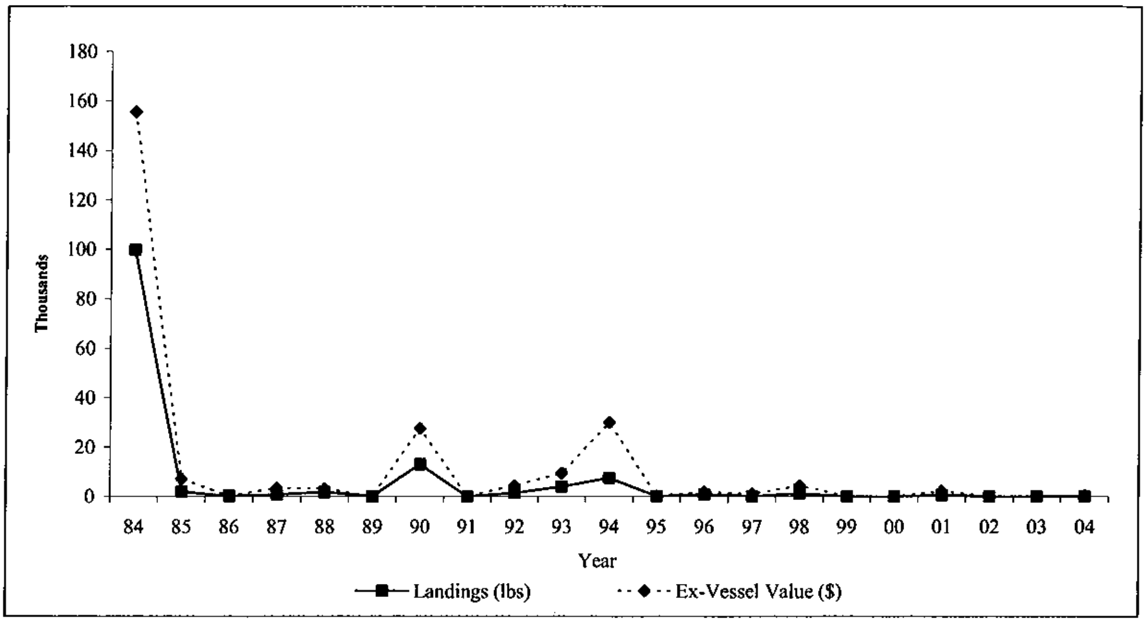

Figure 137. Upper Laguna Madre commercial landings (lbs) and ex-vessel value ($) for white shrimp landed during 1984-2004.

