The Flounder Fishery of the Gulf of Mexico, United States: A Regional Management Plan

Gulf States Marine Fisheries Commission

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THE FLOUNDER FISHERY OF THE GULF OF MEXICO, UNITED STATES:

A REGIONAL MANAGEMENT PLAN

by the

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The Gulf States Marine Fisheries Commission (GSMFC) would like to thank the Flounder Technical Task Force (TTF) for their many hours of work and dedication in developing this flounder fishery management plan (FMP). During the compilation of this plan, we borrowed heavily from two sources in Sections 3 and 4; the Louisiana Department of Wildlife and Fisheries Southern Flounder Management Plan (Adkins et al. 1998) and Enge and Mulholland (1985). Additional material was borrowed from the GSMFC Spotted Seatrout Fishery Management Plan (in preparation) relating to the sociologic characteristics of the recreational fishing sector and were provided by Dr. Bob Ditton (Department of Wildlife and Fisheries, Texas A&M University).

Special thanks are extended to Dr. Richard Leard and Mr. Jim Duffy who served as IJF Program Coordinators in 1995-1996 and 1997, respectively, for their efforts and written contributions to this document. Thanks are also extended to Jack King, Texas Parks and Wildlife Department, who served on the task force as the law enforcement representative in 1996. Appreciation also goes to Dr. Cynthia Moncreiff, Dr. J. Holt, Lisa Engel, Mark Foster, and Kathy VanderKooy for their assistance in providing information and assistance in the review of the plan. The staff of the interjurisdictional fisheries program would also like to send a special thanks to Mrs. Lucia B. Hourihan for continuous support and superb editorial skills.

Preface

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

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

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

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

The gulf and southern flounder fishery management plan (FMP) is a cooperative planning effort of the five Gulf States under the IJF Act. Members of the task force contributed by drafting individually-assigned sections. In addition, each member contributed their expertise to discussions that resulted in revisions and led to the final draft of the plan.

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

Throughout this document, metric equivalents are used wherever possible with the exceptions of reported landings data and size limits which, by convention, are reported in English units. A glossary of fisheries terms pertinent to this FMP is provided in the appendix (Section 14.1). Recreational landings in this document are Type A and B1 and actually represent total harvest, as designated by the NMFS. Type A catch is fish that are brought back to the dock in a form that can be identified by trained interviewers and type B1 catch is fish that are used for bait, released dead, or filleted – i.e., they are killed but identification is by individual anglers. Type B2 catch is fish that are released alive – again, identification is by individual anglers and are excluded from the values in this FMP.

The state of Mississippi has indicated that the reported recreational landings for several near-shore, estuarine species in the Marine Recreational Fisheries Statistics Survey (MRFSS) are under-represented due to a sampling anomaly which reports some fish caught in "state waters" as caught in the "exclusive economic zone." The problem was addressed and corrected for the 2000 MRFSS data.

Abbreviations and Symbols

ADCNR/MRD	Alabama Department of Conservation Natural Resources/Marine Resources Division
BRD	bycatch reduction device
°C	degrees Celsius
DO	dissolved oxygen
DMS	Data Management Subcommittee
EEZ	exclusive economic zone
EFH	essential fish habitat
FWC/FMRI	Florida Fish and Wildlife Conservation Commission/Florida Marine Research Institute
FMP	fishery management plan
ft	feet
g	gram
GSI	gonadal somatic index
GMFMC	Gulf of Mexico Fisheries Management Council
GSMFC	Gulf States Marine Fisheries Commission
hr(s)	hour(s)
ha	hectare
IJF	interjurisdictional fisheries
kg	kilogram
km	kilometer
lbs	pounds
LDWF	Louisiana Department of Wildlife and Fisheries
MFCMA	Magnuson Fishery Conservation and Management Act
m	meter
mm	millimeters
min(s)	minute(s)
MDMR	Mississippi Department of Marine Resources
MRFSS	Marine Recreational Fisheries Statistical Survey
mt	metric ton
n	number
NL	notocord length
NMFS	National Marine Fisheries Service
ppm	parts per million
‰	parts per thousand
PPI	producer price index
SAT	Stock Assessment Team
SD	standard deviation
SE	standard error
sec(s)	second(s)
SL	standard length
S-FFMC	State-Federal Fisheries Management Committee
SPR	spawning potential ratio
TCC	Technical Coordinating Committee
TED	turtle exclusion device
TL	total length
TPWD	Texas Parks and Wildlife Department
TTF	technical task force
TTS	Texas Territorial Sea
TW	total weight
USEPA	United States Environmental Protection Agency
USDOC	United States Department of Commerce
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
YOY	young-of-the-year
yr(s)	year(s)

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1.0 SUMMARY

Gulf (*Paralichthys albigutta*) and southern flounder (*P. lethostigma*) range throughout the Gulf of Mexico from Florida to Mexico. Their habitats, distribution, and abundance change with life history stages and seasonal movements (Sections 3 and 4). They are euryhaline and found in freshwater, brackish water, and saltwater. Gulf and southern flounder are the two most commonly sought species in the Gulf of Mexico because of their larger maximum size. Southern flounder are most common from Mobile Bay, Alabama, to Brownsville, Texas. Gulf flounder are more abundant in the eastern Gulf along the Florida coast.

Southern flounder have been found to occur in a variety of habitats (Sections 3 and 4). They prefer muddy substrates and are relatively abundant in areas where the substrate is composed of silt and clay sediments. Gulf flounder have been found in association with firm or sandy substrates which are more common in the eastern Gulf of Mexico. The apparent substrate preference of gulf flounder may be more an effect of salinity selection, rather than substrate selection. Estuaries with low freshwater inflow result in higher salinities, low sediment loads, lower turbidity, and firmer substrates.

Although flounder are not harvested in the same quantity as other popular commercial and recreational species, they are still an important component of Gulf fisheries (Section 6). Their popularity is primarily due to their excellent quality as food fish. As a result, southern and gulf flounders are the dominant flatfish in commercial and recreational landings for the Gulf. The gulf and southern flounder are valuable recreational species on the Gulf coast where they are harvested mainly by hook and line and gigs. Gear types used to incidentally harvest flounders are basically the same as those used to commercially harvest other marine species and include butterfly nets, shrimp trawls, gill nets, trammel nets, handlines, longlines, and haul seines. Although spears and/or spearing are normally associated with the harvest of flounders, commercial landings for flounders attributed to this method are rarely reported for most states. In the last ten years, however, most entanglement type nets (gill and trammel) have been banned or greatly restricted in the Gulf States. Flounder landings may be further reduced through the use of bycatch devices in the inshore shrimp fishery (i.e., fish and turtle excluders, etc.).

Flounder landings in the Gulf of Mexico remained relatively stable after peaking in the early 1970s (Section 6), although the price per pound has increased significantly (Section 7). Landings declined in 1996 following the implementation of laws and regulations either banning or severely restricting the use of entanglement nets in inshore waters. Whether the demand for flounder can be satisfied by means of harvest other than nets is unknown.

The development of a complete Gulf-wide stock assessment for flounder was not possible due to a lack of speciated flounder data for the Gulf of Mexico. In addition, other inherent problems exist in the Gulf of Mexico flounder fishery regarding the states collection of fishery-dependent and independent data. In the western Gulf, biological reference points (F_{max}, $F_{0.1}$) indicate that female flounder are heavily exploited but are probably not overfished. Males are subject to much higher fishing mortality. Because sex ratios have changed over time, results should be interpreted with caution (Appendix 14.3.1).

In the northcentral Gulf (Appendix 14.3.2), recent regulations (in Louisiana) have significantly reduced harvest and have likely reduced fishing mortality rates from those currently estimated. spawning potential ratios (SPRs) that will result from current regulations will likely be above 30% in Louisiana. In Florida (Appendix 14.3.3), a cursory assessment of population dynamics suggests it is unlikely that gulf flounder are being fished at a maximum level of yield per recruit; however, little can be determined about the spawning stock biomass of gulf flounder. In theory, southern flounder in Florida waters should be more susceptible to growth and recruitment overfishing than gulf flounder.

The limited database for management, bycatch, and habitat reduction and degradation is perhaps the most serious problem facing gulf and southern flounder populations and fishery managers in the Gulf. Other problems are primarily social and economic including transient fishing, illegal harvests, and inconsistent regulations among states. The extent to which these problems affect the Gulf of Mexico flounder fishery is unknown.

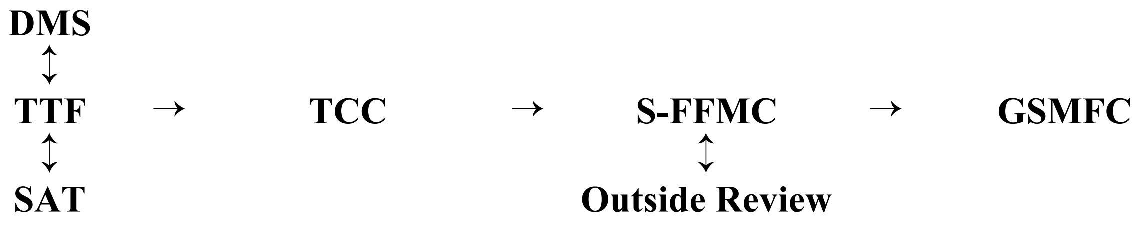
2.0 INTRODUCTION

On October 26, 1995, the State-Federal Fisheries Management Committee (S-FFMC) agreed that gulf and southern flounders would be the next species (fishery) designated for IJF FMP development. Because of the popularity of these species, the lack of consolidated information regarding these fish and the fisheries, and the level of concern for the well being of stocks, the S-FFMC concluded that a Gulf-wide FMP that includes the best available data was needed. The Flounder Technical Task Force was subsequently formed, and an organizational meeting was held April 25-26, 1996.

2.1 IJF Program and Management Process

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

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



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

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

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

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

2.2 Flounder Technical Task Force

Michael Johnson, *Chairman*	National Marine Fisheries Service
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Michael Brainard	Mississippi Department of Marine Resources
Stephen Hein	Louisiana Department of Wildlife and Fisheries
Rebecca Hensley	Florida Fish and Wildlife Conservation Commission
Charles Adams	Florida Sea Grant College Program (economics representative)
Dennis Johnston	Texas Parks and Wildlife Department (enforcement representative)
Dave Ruple	The Nature Conservancy (habitat representative)
Paul Seymour	Seymour & Sons Seafood, Inc. (commercial representative)
Pete Cooper, Jr.	Salt Water Sportsman (recreational representative)

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Larry B. Simpson, Executive Director
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Section	5.0	King, Johnston
Section	6.0	Duffy, Van Hoose
Section	7.0	Adams
Section	8.0	VanderKooy
Section	9.0	All

Section 10.0	Duffy, VanderKooy
Section 11.0	All
Section 12.0	All
Section 13.0	Staff
Section 14.0	All

2.5 FMP Management Objectives

The objectives of the Flounder FMP are:

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

2. To describe the biological, social, and economic aspects of the flounder fisheries.

3. To review state and federal management authorities and their jurisdictions, laws, regulations, and policies affecting the gulf and southern flounder.

4. To ascertain optimum benefits of the flounder fisheries of the United States Gulf of Mexico to the region while perpetuating these benefits for future generations.

5. To set clear and attainable management goals for the gulf and southern flounder fisheries and to suggest management strategies and options needed to solve problems, meet the needs of the stocks, and achieve these goals.

3.0 DESCRIPTION OF STOCK COMPRISING THE MANAGEMENT UNIT

Flatfishes of the family Bothidae are represented in the Gulf of Mexico (Table 3.1) by 27 species of 12 genera (Topp and Hoff 1972, Ginsburg 1952, Gutherz 1967, Hoese and Moore 1998, Robins et al. 1986, Robins et al. 1991). Bothids are euryhaline and found in fresh water (rivers, lakes); brackish water (estuaries, bayous, canals); and salt water (bays, sounds, lagoons, offshore) (Deubler 1960, Gutherz 1967, Hoese and Moore 1998). Their habitats, distribution, and abundance change with life history stages and seasonal movements.

Many of the bothids remain small even at maturity and may be critical components of commercial catch. *Paralichthys* (Gutherz 1967) is the genus that is most abundant in the directed finfish fisheries (both recreational and commercial) with *P. albigutta* and *P. lethostigma* as the two most commonly sought species in the Gulf of Mexico. Southern flounder (*P. lethostigma*) is most common from Mobile Bay, Alabama, to Brownsville, Texas (Norden 1966, Perret et al. 1971, Adkins et al. 1979, Adkins et al. 1998). Gulf flounder, *P. albigutta*, is more abundant in the eastern Gulf along the Florida coast (Hoese and Moore 1998, Gutherz 1967) (Figure 3.1). Species of other Gulf of Mexico flatfish genera (*Ancylopsetta, Cyclopsetta, Etropus, Syacium, Chascanopsetta, and Gastropsetta*) may be a component of the directed fishery because of their maximum size of 250-400 mm SL.

The primary scope of this management plan will be to discuss the two most abundant species of *Paralichthys* in the Gulf of Mexico, the gulf and the southern flounder. Literature on other species is limited and summarized in Table 3.1.

3.1 Geographic Distribution

The range of southern flounder extends from Albermarle Sound, North Carolina, to Laguna de Tamiahua, in northern Mexico (Ginsburg 1952, Hoese and Moore 1998, Manooch 1984, Music and Pafford 1984, Darnell and Kleypas 1987, Gilbert 1986, Shipp 1986). This species is absent everywhere on the lower east coast of Florida (from the Loxahatchee River) and the southwest coast (south of Tampa), except in the Caloosahatchee River estuary (Gilbert 1986, Topp and Hoff 1972). Occurrences of southern flounder were reported by several researchers (Hildebrand 1954, Darnell 1985, Sanders et al. 1990) at depths of up to 120 m and were found to be seasonally distributed from shallow estuaries to deeper waters (Nall 1979, Darnell 1985). Southern flounder are found in the Gulf of Mexico offshore of Alabama, Mississippi, Louisiana, and Texas from the barrier islands to the outer shelf and in Florida on the inner shelf from Apalachee Bay to above Tampa Bay (Reagan and Wingo 1985) (Figure 3.1). Southern flounder are more abundant in the northwestern portion of the Gulf of Mexico (Nall 1979).

In Texas bays, Gunter (1945) reported capturing southern flounder during all seasons but only during March and April in the Gulf. Southern flounder were most abundant from Sabine Pass to Port Aransas, and the lowest catch rate of southern flounder was in the upper Laguna Madre (Matlock 1982, McEachron and Fuls 1996). The distribution of southern flounder through the passes was not evenly distributed within Cedar Bayou, Matagorda Bay, Texas (King 1971). Fish were found to be more concentrated along the channel banks and on the west versus the east shoreline.

Table 3.1. Flatfishes of the family Bothidae from the Gulf of Mexico. Common names reported as accepted by Robins et al. 1991. NR = not reported.

Species	Common Name	Geographic Distribution	Maximum Size (mm)	Depth Range (m)	Notes
Ancylopsetta dilecta (Goode & Bean 1883)	Three-eyed flounder	North Carolina to Brazil, through the Gulf of Mexico and Caribbean	250 TL	Mid to deep, 60-366	Gutherz 1967 and Robins et al. 1986
Ancylopsetta quadrocellata (Gill 1884)	Ocellated flounder	North Carolina to Jupiter, Florida, and the entire Gulf of Mexico to the Campeche Banks	400 SL	Shallow to deep, to 100	Inshore bays and estuaries to offshore waters in the Gulf of Mexico. Larger fish likely in deep water (Topp & Hoff 1972)
Bothus ocellatus (Agassiz 1831)	Eyed flounder	New York to Brazil through the entire Gulf of Mexico. Not verified in northwest Gulf (Hoese and Moore 1998)	150 TL	Shallow <55	Robins et al. 1986. Larvae collected year-round (Smith et al. 1975, Moore 1975)
Bothus robinsi (Topp and Hoff 1972)	Two spot founder	New York to Brazil and along the NE and S Gulf of Mexico. Not verified in northwest Gulf (Hoese and Moore 1998)	150 SL	Shallow <55	Topp & Hoff 1972, Robins et al. 1986, Moore 1975
Chascanopsetta lugubris (Alcock 1894)	Pelican flounder	Atlantic coast of Florida, the Caribbean, Trinidad, and Brazil and the entire Gulf of Mexico	300 TL	Deep, 230-550	Gutherz 1967 and Robins et al. 1986
Citharichthys arctifrons (Goode 1880)	Gulf Stream flounder	New England to S Florida and through E Gulf of Mexico to Yucatan, Mexico	180 TL	Mid to deep, 46-366	Occasionally found at shallow depths of only 22 meters (Gutherz 1967; Robins et al. 1986). Late spring-fall spawning period (Smith et al. 1975)
Citharichthys cornutus (Günter 1880)	Horned whiff	Atlantic and Gulf coasts of the US from Georgia to Texas. Also found in the Bahamas through the Caribbean to Brazil	100 TL	Mid to deep, 27-366	Generally found in waters exceeding 137 m in depth (Gutherz 1967; Robins et al. 1986)

Species	Common Name	Geographic Distribution	Maximum Size (mm)	Depth Range (m)	Notes
Citharichthys gymnorhinus (Gutherz & Blackman 1970)	Anglefin whiff	Common from the Florida Keys and the Florida Shelf, the Bahamas, Caribbean, Central America to Guyana in South America	55 SL	Mid to deep, >350 in the Gulf of Mexico	Probable spring to summer spawning season (Topp & Hoff 1972)
Citharichthys macrops (Dresel 1885)	Spotted whiff	North Carolina to Florida and the NE Gulf of Mexico through the Caribbean to Honduras. Rare in the W Gulf of Mexico	162 SL	Shallow to mid depth, 40	Abundant in NE Gulf shrimp grounds to Campeche. Prefers hard to course, sand-shell bottoms. Probable spawning season from August through December (Topp & Hoff 1972)
Citharichthys spilopterus (Günter 1862)	Bay whiff	New Jersey to Brazil through the Gulf of Mexico to at least Texas and the Caribbean	200 TL	Shallow to mid depth to 73	One of the most common finfishes in the Gulf of Mexico (Gutherz 1967, Kuhn 1979, Robins et al. 1986). Salinity range of 0.5-30.0 ppt in a Texas Bay (Moffet 1975). Occurs inshore to 40 fa, in Gulf ≤20 fa
Cyclopsetta chittendeni (Bean 1895)	Mexican flounder	Limited to the NW Gulf of Mexico to further east than the Mississippi Delta. Also occurs in the Caribbean Sea from Colombia and Venezuela and to Brazil	330 TL	Mid to deep, 18-229	Common throughout the W Gulf of Mexico; it is replaced by *C. fimbriata* east of the Mississippi Delta (Dawson 1968). Topp & Hoff 1972; Gutherz 1967; Robins et al. 1986
Cyclopsetta fimbriata (Goode & Bean 1885)	Spotfin flounder	North Carolina to S Florida and the NE Gulf of Mexico, no further west than the Mississippi Delta. Also through the West Indies to British Guiana	380 TL	Mid to deep, 18-229	Not a late spring spawning season (Topp & Hoff 1972), possibly throughout summer and fall (Gutherz 1967). Not as common in NW Gulf as *C. chittendeni* (Hoese and Moore 1998)
Engyophrys senta (Ginsburg 1933)	Spiny flounder	Florida Keys, Bahamas, and the N Gulf of Mexico through Caribbean to Brazil	100 TL	Mid to deep, 37-183	Considered the smallest bothid in the Gulf of Mexico (Gutherz 1967, Hensley 1977, Robins et al. 1986)

Species	Common Name	Geographic Distribution	Maximum Size (mm)	Depth Range (m)	Notes
Etropus crossotus (Jordan & Gilbert 1882)	Fringed flounder	Chesapeake Bay to S Florida and the entire Gulf of Mexico. Occurs throughout the Caribbean to French Guiana	135 SL	Shallow to mid depth to 51	Commonly enters bays in warmer months. Frequently enters low salinity waters of less than 5 ppt. More common in depths shallower than 26 m. Spawning occurs from March until June (Topp & Hoff 1972). Hoese & Moore (1998) report maximum size at 180 TL
Etropus cyclosquamus (Leslie & Stewart 1986)	Shelf flounder	Cape Hatteras, North Carolina, to Florida and N Gulf of Mexico and west as far as Mississippi	150 TL	Mid depth from 28-36	Retzer 1990, Robins et al. 1991. For detailed species description, see Leslie & Stewart 1986. Hoese & Moore 1998 report species as deep water (sometimes caught under 200 m)
Etropus microstomus (Gill 1864)	Smallmouth flounder	New England to S Florida and west to Mississippi in the N Gulf of Mexico	130 TL	Deep to 91, usually <40	Parr 1931, Gutherz 1967, and Robins et al. 1986. Species is erroneously reported in the Gulf (Leslie & Stewart 1986, Hoese & Moore 1998)
Etropus rimosus (Good & Bean 1885)	Gray flounder	North Carolina to the southern tip of Florida and to Alligator Harbor and south along the Florida Gulf coast. In Gulf of Mexico only found E of Mississippi Delta and off the Yucatan	100 SL	Mid to deep to 180 m	Depth limit in the Gulf of Mexico is about 38 m and east of Mississippi Delta (Leslie & Stewart 1986, Hoese & Moore 1998). Spawning probably occurs during the summer (Topp & Hoff 1972, Robins et al. 1986)
Gastropsetta frontalis (Bean 1895)	Shrimp flounder	North Carolina to Florida Keys and along the Florida Gulf coast to the N Gulf of Mexico. Also found on the Campeche Banks and south to Panama	250 TL	Mid to deep, 35-183	This species is considered rare in the Gulf of Mexico. Spring to early summer spawning season (Topp & Hoff 1972, Robins et al. 1986)