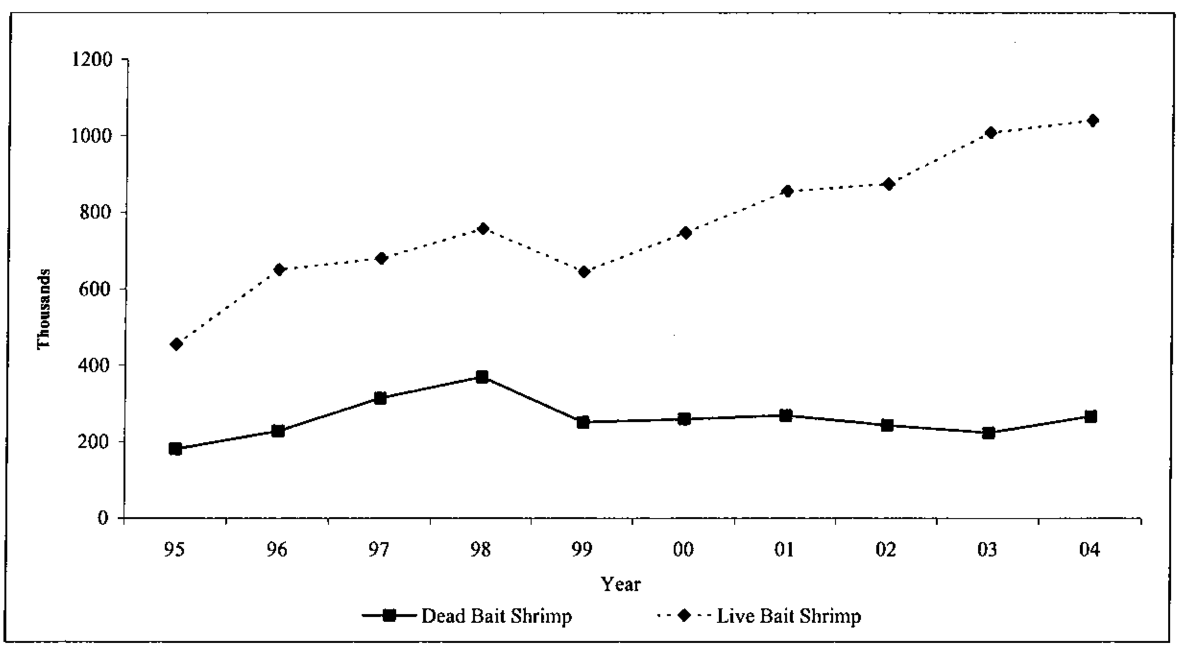

Figure 138. MAPR (Marine Aquatic Product Report) reported live and dead bait shrimp Ex-Vessel Value ($) from the CBBEP area between 1995-2004.

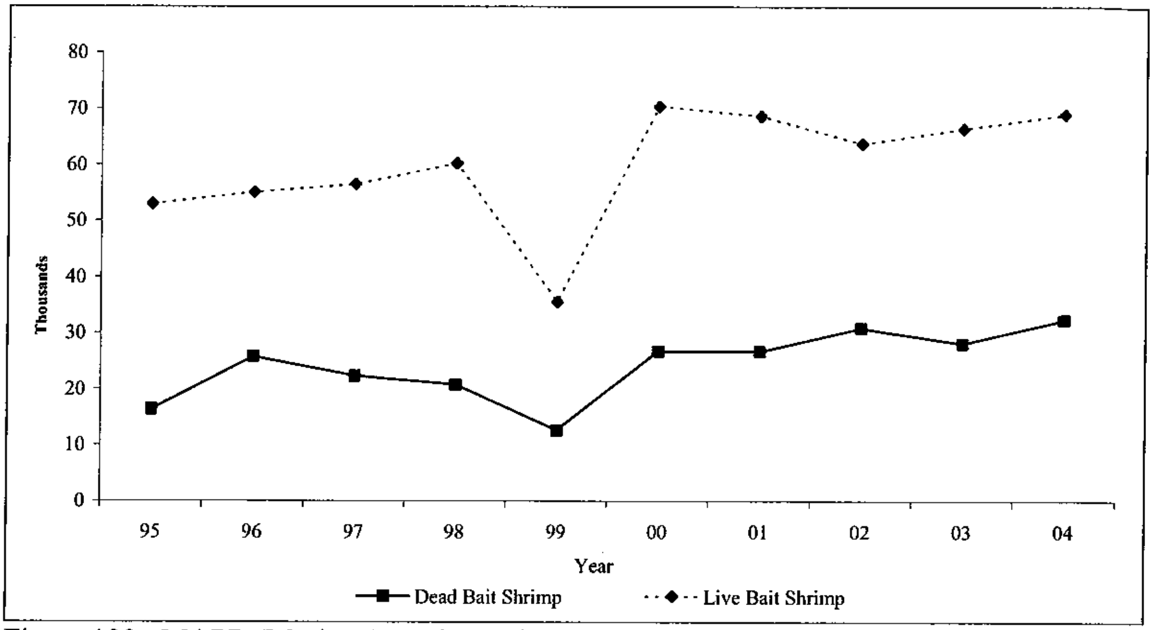

Figure 139. MAPR (Marine Aquatic Product Report) reported live and dead bait shrimp landings (lbs) from Aransas Bay between 1995-2004.