Species	Common Name	Geographic Distribution	Maximum Size (mm)	Depth Range (m)	Notes
Monolene antillarum (Norman 1933)	Slim flounder	North Carolina to Brazil through the entire Gulf of Mexico and Caribbean	NR	Deep, 155-550	Gutherz 1967 implied *M. antillarum* and *M. sessilicauda* to be conspecifics. Robins et al. 1991 treats as a valid species
Monolene sessilicauda (Goode 1880)	Deepwater flounder	Massachusetts to Brazil and entire Gulf of Mexico	180 TL	Deep, 110-457	Hoese and Moore 1998. See notes above for *M. antillarum* (Gutherz 1967)
Paralichthys albigutta (Jordan & Gilbert 1882)	Gulf flounder	North Carolina to S Florida and the Gulf of Mexico to S Texas and the Bahamas. More common along Florida's Gulf coast and NE Gulf of Mexico (not reported from Mississippi and Louisiana inshore waters)	380 TL	Shallow to deep to 128	Robins et al. 1986. Prefers hard or sandy bottom habitat (Gutherz 1967, Topp & Hoff 1972)
Paralichthys lethostigma (Jordan & Meek 1884)	Southern flounder	North Carolina to N Mexico through Gulf of Mexico. Absent south of Loxahatchee River to south of Caloosahatchee Estuary, Florida	910 TL	Shallow to mid depth to 66	Prefers muddy bottom habitat (Topp & Hoff 1972; Stokes 1977). A single specimen was collected in Florida Bay (FWC/FMRI unpublished data)
Paralichthys squamilentus (Jordan & Gilbert 1882)	Broad flounder	North Carolina to Mexico and throughout Gulf of Mexico	460 TL	Shallow to deep, 4-230	Large individuals in deep water but young fish inshore (Gutherz 1967, Fraser 1971, Robins et al. 1986)
Syacium gunteri (Ginsburg 1933)	Shoal flounder	NE coast of Florida south throughout entire Gulf of Mexico and Caribbean	280 TL	Shallow to mid depth, 9-91	Hoese & Moore 1998. Most abundant and frequently caught flatfish on brown shrimp grounds (NW Gulf). Replaced E of Mississippi Delta by *S. micrurum* (Gutherz 1967, Fraser 1971, Robins et al. 1986)

Species	Common Name	Geographic Distribution	Maximum Size (mm)	Depth Range (m)	Notes
Syacium micrurum (Ranzani 1840)	Channel flounder	SE coast (and perhaps SW coast) of Florida. Also found in the Caribbean sea to Brazil in South America as well as West Africa	300 TL	Mid to deep to 412	Generally found in depths in less than 91 m (Gutherz 1967, Fraser 1971, Robins et al. 1986). Often reported in Gulf but Hoese & Moore (1998) were unable to verify, may be *S. papillosum*
Syacium papillosum (Linnaeus 1758)	Dusky flounder	North Carolina to S Florida and throughout the Gulf of Mexico. Also found in the Bahamas and Bermuda, the Caribbean, and south to Brazil in South America	300 TL	Shallow to mid depth to 92	More common east of the Mississippi River (Hoese & Moore 1998). This species prefers more calcareous substrate, more commonly found along the Florida Shelf (see notes for *S. gunteri*). Extended spawning season from Feb-Nov (Topp & Hoff 1972, Robins et al. 1986)
Trichopsetta ventralis (Goode & Bean 1885)	Sash flounder	Throughout the Gulf of Mexico	200 TL	Mid to deep, 33-110	Little known about life history of this species (Gutherz 1967, Anderson & Gutherz 1967, Hoese & Moore 1998, Robins et al. 1986)

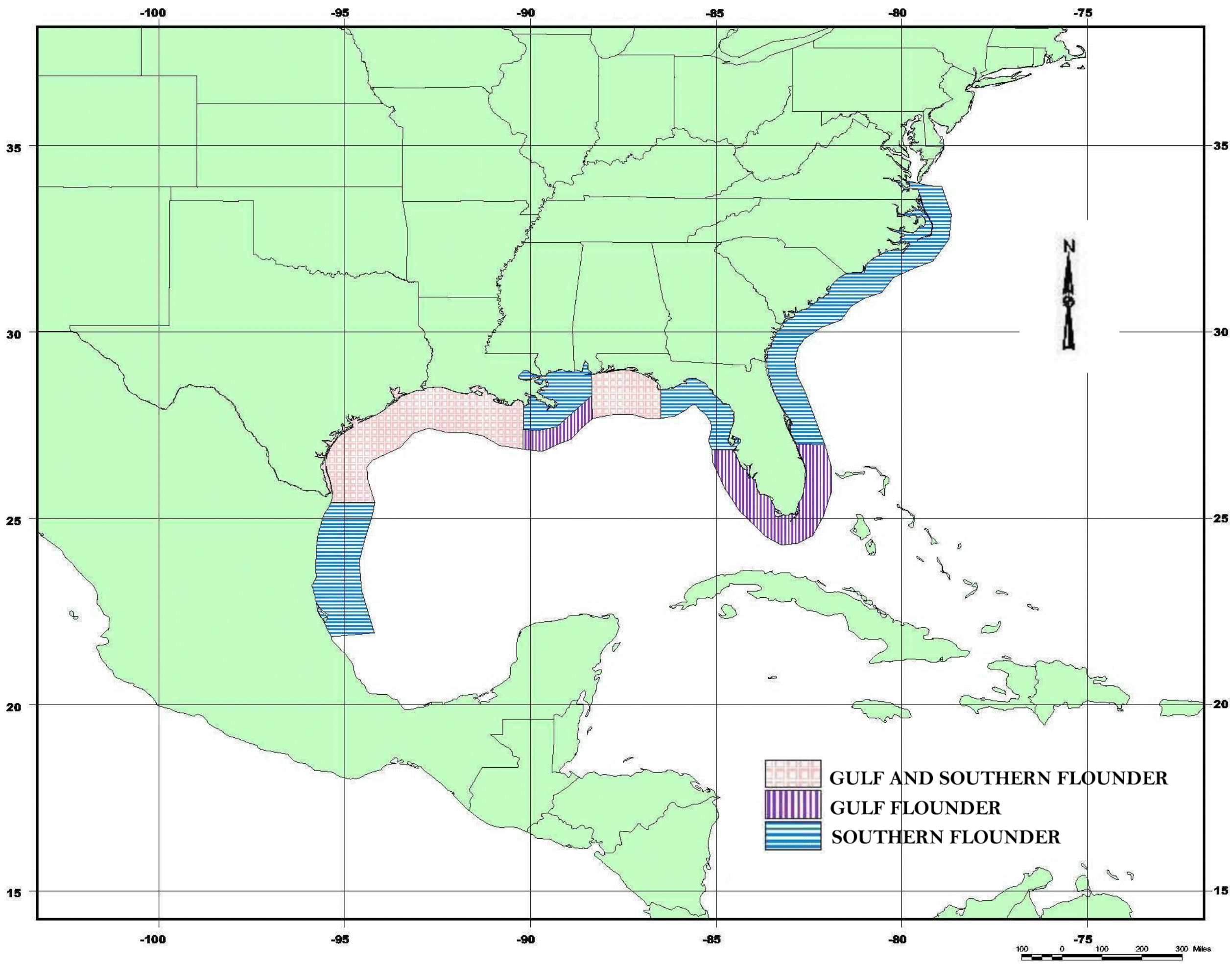

Figure 3.1. Distribution of gulf and southern flounder in the southeastern United States.

In Louisiana, Gunter (1936) stated southern flounder were never plentiful in trawl catches inside Barataria Bay and were rarely taken in nearby Gulf waters. However, Czapla et al. (1991) reported southern flounder to be common to abundant as adults and generally abundant in other life history stages throughout coastal Louisiana. Norden (1966) and Wagner (1973) both ranked southern flounder ninth in abundance from Vermilion and Caminada bays, Louisiana, respectively.

Southern flounder were reported the most common *Paralichthys* in Mississippi and Alabama waters (Christmas and Waller 1973, Swingle 1971). Southern flounder were frequently encountered in the industrial bottomfish survey in Mississippi (Christmas 1973). Swingle (1971) found southern flounder to occur from the Mobile Delta to offshore waters of Alabama. The Alabama Department of Conservation and Natural Resources (ADCNR) found southern flounder present year-round in Mobile and Perdido bays in their 15 year data set from the Fisheries Assessment Monitoring Program (ADCNR unpublished data, M. Van Hoose personal communication).

Compared to the west and northern Gulf of Mexico, southern flounder are less common along Florida's west coast, although they have been collected along the northwest Florida coast (Vick 1964, Nall 1979, Bass and Guillory 1979). The reported distribution of southern flounder along the southern coast of Florida is somewhat unclear. Ginsburg (1952) suggested the species is absent southward from the Indian River on the east coast to Tampa Bay on the west coast. However, recent studies have indicated southern flounder may occur in low numbers in south Florida. Gunter and Hall (1965) reportedly caught two specimens within the Caloosahatchee River estuary. Tabb and Manning (1961) reported two southern flounder specimens caught in Florida Bay, Everglades National Park, and suggested that this species is sometimes caught by recreational anglers off sandy beaches in the area. However, no southern flounder were collected in Florida Bay during routine monthly fisheries independent monitoring samples over a four-year period from 1994 to 1997 (FWC/FMRI unpublished data). One 315 mm SL southern flounder specimen was caught in February 1998 approximately 16 km north of Marathon, Florida, in the Gulf of Mexico. This single specimen was obtained from a commercial fish house in Marathon (FWC/FMRI unpublished data).

Gulf flounder range from Cape Lookout, North Carolina, to lower Laguna Madre, Texas, in waters less than 92 m deep but occasionally in waters as deep as 128 m (Ginsburg 1952, Hildebrand 1954, Simmons 1957, Gutherz 1967). They have occasionally been recorded in the western Bahamas (Böhlke and Chaplin 1993) and are most common in the eastern Gulf of Mexico along the west coast of Florida (Topp and Hoff 1972) (Figure 3.1).

In Texas, Gunter (1945) reported gulf flounder in Aransas Bay and the western Gulf of Mexico but in relatively low numbers compared to southern flounder. Hildebrand (1954), in his study of the fauna of shrimp grounds in the western Gulf of Mexico, also indicated that gulf flounder were relatively rare in this area. Simmons (1957) reported gulf and southern flounder to be common in the upper Laguna Madre on the Texas coast but gave no catch data or relative abundances of the two species. Miller (1965) found both gulf and southern flounder to be uncommon in the shallow (6-28 m) Gulf of Mexico near Port Aransas, Texas. Although gulf flounder occur in lower numbers than southern flounder, they were most abundant along the mid to lower Texas coast (Stokes 1977, McEachron and Fuls 1996, Matlock 1982).

Gulf flounder are more common than southern flounder in lower Perdido Bay, Alabama, but are rare in Mobile Bay and the eastern Mississippi Sound (ADCNR/MRD unpublished data). No records of gulf flounder have ever occurred in Mississippi’s 25 years of fishery-independent sampling by Gulf Coast Research Laboratory (GCRL) personnel (J. Warren personal communication).

In Florida, gulf flounder are more prevalent than southern flounder. Several gulf flounder were collected at St. Andrews Bay by Vick (1964) and Naughton and Saloman (1978). Reid (1954) reported gulf flounder to be the most common flounder at Cedar Key and collected in all months of the year. Murdock (1957) collected a single specimen of gulf flounder near the mouth of the Manatee River. Gulf flounder sampled from Tampa Bay by Springer and Woodburn (1960) were taken during all months of the year except October. Several gulf flounder were collected by trawl and seine during a faunal survey of Charlotte Harbor (Wang and Raney 1971). Springer and McErlean (1962) reported collecting gulf flounder in the Florida Keys. Gulf flounder have been collected by the Fisheries Independent Monitoring Program in most major bay systems (i.e. Indian River Lagoon, Florida Bay, Charlotte Harbor, Tampa Bay, Cedar Key, Apalachicola Bay, Choctawatchee Bay/Santa Rosa Sound and Apalachicola Bay) throughout Florida (FMRI unpublished data).

3.2 Biological Description

All species of *Paralichthys* in the Gulf of Mexico are robust, left-eyed flatfish with large mouths. These bottomfish blend with their background and are nondescript in color and mildly patterned. Gulf and southern flounder display sexual dimorphism with females being larger than males at age. Both species spawn a large number of buoyant, pelagic eggs. The hatchlings are bilaterally symmetrical until they undergo a metamorphosis to a flatfish shape with both eyes on the left side. Following metamorphosis, the bases of both pelvic fins are short and neither extends forward to the urohyal bone (Gilbert 1986). Specific morphology of each life history stage and species will be discussed in Section 3.2.1.2.

Southern flounder have been found to occur in a variety of habitats. They prefer muddy substrates and are relatively abundant in areas where the substrate is composed of silt and clay sediments (Norman 1934, Ginsburg 1952, Powell and Schwartz 1977, Wolff 1977, Randall and Vergara 1978, Etzold and Christmas 1979, Nall 1979, and Phalen et al. 1989). Southern flounder are more abundant in the western Gulf, west of the Mississippi Delta where soft, muddy substrate is more common (Topp and Hoff 1972, Enge and Mulholland 1985). Where sand substrates predominated, southern flounder are relatively scarce, and gulf flounder are more abundant.

Southern flounder are able to acclimate to temperatures from 5.0°-35.0°C and salinities ranging from 0.0‰-60.0‰ (Table 3.2). In a laboratory study, Prentice (1989) found young and adult flounder to be more tolerant of cold in salt water than in fresh water. Physiological adaption to salinity appears to change seasonally and with age (Stickney and White 1974a). Herke (1971), Wolff (1977), and Rogers et al. (1984) found young southern flounder were more numerous in lower salinity waters during spring-early summer (recruitment), while mid-salinity waters yielded larger fish later in the year. Southern flounder are considered to be the largest flounder in the Gulf of Mexico, reaching lengths of over 900 mm TL (Hoese and Moore 1998). Adult southern flounder migrate from bays and estuaries in the fall and winter for the purpose of spawning (Hildebrand and Cable 1930, Gunter 1945, Ginsburg 1952, Stokes 1977). Juvenile and larval southern flounder begin to recruit into the bays and estuaries from January through April (Table 3.3).

Gulf flounder have been found in association with firm or sandy substrates which are more common in the eastern Gulf of Mexico (Topp and Hoff 1972, Stokes 1977, Naughton and Salomon 1978, Nall 1979). The apparent substrate preference may be more an effect of salinity selection, rather than substrate selection. Estuaries with low freshwater inflow result in higher salinities, low sediment loads, lower turbidity, and firmer substrates (Enge and Mulholland 1985).

Gulf flounder have been shown to tolerate a wide range of temperatures (8°-32.5°C) and salinities ranging from 6‰-60‰ (Table 3.4). However, most researchers report the majority of gulf flounder are found in salinities above 20‰ (Gunter 1945, Simmons 1957, Springer and Woodburn 1960). Gulf flounder do not grow as large as southern flounder and reach a maximum size of about 600 mm TL. Like southern flounder, adult gulf flounder spend a portion of the year in bays and estuaries and emigrate into deeper waters in the Gulf of Mexico, where spawning takes place during the fall and winter (Ginsburg 1952). The appearance of juvenile gulf flounder in the bays and estuaries begins in January and peaks in March (Stokes 1977) (Table 3.5).

Table 3.2. Salinities and temperatures at which southern flounder were collected by area and author. NA = not available or reported.

State	Salinity (‰)	Temperature (°)	Area	Author(s)
Texas	Adults: 2.0-36.2 (few above 25.0) Juvenile recruitment: 19.6-30.0	Adults: 9.9-30.5 Juvenile recruitment: 14.5-21.6	Coastal area	Günter 1945
	Sharply limited above 45; occasionally found to 60	Not reported	Laguna Madre	Simmons 1957
	6.0-36.0	Juvenile recruitment: 16.0 (as low as 13.8, adults from 10.0-31.0)	Aransas Bay	Stokes 1977
Louisiana	0.0-30.0	5.0-34.9	Coastal area	Perret et al. 1971
	3.3-26.0	6.2-31.0	Coastal area	Dunham 1972
	1.5-26.0	14.0-35.0	Caminada Bay	Wagner 1973
	2.5-7.0	10.0-11.0	Vermilion Bay	Perret & Caillouet 1974
	0.3-8.9	8.0-30.7	Vermilion Bay	Juneau 1975
	0.0-0.9	15.0-34.9	Lakes Pontchartrain & Maurepas	Tarver & Savoie 1976
	0.3-31.9	10.4-29.8	Coastal area	Burdon 1978
	5-20	10.4-29.8	Coastal area	Barret et al. 1978
Mississippi	19.9-37.9	13.3-28.0	Coastal area	Franks et al. 1972
	0.0-36.2	5.0-34.9	Coastal area	Etzold & Christmas 1979
Alabama	0.0-30.0	8.0-32.0	Mobile Bay/ Little Lagoon	ADCNR/MRD unpublished data
Florida	0.0-30.2	12.0-31.0	St. Johns River	Tagatz 1967
Georgia	Often enter fresh water	Eurythermal in shallow waters	Estuary	Dahlberg 1972
	New recruits in least saline portion of distribution	Not reported	Salt marsh estuary	Rogers et al. 1984
South Carolina	0.8-34.8	7.2-30.8	Charleston Harbor, Stono, Edisto, and Coosaw rivers	Wenner et al. 1990

State	Salinity (‰)	Temperature (°)	Area	Author(s)
North Carolina	0.0-35.0 (most in upper portion of estuary less than 11.0)	7.0-29.0	Pamlico Sound & adjacent waters	Powell 1974
	0.0-28.0 (most found in 5.0-18.0)	NA	Pamlico/ Albermarle Peninsula	Epperly 1984
	0.0-33.6	7.2-31.8	Beaufort estuaries	Tagatz & Dudley 1961
	Postlarvae: 0.2-35.0	8.0-16.0	Estuary	Williams & Deubler 1968
	Juveniles: 0.0-35.0 (most below 17.0)	NA	Pamlico Sound/ adjacent estuaries	Powell & Schwartz 1977
	0.6-33.4	NA	Newport River	Turner & Johnson 1973

Table 3.3. Recruitment time and size of YOY southern flounder by area and author. All sizes reported as TL (mm), except where noted.

State	Recruitment Time	Recruitment Size	Area	Comments	Author(s)
Texas	December February-April	17-40	Aransas Bay	Youngest fish in May (80 mm)	Günter 1945
	March-May (April)	37-120 (25-54)	Cedar Bayou, central coast	Abundant March-May	Simmons & Hoese 1959
	February-May	18-34	East Lagoon, Galveston Island	One juvenile 102 mm in September	Arnold et al. 1960
	December	Postlarvae (35-50)	Lower Laguna Madre & adjacent waters		Breuer 1962
	December-April (peak abundance January-March)	Postlarvae (mean of 11)	Coastal area	*Paralichthys* spp. (*P. lethostigma* inclusive)	King 1971
	Beginning January (peak abundance in February)	10	Aransas Bay		Stokes 1977

State	Recruitment Time	Recruitment Size	Area	Comments	Author(s)
	February	YOY	Matagorda Bay		Ward et al. 1980
Louisiana	April	5-10	Barataria Bay	YOY were 120-150 mm by May-June	Gunter 1938
	Spring	25-51	Delta National Wildlife Refuge	Mississippi River Delta	Kelly 1965
	March	11-30	Vermilion Bay	13-51 mm in April	Norden 1966
	January (March)	21-24 (6-31)	Chandeleur Islands	YOY were 55 and 88 mm by May & June, respectively	Laska 1973
	December-February	8-14 SL	Caminada Pass		Sabins 1973
	January-March (peaks February-March)	Mostly 0-30 SL groups	SW coastal marshes	5 mm SL size groups	Rogers & Herke 1985
	March-May	Juveniles	Calcasieu Estuary	Nursery usage	Felley 1989
Mississippi	March-May	<38	Estuary		Christmas & Waller 1973
	December-May	Larvae	Coastal area	Inshore immigration to nursery	Etzold & Christmas 1979
Alabama	January-April	10-15 SL	Low salinity areas of Mobile Bay	Highest densities in Weeks Bay	ADCNR/MRD unpublished data
Florida	March	22-56	St. Johns River		Tagatz 1967
Georgia	Peaked & ended in March	YOY	Salt marsh estuaries	Highest catches in upper estuaries	Rogers et al. 1984
South Carolina	January-March (peaked in March)	Postlarvae	Charleston Harbor, Stono, Edisto, & Coosaw rivers	June catches of large and small YOY from November-January & February-March spawn, respectively	Wenner et al. 1990

State	Recruitment Time	Recruitment Size	Area	Comments	Author(s)
North Carolina	November-April (peaked in December)	Larvae	Continental shelf from Cape Cod, Massachusetts to Cape Lookout, North Carolina	*Paralichthys* sp. (*P. lethostigma*, inclusive)	Smith et al. 1975
	Winter months	8-16	Pamlico Sound and adjacent estuaries	Largest catches in upper river, low salinity areas	Powell & Schwartz 1977
	Beginning March	10-40	Coastal areas	YOY migrated to upper river areas at 18-65 mm	Ross et al. 1982
	January-March (peaked in March)	10-20 SL	Estuaries	Oligohaline marshes	Rozas & Hackney 1984
	March (peaked in April-May)	YOY	Pamlico Sound & adjacent estuaries		Ross & Epperly 1985
	December-March (peaked in early February)	Larvae	Newport River estuary, just inside Beaufort Inlet	Most abundant bothid caught	Warlen & Burke 1990
	Late November-April (peaked in February-March)	Larvae-postlarvae	Newport & North River estuaries	Largest catch on tidal flats at estuary head	Burke et al. 1991

Table 3.4. Salinities and temperatures at which gulf flounder were collected by area and author. NA = not available or reported.