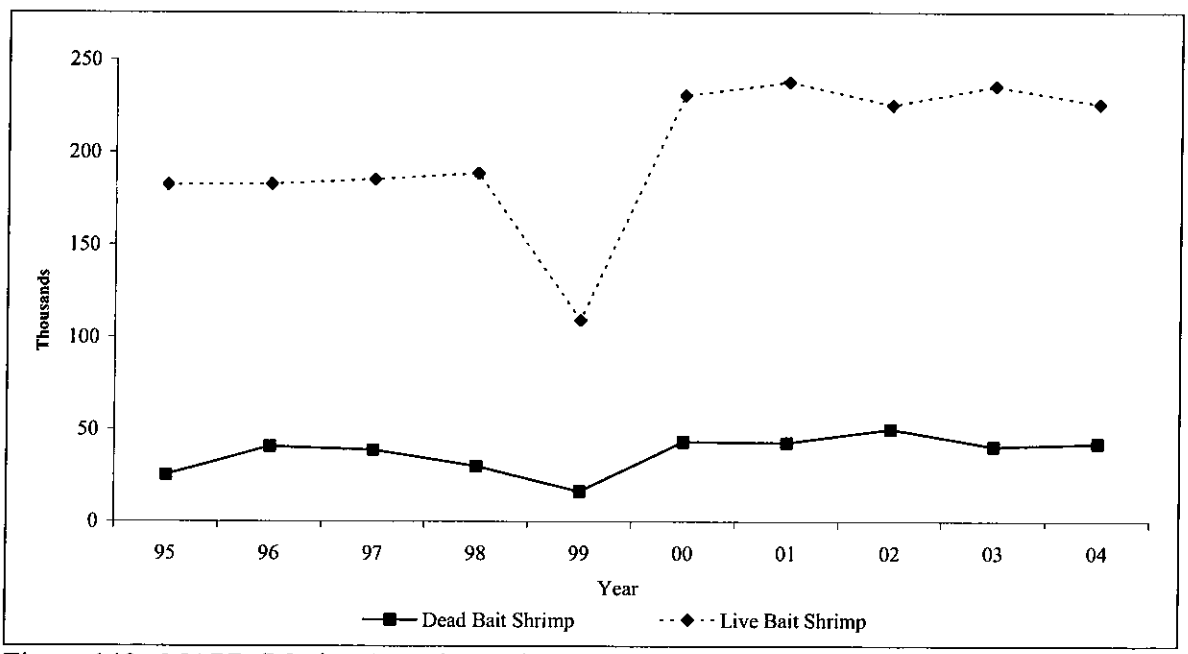

Figure 140. MAPR (Marine Aquatic Product Report) reported live and dead bait shrimp Ex-Vessel Value ($) from Aransas Bay between 1995-2004.

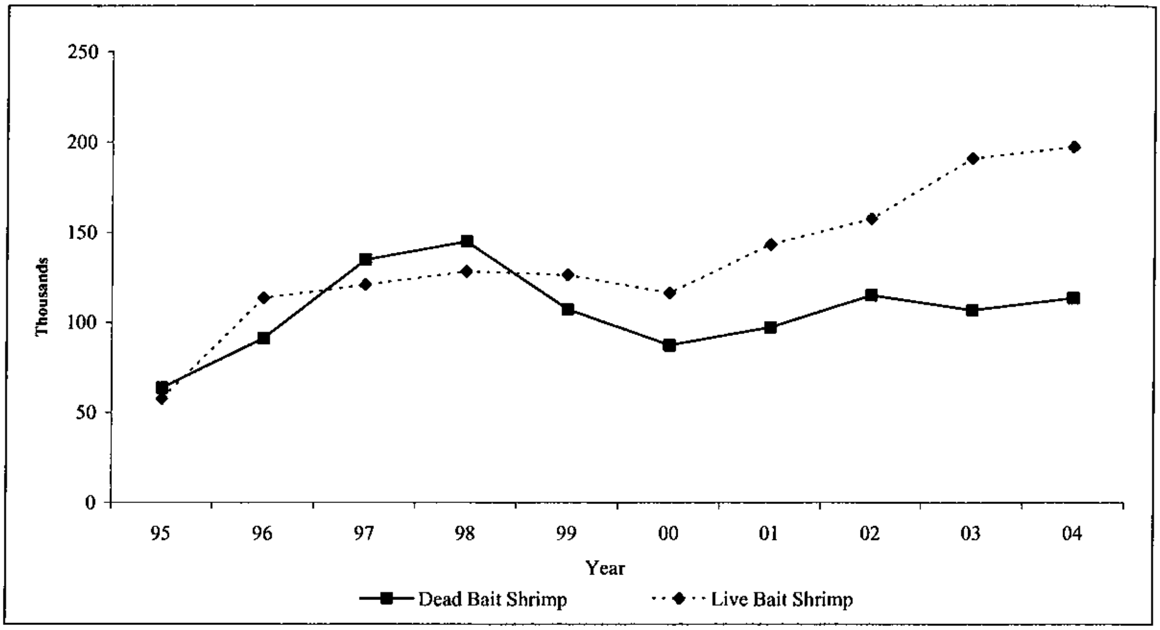

Figure 141. MAPR (Marine Aquatic Product Report) reported live and dead bait shrimp landings (lbs) from Corpus Christi Bay between 1995-2004.

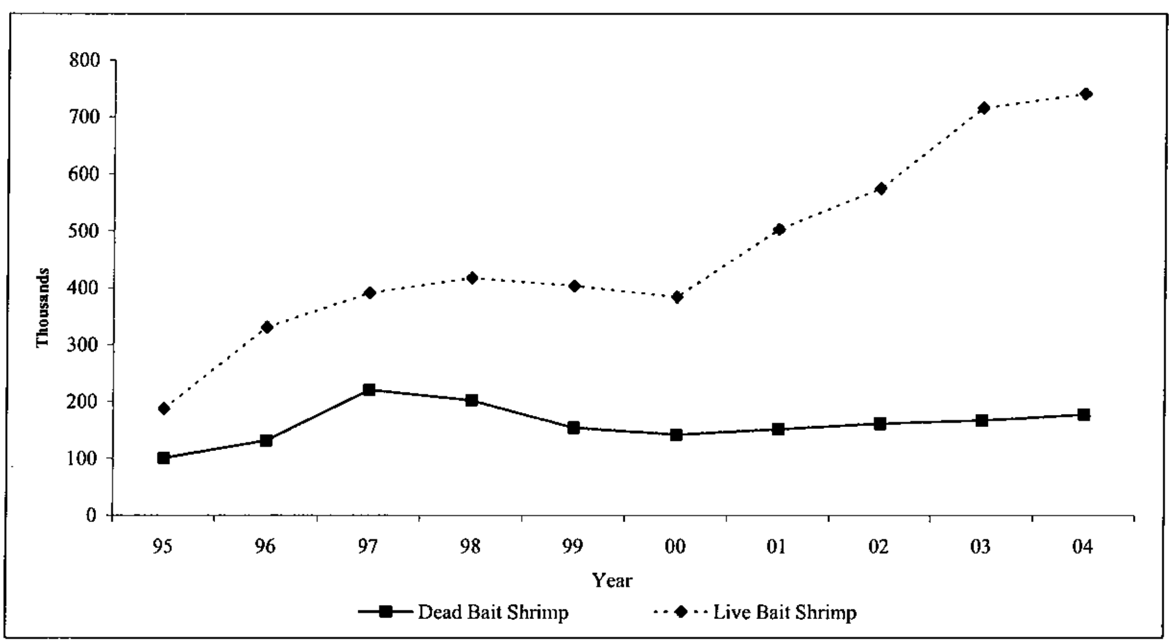

Figure 142. MAPR (Marine Aquatic Product Report) reported live and dead bait shrimp Ex-Vessel Value ($) from Corpus Christi Bay between 1995-2004.