State	Salinity (‰)	Temperature (°)	Area	Author(s)
Texas	25.0-35.2 (one of twelve at 9.6)	15.4-30.3	Coastal area	Gunter 1945
	Sharply limited above 45; occasionally found to 60	NA	Laguna Madre	Simmons 1957

State	Salinity (‰)	Temperature (°)	Area	Author(s)
	Above 16.0	Juvenile recommended at 16.0 (as low as 13.8; adults from 10.0-31.0	Aransas Bay	Stokes 1977
Florida	30.7 (n=1)	23.0	Manatee River	Murdock 1957
	13.7-33.7 (very few below 20.0)	11.2-32.5	Tampa Bay	Springer & Woodburn 1960
	37.9	23.0-28.1	Florida Keys	Springer & McErlean 1962
	33.0-36.0	13.0-29.0	St. Andrews Bay	Vick 1964
	7.7-24.7	11.0-30.8	St. Johns River	Tagatz 1967
	33.4-35.7	15.9-27.0	Florida Shelf near Tampa Bay	Topp & Hoff 1972
	17.5-31.5	8.3-30.6	Cedar Key	Reid 1954
	12.0-35.0	13.0-32.0	St. Andrews Bay	Naughton & Saloman 1978
	1.0-37.0 (95%>20.0)	14.0-32.0	Tampa Bay	FWC/FMRI unpublished data
	2.0-38.0 (80%>20)	14.0-33.0	Charlotte Harbor	
	1.0-34.0 (37%>20)	11.0-31.0	Choctawatchee Bay	
	21.0-42.0	16.0-34.0	Florida Bay	
Alabama	6.0-35.0 (rarely below 20)	7.2-31.7	Gulf Beaches/ Perdido Bay	ADCNR/MRD unpublished data
North Carolina	27.5-37.8	9.4-29.5	Beaufort estuaries	Tagatz & Dudley 1961
	Postlarvae: 22.0-35.0	8.0-16.0	Estuary	Williams & Deubler 1968
	Juveniles: 6.0-35.0 (rarely below 20.0)	NA	Pamlico Sound adjacent estuaries	Powell & Schwartz 1977
	30.2-34.5	NA	Newport River	Turner & Johnson 1973

Table 3.5. Recruitment time and size of young-of-year gulf flounder by area and author. All sizes in mm TL, except where noted.

State	Recruitment Time	Recruitment Size	Area	Comments	Author(s)
Texas	Beginning in January (peak abundance in February)	10	Aransas Bay		Stokes 1977
Alabama	February-April	15 SL	Alabama beaches	Specimens <15 SL are collected but unidentifiable	ADCNR/MRD unpublished data
Florida	January-April	12-20	Tampa Bay		Springer & Woodburn 1960
	March	51-57	St. Johns River		Tagatz 1967
	January-May	10-15 SL	Cedar Key		Reid 1954
	December-March	Larvae	Florida shelf near Tampa Bay		Topp & Hoff 1972
	Began December & January	10 SL	West coast	Some latitudinal variation in recruitment time	FWC/FMRI unpublished data
	Peaked in February		Charlotte Harbor		
	Peaked in March		Tampa Bay		
	Peaked in April		Choctawatchee Bay		

3.2.1 Classification and Morphology

3.2.1.1 Classification

The following classification includes species that might be encountered in directed fisheries due to maximum size (see Table 3.1 for a complete list of species from the family Bothidae in the Gulf of Mexico). Higher classification follows that of Greenwood et al. (1966). The American Fisheries Society (Robins et al. 1991) accepted, common names are in parenthesis following the species name.

Superorder: Acanthopterygii
    Order: Pleuronectiformes
        Family: Bothidae
            Genus: *Paralichthys*
                Species: *albigutta* (gulf flounder)
                Species: *lethostigma* (southern flounder)
                Species: *squamilentus* (broad flounder)
            Genus: *Cyclopsetta*
                Species: *chittendeni* (Mexican flounder)
                Species: *fimbriata* (spotfin flounder)
            Genus: *Ancylopsetta*
                Species: *quadrocellata* (ocellated flounder)
                Species: *dilecta* (three-eyed flounder)
            Genus: *Syacium*
                Species: *gunteri* (shoal flounder)
                Species: *papillosum* (dusky flounder)
                Species: *micrurum* (channel flounder)
            Genus: *Chascanopsetta*
                Species: *lugubris* (pelican flounder)
            Genus: *Gastropsetta*
                Species: *frontalis* (shrimp flounder)

The valid name for southern flounder is *Paralichthys lethostigma* (Jordan and Meek 1884). The scientific name is derived from the Greek words *Paralichthys* meaning "parallel fish," *lethostigma* means "forgetting" and "spot." The name assigned this fish literally means a "parallel fish that forgot its spots" (Gowanloch 1933). This refers to this species lying close to the bottom and being uniformly colored as opposed to other related flatfishes which generally possess spots. Other common names for the southern flounder include southern large flounder (Ginsburg 1952); mud flounder, halibut, plie (Louisiana French); southern fluke (Breuer 1962); lenguado (Spanish); and doormat (Gowanloch 1933, Hoese and Moore 1998, Reagan and Wingo 1985, Gilbert 1986).

The following synonymy for southern flounder is abbreviated from Jordan and Evermann (1898):

Platessa oblonga DeKay 1842
Pseudorhombus oblongus Gunther 1862
Chaenopsetta dentata Gill 1864
Pseudorhombus dentatus Goode 1879
Paralichthys dentatus Jordan and Gilbert 1882
Paralichthys lethostigma Jordan and Meek 1884.

Gulf flounder is the valid common name recognized for *P. albigutta* by the American Fisheries Society (Robins et al. 1991). The Latinized word, *albigutta*, literally means “white drop” and refers to the presence of three white ocelli characteristic of this species (Borror 1960). Other common names include sand flounder, flounder, and fluke (Gilbert 1986).

The valid name for gulf flounder is *Paralichthys albigutta* Jordan and Gilbert (1882). The following synonymy is adapted from Topp and Hoff (1972):

Pseudorhombus ocellaris Jordan and Gilbert 1879
Pseudorhombus dentatus Jordan and Gilbert 1879
Paralichthys albigutta Jordan and Gilbert 1882
Paralichthys albiguttus Jordan and Evermann 1898
Paralichthys abligutulus Pearse et al. 1942
Paralichthyes albigutta Vick 1964.

3.2.1.2 Morphology

Various authors have described the morphology of *Paralichthys* spp. and other bothids. The following descriptions are summarized for southern and gulf flounder. Comments regarding other species will be noted.

3.2.1.2.1 Eggs

Norman (1934) and Benson (1982) reported eggs to be pelagic, buoyant, and containing a single oil globule in the yolk. The eggs are spherical and have a rigid shell (Smith 1973, Ward et al. 1980). Recently released southern flounder eggs examined by Henderson-Arzapalo et al. (1988) had mean diameters of 0.92 mm. Gulf flounder eggs were spherical with mean diameters of 0.87 mm and contained an oil globule with a mean diameter of 0.18 mm (Powell and Henley 1995).

3.2.1.2.2 Larvae

According to Gutherz (1970), one of the problems encountered in dealing with larval flatfish is that larvae which have been collected over a wide geographic range and a long period of time may show varying rates of development between different stages. He stated,

> "characters that can be used to identify bothid larvae fall into two categories: (1) transitory, those which are present during part or all of the larval period but eventually are lost and (2) permanent, those which develop during the larval period and are retained in the juvenile and adult stages."

Gutherz (1970) described transitory characters as larval pigmentation, elongate fin rays, and head and body spination. Permanent characters would include meristic counts, the placement of pelvic fin bases and fin rays, and the arrangement of the caudal fin rays with relation to the bones of the hypural plate.

The embryo becomes a larva when it switches from exclusively endogenous feeding to exogenous feeding (Balon 1975). Initial stages of bothid larvae are symmetrical until the right eye migrates to the left side of the body during metamorphosis (Ahlstrom et al. 1984). The migrating eye moves externally over the mid-dorsal ridge anterior to the origin of the dorsal fin or through the head between the dorsal fin and the supraorbital bars of the cranium (Gutherz 1970). All bothids except the genus *Bothus* have this type of eye movement. In *Bothus* spp., the right eye moves through a deep groove in the head with the tissue being absorbed and regenerated (Martin and Drewry 1978).

The larval stage of southern flounder is from hatching through metamorphosis, beginning at 40-46 days (8-11 mm TL) and completing developmental change at 50-51 days. Following this change, fingerlings become completely demersal (Arnold et al. 1977).

The following summarizes the development of larval *Paralichthys* spp. as described by Hildebrand and Cable (1930) (Figure 3.2). All measurements are total length.

> "At 2.5 mm, larvae have an enlarged head with a prominent hump over the eyes which encloses the brain, a deeply compressed body, and a long slender tail. From 2.5-4.0 mm, rows of dark spots form on the ventral edge of the abdomen and the beginnings of a small fin are evident on the nape. Metamorphosis begins around 4 mm and this fin serves as a recognition mark as larvae metamorphose. By 6 mm, the occipital hump has begun to disappear as the brain is completely enclosed and the small fin on the nape is well developed. At 7 mm, the body is more compressed and the right eye is now slightly higher than the left as it begins to migrate towards the left side of the body. The caudal fin is more fully developed and rays are appearing in the dorsal and anal fins. At 8 mm, the fish is beginning to look more like a flounder: it is much more compressed and the right eye has migrated to where it is near the dorsal ridge and is partly visible from the left side. Pigmentation is identical and equal on both sides of the fish."

In laboratory-reared and field-collected specimens, recently hatched gulf and southern flounder larvae ranged from 1.8 to 2.2 mm and 2.0 to 2.2 mm notochord length (NL), respectively (Powell and Henley 1995). The pigment on embryos and newly hatched larvae were relatively more developed in gulf flounder than in southern flounder. Powell and Henley (1995) also noted that at any given size, development was generally more advanced in gulf than in southern flounder. They used pigmentation, spination, and meristic counts to separate southern and gulf flounder. They found differences in the pigmentation on the lateral surface of the hindgut and caudal areas between laboratory-reared specimens of the two species but cautioned that these differences may not be consistent on wild specimens. Cranial spines appeared to be diagnostic in separation of early preflexion larval forms, as southern flounder have three cranial spines, and gulf flounder have from zero to two spines. Deubler (1958) suggested postlarval southern and gulf flounder are difficult to separate since pigmentation and vertebral counts are similar. Although dorsal and anal ray counts generally separate the two species, he suggested a combination of characteristics be used to differentiate them (Table 3.6).

3.2.1.2.3 Juveniles

The juvenile stage is generally not distinguishable from adults except for size and maturity (Hoese 1965). Southern flounder were considered juveniles by Stokes (1977), Etzold and Christmas (1979), and Nall (1979) from about 11-300 mm TL. The juvenile stage for gulf flounder includes fish from about 11-290 mm TL (Topp and Hoff 1972, Stokes 1977).

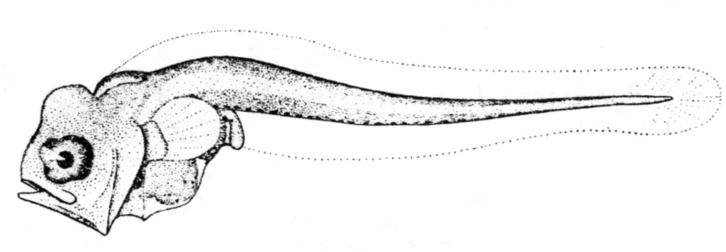

Figure 3.2a. 2.75 mm TL.

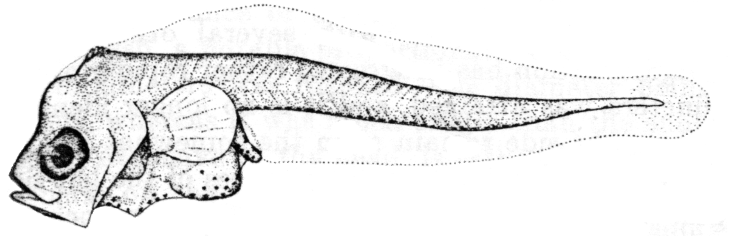

Figure 3.2b. 4.0 mm TL.

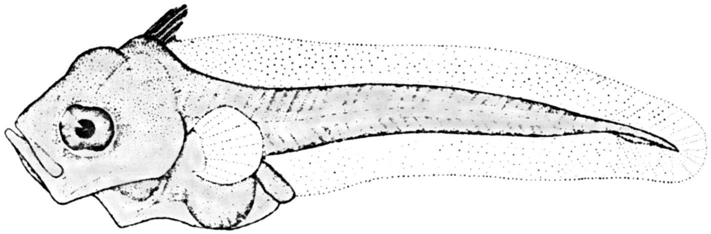

Figure 3.2c. 5.5 mm TL.

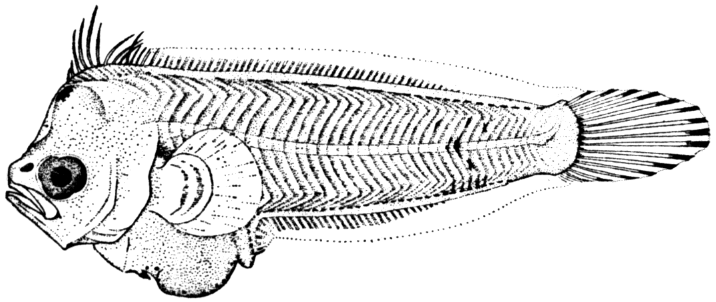

Figure 3.2d. 7.0 mm TL.

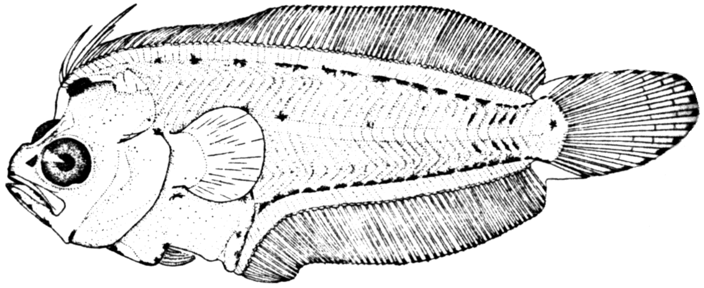

Figure 3.2e. 8.0 mm TL.

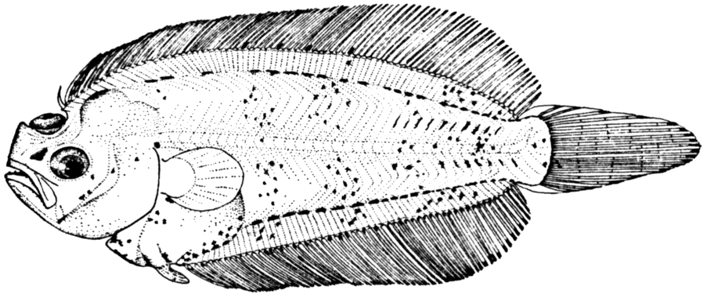

Figure 3.2f. 11.0 mm TL.

Figure 3.2. Typical larval stages of *Paralichthys* sp. (from Hildebrand and Cable, 1930).

Table 3.6. Comparisons of morphometric characters for southern and gulf flounder (Gutherz 1967).

Character Type	Southern Flounder	Gulf Flounder
Dorsal fin rays	80 to 95	71 to 85
Anal fin rays	63 to 74	53 to 63
Pectoral fin rays (ocular side)	11 to 13	10 to 12
Gill rakers (upper & lower arch)	2 to 3 + 8 to 11	2 to 4 + 9 to 12
Lateral line scales	85 to 100	47 to 60
Vertebral count (precaudal & caudal)	10 or 11 + 27 or 28	10 + 27
Body depth to standard length (%)	39 to 47	39 to 47
Eye diameter to head length (%)	15 to 19 (decreasing with increasing size)	17 to 21 (decreasing with increasing size)
Upper jaw length to head length	47 to 51 (increasing with increasing size)	46 to 50 (increasing with increasing size)
Pigmentation on ocular side	Ocular side light to dark brown with diffuse nonocellated spots and blotches that tend to be absent in large specimens. Blind side immaculate or dusky.	Ocular side light to dark brown with numerous spots and blotches; three most prominent spots ocellated and arranged in a triangular pattern, usually conspicuous but sometimes faint; other spots faint and usually not ocellated. Blind side immaculate or dusky.

In juvenile southern flounder (approximately 11 mm TL), the right eye is fully on the ridge of the head, and pigmentation has begun to change with new chromatophores more fully developed and appearing as faint crossbars on the left side, the right side remaining unchanged (Hildebrand and Cable 1930). In individuals 13 to 20 mm, the groups of chromatophores are more diffuse and so arranged to suggest broad cross bands. At about that size, specimens of gulf flounder somewhat resemble those of southern flounder. At 16 mm, both eyes are present on the left side, and the fish is beginning to look more like an adult in appearance. Pigmentation is more pronounced with numerous chromatophores on the left side of both the body and the fins. Small southern flounder, between 20 and 45 mm, show characteristic groups of chromatophores, each group consisting of a blotch-like concentration of minute pigment dots interspersed with coarser chromatophores. This grouped concentration of chromatophores gives a gross appearance of blotches which may be somewhat coalescent. The coarser chromatophores in southern flounder may be scattered between but are especially concentrated on the blotches. Specimens ≥50 mm generally have the color pattern of large fish. Sometimes the spots are saliently distinct in specimens up to about 150 mm. In such individuals, the three spots forming the large triangle are most prominent as in gulf flounder, but they are not ocellated. As both species grow, the eyes decrease in size relative to snout length, and the mouth has a more upward and forward curve (Hildebrand and Cable 1930).

In young gulf flounder examined, the three characteristic ocellated spots forming the large triangle are distinct in those as small as 17 mm and resemble those of the adults. The aggregations of coarse chromatophores overlaying the blotches which are present in southern and summer (*Paralichthys dentatus*) flounder are absent or very sparsely developed in gulf flounder. The other spots on the body are already present in fish between 17 and 30 mm in the form of small specks in five longitudinal rows, becoming large and diffuse in fish over 30 mm (Ginsburg 1952).

A description and comparison on the osteology of juvenile gulf, southern, and summer flounder from the southeastern Atlantic coast was given by Woolcott et al. (1968). By the time most fish are 50 mm SL, they have acquired most of the adult skeletal characteristics. Posterior extremity of maxillary reaches to a vertical through posterior margin of pupil at 35 mm SL, through posterior margin of eye at 50-100 mm, and past eye in specimens over 100 mm SL. Origin of dorsal fin is somewhat behind anterior margin in specimens under 100 mm SL. Accessory scales usually begin to appear in specimens 110-120 mm SL. Woolcott et al. (1968) found juvenile gulf flounder could be reliably separated from the other species by having lower pterygiophore, dorsal, and anal fin ray counts (Table 3.6). Delamater and Courtenay (1974) found all species of *Paralichthys* to have accessory scales, but because of the late appearance, the usefulness as a diagnostic characteristic for juveniles is limited.

3.2.1.2.4 Adults

Chief characteristics which distinguish *Paralichthys* spp. are of a meristic nature. Ginsburg (1952) stated that for the two common Gulf of Mexico species, the southern flounder may be readily distinguished from the gulf flounder by its distinctive color, all of the spots being diffuse, none especially prominent or ocellated (Figures 3.3 and 3.4). It may be possible that specimens of gulf flounder could be confused with those of southern flounder whenever the identification is based on the presence or absence of ocelli, since these are sometimes faint (Ginsburg 1952, Gutherz 1967). However, dorsal and anal ray and scale counts are reliable diagnostic characteristics for distinguishing the two species (Table 3.6). More detailed morphological descriptions of the two species may be found in Ginsburg (1952) and Gutherz (1967).

Accessory scales are rather sparse (may be more numerous in large fish) in southern flounder with more in the gulf flounder (Ginsburg 1952). The interorbital space in southern flounder is rather wide, becoming markedly broad in large fish and conspicuously more so than in gulf flounder. The body becomes deep in large individuals of southern flounder.

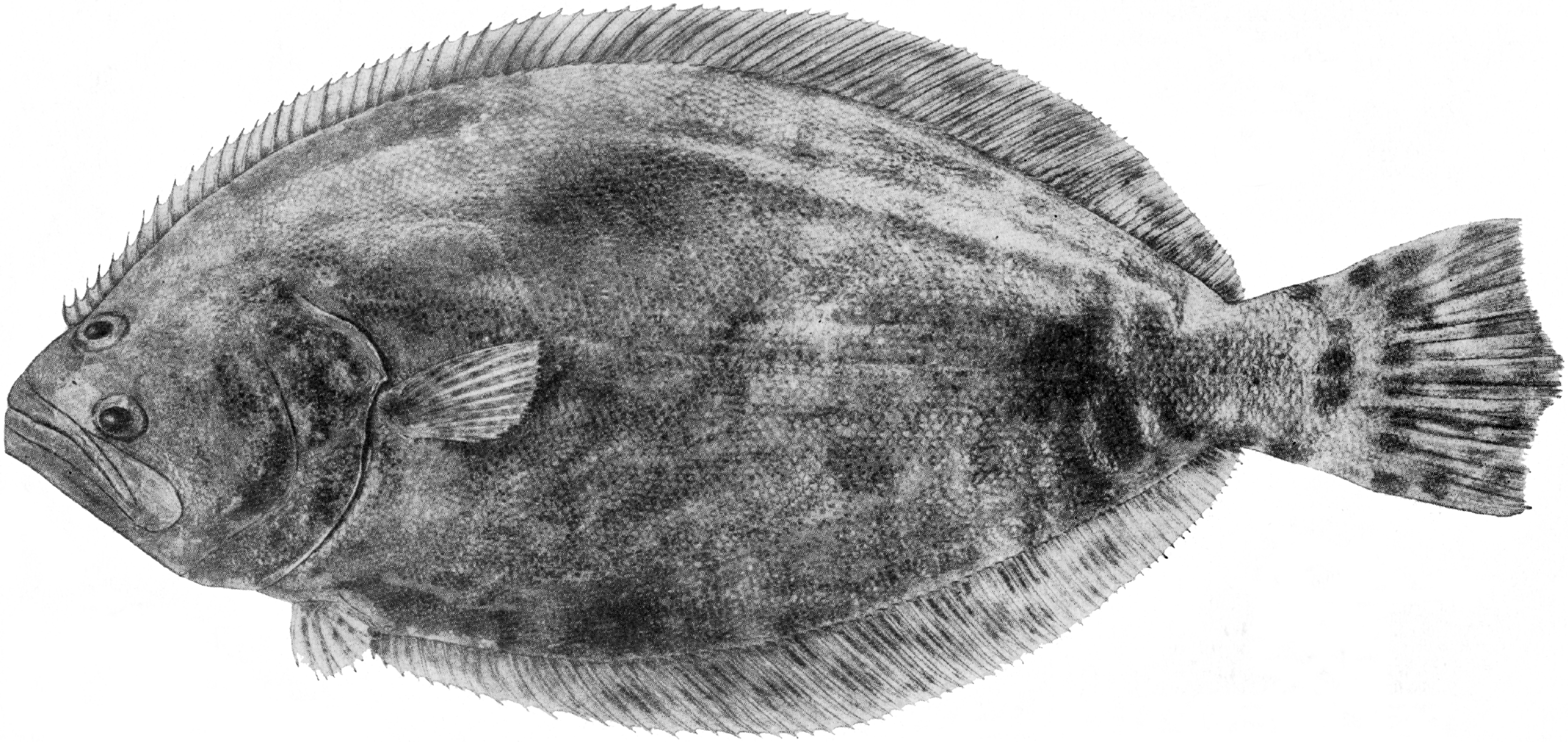

Figure 3.3. Adult *Paralichthys lethostigma*, 393 mm TL (from Ginsburg 1952).

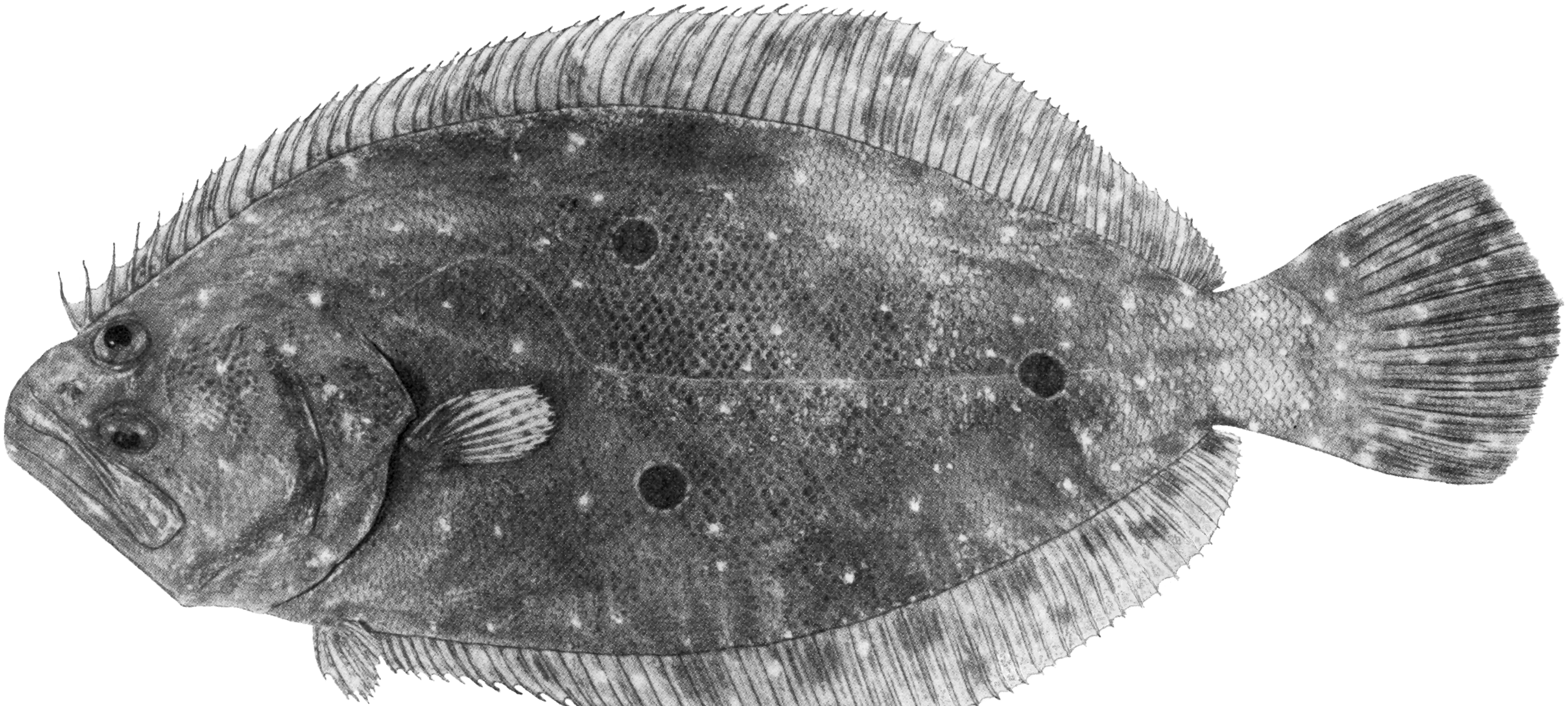

Figure 3.4. Adult *Paralichthys albigutta*, 373 mm TL (from Ginsburg 1952).

Ginsburg's (1952) description of the coloration for adult southern flounder is detailed below:

> "Body irregularly shaded with darker and lighter. The five longitudinal rows of spots more or less evident, usually diffuse, blending more or less with the darker shadings, and tending to disappear entirely in larger individuals. None of the spots ocellated. Sometimes the spots are saliently distinct in specimens up to about 150 mm, and in such individuals the three spots forming the large triangle are most prominent as in albigutta, but they are not ocellated. The relative intensity of the shadings on the body is subject to great variation as in related species; some specimens being very light all over, especially in life, and others being very dark. After being landed, specimens of this species usually have whitish spots irregularly snowed over the body; these usually disappear after the death of the fish, but are sometimes present also in preserved specimens."

The following description of the coloration for adult gulf flounder is from Ginsburg (1952):

> "The typical 5 longitudinal rows of spots more or less evident, diffuse. Most prominent spots on body, three in number, the perpendicular spot and two at anterior ends of the two intermediate rows, forming the angles of an imaginary scalene triangle; these three spots conspicuous and ocellated in the great majority of individuals, sometimes rather faint. Other spots on body fainter and mostly not ocellated; sometimes one or more ocellated spots at posterior end of subdorsal row, less frequently at posterior end of supra-anal row, and rarely at middle of intermediate rows. Body variously shaded with light and dark hues. Frequently quite light and sometimes notably dark, the ocellated character of the three spots in such specimens sometimes faint, but these spots nearly always rather more prominent than the other blotches on the body. Individuals frequently snowed over densely with white spots, tending to disappear after death but frequently persistent in preserved specimen."

3.2.1.2.5 Anomalies and Abnormalities

The types of anomalies encountered in the family Bothidae can be grouped into either pigmentation or structural abnormalities, or in some cases, both. Hoese and Moore (1998) refer to "reversal" in members of the Bothidae family as "possessing internally correct features while exhibiting external features on the wrong side." Although this is rare in both southern and gulf flounders (Hoese and Moore 1998), Gutherz (1967) reported "reversal" as being common in 40%-60% of various Pacific bothid species. Reported pigmentation abnormalities in bothids include partial or complete ambicoloration, in which part or all of the blind (right) side of the fish is pigmented in addition to the normal (left) pigmented side (Norman 1934, Gudger 1935). In some cases, fish have developed both reversal and ambicoloration characteristics (Deubler and Fahy 1958, White 1962). Albinism has also been reported in flatfish (Dawson 1967, Hoese and Moore 1998). Theories explaining the cause of ambicoloration include: prolonged pelagic stage (subjecting the future blind side to prolonged light) exposure to prolonged periods of light on the blind side after metamorphosis (Norman 1934, DeVeen 1969, Gartner 1986); germinal factors, disruption of embryonic transformation mechanisms and mutations (resulting in secondary bilateral symmetry), and injuries of the vertebral column during development (Norman 1934); susceptibility of larval hatching in total darkness and low food levels during larval rearing (DeVeen 1969); temperature during larval development (DeVeen 1969, Gartner 1986); and depth of occurrence (Gartner 1986).

Complete ambicoloration is usually associated with hooked-shaped dorsal fin and incomplete migration of the eye (Dawson 1962). Gudger and Firth (1936) examined several partial ambicolored, four-spotted flounder (*P. oblongus*) and concluded that whenever the entire lower body of the blind side is pigmented and one-quarter to one-third of the head on the blind side is pigmented, the rotating eye will not complete migration beyond the dorsal crest and the anterior dorsal fin will be hooked. Gray (1960) also described a partial ambicolored southern flounder and noted the presence of a “hooked” dorsal fin on this specimen. Powell and Schwartz (1977), using radiographic examinations of southern flounder, found incomplete ambicolorates manifested no structural abnormalities while totally ambicolored specimens possessed atypical osteological structures in the orbital region and "hooked" dorsal fins. They believed skeletal damage did not cause ambicoloration or the hooked conditions in southern flounder. Dawson (1967) described two southern flounder with osteological and pigmentation abnormalities, one with pterygiophore and the other with vertebral abnormalities. In another publication, Dawson (1969) described a nearly total ambicolorate southern flounder with a hooked dorsal fin and partially rotated eye and another specimen with a combination of melanism, albinism, and xanthochromism (golden-yellow coloration). Several southern flounder of various stages of ambicoloration have been collected in Louisiana (specimens on file, LDWF). Deubler and Fahy (1958) described a reversed ambicolorate summer flounder from North Carolina. This specimen possessed both eyes on the right side of the head, rather than the left, and the right pectoral fin, normally the shorter, was longer than the left.

Powell and Schwartz (1972) described the caudal structure of a double-tail southern flounder from North Carolina waters, as well as other pigment anomalies of the genus *Paralichthys*. Ginsburg (1952) reported pectoral fin abnormalities in one specimen that possessed no pectoral rays on the eyed side and 11 on the blind side.

Morphological anomalies of gulf flounder have been reported in the literature and follow the patterns seen in other Paralichthids. White (1962) described a reversed ambicolorate postlarval gulf flounder from Bogue Sound, North Carolina, which represents the first reported reversal and ambicoloration of this species. This flounder was a 8.5 mm SL postlarval individual with pigmentation on both sides of the body and the migrating eye located on the dorsal ridge. The hooked dorsal fin, present on all other complete ambicolorates, was likely not yet developed in this postlarval flounder. A partial ambicolorate gulf flounder from Tampa Bay, Florida, was reported by Hoff (1969). In his specimen, the pelvic fin on the blind side was equal in length to that of the eyed side. Pelvic fins are usually unequal in length in paralichthid flounders. Although the entire head was unpigmented on the blind side and the rotated eye was completely migrated, this specimen possessed a slightly hooked anterior dorsal fin.

3.2.2 Age and Growth

White and Stickney (1973) and Ginsburg (1952) referred to southern flounder as the largest bothid flounder of the Gulf coast. Jordan and Gilbert (1883) reported the largest southern flounder in South Carolina to be 762 mm TL. The largest specimen examined by Ginsburg (1952) from North

Carolina was 660 mm TL, and the largest specimen reported by Nall (1979) from the northern Gulf of Mexico was 585 mm TL. Hoese and Moore (1998) reported this species reaches a length of 910 mm TL, and Pew (1966) reported weights of up to 11.8 kg. The all-tackle world record for recreationally-caught southern flounder was landed in 1983 in Nassau Sound, Florida, and was 838 mm TL and 9.3 kg (see Table 6.13).

Yolk sac larvae of laboratory-spawned southern flounder measured 1.2-1.4 mm TL with a 0.7 mm long yolk sac containing a single oil globule at its posterior edge (Lasswell et al. 1978). Metamorphosis of southern flounder laboratory-cultured yolk sac larvae began at 40-46 days (8-11 mm TL) and was complete at 50-51 days, after which time fingerlings became completely demersal (Arnold et al. 1977). In preserved postlarvae collected for growth studies, Deubler (1960) measured 8-12 mm SL southern flounder which weighed 15 mg. In January, Wenner et al. (1990) found newly recruited southern flounder young-of-the-year (YOY) were 10 mm in length (after preservation) and ranged between 20-130 mm by May according to modes of progressive monthly histograms.

Wenner et al. (1990) found little growth of southern flounder in shallow marsh habitats from January through March in South Carolina. As water temperatures warmed to 20°C in May, growth rate and average size accelerated. White and Stickney (1973) found water temperatures below 20°C and above 30°C to retard growth and suggested the optimum was within the 20°-30°C range. Deubler (1960) and Deubler and White (1962) noted better postlarvae growth at cooler temperatures and higher salinities (30‰). Postlarval southern flounder seek lower salinity water in the spring, summer, and fall and return to more saline waters in winter as they approach age-1. Stickney and White (1974a) found postlarval southern flounder growth most rapid at salinities as high as 30‰. Salinity requirements change rapidly with age, and within a few months, juvenile southern flounder grow most rapidly at low (5‰-10‰) salinities. These changes probably relate to their normal migrational patterns.

Etzold and Christmas (1979) indicated there was some evidence of differing growth rates from various areas. Stickney and White (1974a) found five-month old southern flounder to average 28 g in North Carolina and 15 g in Georgia. Growth in North Carolina required ten weeks for a 500% weight increase from the initial 0.5 g. Christmas and Waller (1973) collected individuals less than 38 mm TL in March, April, and May in Mississippi estuaries. Young fish from 17-40 mm TL were caught in Aransas Bay, Texas, during December, February, March, and April (Gunter 1945). The youngest fish were 80 mm TL in May and increased rapidly during summer. Martin and McEachron (1986) reported that mean lengths of southern flounder in Texas waters increased from 42 mm TL in February to 66 mm TL in March. Powell and Schwartz (1977) reported 130 mm TL southern flounder by December of the first year while Ross et al. (1982) found 60-160 mm TL fish in October and November. Analysis of otoliths confirmed the YOY grew to 170 mm in June, averaging 210 mm by November (Wenner et al. 1990). Their age/growth observations indicated 90-100 mm TL fish taken in spring may have been slow growing age-1 juveniles recruited the previous year.

In his review of age/growth studies of *Paralichthys,* Gilbert (1986) noted analysis of size classes may be of limited value because of variable individual growth rates and protracted spawning seasons. In North Carolina, Fitzhugh (1993) found differential growth among age-0 southern flounder and attributed the broad variation in size differences of juveniles to differential growth rates among individuals rather than date of spawn. He also suggested ontogenetic change in diet (switch to piscivory) was a major contributing factor for growth differences among age-0 flounder. Growth rates might have also been influenced by size and availability of prey as well as environmental factors. His observed growth rates ranged from 0.35 to 1.5 mm TL/day (0.65±0.28 mm TL/day; mean±SD). In pond studies, Wright et al. (1993) noted instantaneous daily growth rates were determined to be 0.012 $g \cdot g^{-1}$ day^{-1} for small flounder (216 mm SL) and 0.0052 $g \cdot g^{-1}$ day^{-1} for large flounder (268 mm SL). Based upon multiple tag recaptures of five southern flounder in South Carolina, Wenner et al. (1990) estimated growth rate of 0.17 mm/day. Matlock (1985) estimated mean daily growth rate from tagged southern flounder at 0.647 mm TL/day for fish between 250-560 mm TL in Texas bays.

Wenner et al. (1990) calculated lengths of southern flounder based on von Bertalanffy's growth equation as listed in Tables 3.7 and 3.8. The von Bertalanffy growth parameters by various authors and locations are shown in Table 3.9. Most authors report similar parameters except Nall (1979), who predicted a theoretical maximum age of 20 years and a maximum SL of 1,461 mm. The oldest fish in Nall's study was ten years old; he suggested growth was limited by life span and not by maximum size. In contrast, most researchers believe in a much shorter life span and maximum size (Stokes 1977, Wolff 1977, Music and Pafford 1984, Palko 1984, Frick 1988, Wenner et al. 1990, Stunz et al. 1996). For example, Stunz et al. (1996) estimated the theoretical size of southern flounder at 309 mm and 660 mm TL for males and females, respectively.

Nall (1979) described growth of southern flounder as isometric where weight increased directly with length. Some length-weight relationships (male and female combined) calculated for southern flounder are:

Texas: Log_{10} (weight, g) = 3.13 $\log_{10}$ (TL, mm)-5.26 (Harrington et al. 1979)

Northern Gulf of Mexico: Log_{10} (weight, g)=3.10 $\log_{10}$ (SL, mm)-4.92 (Nall 1979)

Additional length-weight relationships and predictive equations are given in Table 3.10.

Aging techniques include length/frequency, dorsal and anal fin ray count, and use of scales and hard parts (otoliths and vertebrae). An evaluation of hard parts by Palko (1984) for determining age of selected fish, including gulf and southern flounder, revealed both otoliths and vertebrae were useful (the former giving the best results). Various authors have used scales and/or otoliths to age southern flounder and found annuli to be formed once annually (Music and Pafford 1984, Nall 1979, Stokes 1977, Wenner et al. 1990). Wenner et al. (1990) found annulus deposition began in January and was completed by April in most YOY. One translucent and one opaque ring were formed annually and were determined suitable for age estimates. Stunz et al. (1996), using marginal increment analysis, found one opaque band was formed on otoliths of southern flounder from Texas once each year during January to April.

Table 3.7. Mean observed total length (OBS TL) with sample size (n), standard deviation (SD), and predicted von Bertalanffy total length (VB TL) for each sex of southern flounder by yearly quarters; units are mm (Wenner et al. 1990).

	Males				**Females**			
Age	**n**	**SD**	**OBS TL**	**VB TL**	**n**	**SD**	**OBS TL**	**VB TL**
0.375	10	13	139	155	14	20	138	151
0.625	71	30	180	176	166	31	194	186
0.875	50	36	209	197	89	40	218	218
1.125	21	45	201	216	21	43	222	249
1.375	74	39	219	234	74	48	265	278
1.625	115	23	251	251	89	43	296	305
1.875	117	23	271	267	74	51	320	331
2.125	15`	21	378	282	7	42	346	356
2.375	18	30	399	296	65	52	404	379
2.625	47	37	322	309	56	50	427	400
2.875	28	31	316	321	56	56	409	421
3.125	0			333	47	172	452	440
3.375	4	46	310	344	21	52	488	458
3.625	3	50	328	354	18	48	448	475
3.875					10	71	464	491
4.125					2	62	564	507
4.375					0			521
4.625					5	73	520	535
4.875					2	229	493	547
5.125					0			559
5.375					1		572	571
5.625					4	37	546	582
5.875					1		571	592
7.125					1		703	634

Table 3.8. Mean observed weight (OBS WT) in g, total length (OBS TL) in mm, and predicted von Bertalanffy total length (VB TL) in mm for southern flounder by age in years (Wenner et al. 1990).

Age	Male					Female				
	n	OBS WT	n	OBS TL	VB TL	n	OBS WT	n	OBS TL	VB TL
1	320	180	327	248	206	251	298	258	288	234
2	99	350	108	310	274	173	869	184	410	344
3	7	335	7	316	327	49	1258	53	467	431
4						9	1908	9	524	499
5						6	2014	6	554	554
6						0		0		597
7						1	5000	1	703	630

Table 3.9. Estimates of von Bertalanffy growth parameters for southern flounder by author. Symbols are as follows: M = male; F = female; C = sexes combined; L∞ = asymptotic length (i.e., the mean length of the fish of a given stock would reach if they grew forever); K = curvature parameters of the von Bertalanffy growth formula, t_0 = the "age" of fish at length zero.

State	Sex	Unit of Measure	L∞	K	t_0	Notes	Author
Texas	M	TL (mm)	309	0.701	-0.421	Back-calculated models	Stunz et al. 1996
	F		660	0.209	-1.317		
Alabama/ Florida	F	TL (mm)	607	0.38	0.40	Age 1-3 Back-calculated models	Frick 1988
			734	0.21	-0.55	Age 1-5	
South Carolina	M	TL (mm)	518	0.246	-1.066	Mean observed length modals	Wenner et al. 1990
	F		759	0.235	-0.570		
NW Florida	C	SL (mm)	1461	0.0308	1.8629	Back-calculated model	Nall 1979*

*Subsequent studies have questioned the accuracy of these data.

Table 3.10. Length-weight relationships and predictive equations for southern flounder separated by sex (M = male, F = female, C = combined sexes). NA = not available.

State	Sex	Length-weight Relationship	Predictive Equations	Author(s)
Texas	C	Log_{10} W=3.13 Log_{10} TL-5.26 (r^2=0.984, n=2211)	TL=8.96+1.18 SL (r^2=0.995, n=2417)	Harrington et al. 1979
	M	Log_{10} W=3.31 Log_{10} TL-5.69 (r^2=0.975, n=33)	NA	Stuntz 1995
	F	Log_{10} W=3.30 Log_{10} TL-5.66 (r^2=0.991, n=206)		
	C	Log_{10} W=3.27 Log_{10} TL-5.61 (r^2=0.990, n=239)		
NW Florida	C	Log_{10} W=3.10 Log_{10} SL-4.92 (r^2=NR, n=175)	SL=5.34+0.82 TL (r^2=0.985, n=NR)	Nall 1979
South Carolina	M	Log_{10} W=3.17 Log_{10} TL-5.38 (r^2=0.984, n=675)	TL=6.95+1.19 SL (r^2=0.991, n=655)	Wenner et al. 1990
	F	Log_{10} W=3.15 Log_{10} TL-5.33 (r^2=0.995, n=926)	TL=9.09+1.18 SL (r^2=0.997, n=885)	
	C	Log_{10} W=3.13 Log_{10} TL-5.28 (r^2=0.994, n=1753)	TL=6.12+1.19 SL (r^2=0.997, n=1737)	
Georgia	M	Log_{10} W=2.98 Log_{10} TL-4.89 (r^2=0.95, n=12)	NA	Music & Pafford 1984
	F	Log_{10} W=2.97 Log_{10} TL-4.84 (r^2=0.98, n=105)		
	C	Log_{10} W=3.09 Log_{10} TL-5.16 (r^2=0.98, n=233)		

Various ages of southern flounder have been reported. Most authors report southern flounder females up to age-6 and males to age-3 (Stokes 1977, Wolff 1977, Music and Pafford 1984, Palko 1984, Frick 1988, Wenner et al. 1990, Stunz et al. 1996) (Table 3.11). However, Nall (1979) reported collecting a fish ten years of age.