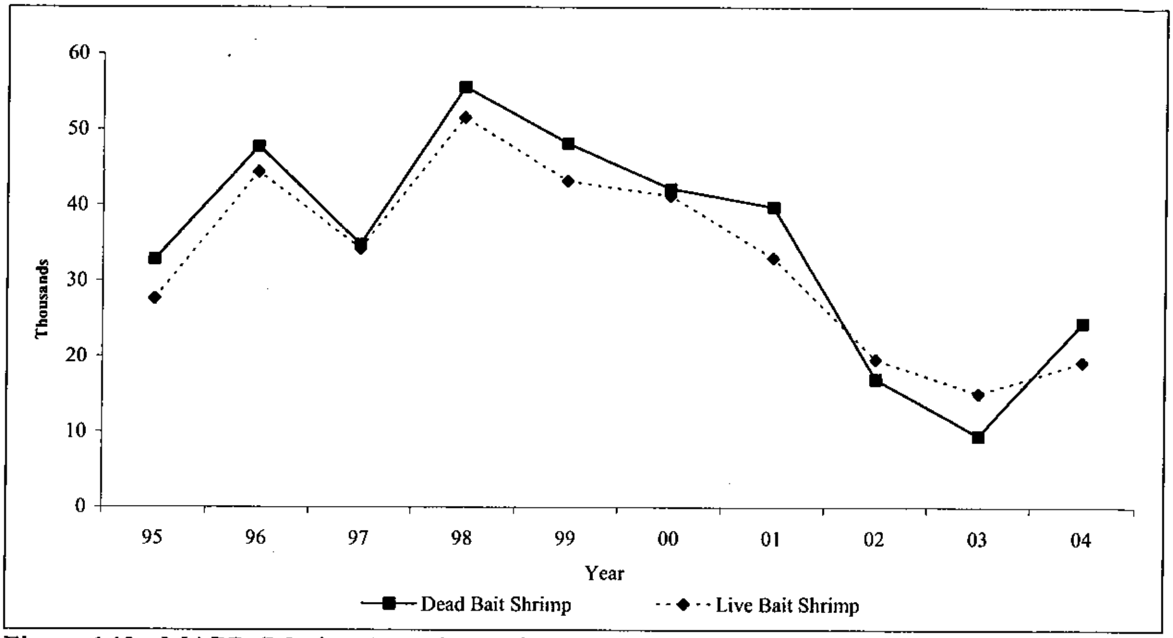

Figure 143. MAPR (Marine Aquatic Product Report) reported live and dead bait shrimp landings (lbs) from the Upper Laguna Madre between 1995-2004.

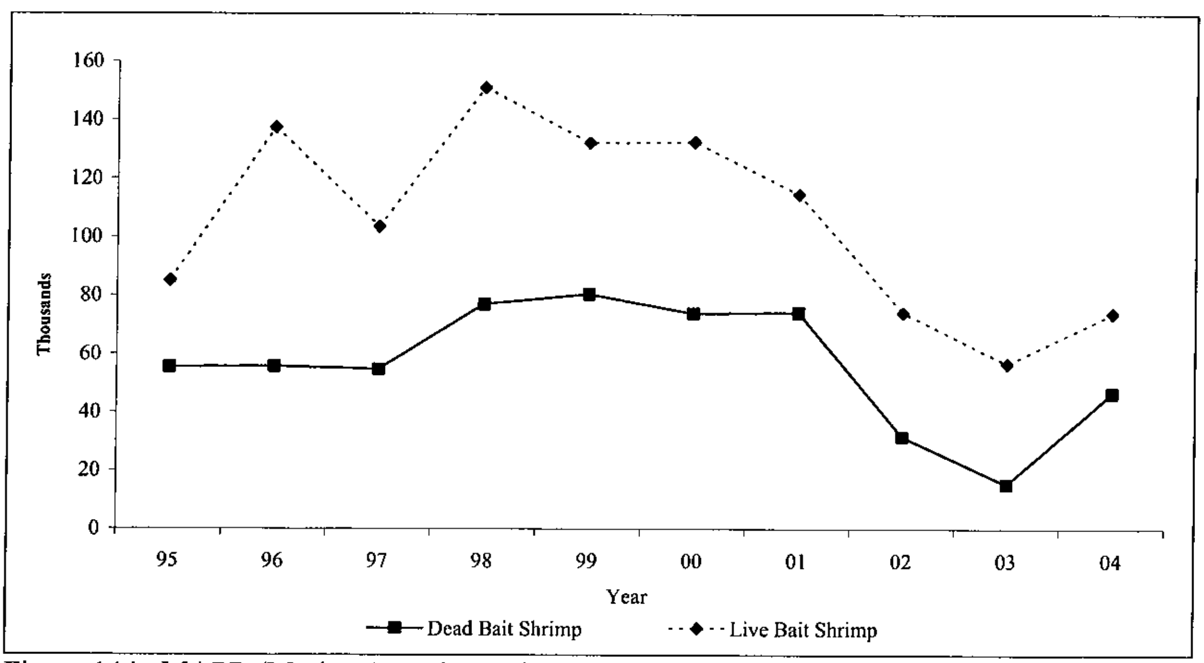

Figure 144. MAPR (Marine Aquatic Product Report) reported live and dead bait shrimp Ex-

Vessel Value ($) from the Upper Laguna Madre between 1995-2004.

VII. APPENDIX . Summary of historical sampling dates, gear description, procedures, dates, number of samples collected, and weighting factors.

Table A.1. Historical sampling dates (month/year) by bay system and gear.

GEAR	ARANSAS	CORPUS CHRISTI	UPPER LAGUNA
GILL NET	Nov. 1975-Present	Nov. 1975-Present	Nov. 1975-Present
BAY TRAWL	Jan. 1982-Present	May 1982-Present	May 1982-Present
BAY BAG SEINE	Oct. 1977-Present	Oct. 1977-Present	Oct. 1977-Present

Table A.2. Resource sampling gear descriptions.

GEAR	GEAR DESCRIPTION
Gill Net	Monofilament, 183 m long; 1.2 m deep with separate 45.7 m sections of 7.6, 10.2 (#12 monofilament), 12.7 and 15.2 cm (#18 monofilament) stretched mesh tied together in ascending mesh size.
Trawl	6.1 m wide at mouth with 3.8 cm stretched nylon multifilament mesh throughout and doors 1.2 m long and 0.5 m tall.
Bag Seine	18.3 m long; 1.8 m deep with 1.3 cm stretched nylon multifilament mesh in the 1.8 m wide central bag with remaining webbing 1.9 cm stretched mesh.

Table A.3. Historical sampling procedures by gear.

GEAR	HISTORICAL SAMPLING PROCEDURES
GILL NET	Monofilament gill nets have been systematically used in each of the bay systems in the CBBEP area since November (Figure 1). Prior to September 1984, sites for setting gill nets during spring (ten week period, generally, 15 April-15 June) and fall (Ten week period, generally, 15 September-15 November) were randomly selected from about 100 stations in each bay system (McEachron and Green 1985). Beginning September 1984, current site selection methods were adopted. Prior to fall 1981, no less than one nor more than 18 overnight gill net sets occurred in each season in each bay system. Since fall 1981, 45 gill nets were set overnight during each season in each bay system.
BAY TRAWLS	Trawls have been systematically used in the CBBEP area since 1982. From January 1982 to present, 20 monthly samples were collected in Aransas Bay. Beginning in May 1982, 20 monthly samples were collected in Corpus Christi Bay and 10 in the upper Laguna Madre.
BAY BAG SEINE	Bay bag seine samples have been systematically collected in each of bay systems ion the CBBEP area since October 1977. Bay bag seine samples were collected by pulling the seine 15.2-30.5 m parallel to shore prior to September 1984; since then it has been pulled 15.2 m. Prior to September 1984, sites for sampling with bag seines (monthly) were randomly selected from about 100 stations in each bay system (McEachron and Green 1985). Prior to October 1981, six bag seine samples were collected each month in each bay system (except during June 1978 when no samples were collected). From October 1981 through August 1984, 10 bag seine samples were collected each month in each bay system; half of the samples were collected during each of the first and last two fullest weeks of each month (McEachron and Green 1985). Beginning September 1984, half of the monthly samples were collected during the 1st-15th and half during the 16th-31st of each month. From April 1988 through December 1989, 12 bag seine samples were collected each month in each bay system. Beginning January 1990, 16 bag seine samples were collected each month in each bay system. Beginning January 1992, 20 samples were collected in each bay system each month.

Table A.4. Number of samples collected during routine resource monitoring by bay, gear, and year.