A significant difference in growth rates was noted between male and female southern flounder beginning at ages-0 and 1 (Table 3.11). By December, male YOY averaged 263 mm TL and females 330 mm TL, and on an annual basis, age-2 females averaged 100 mm TL longer than males (Wenner et al. 1990). Stokes (1977) also reported males exhibited slower growth than females and did not exceed 320 mm TL. His data indicated five age classes of females (to 620 mm TL) and three age classes of males. He found males and females of equal size had comparable weights, but females at age were larger. In a northern Gulf of Mexico study, Frick's (1988) oldest, female southern flounder was an age-4, 623 mm TL fish; the oldest male was an age-1, 340 mm TL fish. He also noted the growth rate among females to be greater than males. Other published length at age estimates are listed in Table 3.11.

Gulf flounder do not get as large as southern flounder. Early reports by Ginsburg (1952) and Jordan and Swain (1885) gave 390 mm TL as the largest gulf flounder specimen examined. The largest female and male gulf flounder examined by Stokes (1977) was 420 and 290 mm TL, respectively. Vick (1964) reported an individual measuring 710 mm TL (sex not indicated) from St. Andrews Bay, Florida, but this may have been based on a misidentified specimen of southern flounder. However, Safrit and Schwartz (1988) supported Vick's reported size of gulf flounder using a length-weight regression of their own data from North Carolina. Their largest reported male and female gulf flounders were 426 mm and 673 mm TL, respectively. The largest specimen of gulf flounder examined by Nall (1979) was 467 mm TL (sex not indicated). The all-tackle IGFA world record for recreationally caught gulf flounder is 533 mm TL and 2.8 kg, caught in 1996 on Dauphin Island, Alabama (see Table 6.13).

In a technical report on the evaluation of aging determination for several species, Palko (1984) found five "mark groups" that are presumed to represent annuli from gulf flounder otoliths. Using otoliths for age determination, her back-calculated, weighted mean TL for gulf flounder were 152, 238, 332, 359, and 519 mm for mark groups I through V (ages 0-4), respectively. Palko's largest specimen examined was 548 mm TL. Palko (1984) concluded scales were not satisfactory aging structures for either southern or gulf flounder because of inconsistent or indistinguishable markings.

Only one published age and growth study on the gulf flounder exists (Stokes 1977). Based on 123 specimens, Stokes suggested that male and female gulf flounder from Aransas Bay, Texas, live only two and three years, respectively (Table 3.12). However, Stokes believed that older gulf flounder may reside in deeper water outside of his sampling area.

Table 3.11. Age/length estimates for southern flounder by author and area. Age corresponds to number of otolith annuli, except where noted. NR = not reported.

			Age										
State	**Sex**	**Unit of Measure**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**Author(s)**
TX	F	Observed TL	10-300	301-450	451-530	531-570	571-620						Stokes 1977
	M	Observed TL	10-230	231-280	281-320								
	F	TL[1]		253	328	402	429						Stunz et al. 1996
	M	TL[1]		194	252	284	292						
MS	NR	Mean TL	230	340	480								Etzold & Christmas 1979
FL/ AL	F	Weighted Mean TL		232	351	411	468	527[2]					Frick 1988
	M	Weighted Mean TL		179	278								
	F	TL[1]		258	366	422	474	527[2]					
	M	TL[1]		169	278								
FL (NW)	NR	Weighted Mean FL		115	210	283	326	332	376	420	426[2]	405[2]	Palko 1984[3]
GA	F	TL[1]		173	334	460	585	605	680				Music & Pafford 1984[4]
	M	TL[1]		119	244	342							
SC	F	TL[1]		234	344	431	499	554	597	630			Wenner et al. 1990
	M	TL[1]		206	274	327							

[1] Mean back-calculated lengths.

[2] Based on sample sizes ≤5 fish.

[3] Age corresponds to vertebral rings.

[4] Age corresponds to scale circuli.

Table 3.12. Age/length estimates for gulf flounder by author and area. Age corresponds to number of otolith annuli.

			Age							
State	**Sex**	**Unit of Measure (mm)**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**Author(s)**
Texas	F	Observed TL	10-290	291-360	361-420					Stokes 1977
	M	Observed TL	10-220	221-290						
Florida (E & W Coasts)	F	Mean SL	235	279	324	329	409[1]			FWC/FMRI unpublished data
	M	Mean SL	208	241	265[1]	260[1]	251[1]	296[1]		
FL (NW)	NR	Weighted Mean FL	152	238	332	359[1]	519[1]			Palko 1984

[1] Based on sample sizes ≤5 fish.

Preliminary age determination of 296 gulf flounder sampled from Florida's east and west coast (FWC/FMRI unpublished data) indicated individuals from Florida may live longer than those reported by Stokes (1977) from the Texas coastal waters. One age-5 male and three age-4 female gulf flounder were examined (Table 3.12). These data indicated males (n=51) reached a maximum size of 270 mm SL in their first year; the largest male was an age-1 individual at 368 mm SL. Female gulf flounder (n=245) grew to a larger size in their first year than males and reached a maximum of 293 mm SL; the largest female gulf flounder measured was 456 mm SL and was age-4 (Table 3.12). Recent aging of gulf flounder from St. Andrews Bay, Florida, by other researchers corroborate these findings (G. Fitzhugh personal communication).

Stokes (1977) reported upper weights for male gulf flounders in their first and second years at 0.15 kg and 0.27 kg, respectively. Upper weights for female gulf flounder in their first, second, and third years of life were 0.27 kg, 0.57 kg, and 1.01 kg, respectively.

Male gulf flounder from Aransas Bay, Texas, grew slower than females but had similar length-weight relationships (Stokes 1977). Based on 34 unsexed individuals, Nall (1979) calculated the length-weight relationship for gulf flounder from the northern Gulf of Mexico as:

$$\mathrm{Log}_{10}\,(\text{weight, g})=2.81\ \log_{10}(\text{SL, mm})-4.23$$

The length-weight relationship for gulf flounder (sexes combined) from Florida (FWC/FMRI unpublished data) was:

$$\mathrm{Log}_{10}\,(\text{weight, g})=3.104\ \log_{10}(\text{TL, mm})-5.196\ (r^2 = 0.992,\ n=376)$$

$$\mathrm{Log}_{10}\,(\text{weight, g})=3.029\ \log_{10}(\text{SL, mm})-4.769\ (r^2=0.992,\ n=998)$$

Length-weight relationships and predictive equations for gulf flounder are given in Table 3.13.

Based on 34 individuals, Nall (1979) reported gulf flounder from the northern Gulf of Mexico to have allometric growth (weight increases proportionally at a slower rate than length), whereas southern flounder have isometric growth. However, the isometric growth suggested by Nall (1979) does not agree with other studies of southern flounder, and its accuracy has been in question (Wenner et al. 1990). Nall's small sample size of gulf flounder precluded him from attempting any age and growth analyses with that species.

3.2.3 Reproduction and Genetics

3.2.3.1 Reproduction

3.2.3.1.1 Gonadal Development

Stokes (1977) first found sexual differentiation of southern flounder discernible when they attained approximately 170 mm TL and indicated both southern and gulf flounder females matured at two years of age in this Texas study. Southern flounder progressed from an immature to maturing stage during the first year. Adults in the developing stage began to enter the catch during mid-September. Developed stages were apparent from October through December and finally became gravid in December. All specimens examined exhibited early stages of gonadal development (I-III). Gravid fish were noted when they were age-2, and the initial spawn occurred when they were age-2 (Stokes 1977).

Table 3.13. Length-weight relationships and predictive equations for gulf flounder separated by sex (M = male, F = female, C = combined sexes). NA = not available.

State	Sex	Length-weight Relationship	Predictive Equations	Author(s)
FL NW	C	Log_{10} W=2.81 Log_{10} SL-4.23 Log_{10} (r^2=NR, n=34)	SL= -4.82+0.83 TL (r^2=0.999, n=NA)	Nall 1979
FL	C	Log_{10} W=3.104 Log_{10} TL-4.196 (r^2=0.992, n=376)	TL=1.70+1.20 SL (r^2=0.989, n=376)	FWC/FMRI unpublished data
		Log_{10} W=3.029 Log_{10} SL-4.769 ($r^{2=}$0.992, n=998)	SL=1.12+0.83 TL (r^2=0.989, n=376)	
NC	C	Log_{10} W=3.13 Log_{10} TL-5.24 (r^2=0.96, n=75)	NA	Safrit & Schwartz 1988

In a South Carolina study, first maturity of male and female southern flounder was noted at 230 mm and 320 mm TL, respectively. All males greater than 310 mm and females greater than 380 mm TL were mature (Wenner et al. 1990). Etzold and Christmas (1979) found southern flounder to become sexually mature by age-3 (338 mm SL) in Mississippi waters. They found the smallest, sexually mature fish at 229 mm SL. Music and Pafford (1984) found the smallest southern flounder for which sex could be determined through gross examination to be 130 mm TL (age-0) for females and 232 mm TL (age-1) for males. The smallest female captured with spawning potential (based on use of gonadosomatic indices) was 243 mm TL, while the smallest, potentially-spawning male was 170 mm TL in a Louisiana study (Shepard 1986). Recent histological work by Fischer (1999) indicates that spawning in southern flounder occurs for 60 days from December through January.

Gonadal development in 58% of the female southern flounder from Alabama was observed as early as August (Nall 1979) and occurred through December in Texas (Gunter 1945, Stokes 1977, Stunz et al. 1996). Gonadal Somatic Indices (GSI) by size categories for southern flounder collected from Matagorda Bay (Stunz et al. 1996) are listed in Table 3.14.

Based on gonadal examination, Topp and Hoff (1972) reported female gulf flounder mature at about 145 mm SL. Stokes (1977) indicated that gulf flounder contained maturing gonads at the end of their first year of life and had developed and/or gravid gonads from October through December of their second year of life.

Table 3.14. Gonadosomatic index (GSI) by size category for male and female southern flounder collected from Matagorda Bay, Texas, from September 1994 to January 1995. Numbers in parenthesis indicate sample size (Stunz et al. 1996).

	Mean GSI + 1 SD	
Size Categories	**Male**	**Female**
201-205	0.052 + .018 (5)	0.173 + 0.067 (27)
251-300	0.246 + .230 (13)	0.215 + 0.198 (38)
301-350	0.417 + .300 (13)	0.538 + 0.279 (20)
351-400		1.284 + 1.500 (45)
401-450		1.749 + 1.177 (38)
451-500		1.471 + 0.960 (11)

3.2.3.1.2 Spawning and Season

Virtually all spawning in both gulf and southern flounder occurs offshore, as adults which do not migrate offshore showed no further gonadal development in inshore waters (Stokes 1977, FWC/FMRI unpublished data). Additionally, tag returns indicated that for southern flounder along the Texas coast, it was probable that older males do not return to the bays after emigration, remaining instead offshore for the duration of their lives (Stokes 1977). He concluded that emigration of male southern flounder preceded that of females, and male flounder were not present in the samples after November 25. In this study, maximum emigration from Aransas Pass was between November 11-14. Benson (1982) also reported southern flounder spawned offshore and stated that waters 30-66 m deep were most often utilized.

The GSIs plotted by month indicated an increase in gonadal condition of females beginning in August and continuing to November for southern flounder caught in Louisiana (Shepard 1986). An observed decline in December indicated a peak in spawning activity for that month. The termination of the spawning season was not determined in this study, due to the lack of samples during the months of January through April. Henderson-Arzapalo et al. (1988) found southern flounder exposed to a four-month compressed conditioning cycle spawned from early December to February (Table 3.15).

Table 3.15. Gonadal condition of southern flounder exposed to a four-month compressed conditioning cycle, Perry R. Bass Marine Fisheries Research Station, Palacios, Texas, 1985-1986. Spawning occurred from December 8, 1985 through February 13, 1986. Tank temperature was kept at 18°C, photoperiod at 9 hrs light/day (modified from Henderson-Arzapalo et al. 1988).

Date	Females		Males	
	TL (mm)	Mean ovum diameter (mm) (± 1 SD)	Number with flowing milt	Number without flowing milt
September 4, 1985	430	no sample	0	4
	435	fluid only		
	452	no sample		
	522	fluid only		
December 6, 1985	415	no sample	0	4
	435	0.56 ± 0.12		
	440	fluid only		
	457	no sample		
	532	tissue and fluid		
December 20, 1985	410	1.05 ± 0.04	3	1
	437	0.52 ± 0.80		
	445	0.60 ± 0.08		
	468	0.56 ± 0.08		
	533	0.50 ± 0.05		
February 13, 1986	415	0.75 ± 0.30	3	1
	430	0.45 ± 0.24		
	445	0.69 ± 0.12		
	460	0.87 ± 0.28		
	535	0.60 ± 0.09		

Gulf flounder appear to spawn offshore in the Gulf of Mexico in the late fall and early winter, with some spawning occurring in the late winter (Ginsburg 1952). Hildebrand and Cable (1930) reported female gulf flounder with large roe in October and November near Beaufort, North Carolina. They concluded spawning occurred offshore, based upon the frequency and distribution of small fry near Beaufort Inlet. Reid (1954) reported that in the Cedar Key area, gravid females were collected in October, and based on young fish appearing in January, spawning probably occurs in late fall or early winter. Stokes (1977) suggests gulf flounder migrate from Texas bays to the Gulf of Mexico for spawning from mid-October through December. Macroscopic examination of 80 specimens by Topp and Hoff (1972) led investigators to conclude gulf flounder spawn in the Gulf of Mexico from November through February. They also examined ripe males in January from the northern Gulf of Mexico and spent females from Tampa Bay in February.

3.2.3.1.2.1 Courtship and Spawning Behavior

Lasswell et al. (1977) observed several spawning acts of southern flounder and reported each act to involve one male and one female. In each observation, the male released a small amount of sperm which may have been insufficient to fertilize all eggs released by the female.

Arnold et al. (1977) conducted laboratory experiments and reported courtship and spawning behavior of southern flounder (Table 3.16). They noted males attended females three weeks prior to spawning. Males followed females and positioned their heads near the female's vent when they rested. Actual spawning occurred at midday in the laboratory, near the surface, and only the larger (>2 kg) females spawned. They spawned more than three times each. They further classified southern flounder as serial spawners, having an extended spawning season of variable duration.

Table 3.16. Photoperiod and temperature regimes used to induce spawning of southern flounder in a 29.92 kl spawning tank, August 1976 through January 1977 (Arnold et al. 1977).

	Photoperiod (hrs)				
Month	**Light**	**Dark**	**Mean Temperature (°C)**	**Temperature Range (°C)**	**Laboratory Season**
August	15	9	26.5	26.0-27.0	Spring
September	12	12	26.5	25.5-27.5	Summer
October	12	12	22.8	20.7-25.0	Late Summer
November	9	15	17.0	16.0-19.5	Fall
December[1]	9	15	17.0	16.5-17.5	Fall
January[2]	9	15	17.0	16.5-17.5	Fall

[1] First spawn 12/21/76.

[2] Last spawn 1/3/77.

Sex ratios of southern flounder as reported by Music and Pafford (1984) may also affect reproductive success. An overall female to male ratio of 9.5:1 was recorded from a total of 116 southern flounder. Other female to male ratios have been reported by Stunz et al. (1996) from Texas (6F:1M) and Shepard (1986) who sampled 206 southern flounder in Louisiana (6.35F:1M). Colura (personal communication) suggests that a lower ratio of males (possibly due to bycatch) may lead to decreased spawning success and stated that a high number of males are necessary for mixing of milt and eggs for a successful spawn.

Observations of courtship and/or spawning behavior for gulf flounder have not been reported in the literature. Visual observations by researchers near Cedar Key, Florida, indicated spawning gulf flounder form aggregations consisting of up to forty individuals over natural and artificial reef habitat during winter months. Although actual spawning has not been observed, "pre-spawning" behavior consisting of several smaller males lying on top of a single female has been documented (F. Voss personal communication).

Sex ratio for gulf flounder were found to be 4.9F:1M from a total of 299 individuals collected in a statewide in the Fisheries Independent Monitoring Program in Florida (FWC/FMRI unpublished data). No other reports of sex ratios exist for gulf flounder.

3.2.3.1.2.2 Spawning Duration

During a laboratory spawning and larval study using six pairs of adult southern flounder, Arnold et al. (1977) observed spawning on 12 consecutive days after an initial spawn on December 21, 1976. Ginsburg (1952) and Hildebrand and Cable (1930) stated southern flounder may spawn for extended periods, although the general season was fall and early winter. In North Carolina, flounder spawning has been reported during fall and early winter, peaking in November and December (Ross and Epperly 1985, Smith et al. 1975).

Gunter (1945) and Simmons (1951) reported southern flounder spawning in winter, primarily November to January, along the Gulf of Mexico coast over the inner and central continental shelf. Southern flounder left a Texas bay to spawn in the Gulf of Mexico from October 16, 1974 through December 12, 1974 (Stokes 1977). Etzold and Christmas (1979) stated spawning took place in near offshore waters of Mississippi from September to January with peak activity occurring in October. Appearance of 90-120 day old flounder (20-50 mm) occurs annually in Weekes Bay, a small embayment connected to Mobile Bay, during March and April (ADCNR unpublished data). Gunter (1938) reported this species to spawn from September to April; Ginsburg (1952) concluded spawning activities extended from late fall to early winter.

The spawning period for gulf flounder, like that of southern flounder, is late fall-early winter (Ginsburg 1952). Stokes (1977) collected gravid females moving through the channels toward the Gulf of Mexico near Aransas Bay, Texas, from October through December. Topp and Hoff (1972) reported collecting ripe males and gravid females between 20-40 m depths in the eastern Gulf of Mexico from November through February. Young-of-the-year (YOY) gulf flounder are regularly collected in lower Perdido Bay and Little Lagoon, Alabama, from April to June (ADCNR unpublished data).

3.2.3.1.2.3 Location and Effects of Temperature, Salinity, and Photoperiod

Mass emigration of adults from bays and estuaries in response to colder water temperature has been reported for both southern and gulf flounders by numerous researchers (Hildebrand and Cable 1930, Gunter 1945, Ginsburg 1952, Reid 1954, Topp and Hoff 1972, Stokes 1977, and Benson 1982). Stokes (1977) reported emigration of both adult southern and gulf flounder from Aransas Bay, Texas, occurred when water temperatures declined approximately 4°-5°C (from an average of 23.0°C in October to 14.1°C in December). Gulf flounder from the Gulf coast of Florida follow a similar pattern of emigration following a drop in water temperatures during the fall and winter (Topp and Hoff 1972). These movements appear to be triggered by the onset of cold fronts (G. Fitzhugh personal communication and F. Voss personal communication).

Miller et al. (1984) suggested several advantages of winter spawning including: greater survival at reduced temperature associated with reduced metabolism, refuge from predation, and advantageous currents into nursery areas from offshore spawning grounds. Water temperature has a definite impact on stages of gonadal development in preparation for spawning. Arnold et al. (1977) induced laboratory spawning at a mean temperature ranging from 17.0°-26.5°C and a salinity of 28‰ (Table 3.16), similar to offshore environmental conditions in early winter.

Immigration of juvenile gulf flounder into the bays and estuaries began in December when water temperatures were as low as 13.8°C and peaked in March with temperatures near 16°C (Stokes 1977). Juvenile gulf flounder in Florida indicated a similar immigration pattern (FWC/FMRI unpublished data). In Charlotte Harbor and Tampa and Choctawhatchee bays, juvenile recruitment peaked in February, March, and April, respectively, when average water temperatures were near 18°C.

Normal winter spawning conditions of 18°C and a 9 hr light:15 hr dark photoperiod induced spawning in southern flounder exposed to a four-month compressed conditioning cycle (Table 3.17). Gonadal maturation and release of eggs occurred only when laboratory conditions patterned the natural season. Regardless of temperature and photoperiod manipulation, eggs were released only during December-February and were usually released between 0500-0900 hrs.

Egg releases began December 8, 1985 and continued through February 13, 1986. By March 31, 1986, all females were refractory (Henderson-Arzapalo et al. 1988). Arnold et al. (1977) reported similar results, as laboratory kept southern flounder spawned only at 17°C, 9 hr light conditions (Table 3.16). This characteristic may be physiologically regulated, as Hickman (1968) found adult southern flounder to exhibit seasonal changes in osmoregulatory processes. These changes corresponded to spawning migrations between estuarine and offshore waters. Stickney and White (1974a) also noted physiological adaptation to salinity appeared to change seasonally and with age.

Lasswell et al. (1977) acclimated newly metamorphosed southern flounder from 28‰-32‰ into fresh water (<1‰) within a three hour period and achieved 100% survival. They reported rapid growth of fish stocked into freshwater lakes (1.5 kg/yr) and noted a 14-month old fish weighing 2.0 kg which fed primarily on sunfishes. Lower salinity waters stress juvenile fish less, resulting in lower mortality and better growth (Stickney and White 1974a, Hickman 1968). Stickney and White

(1974a,b) reported southern flounder may not be physiologically adapted to lower salinities until late postlarval size, but Deubler (1960) demonstrated that they were able to survive and grow at salinities ranging from 0‰-30‰ without prior acclimation. Higher salinities were also indicated to be advantageous to rapid growth and larger sizes of postlarval southern flounder when food supply, temperature, and light were controlled (Deubler 1960). Although euryhaline, they grow most rapidly at high salinities (30‰) until reaching advanced postlarval stages, whereupon low salinity water is preferred. Deubler and White (1962) and Peters and Angelovic (1971) reported faster growth of southern flounder at higher salinities.

Table 3.17. Number of eggs released by captive southern flounder, Perry R. Bass Marine Fisheries Research Station, Palacios, Texas. Tank conditions were 18°C and 9 hr light:15 hr dark photoperiod except for the period from January 7 through March 25, 1985 when photoperiod was reduced to 4 hr light daily. ND = not determined (Henderson-Arzapalo et al. 1988).