	Bag Seine			Bay Trawl			Spring Gill Net			Fall Gill Net		
Year	Aransas Bay	Corpus Christ Bay	Upper Laguna Madre	Aransas Bay	Corpus Christ Bay	Upper Laguna Madre	Aransas Bay	Corpus Christ Bay	Upper Laguna Madre	Aransas Bay	Corpus Christ Bay	Upper Laguna Madre
1984	120	120	120	240	240	120	45	45	45	45	45	45
1985	120	120	120	240	240	120	45	45	45	45	45	45
1986	120	120	120	240	240	120	45	45	45	45	45	45
1987	120	120	120	240	240	120	45	45	45	45	45	45
1988	138	138	138	240	240	120	45	45	45	45	45	45
1989	144	144	144	240	240	120	45	45	45	45	45	45
1990	192	192	192	240	240	120	45	45	45	45	45	45
1991	192	192	192	240	240	120	45	45	45	45	45	45
1992	240	240	240	240	240	120	45	45	45	45	45	45
1993	240	240	240	240	240	120	45	45	45	45	45	45
1994	240	240	240	240	240	120	45	45	45	45	45	45
1995	240	240	240	240	240	120	45	45	45	45	45	45
1996	240	240	240	240	240	120	45	45	45	45	45	45
1997	240	240	240	240	240	120	45	45	45	45	45	45
1998	240	240	240	240	240	120	45	45	45	45	45	45
1999	240	240	240	240	240	120	45	45	45	45	45	45
2000	240	240	240	240	240	120	45	45	45	45	45	45
2001	240	240	240	240	240	120	45	45	45	45	45	45
2002	240	240	240	240	240	120	45	45	45	45	45	45
2004	240	240	240	240	240	120	45	45	45	45	45	45

Table A.5. Weighting factors used in calculating coastwide average catch rates.

Area	Gill net and[a] bay bag seine	Bay[b] trawl
BAY SYSTEM		
Aransas	263.5	2.251
Corpus Christi	171.3	3.357[c]
Upper Laguna Madre	222.3	1.534
Total	657.1	7.142

[a] Equals miles of shoreline (Matlock and Osborn 1982).

[b] Equals total bay surface area (divided by 10,000) minus 1977 estimate of shallow water area (<=1.2 m)(for the upper and lower Laguna Madre) or minus the mean of 1972 and 1977 estimates (for other bays)(Matlock and Osborn 1982).

[c] No estimate was available for 1977 shallow water area, so 1977 area was estimated as proportion of sampling grid zones that are designated as trawls grids, times the total surface area of the bay.

Table A.7. Number of days surveyed, number of private-boat interviews, and number of private-boat anglers interviewed in the CBBEP area bays and passes by bay and year (1984-2004).

Survey Year	Aransas	Corpus Christi	Upper Laguna Madre	CBBEP
Number of days surveyed				
1984-1985	133	133	133	399
1985-1986	133	133	133	399
1986-1987	133	133	133	399
1987-1988	133	133	133	399
1988-1989	130	130	131	391
1989-1990	133	133	133	399
1990-1991	133	133	133	399
1991-1992	133	133	133	399
1992-1993	133	133	133	399
1993-1994	133	131	131	395
1994-1995	133	133	133	399
1995-1996	133	133	133	399
1996-1997	133	133	133	399
1997-1998	133	133	133	399
1998-1999	130	130	130	390
1999-2000	131	131	131	393
2000-2001	133	133	133	399
2001-2002	133	133	133	399
2002-2003	133	133	133	399
2003-2004	133	133	133	399
2004-2005	133	133	133	399
Number of interviews				
1984-1985	372	569	393	1334
1985-1986	609	695	1103	2407
1986-1987	575	717	1252	2544
1987-1988	686	761	1413	2860
1988-1989	812	662	1414	2888
1989-1990	692	774	1267	2733
1990-1991	543	665	426	1634
1991-1992	721	776	983	2480
1992-1993	1370	1244	1123	3737
1993-1994	1586	1249	1116	3951
1994-1995	1615	1440	1268	4323
1995-1996	1462	1317	1335	4114
1996-1997	1221	1124	1187	3532
1997-1998	1438	1242	1531	4211
1998-1999	1605	1372	1521	4498
1999-2000	1744	1326	1921	4991
2000-2001	1518	1353	1616	4487
2001-2002	1583	1200	1354	4137
2002-2003	1527	1095	1296	3918
2003-2004	1615	1228	1301	4144
2004-2005	1677	1404	1489	4570
Number of anglers interviewed				
1984-1985	886	1392	1049	3327
1985-1986	1524	1676	2871	6071
1986-1987	1328	1694	3078	6100
1987-1988	1690	1816	3479	6985
1988-1989	1969	1575	3390	6934
1989-1990	1669	1807	3078	6554
1990-1991	1324	1567	1003	3894
1991-1992	1600	1811	2316	5727
1992-1993	3057	2855	2700	8612