1984-1985 Spawning Season		**1985-1986 Spawning Season**	
Date	**Number of Eggs**	**Date**	**Number of Eggs**
December 18, 1984	ND	December 8, 1985	5,000
December 19, 1984	ND	December 13, 1985	3,200
December 26, 1984	ND	December 17, 1985	2,900
December 31, 1984	ND	December 18, 1985	2,400
January 2, 1985	ND	December 24, 1985	1,400
January 3, 1985	ND	December 30, 1985	66
January 8, 1985	1,900	December 31, 1985	6,900
January 9, 1985	6,200	January 1, 1986	4,000
January 10, 1985	3,100	January 2, 1986	1,000
January 17, 1985	3,100	January 6, 1986	18,800
January 18, 1985	18,100	January 7, 1986	28,900
		January 10, 1986	1,500
		January 11, 1986	4,800
		January 13, 1986	9,500
		January 17, 1986	6,100
		January 24, 1986	6,100
		January 26, 1986	1,600
		January 29, 1986	4,700

1984-1985 Spawning Season		1985-1986 Spawning Season	
Date	Number of Eggs	Date	Number of Eggs
		January 30, 1986	2,800
		January 31, 1986	20,500
		February 1, 1986	1,900
		February 7, 1986	3,200
		February 9, 1986	3,500
		February 13, 1986	28,400

Little information is available concerning acceptable or preferred dissolved oxygen (DO) levels, although Burdon (1978) reported collecting fish from 4.0-10.5 ppm.

Paralichthid larvae evidently are more light sensitive than other common species and exhibit somewhat different diurnal behavior. Weinstein et al. (1980) found numbers of paralichthid larvae collected at night exceeded those taken during daylight. They also found a tidal response exhibited by paralichthid (presumably southern flounder) larvae. Apparently they settled to the bottom during ebb tide and rose to the surface during flood tide, resulting in a net landward transport. This characteristic was thought to enhance the ability of larval stages to penetrate freshwater streams.

3.2.3.2 Migration and Larval Transport

Benson (1982) described southern flounder as a "euryhaline, estuarine dependent bottom fish" seasonally distributed from deep Gulf waters (110 m) to shallow estuaries. Influx of YOY into estuaries and a movement into more saline waters with growth indicates southern flounder migrate seasonally through a salinity gradient, moving from lower salinities of the estuaries in spring to higher salinities offshore during winter.

Simmons and Hoese (1959) noted an intense seaward movement of these fish during fall months associated with declining water temperatures; by November/December all recorded movement was Gulfward. Stokes (1977) found adult southern flounder leaving Texas bays from mid-October to mid-December, peaking in mid-November. This seasonal movement was also associated with a 4°-5°C decrease in water temperature. Arnold et al. (1960) reported a "fall run" of southern flounder in October and November at Galveston Island, Texas, which was thought to be associated with spawning activities. In contrast, moderate to warm winters can cause departure from bays to occur over an extended period rather than a mass exodus following a severe cold front (Hoese and Moore 1998).

In laboratory experiments, Peters (1971) and Peters and Angelovic (1971) found juvenile southern flounder grew optimally at low salinities and high temperatures. Stickney and White (1974a) reported advanced postlarval fish preferred lower salinities (5‰-15‰) and proposed the physiological adaptation to salinity which changes seasonally and with age might relate to migration.

Because temperature and salinity influence food conversion in southern flounder, seasonal migrations afford fish with optimal conditions that maximize conversion efficiency and growth, provided there is sufficient availability of food (Peters and Kjelson 1975). Hickman (1968) found the kidney of southern flounder to possess the ability to function differently in fresh water than in seawater, an essential process for euryhaline species.

Other researchers describing a fall and early winter migration include Hildebrand and Cable (1930), Kelly (1965), Hoese and Moore (1998), and Shepard (1986). Some authors included older juveniles along with adults in this Gulfward movement (Ginsburg 1952, Fox and White 1969, Stokes 1973, Powell and Schwartz 1977, Randall and Vergara 1978). Although some YOY leave estuaries in the fall, most remain and overwinter in deeper holes and channels (Gunter 1938, 1945). Ogren and Brusher (1977) and Stokes (1977) also noted some adults remained and utilized deeper portions of the estuary during winter. Fisheries Independent Monitoring data from Florida suggest that some gulf flounder adults may remain within bays and estuaries during winter months and not migrate offshore. A large number of gulf flounder over 250 mm SL were collected in nearly every year sampled from Tampa Bay, Charlotte Harbor, and Choctawatchee Bay/Santa Rosa Sound during October through January (FWC/FMRI unpublished data). In Texas, Stokes (1977) reported highest winter catches within bays at stations along or within the Gulf Intracoastal Waterway. In North Carolina, Devries and Harvell (1982) believed some southern flounder overwintered in the Pamlico River or returned there the following spring or summer from areas of deeper water.

From the time of recruitment, age-0 and 1 southern and summer flounder were abundant in North Carolina estuaries for 18-20 months with age-1 moving seaward by mid to late summer of their second year (Powell and Schwartz 1977). Analysis of length/frequency data for southern flounder led Devries and Harvell (1982) to suggest a higher proportion of age-2 or older fish migrated to the ocean in the fall than age-1 fish. Smith (1981) stated YOY southern flounder remained in and utilized nurseries up to their second year of life. In seaward migrations during fall months, males appeared to leave estuaries earlier than females (Simmons 1957, Simmons and Hoese 1959, Stokes 1977).

Stokes (1977) found inconsistent movement patterns between and within bays and reported one tagged southern flounder recaptured 77.2 km northeast of the tag site. Green (1986) accumulated 25 yrs of fisheries independent program tag and release data from coastal Texas waters. Results indicated the majority (58%) of southern flounder were recaptured within five km of the tagging location and 69% within the same bay system. Most recaptures were within 90 days of release. During a four-year study in coastal Georgia, the average time at large for tagged southern flounder was 215 days with normal movement of 54 km. Only 32% of all recoveries were within the estuary of release and occurred during summer and fall. Greatest recorded movement outside the estuary was seaward toward warmer, higher salinity waters in the fall (Music and Pafford 1984). In North Carolina waters, Devries and Harvell (1982) received most southern flounder returns in less than 40 days within 6.4 km of the release site. Intermediate and long-term returns indicated a seaward movement. Similar results were noted by Monaghan (1992) in North Carolina waters and Wenner et al. (1990) in South Carolina waters. These studies reported some individuals traveled considerable distances: Music and Pafford (1984), 556 km; Monaghan (1992), 428 km; Wenner et al. (1990), 404.7 km in 472 days; Green (1986), 15.2% moved >40 km; and Devries and Harvell

(1982), several in excess of 322 km with one at 740 km and another moving 645 km in 131 days, averaging 4.9 km/day.

Shallow marsh lakes and blind bayous were believed to be prime habitat for early immigrating southern flounder in a Texas river delta (Conner and Truesdale 1972). Estuarine habitat is an important nursery area for some euryhaline transient species for a period of time, although residence time in these low salinity intertidal habitats utilized for postlarval and early juvenile development is relatively short (Rozas and Hackney 1984). They proposed that young utilized other areas for further development. Rogers et al. (1984) found an abundance of southern flounder recruits used shallow nursery areas on a size-specific basis. They suggested fish moved toward deeper, more saline waters as size increased. Deubler and Posner (1963) found southern flounder postlarvae to actively migrate from areas where DO was below 3.7 ppm. This response was the same regardless of temperature. They also reported postlarvae to retreat from water temperatures over 25.3°C.

A number of researchers have described the movement of southern flounder into fresh water (Perret et al. 1971, Dahlberg 1972, Swingle and Bland 1974, Hoese and Moore 1998, Yerger 1977, Etzold and Christmas 1979, Epperly 1984, and Rogers et al. 1984). Utilization of these more inland, less saline areas during recruitment was followed by movement to more saline areas with growth (Rogers et al. 1984). Simmons (1957) reported southern flounder in 60‰ salinities, though sharply limited in distribution above 45‰. Generally, preference appears to be within the 5‰-20‰ range, as indicated by Gunter (1945), Williams and Deubler (1968), Tarver and Savoie (1976), and Epperly (1984). Effects of salinity on advanced postlarval southern flounder indicate a preference of 5‰-15‰ and suggest a physiological adaptation to a seasonal distribution pattern which appears to change seasonally and with age (Stickney and White 1974a). White and Stickney (1973) also reported a change in optimum salinity with age for southern flounder. Adults sought high salinity waters in winter and returned inshore the following season (Stickney and White 1974a).

Southern flounder have been found in large numbers as far as Fort Jackson, Louisiana, on the Mississippi River which is at least 29 km upriver from the nearest outlet to Breton Sound (P. Cooper, Jr. personal communication). Southern flounder have also routinely been captured at least 13 km upriver in the Atchafalaya River in Louisiana (G. Adkins personal communication). Gunter (1956) includes southern flounder in his list of euryhaline fishes of North and Middle America. Darnell et al. (1983) found larger concentrations of this species in relatively deep water west of the Mississippi River and shallow waters just offshore of Texas. Tagatz (1967) reported collecting southern flounder in waters from 16-135 km from the mouth of the St. Johns River on the east coast of Florida and in salinities ranging from 0.0‰-30.2‰.

Swingle (1971) found southern flounder to be most abundant in May, June, and July with equal distribution from fresh water to 30‰. Southern flounder have been collected from both the Alabama and Tombigbee rivers over 100 river miles above the head of Mobile Bay (Mette 1996).

A schematic model of the life history of southern and gulf flounder is illustrated in Figure 3.5. Following a winter spawn on the continental shelf, eggs and early life stages drift passively toward estuaries with prevailing currents. In North Carolina waters, Miller et al. (1984) analyzed shelf currents and believed larval distribution more likely a function of currents than active swimming. In a North Carolina estuary, peak recruitment of fall and winter spawned larvae coincided with favorable growth and survival conditions. The extended period of recruitment ensures survival of at least some larvae during favorable conditions (Warlen and Burke 1990). In North Carolina, peak recruitment of southern flounder occurred from April-June (Ross and Carpenter 1983). Ross and Epperly (1985) proposed an April or May peak in Pamlico Sound, North Carolina, while Rozas and Hackney (1984) described a March peak in North Carolina oligohaline marshes.

Southern flounder larvae have been collected as early as November from east coast waters but no earlier than December along the Gulf coast with some variation among researchers by area. Most agree on a peak arrival in the estuaries from February-March (Table 3.3). Smallest individuals and maximum inshore migration was noted in February by Stokes (1977) in the area of Aransas Bay, Texas, with the earliest immigrants arriving in January. Martin and McEachron (1986) reported juvenile catch rates of immigrating juvenile southern flounder in and near Texas Gulf passes to be significantly variable among bay systems. Juvenile densities ranged from 1.3-239.6 flounder/ha (Cedar Bayou and San Luis Pass). McEachron and Fuls (1996) reported the highest catch rates of juvenile southern flounder occurred in the Galveston Bay system followed by Sabine Lake and East Matagorda and Aransas bays.

In a Georgia salt marsh, Rogers et al. (1984) found recruitment to terminate in March which coincides with peak abundance. Etzold and Christmas (1979) reported an inshore movement of recruits from December through May in coastal Mississippi.

In Louisiana, studies in the major estuarine systems indicated initial arrival of southern flounder recruits in January, increasing in February and March, and continuing through April (Table 3.3). Size at recruitment ranged from a 0-5 mm SL group in January (Rogers and Herke 1985) to 51 mm TL in April (Norden 1966). Rogers and Herke (1985), while investigating arrival of YOY in southwest Louisiana marshes, found catch/sample occurring in two peaks (February and March). Felley (1989) reported juvenile southern flounder appeared during spring months (March-May) in the Calcasieu Lake estuary, Louisiana. Norden (1966) also collected 11-30 mm TL juveniles in March, while Gunter (1938) found numerous small southern flounder (50-100 mm TL) along outer beaches of Barataria Bay, Louisiana, during April and larger fish (120-150 mm TL) in trawl catches one to two months later. Southern flounder juveniles 21-24 mm TL were collected during January near Chandeleur Island, Louisiana, by Laska (1973). He also reported two individuals measuring six and seven mm TL (presumably southern flounder) and 20 others ranging from 15-31 mm TL during March. By May, young flounder had attained 55 mm TL, and one specimen of 88 mm TL was measured in June.

As with southern flounder, gulf flounder larvae begin to move shoreward with the tides beginning in December. Larvae were reported offshore near Tampa Bay, Florida, from December through early March (Topp and Hoff 1972). Reid (1954) reported first collecting young fish, 10-15 mm, in January in the Cedar Key area of Florida. The periodicity of recruitment of young juvenile flounder into the bays and estuaries may be geographically variable. Preliminary data from the west coast of Florida (FWC/FMRI unpublished data) indicate that there may be a relationship between the latitude and/or mean temperature of the bays and the patterns of recruitment. Data from Charlotte Harbor, along the southwest Florida coast, indicated recruitment of young fish (10-50 mm SL) reached a peak in February while recruitment in Tampa Bay peaked in March. In Choctawhatchee Bay along the Florida Panhandle, juvenile recruitment did not peak until April.

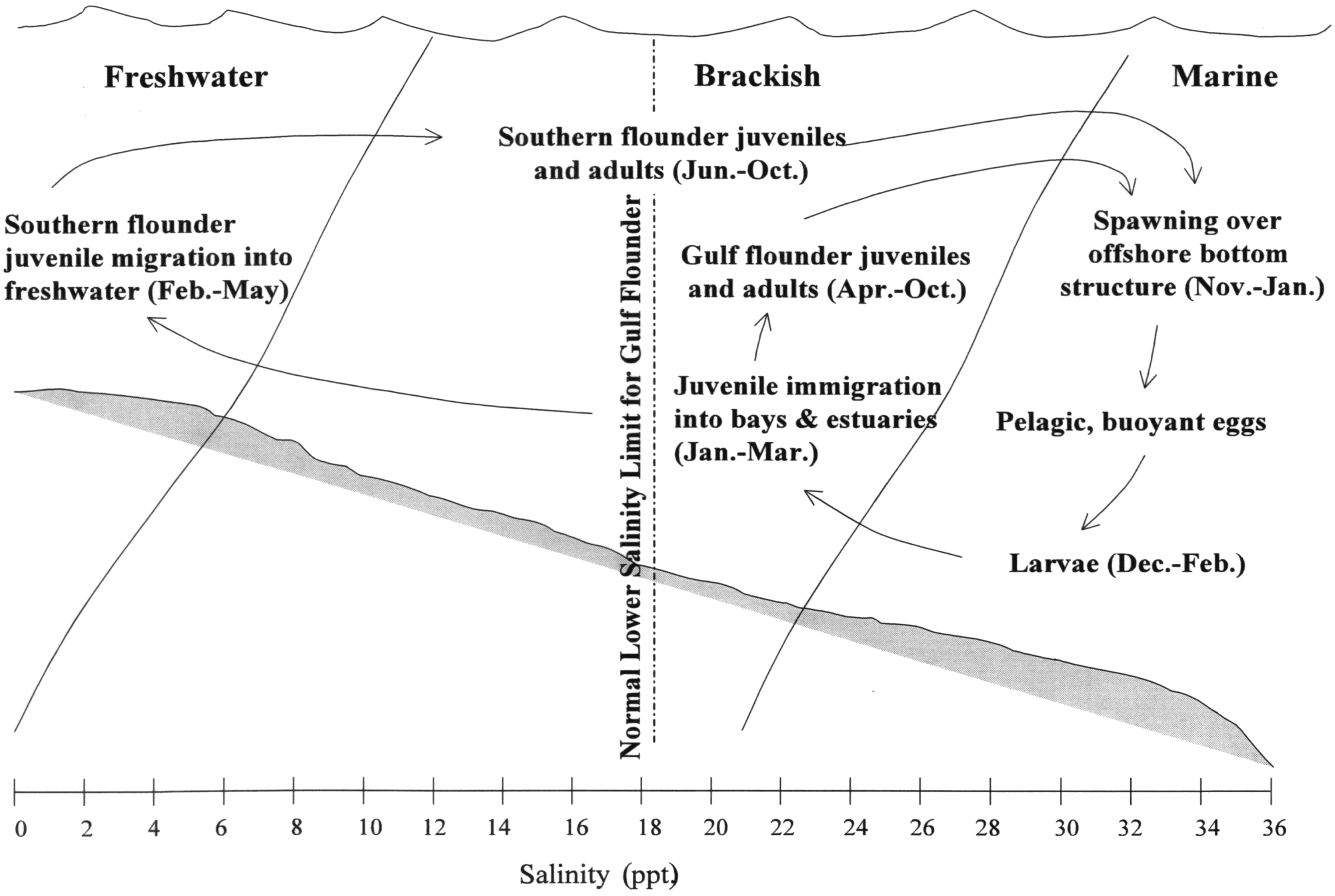

Figure 3.5. Schematic model of life history stages for southern and gulf flounder.

Williams and Deubler (1968) reported southern flounder postlarval immigration related to lunar phase, but no correlation was found between rate of immigration and wind. King (1971), however, found the rate of immigration of paralichthid postlarval species in Texas waters was significantly correlated with wind direction, and immigration was greatest during onshore or southerly winds. His data also indicated higher rates of immigration with increased salinities and current velocities along with more turbid water and increased tidal amplitude (including duration of flood tides). King (1971) further recorded postlarval *Paralichthys* spp. in greatest numbers near the sides of channels and slightly higher numbers near the west bank as opposed to the east bank of the Cedar Bayou, Texas, inlet. Horizontal distribution was uneven within the inlet. No correlation was noted between rate of ingress and air or water temperatures, although Stokes (1977) found immigration beginning in Texas at water temperatures as low as 13.8°C and peak influx at 16.0°-16.2°C for southern flounder.

Immigration of juvenile southern flounder began during February 1974 and January 1975 near Aransas Pass, Texas (Stokes 1977). As indicated by the incidence of capture, February was the month of greatest immigration during both years. Using dredge and minnow seines, juveniles were recorded in passes near the Gulf first, inshore channels second, and inshore bays last. They were most numerous in bays during spring months, peaked in June or July, and decreased thereafter. Sampling gear avoidance by larger fish was thought to be the main reason for decreased catch.

Smith (1981) reported localized movement associated with tidal stages, as southern flounder moved on and off of shallow bars and flats with the rise and fall of tides. In a southeast Louisiana tidal pass, Sabins (1973) and Sabins and Truesdale (1975) noted juvenile southern flounder catch appeared to be affected by tidal stages more than light cycles. He described the tendency for young to concentrate along channel edges, especially in quieter waters along the western edge of the tidal channel during ebb tide and then move inland with flood tides. Both papers suggested similar diel patterns among immigrating YOY might aid individuals to maintain a shoreward transport and avoid being flushed seaward. Weinstein et al. (1980) presented similar findings from North Carolina estuaries.

Although southern flounder larvae were not abundant south of Cape Hatteras, North Carolina, they were collected on the outer half of the shelf (Smith et al. 1975). It was postulated that some of those larvae were spawned locally, while others were transported into the area surveyed from southern spawning grounds.

In North Carolina estuaries, peak recruitment of juvenile *Paralichthys* spp. usually occurred when stratification and tidal exchange ratios were at a yearly maximum. To avoid being flushed from the estuary following recruitment, flounders exhibited behavioral responses to photoperiod and tide (Weinstein et al. 1980). They suggested postlarval transport into the marshes and freshwater areas was enhanced by a surface migration on flood tides at night and "riding out" ebb tides on or near the bottom. The study implied tidal response might be the primary mechanism utilized by postlarval flounder to reach suitable nursery habitats. Deubler (1958), Tagatz and Dudley (1961), and Williams and Deubler (1968) found southern flounder postlarvae to enter North Carolina estuaries during winter. Following a late fall/early winter oceanic spawn (Smith et al. 1975), southern flounder larvae were collected during nighttime flood tides as they entered North Carolina estuaries (Warlen and Burke 1990). In a study spanning four winters in two North Carolina estuaries, Burke et al. (1991) collected metamorphosing, planktonic larvae from late November to mid-April with a peak in February. Recruits initially settled on high salinity intertidal flats followed by upstream movement toward the head of the estuary where they settled on shallow tidal flats with muddy substrates. Salinity affected distribution more than substrate. According to Powell and Schwartz (1977), advanced juvenile southern and summer flounders sought out nursery grounds in North Carolina estuaries characterized by low salinities and muddy substrates. During March, YOY ranging from 10-40 mm TL were first captured in estuarine waters of North Carolina. Young juveniles apparently sought upper reaches of tributaries during recruitment, as they were captured in open water areas until April at which time very few were observed. Flounder catches were dominated by YOY in the northern tributary system and ranged 18-65 mm TL in size (Powell and Schwartz 1977). Southern flounder YOY were also found to appear in maximum numbers during spring in North Carolina by Ross et al. (1982) which corresponded to larval and juvenile recruitment patterns of the majority of estuarine dependent species

Juveniles decreased rapidly in numbers in upper creeks after April in the southern area of North Carolina and movement was completed by July. In the northern area, flounder utilized shallow tributaries through July, with decreasing numbers noted thereafter. Turner and Johnson (1973) reported similar findings from South Carolina when they found large numbers of small southern flounder in tidal streams, with most occurring in April. They stated these were all YOY moving into nursery areas.

Other studies indicated migration of postlarval and juvenile southern flounder toward freshwater or low salinity intertidal zones (Hildebrand and Cable 1930, Powell and Schwartz 1977, Weinstein 1979, Weinstein et al. 1980, Smith 1981, Ross et al. 1982, Rogers et al. 1984, and Rozas and Hackney 1984). In South Carolina, Wenner et al. (1990) noted distribution of YOY southern flounder (January-April) was nearly three times greater at the farthest upriver station than at the site nearest the ocean. Rogers et al. (1984) found the highest abundance of recruits to concentrate in northerly estuaries in freshwater conditions and to utilize the shallow nursery area on a size-specific basis. As residence time and growth increased, movement toward more saline waters began. Since less saline headwaters of the total distribution range are utilized first with subsequent movement to more saline waters occurring with growth, there is a "filling up backward" of the nursery (Herke 1971, Weinstein 1979).

3.2.3.3 Fecundity

In a laboratory experiment, Arnold et al. (1977) observed southern flounder to spawn 13 times which produced a total of $1.2\text{x}10^5$ eggs with a fertilization rate of 30%-50%. Lasswell et al. (1977) reported three spawning southern flounder females to produce approximately 40,000 eggs each. The fertilization percentage and hatching rate was similar to that reported by Arnold et al. (1977), averaging only 26% and 50% for each, respectively. In another study, Lasswell et al. (1978) found southern flounder females to produce approximately 5,000 eggs per spawn that were fertilized (a fertilization rate of approximately 80%). These eggs hatched within 40 hrs at a water temperature of 22°C.