Table A.7. (Cont'd.)

Survey Year	Aransas	Corpus Christi	Upper Laguna Madre	CBBEP
Number of anglers interviewed (Cont,'d.)				
1993-1994	3769	2891	2691	9351
1994-1995	3790	3369	3073	10232
1995-1996	3500	3135	3235	9870
1996-1997	2924	2632	2834	8390
1997-1998	3446	2919	3653	10018
1998-1999	3821	3260	3613	10694
1999-2000	4241	3183	4638	12062
2000-2001	3732	3320	3925	10977
2001-2002	3942	2912	3238	10092
2002-2003	3767	2638	3179	9584
2003-2004	3998	2877	3172	10047
2004-2005	4159	3403	3647	11209

Table A.8. Number of days surveyed, number of party-boat interviews, and number of party-boat anglers interviewed in the CBBEP area bays and passes by bay and year (1984-2004).

Survey Year	Aransas	Corpus Christi	Upper Laguna Madre	CBBEP
Number of days surveyed				
1984-1985	133	133	133	399
1985-1986	133	133	133	399
1986-1987	133	133	133	399
1987-1988	133	133	133	399
1988-1989	130	130	131	391
1989-1990	133	133	133	399
1990-1991	133	133	133	399
1991-1992	133	133	133	399
1992-1993	133	133	133	399
1993-1994	133	131	131	395
1994-1995	133	133	133	399
1995-1996	133	133	133	399
1996-1997	133	133	133	399
1997-1998	133	133	133	399
1998-1999	130	130	130	390
1999-2000	131	131	131	393
2000-2001	133	133	133	399
2001-2002	133	133	133	399
2002-2003	133	133	133	399
2003-2004	133	133	133	399
2004-2005	133	133	133	399
Number of interviews				
1984-1985	10	9	1	20
1985-1986	26	11	12	49
1986-1987	24	8	26	58
1987-1988	30	12	37	79
1988-1989	49	15	94	158
1989-1990	70	25	81	176
1990-1991	56	22	22	100
1991-1992	66	37	77	180
1992-1993	195	24	114	333
1993-1994	176	33	73	282
1994-1995	180	50	101	331
1995-1996	204	51	126	381
1996-1997	159	60	156	375
1997-1998	204	35	166	405
1998-1999	241	45	208	494
1999-2000	186	58	302	546
2000-2001	251	51	324	626
2001-2002	301	86	280	667
2002-2003	241	52	250	543
2003-2004	262	72	222	556
2004-2005	296	50	247	593
Number of anglers interviewed				
1984-1985	32	32	2	66
1985-1986	85	38	35	158
1986-1987	77	32	89	198
1987-1988	102	46	133	281
1988-1989	166	64	320	550
1989-1990	265	98	283	646
1990-1991	213	82	70	365
1991-1992	251	132	282	665
1992-1993	740	98	403	1241

Table A.8. (Cont'd.)

Survey Year	Aransas	Corpus Christi	Upper Laguna Madre	CBBEP
Number of anglers interviewed (Cont'd.)				
1993-1994	673	137	278	1088
1994-1995	701	207	364	1272
1995-1996	767	221	487	1475
1996-1997	615	239	561	1415
1997-1998	782	133	628	1543
1998-1999	945	188	788	1921
1999-2000	723	230	1139	2092
2000-2001	969	193	1237	2399
2001-2002	1169	350	1082	2601
2002-2003	942	189	953	2084
2003-2004	1001	285	854	2140
2004-2005	1137	201	867	2205