When reporting on flatfish in general, White and Stickney (1973) stated that females often release over 100,000 eggs per spawning season depending upon species. Henderson-Arzapalo et al.

(1988) reported a relatively low batch fecundity for southern flounder of 24 egg releases consisting of from 66 to 28,900 eggs occurring between December and February (Table 3.17). Based upon those data, they stated it was indicated that batch fecundity was inherently small when compared to most cultured flatfish species. Benson (1982) reported approximately 100,000 eggs during the entire spawning season for a single southern flounder. Fischer (1999) determined batch fecundity for southern flounder in Louisiana waters ranged from 14,046 to 68,829 ova per batch. He also reported spawning frequency ranged from once every 3.6 days (in 1991) and once every 6.4 days (in 1993). No fecundity estimates are available for the gulf flounder.

3.2.3.4 Incubation

Stokes (1977) reported sexually mature adults of both southern and gulf flounder emigrating offshore during October-December and juveniles immigrating during January-February in Texas. This indicates a very short larval period of three or four months, assuming courtship and spawning behavior occurs sporadically during the October-December period.

Lasswell et al. (1978), utilizing carp pituitary hormone to induce laboratory spawning of southern flounder, reported eggs hatched in 40 hrs at water temperatures of 22°C. Arnold et al. (1977) stated laboratory-spawned eggs of southern flounder hatched in 61-76 hrs at 16.5°-17.5°C.

3.2.3.5 Genetics

Genetics studies of southern flounder are rare. Allozyme and mitochondrial DNA variation were compared between Texas and North Carolina to determine the population structure of southern flounder on the Texas coast (Blandan et al. 1996):

> "Analyzes of allozyme variation revealed levels of population subdivision greater than that obtained from other fishes examined along the Texas coast. Cluster analyzes (UPGMA) of allozyme data sets found little congruence between genetic relatedness of populations and geographic position. However, analyzes of mitochondrial DNA revealed a more comprehensible pattern. North Carolina southern flounder are genetically distinct from all Texas populations, while on the Texas coast the upper coast and the middle coast are genetically similar relative to the lower coast."

Allozyme data in this study suggests that southern flounder from Mississippi, Alabama, Louisiana, and Florida more closely resemble those from the Atlantic coast than from those along the southern coast of Texas (Blandon et al. 1996).

Blandon et al. (1996) also reported:

> "Clinal variation in allele and haplotype frequency may be the most striking genetic characteristic of coastal marine organisms. Such clines may well represent gene flow in what is essentially linear habitat space. However, it is also important to keep in mind that such clines may represent genetic adaptation to spatially diverse environmental conditions (King and Zimmerman 1993), and thus may be important

> to management decisions. Clines in allele and haplotype frequency were found in southern flounder. All clines were statistically insignificant. However, further examination of clinal variation in non-sampled areas is needed to ascertain the role clines play in the population structure of southern flounder."

3.2.4 Parasites and Diseases

All fish harbor disease organisms, and the potential for outbreak of disease always exists, especially following periods of stress (White and Stickney 1973). There is one parasite (*Hysterothylacium* type MB), an ascaridoid nematode, reported as a potential threat to public health (Overstreet and Meyer 1981).

Christmas (1973) believed that human coastal population growth and industrial pollution was responsible for fish kills along its coast. Sindermann (1979) cited pollution and habitat degradation associated with cases of vibriosus and fin erosion in summer flounder. Overstreet and Howse (1977) believed some types of "fin rot syndrome," which described several non-specific hemorrhagic lesions usually found on fins, occurred on 10% of southern flounder during summer months and 5% on an annual basis. They believed at least some of the lesions could be attributed to pollutants. Overstreet and Howse (1977) explained that pollutants can affect animals directly by causing acute to chronic diseases or they can affect the animals indirectly by stressing them and thus allowing them to be vulnerable to parasites or other disease agents. The pollutants can also form synergistic or other-type relationships between the pollutant and another chemical or disease-causing agent causing predators to become affected by feeding on exposed animals or destroying the environment so that animals can no longer live, grow, or reproduce. At least two juvenile ascaridoids (*Hysterothylacium*) have been found to infect southern flounder (Deardorff and Overstreet 1981).

Ectoparasites are fairly common on southern flounder; stress or even death can result from the presence of large numbers of these organisms (Etzold and Christmas 1979). Of 19 southern flounder (22.4-35.5 cm) examined by Williams (1979) from the Mobile Bay region, a single parasitic leech (*Myzobdella lugubris*) was reported from the right pectoral fin of one individual. Sawyer et al. (1975) considered the southern flounder the most common host for that leech in Mississippi, where they also reported the related *Calliobdella vivida*. Overstreet (1978) reported the presence of a non-permanently attached transparent copepod (*Caligus praetextus*) on southern flounder. Argulids, commonly called "fish lice," can also cause host damage. Some species of parasites show species selectivity; *Argulus flavescens* commonly infests the skin of southern flounder and appear as small colored dots (Overstreet 1978).

Overstreet (1978) and Becker and Overstreet (1979) noted the trypanosome (*Trypanoplasma bullocki*) in blood of southern flounder and listed it as the most common blood flagellate in Mississippi estuaries. Another protozoan, a hemogregarine assumed to be *Haemogregarina platessae,* occurred in the red blood cells of the flounder (Becker and Overstreet 1979). Those authors suggested that both protozoans were transmitted to the flounder by *Calliobdella vivida*.

A nematode (round worm) of the family Philometridae was also found to infect the mouth of the southern flounder (Overstreet 1978). Members of this group appear reddish and release live larvae rather than eggs. This species was recently abundant in the flounder after not being observed for several years. Blaylock and Overstreet (1999) have described the new species as a member of a new genus. Other species appear in a variety of locations in fish including the body cavity, gonads, subdermally, in musculature, and between fin rays. Overstreet and Edwards (1976) described two benign pseudo encapsulated mesenchymal tumors beneath the gular membrane of a southern flounder and attributed the subcutaneous tumors to the presence of a philometrid nematode or a didymozoid trematode.

The literature for information on parasites and diseases of the gulf flounder is sparse except for juvenile nematodes (e.g., Deardorff and Overstreet 1981).

3.2.5 Feeding, Prey, and Predators

Paralichthid flounder appear well adapted for feeding on quick moving prey such as fish and shrimp which occur throughout the water column. Development of large optic lobes, large mouths with strong teeth, and stomachs with large storage capacities enhance their predatory feeding abilities (DeGroot 1971). Southern flounder has been described as an estuarine-dependent carnivore at the top of the food chain (Wagner 1973) which feeds as an ambush predator (Minello et al. 1989) exhibiting a "lay and wait" feeding behavior (Music and Pafford 1984).

In aquarium experiments of southern flounder (Henderson-Arzapalo et al. 1988), characteristic feeding activity was described as a normal, burrowing pattern. Small fish (84-94 mm TL) exhibited various patterns of feeding behavior including active searching on the bottom and in the water column (Minello et al. 1987). Prey stalking behavior for summer flounder was described by Olla et al. (1972), and similar behavior is likely to occur in both southern and gulf flounder. Often the fish remained motionless on the bottom and waited for potential prey to come within striking distance before attacking (Minello et al. 1987). Bothids have been classified as primarily visual feeders by DeGroot (1971). In southern flounder observed by Minello et al. (1987), all stalking activity was accompanied by active eye movements tracking potential prey which suggested the primary use of vision in prey detection. In addition to vision, the southern flounder may use sensory mechanisms such as the lateral line for prey detection at night. Minello et al. (1987) noted older southern flounder juveniles and adults fed actively day and night with highest feeding rates during the afternoon. Smaller flounder consumed approximately 7.6% of their live weight, and larger fish ate about 4.0% of their live weight each day. Music and Pafford (1984) found feeding activity was greatest at water temperatures of 16°-25°C during the three-day period following a first quarter moon and the three-day period prior to a new moon. In pond studies, Wright et al. (1993) noted predation by southern flounder was a size-structuring force on the prey fish assemblage in the pond, and flounder respond to an increase in prey density by an increase in consumption (Holling 1959).

For southern flounder, early life stages reportedly fed primarily on plankton in Mississippi (Gilbert 1986, Etzold and Christmas 1979), and young southern flounder fed on bottom invertebrates in Lake Pontchartrain, Louisiana (Darnell 1958). Stokes (1977) found smaller fish (10-150 mm TL) fed primarily upon mysids. Overstreet and Heard (1982) concurred, specifically identifying the dominant mysid as *Mysidopsis almyra.* Stokes (1977) found larvae ate various forms of zooplankton, and juveniles fed largely on shrimp, crabs, menhaden, croaker, and other flounder. In North Carolina, Fitzhugh et al. (1996) found southern flounder less than 150 mm TL utilized invertebrates, primarily mysids such as *Mysidopsis bigelowi* and *Neomysis americana*. Individuals between 151-250 mm TL contained the greatest frequency of fish prey, most commonly bay anchovy (*Anchoa mitchilli*), spot (*Leiostomus xanthurus*), and Atlantic croaker (*Micropogonias undulatus*). They suggested consumption of fish prey within this size group was more variable among females than males.

Southern flounder consume a wide variety of food items (Table 3.18). Fish become the major component of the diet with increasing size (Stokes 1977, Powell and Schwartz 1979, Smith 1981, Overstreet and Heard 1982). In Texas waters, Stokes (1977) listed the common prey found in southern flounder larger than 150 mm SL as: anchovy (*Anchoa* spp.), mullet (*Mugil* spp.), shrimp (*Penaeus* spp.), menhaden (*Brevoortia* spp.), and Atlantic croaker (*Micropogonias undulatus*). Minello et al. (1989) reported southern flounder as the dominant fish predator on brown shrimp (*P. aztecus*) during spring in Galveston Bay. They fed on shrimp only until the prey reached 33%-50% of the total length of the predator. Minello et al. (1987) noted an increase in the predation rate of southern flounder from 84-94 mm SL on brown shrimp in turbid water and suggested it was related to feeding tactics of the predator and prey behavior. In a Texas estuary, Moffet (1975) found penaeid shrimp and portunid crabs in the stomachs of southern flounder that ranged from 105-255 mm TL.

In Mississippi Sound, southern flounder stomachs most frequently contained fish, with approximately one-third containing penaeid shrimp from spring through autumn. When penaeid shrimp availability was low in winter, they were replaced by mysidaceans. Of prey fish species reported, a high incidence of bay anchovy was noted (Overstreet and Heard 1982). While studying Lake Pontchartrain, Louisiana, Darnell (1958) examined 14 southern flounder (240-490 mm), and Levine (1980) examined four (102-300 mm). Both reported a prevalence of bay anchovy in the stomachs. Fox and White (1969) reported approximately 94% (by volume) of southern flounder stomachs from Barataria Bay, Louisiana, contained juvenile striped mullet (*Mugil cephalus*) and anchovies.

Southern flounder utilized more individual prey of the same size class as flounder length increased rather than utilization of larger food items (Fox and White 1969). They found the same type of diet irrespective of an increase in flounder size and attributed it to seasonal availability of food in the bay system. Darnell (1958) also stated the relative percentage of food utilized from one environment to another may be related to seasonal availability rather than prey selectivity. However, Rice et al. (1993) found a size-dependent predation rate between spot and southern flounder in North Carolina pond studies (i.e., small spot survived better when predator size was larger, and larger spot survived better when predator size was smaller). Wenner et al. (1990) described ontogenetic changes in southern flounder diet for four major prey species in South Carolina waters. The primary decapod crustaceans utilized for food were palaemonid shrimp, while more important fish species included mummichog (*Fundulus heteroclitus*), spot, and striped mullet. As flounder size increased, striped mullet became the most important prey species.

Table 3.18. Food preference of southern flounder derived from available literature. NR = not reported.

State	Stomachs Examined	Number with Food	Flounder Size (mm)	Food Preference	Other Foods	Author(s)
TX	16	8	240-490 TL	Mullet, *Anchoa mitchilli*, unidentified fish, *Penaeus setiferus* & *P. aztecus*	Pinfish, mojarra, & stone crab	Gunter 1945
	34	27	NR	Unidentified shrimps & fishes	*Penaeus* spp., *P. aztecus*, *Crangon* spp., *Palaemonetes* spp., *Squilla empusa*, *Lagodon rhomboides*	Kemp 1949
	24	NR	NR	Shrimp present in 50% of stomachs. Fishes (including menhaden) present in 40%	Miscellaneous invertebrates in <5%	Knapp 1950
	36	15	NR	Penaeid & unidentified shrimps	Crabs & unidentified fish	Miles 1949
	7	4	159-265 TL	75% fish, 25% shrimp	NR	Reid 1955
	4	NR	NR	Primarily fishes & shrimps	NR	Reid et al. 1956
	626	343	10-150 TL >150 TL	95% invertebrates (primarily mysids) 70% fish (*Anchoa* spp., *Brevoortia* spp., sciaenids, *Mugil* spp., & unidentified fish	Penaeid shrimp most frequently found invertebrate food item in larger flounder	Stokes 1977
	10	9	36-177 SL	Fish in 60% of stomachs including *Micropogonias undulatus* & *Archosargus probatocephalus*	Arthropods, polychaetes, & bivalves	Matlock & Garcia 1983
LA	19	14	113-380	89% *A. mitchilli*, *Micropogon undulatus* (earlier name for *Micropogonias undulatus*), & unidentified fish remains	7% blue & mud crabs, 4% clams, gastropod, schizopods, & unidentified organic material	Darnell 1958

State	Stomachs Examined	Number with Food	Flounder Size (mm)	Food Preference	Other Foods	Author(s)
	305	171	60-602 TL	94% juvenile *Mugil cephalus* & *Anchoa* sp. (by volume)	6% crustaceans	Fox & White 1969
	11	4	102-300 SL	75% *A. mitchilli*, 25% *M. undulatus*	One *Gammarus* sp. amphipod	Levine 1980
MS	NR	NR	Larvae/early juveniles Late juveniles/adults	Plankton Crustaceans (shrimp)/ small fish	NR	Etzold & Christmas 1979
	212	97	125-410 SL	*A. mitchilli* & penaeid shrimps	>20 various items	Overstreet & Heard 1989
GA	221	113	<200 TL	Nearly equal proportions of fish & crustaceans	NR	Music & Pafford 1984
			201-400 TL	Increase in fish (bay anchovy & sea catfish)		
			>400 SL TL	Fish preference dominated by sea catfish (mullet & menhaden also present)		
NC	1573	815	<150 TL	62% mysids	NR	Fitzhugh et al. 1996
			151-250 TL	85% fish (*A. mitchilli*, sciaenids, & other fishes)		
	160	NR	20-60 SL	Gammarid amphipods & mysid shrimp	Copepods, insects, fish & invertebrate parts	Burke 1995
	430	234	100-200 TL	32% crustacean (mostly mysid shrimp)	NR	Powell & Swartz 1979
			>200 TL	96% fish (mostly engraulids & sciaenids)		

The food preference of gulf flounder is similar to that of other Paralichthid flounders (including southern flounder) in that the young feed primarily on crustaceans and change to a more piscivorous diet as they grow larger (Table 3.19). Examination of stomach contents of gulf flounder by Topp and Hoff (1972) revealed penaeid shrimp, portunid crabs, anchovies, striped killifish (*Fundulus similis*), pipefishes (*Syngnathus* spp.), grunts (*Haemulon* spp.), and code goby (*Gobiosoma robustum*). Springer and Woodburn (1960) reported the stomach contents of gulf flounder from Tampa Bay. For fish under 45 mm SL, crustaceans were present in four out of six with one stomach being empty. Of 16 stomachs examined from fish 46 mm to 100 mm SL, six contained fishes, five contained crustaceans, and five were empty. All the stomachs from fish over 100 mm SL contained fish or were empty. Reid (1954) stated that young gulf flounder in the Cedar Key, Florida, area feed primary on amphipods and other small crustaceans. At about 45 mm SL, they began feeding upon fish, and this becomes the main element of their diet as the flounder become larger. Stokes (1977) reported similar findings with gulf flounder along the Aransas Bay, Texas, area; invertebrates accounted for 84% of the food in the stomachs of fish 10 to 150 mm TL, and 72% of the food in stomachs of fish larger than 150 mm TL were fish.

Table 3.19. Food preference of gulf flounder derived from available literature. NR = not reported.

State	Stomachs Examined	Number with Food	Flounder Size (mm)	Food Preference	Other Foods	Author(s)
TX	626	242	10-150 TL	84% invertebrates	NR	Stokes 1977
			>150 TL	72% fishes (mostly (*Anchoa* sp., clupeids, sciaenids, & *Mugil* sp.)		
FL	27	NR	<45 SL	Primarily amphipods	NR	Reid 1954
			46-400 SL	Small crustaceans & fish (mainly *Orthopristis chrysopterus*, earlier name for *Orthopristis chrysoptera*)		
	NR	NR	<45 SL	80% crustaceans	NR	Springer & Woodburn 1960
			45-100 SL	45% crustaceans & 55% fishes		
			>100 SL	100% contained fishes		

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

4.1 Description of Essential Fish Habitat

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

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

For the purposes of describing those habitats that are critical to flounder in this FMP, this definition was utilized; however, these areas are referred to as "essential habitat" to avoid confusion with EFH mandates in the Magnuson-Stevens Act. These mandates include the identification and designation of EFH for all federally-managed species, development of conservation and enhancement measures including those which address fishing gear impacts, and require federal agency consultation regarding proposed adverse impacts to those habitats.

4.2 Gulf of Mexico

Southern and gulf flounder spawning occurs offshore (Section 3.2.3.1.2) in the colder winter months (Stokes 1977, Shepard 1986). The eggs which are pelagic and buoyant (Norman 1934, Benson 1982) drift with the prevailing currents, and the hatching larvae are transported on these currents into the estuaries. An overview of the prevailing Gulf circulation, sediments, and inshore nursery characteristics is key in understanding how the young flounder are passively and actively transported through these critical habitats as they grow and eventually spawn, starting the cycle again.

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

Gulf while discharge from the Mississippi/Atchafalaya Rivers creates areas of high productivity that are occupied by many commercially and recreationally-important marine species.

The Gulf coast wetlands and estuaries provide the habitat for an estimated 95% of the finfish and shellfish species landed commercially and 85% of the recreational catch of finfish (Thayer and Ustach 1981). Five of the top-ten commercial fishery ports in the United States are located in the Gulf and account for an estimated 559.7 million kg of fish and shellfish harvested annually from the Gulf (USDOC 1998). The Gulf fishery accounts for 18% of the nation's total commercial landings and supports the most valuable shrimp fishery in the United States (USDOC 1998). Additionally, the Gulf of Mexico's wetlands, coastal estuaries, and barrier islands also support large populations of wildlife (e.g., waterfowl, shorebirds); play a significant role in flood control and water purification; and buffer the coastal mainland from hurricanes and lesser storm events.

4.2.1 Circulation Patterns and Tides

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

Moving clockwise, the Loop Current dominates surface circulation in the eastern Gulf and generates permanent eddies over the western Gulf. During late summer and fall, the progressive expansion and intrusion of the loop reaches as far north as the continental shelf off the Mississippi River Delta. High productivity associated with the discharge from the Mississippi/Atchafalaya River systems benefits numerous finfish and invertebrate species that use the northern Gulf as a nursery ground. Additionally, dispersal of tropical species from the Caribbean into the Gulf is accomplished via Loop Current transport. Nearshore currents are driven by the impingement of regional Gulf currents across the shelf, passage of tides, and local and regional wind systems. The orientation of the shoreline and bottom topography may also place constraints on speed and direction of shelf currents.

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

Tide type varies widely throughout the Gulf with diurnal tides (one high tide and one low tide each lunar day of 24.8 hrs) existing from St. Andrew's Bay, Florida, to western Louisiana. The tide is semi-diurnal in the Apalachicola Bay area of Florida, and mixed (diurnal, semi-diurnal, and combinations of both) in west Louisiana and Texas. Gulf tides are small and noticeably less developed than along the Atlantic or Pacific coasts. The normal tidal range at most places is not more than 0.6 m. Despite the small tidal range, tidal current velocities are occasionally high especially near the constricted outlets that characterize many of the bays and lagoons.

4.2.2 Sediments

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

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

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

4.2.3 Submerged Vegetation

Submerged vegetation comprises an estimated 1,475,000 ha of seagrasses and associated macroalgae in the estuarine and shallow coastal waters of the Gulf (Holt et al. 1983). Turtle grass *(Thalassia testudinum)*, shoal grass (*Halodule wrightii*), manatee grass (*Syringodium filiforme*), star grass (*Halophila engelmanni*), and widgeon grass (*Ruppia maritima*) are the dominant seagrass species (GMFMC 1998). Distribution of seagrasses in the Gulf is predominantly (98.5%) along the Florida and Texas coasts with 910,000 ha of seagrass being located on the west Florida continental shelf, in contiguous estuaries, and in embayments (Holt et al. 1983). Macroalgae species including *Caulerpa* sp., *Udotea* sp., *Sargassum* sp., and *Penicillus* sp. are found throughout the Gulf but are most common on the west Florida shelf and in Florida Bay.

Duke and Kruczynski (1992) provide a status and trends assessment of emergent and submerged vegetated habitats of Gulf of Mexico coastal waters. Coastal wetlands of the Gulf of Mexico are of special interest because of their recognized importance in maintaining productive fishery resources. The USFWS National Wetland Inventory data (aerial photographs) from 1972-1984 provide the current status of five wetland categories for the Gulf coast states (seagrass habitat was not included in the NOAA survey). The five coastal wetland types included: 66% salt marsh, 17% forested scrub-shrub, 13% tidal flats, 3% tidal fresh marsh, and 1% forested. Louisiana contains most of the Gulf's salt marshes with 69%, followed by Texas (17%), Florida (10%), Mississippi (2%), and Alabama (1%). Texas contains 54% of the tidal flats, and Florida has 97% of the estuarine forested scrub-shrub (mostly mangrove) (Duke and Kruczynski 1992).

4.2.4 Emergent Vegetation

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

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

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

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

4.3 Estuaries

Gulf estuaries provide essential habitats for a variety of commercially and recreationally important species serving primarily as nursery grounds for juveniles but also as habitat for adults during certain seasons. The Gulf of Mexico is bordered by 207 estuaries (Buff and Turner 1987) that extend from Florida Bay to the Lower Laguna Madre. Perret et al. (1971) reported 5.62 million ha of estuarine habitats in the Gulf States including 3.2 million ha of open water and 2.43 million ha of emergent tidal vegetation (Lindall and Saloman 1977). Emergent tidal vegetation includes 174,000 ha of mangrove and one million ha of salt marsh (USDOC 1991); submerged vegetation covers 324,000 ha of estuarine bottom throughout the Gulf (GMFMC 1998). The majority of the Gulf's salt marshes are located in Louisiana (63%) while the largest expanses of mangroves (162,000 ha) are located along the southern Florida coast (GMFMC 1998).

4.3.1 Eastern Gulf

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

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

4.3.2 Northern Central Gulf

The northern central Gulf includes Alabama, Mississippi, and Louisiana. Total estuarine area for Louisiana includes 29 major water bodies covering 2.9 million ha of which 1.3 million ha is surface water and 1.5 million ha is marsh (Perret et al. 1971). The eastern and central Louisiana coasts are dominated by sand barrier islands and associated bays and marshes. The most extensive marshes in the United States are associated with the Mississippi/Atchafalaya River deltas. The loss of wetlands along the Louisiana Coastal Zone is estimated to be 6,600 ha/yr (USEPA 1994). The shoreline of the western one-third of Louisiana is made up of sand beaches with extensive inland marshes. A complex geography of sounds and bays protected by barrier islands and tidal marshes acts to delay mixing resulting in extensive areas of brackish conditions. The Alabama and Mississippi coasts are bounded offshore by a series of barrier islands which are characterized by high energy sand beaches grading to saltwater marshes with interior freshwater marshes. The mainland shoreline is made up of saltwater marsh, beach, seawall, and brackish-freshwater marsh in the coastal rivers. Approximately 26,000 ha of mainland marsh existed in southern Mississippi in 1968, and salt marsh on the barrier islands covers 860 ha (GMFMC 1981).

Approximately 2,928 ha of submerged vegetation, including attached algae, have been identified in Mississippi Sound and in the ponds and lagoons on Horn and Petit Bois islands (C. Moncreiff personal communication). Approximately 4,000 ha of mainland marsh along the Mississippi Coastal Zone have been filled for industrial and residential use since the 1930s (Eleuterius 1973). Seagrasses in Mississippi Sound declined 40%-50% since 1969 (Moncreiff et al. 1998). Alabama's coastal zone contains five estuarine systems covering 160,809 ha of surface water and 14,008 ha of tidal marsh (GMFMC 1998). An estimated 4,047 ha of submerged vegetation exists in the Alabama Coastal Zone.

In general, estuaries and nearshore Gulf waters of Louisiana and Mississippi are low saline, nutrient-rich, and turbid due to the high rainfall and subsequent discharges of the Mississippi, Atchafalaya, and other coastal rivers. The Mississippi River deposits 684 million mt of sediment annually near its mouth (Holt et al. 1983). Average (1980-1988) discharges for the Mississippi and Atchafalaya rivers were 1,400m^3/sec and 6.02m^3/sec, respectively. As a probable consequence of the large fluvial nutrient input, the Louisiana nearshore shelf is considered one of the most productive areas in the Gulf of Mexico.

4.3.3 Western Gulf

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

4.4 General Distribution

Paralichthids are euryhaline and distributed over most of the habitats occurring in the northern Gulf of Mexico including freshwater rivers and lakes, brackish estuaries, bayous, canals, saltwater bays, sounds, and lagoons as well as offshore (Deubler 1960, Gutherz 1967, Hoese and Moore 1998). Generally, adults of both southern and gulf flounder move offshore in the winter where they spawn in response to changing water temperatures (Section 3.2.3.1.2.4). Eggs and larvae are transported inshore to estuarine nursery areas where they metamorphose into the "flatfish" shape and continue to grow (Böhlke and Chaplin 1993, Hoese and Moore 1998). Postlarval and juvenile southern flounder generally move to areas of lower salinities and become established in vegetated shallows of estuarine habitats (Gunter 1945, Deubler 1960).

Southern flounder is most common along the western Gulf of Mexico along the Texas and Louisiana coasts (Norden 1966, Perret et al. 1971, Adkins et al. 1979); gulf flounder are more abundant in the eastern Gulf along the Florida coast (Hoese and Moore 1998, Gutherz 1967). Although some overlap occurs in the waters off eastern Louisiana, Mississippi, and Alabama, southern flounder is not abundant seaward of the barrier islands in the Tuscaloosa Trend (Darnell 1985). For a map of gulf and southern flounder distribution, see Figure 3.1.

Powell and Schwartz (1977) believed that benthic substrate and salinity were the two most important factors affecting paralichthids distribution. Southern flounder preferred muddy substrates and were relatively abundant in areas with silt and clay sediments (Norman 1934, Powell and Schwartz 1977, Hoese and Moore 1998, Randall and Vergara 1978, Etzold and Christmas 1979, Nall 1979, Phalen et al. 1989) and organic-rich mud substrates (Burke et al. 1991). Gulf flounder prefer hard or sandy substrates (Ginsburg 1952, Stokes 1977, Nall 1979). Aquatic vegetation does not appear important to adult *Paralichthys* but is utilized by juveniles (Gilbert 1986, Burke et al. 1991). Juvenile southern flounder apparently select estuarine microhabitats based primarily on substrate type and salinity (Burke et al. 1991).

4.5 Spawning Habitat

Detailed description of spawning habitat for gulf and southern flounder does not exist in the literature. Numerous authors have stated that both species spawn offshore in the Gulf during fall and winter months (Hildebrand and Cable 1930, Ginsburg 1952, Gunter 1945, Simmons 1951, Reid 1954, Topp and Hoff 1972, Stokes 1977, Etzold and Christmas 1979). However, these determinations have been based primarily upon the paucity of ripe females and males in inshore waters during the winter or the occasional gravid female caught along passes during the fall migration. Very little information describing the habitat associated with spawning flounder exists, and most studies dealing with spawning behavior and courtship involve laboratory experiments with southern flounder (Arnold et al. 1977, White and Stickney 1973, Lasswell et al. 1978, Henderson-Arzapalo et al. 1988). Benson (1982) suggested southern flounder spawn in offshore Mississippi waters between 30-66 m. Topp and Hoff (1972) reported making determinations of spawning activity of gulf flounder collected in water 18-37 m between November through February.

Some anecdotal information of gulf flounder spawning aggregations exists from the west coast of Florida. During routine monitoring of artificial reef structures by University of Florida and Florida Sea Grant researchers from 1989-1991, numerous gulf flounder were observed to aggregate within close proximity of one another. These structures, approximately 37 km offshore Cedar Key, Florida, were concrete rubble and culverts made up of 35-60 pieces located approximately 150 m apart and in water about 12 m in depth. Aggregations of up to 40 flounder were observed during one excursion on December 12, 1991, which typically consisted of smaller groups of three to six fish that were often in physical contact with one another. Some groups (specimens collected) comprised of a female lying on top of, or near a concrete clump, with a male lying partially or entirely on top of her. Although no apparent spawning was observed, the collection of ten individuals (334-492 mm TL) indicated eggs were running ripe, and the gonadosomatic index of these specimens were substantially higher than that of flounder collected within estuaries and bays in Florida during the same time of year (F. Voss personal communication, FWC/FMRI unpublished data). These and other observations of researchers and scuba divers along the panhandle of Florida suggest that both species of flounder may utilize various types of structure as spawning aggregation sites throughout the winter months.

Other researchers have suggested similar spawning habitat for gulf and southern flounder in the panhandle of Florida. Eighty-two female gulf flounder containing hydrated ova have been collected from offshore sites over artificial reefs and natural limestone outcroppings, whereas only one female from inshore (St. Andrews Bay) sites contained hydrated ova (G. Fitzhugh personal communication).

4.6 Egg and Larval Habitat

Since southern and gulf flounder spawn offshore, their embryos are adapted to developing in seawater at salinities of 30‰-35‰. Nutrition is endogenous at this stage, so prey availability is not a limiting factor. With the possible exception of thermal shock, predation is probably the only factor limiting survival of the buoyant, planktonic embryos (Deubler 1960).

Like many other fish species with pelagic larvae, it appears that very little habitat selection actually occurs in early larvae. The larval period of the southern flounder, and presumably the gulf flounder, lasts less than two months (Arnold et al. 1977) and is spent in marine waters as the fish move toward inshore waters. Studies have shown that most larval fish movement is passive and tends to be driven by both prevailing winds and currents. Sogard et al. (1987) and Lyczkowski-Shultz et al. (1990) stressed the importance of current transportation for offshore spawners to the success of larvae. In addition, plankton density is an important determinant of larval survival, and a "critical period" occurs at the onset of exogenous feeding initiation and immediately thereafter (Laurence 1977). Numerous studies have demonstrated how patchy areas of higher prey concentrations can increase growth rates in larval fish (Houde and Taniguchi 1979, Comyns 1997) thereby reducing the length of the period when larval fish are most vulnerable to predation (Houde and Schekter 1978, Webb 1981, Folkvord and Hunter 1986, Butler and Pickett 1988, Fuiman 1989).

Rogers et al. (1984) found an abundance of southern flounder recruits used shallow water nursery areas on a size-specific basis. As the fish grow, they move toward deeper, more saline waters. Shallow marsh lakes and blind bayous were believed to be prime habitat for early immigrating southern flounder in a Texas river delta (Conner and Truesdale 1972).

4.7 Juvenile Habitat

4.7.1 General Conditions

Immigration of postlarval and early juvenile gulf flounder into the bays and estuaries begins in December at water temperatures of 13.8°C and peaks in March with temperatures near 16°C (Stokes 1977). Juvenile gulf flounder in Florida exhibit similar patterns. In Charlotte Harbor and Tampa and Choctawhatchee bays, juvenile recruitment occurred in February, March, and April when average water temperatures neared 18°C (FWC/FMRI unpublished data).

Juveniles are generally collected during spring, summer, and early fall. In tidal passes of Louisiana, Sabins (1973) and Sabins and Truesdale (1975) noted a tendency for the young to be concentrated along channel edges especially in quieter waters, and juvenile southern flounder catch appeared to be affected by tidal stage. Studies have also indicated the migration of postlarval and juvenile southern flounder toward freshwater and low salinity intertidal zones (Hildebrand and Cable 1930, Powell and Schwartz 1977, Weinstein et al. 1980, Rogers et al. 1984). Little published information exists documenting specific substrates utilized by young flounder.

4.7.2 Salinity, Temperature, and Dissolved Oxygen Requirements

Effects of salinity on late postlarval southern flounder indicate a preference for 5‰-15‰ and suggest a physiological adaptation to salinity which appears to change seasonally and with age (Stickney and White 1974a). Deubler and Posner (1963) found southern flounder postlarvae to actively migrate from areas of low DO (<3.7 ppm). This response was the same, regardless of temperature. They also reported postlarvae to retreat from water temperatures more than 25.3°C.

4.7.2.1 Salinity

While it appears that postlarval southern flounder are highly euryhaline and can survive abrupt transfers from 30‰ seawater to freshwater (Deubler 1960), early juveniles may not be adapted to low salinities (Stickney and White 1974a). Stickney and White (1974a) suggest that based on growth rate, older juvenile southern flounder are physiologically adapted to lower salinities since they migrate from offshore to low salinity estuaries by the time they reach 0.5 g. However, Deubler (1960) demonstrated that southern flounder were able to survive and grow at salinities ranging from 0‰-30‰ without prior acclimation. Higher salinities were also indicated to be advantageous to rapid growth and larger sizes of postlarval southern flounder when food supply, temperature, and light were controlled (Deubler 1960). Lower salinity waters stress juvenile fish less resulting in lower mortality and better growth (Stickney and White 1974a, Hickman 1968).

Gunter (1945) captured juvenile southern flounder (17-40 mm) in Texas estuaries at salinities of 19.6‰-30.0‰. In North Carolina estuaries, Williams and Deubler (1968) collected southern flounder in salinities from 0.02‰-35‰. In areas less than 12‰, southern flounder dominated; as salinity increased, gulf flounder replaced them (Powell and Schwartz 1977) (Tables 3.2a and 3.2b).

Gilbert (1986) stated gulf flounder rarely entered areas of reduced salinities (less than 20‰) and never entered freshwater. In Pamlico Sound, North Carolina, juvenile gulf flounder were collected at salinities ranging from 6‰-35‰ but were most abundant near the estuary mouth where salinities were highest (Powell and Swartz 1977). Williams and Deubler (1968) never captured gulf flounder postlarvae in salinities lower than 22‰. In their collections of juvenile paralichthids from North Carolina estuaries, Powell and Schwartz (1977) found gulf flounder to be rare in most locations where the salinities were below 20‰.

4.7.2.2 Temperature

Juvenile southern and gulf flounder began immigrating into Texas estuaries from the Gulf at temperatures of 13.8°C, but peak movement occurred when water temperatures were 16.0°-16.2°C (Stokes 1977). Gunter (1945) captured juvenile (17-40 mm) southern flounder in Texas estuaries at water temperatures between 14.5°-21.6°C. Moffet (1975) sampled in Galveston and Trinity bays and collected juvenile southern flounder in temperatures from 12.7°-39.0°C. Peters and Kjelson (1975) determined that the temperature for maximum conversion efficiency in juvenile southern flounder increases as salinities decrease. Therefore, temperature may indirectly affect flounder survival by shifting the duration of time that young flounder spend in a size class, potentially increasing their vulnerability to predation (Enge and Mulholland 1985).

4.7.2.3 Dissolved Oxygen

Juvenile southern flounder in a laboratory study gradually withdrew to more highly oxygenated water as DO concentrations fell below 3.7 ppm. Although general activity increased as water temperatures increased, there was no change in sensitivity to oxygen depletion at temperatures of 6.1°, 14.4°, and 25.3°C (Deubler and Posner 1963).

4.7.2.4 Vegetation

In Texas, juvenile southern flounder were most abundant during spring months in estuaries characterized by dense patches of shoal grass, *Halodule wrightii*, covering 30%-60% of the total area (Stokes 1977). Juvenile gulf flounder were taken in areas of dense patches (30%-60% of the total area) as well as areas of light stands of shoal grass (<30% of the total area) (Stokes 1977).

4.7.2.5 Substrate

Substrate preferences of juveniles appear to be similar to that of adults. Moffet (1975) sampled the Chocolate Bayou estuary (part of the Galveston Bay system) from June 1969 through October 1971. Southern flounder were present year-round, and YOY were collected during the winter and spring in association with saltmarsh, mud and shell bottoms, and shoreline banks. Vick (1964) reported catching juvenile southern flounder over mud bottom from St. Andrews Bay, Florida. In Mississippi's fishery-independent sampling, juvenile southern flounder were most abundant in association within a natural inland bayou where mud bottom predominated (MDMR unpublished data). In North Carolina, Powell and Schwartz (1977) reported juvenile southern and summer flounder sought nursery grounds in estuaries characterized by low salinities and muddy substrates.

4.8 Adult Habitat

4.8.1 General Conditions

Southern flounder are more abundant in the western Gulf where soft, muddy substrate is more common (Topp and Hoff 1972, Enge and Mulholland 1985). Where sand substrate predominated, southern flounder were relatively scarce, and gulf flounder were more abundant. Adult flounder migrate from bays and estuaries in the fall and winter to spawn (Hildebrand and Cable 1930, Gunter 1945, Ginsburg 1952, Stokes 1977), and larval and juvenile flounder return in late winter and spring (Stokes 1977). Both species tolerate a wide range of temperatures and salinities varying to some degree with developmental stages.

4.8.2 Salinity, Temperature, Dissolved Oxygen, and pH Requirements

4.8.2.1 Salinity

Adult southern flounder are highly euryhaline, but adult gulf flounder avoid low salinities. Where both species co-occur, gulf flounder is more abundant than southern flounder in salinities over 20‰. Southern flounder seem to prefer salinities between 5‰-20‰ (Gunter 1945, Williams and Deubler 1968, Perret and Caillouet 1974, Tarver and Savoie 1976, Stokes 1977, Barrett et al. 1978); gulf flounder seem to prefer salinities higher than 20‰ (Gunter 1945, Springer and Woodburn 1960, Topp and Hoff 1972). Seasonal changes in the southern flounder's osmoregulatory processes appear to correspond to spawning migrations between estuarine and offshore waters (Hickman 1968).

Simmons (1957) reported collecting both gulf and southern flounder from the Texas coast in salinities up to 60‰ (Table 3.2). In Aransas Bay, Texas, southern flounder were taken only in salinities of 6‰-36‰ and gulf flounder only at salinities averaging over 16‰ (Stokes 1977). Although one gulf flounder collected by Gunter (1945) in Texas was reported from a salinity of 9.6‰, ten were reported at salinities between 25‰-35‰. Over his whole study, Gunter (1945) collected southern flounder from a wide range of salinities from 0.0‰ to >30.0‰. Southern flounder collected by Perret et al. (1971) in Louisiana estuaries were distributed equally over salinities of 0.0‰ to >30‰. In an assessment and monitoring project conducted over the past thirteen years by the ADCNR/MRD in Perdido Bay, Alabama, only southern flounder were captured in the lower salinity, upper bay stations ranging from 8‰ to 18‰ (ADCNR/MRD unpublished data). At the mid-bay stations (13‰-20‰), southern and gulf flounder were captured in approximately equal numbers. At the higher salinity, lower bay stations (19‰-28‰), gulf flounder were taken in high numbers and southern flounder in very low numbers.

Reid (1954) reported gulf flounder were collected in salinities from 17.5‰-31.5‰ near Cedar Key, Florida (Table 3.4). Subrahmanyam and Drake (1975) collected gulf and southern flounders in nearly equal numbers along salt marshes of Apalachee Bay, Florida. Comp (1985) characterized gulf flounder as both a marine and estuarine species in his survey of fishes in Tampa Bay, Florida. Murdock (1957) reported a single specimen of gulf flounder near the mouth of the Manatee River in 30.7‰. Gulf flounder were sampled from Tampa Bay by Springer and Woodburn (1960) in salinities from 13.7‰-33.7‰ and in St. Andrews Bay, Florida, by Vick (1964) in salinities from 33‰-36‰ . Gulf flounder were collected in several bay systems in Florida, including Tampa Bay, Charlotte Harbor, Choctawatchee Bay, and Florida Bay by the Fisheries Independent Monitoring program (FWC/FMRI unpublished data). Although gulf flounder were collected in salinities ranging from 1‰-38‰, the majority of fishes were from waters less than 20‰ (Table 3.2b). Tagatz (1967) collected gulf and southern flounder from the St. Johns River, Florida. However, the gulf flounder was never collected further than 40 km from the mouth of the river nor in salinities less than 12.0‰. Comparatively, southern flounder were collected as far as 135 km upstream and in salinities of 0.0‰.

4.8.2.2 Temperature

In Gulf coast populations of southern and gulf flounders, adults emigrate to offshore waters during cooler months (September through April) which is likely a result of spawning patterns triggered by cold fronts (Section 3.2.3.1.2.4). Adult immigration back to estuarine waters occurs in warmer months. Flounder have been collected from a wide range of temperatures ranging from 5.0°-34.9°C (Table 3.2). Gunter (1945) collected southern flounder in a Texas estuary at temperatures of 9.9°-30.5°C. In Louisiana estuaries, Perret et al. (1971) collected adult southern flounder at temperatures of 5.0°-34.9°C, and Springer and Woodburn (1960) collected flounder in the Tampa Bay area at 11.2°-32.5°C. In Aransas Bay, Texas, Stokes (1977) collected both southern and gulf flounders at temperatures of 10.0°-31.0°C; adults left the bay for Gulf waters when the mean water temperature dropped from 23.0°C in October to 14.1°C in December. Of seven peak periods of emigration from Aransas Bay, four occurred when cold fronts reduced water temperatures by 4°-5°C (Stokes 1977). The upper thermal limit for gulf and southern flounder is approximately 35°C (Table 3.2a and b). Gulf flounder were collected in temperatures ranging from 11°-33°C in several bay systems in Florida, including Tampa Bay, Charlotte Harbor, Choctawatchee Bay, and Florida Bay by the Fisheries Independent Monitoring Program (Table 3.4).

4.8.2.3 Dissolved Oxygen and pH

Along many nearshore areas of the northern Gulf of Mexico, a local phenomena known as "jubilees" may occur in late summer when shallow waters are nearly devoid of DO causing fish mortalities. Such events occur suddenly under very specific conditions, e.g., calm, shallow waters with high water temperatures. Very little scientific data has been collected during jubilee events, although Gunter and Lyles (1979) attributed plankton blooms for their occurrence. C. Moncreiff (personal communication) attributes the cause more precisely to a monospecific dinoflagellate bloom where DO may range between 0-2 ppm. Blue crabs and flounder, as well as many other species, are often impacted by these events resulting in rapid death of organisms in the affected area.

Low DO occurs during brief periods in summer when biological and chemical oxygen demands are high and thermal or salinity stratification inhibits mixing of the water column. When DO decreases to a stressful level, most flounder typically leave the area in search of higher concentrations of DO. Although the lower lethal limits of DO for southern and gulf flounders are unknown, 3.0 ppm is typically stressful to other fish species (Hoss and Peters 1976). In Louisiana estuaries, southern flounder have been collected at DO concentrations of 4.0-10.5 ppm (Barrett et al. 1978). In Aransas Bay, Texas, southern flounder were caught where pH ranged from 7.65-8.60, and there was no apparent relationship between pH and flounder distribution and abundance (Stokes 1977).

Flounder appear to be only moderately susceptible to low oxygen levels which build gradually, generally moving out of an area when DO levels get too low. Such movements result in displacement rather than mortality.

4.8.2.4 Depth

Gulf and southern flounder can be found in a wide range of depths from less than one meter inshore to over 120 m offshore (Table 3.1). In general, depth preference is a function of both life history stage and season. In the warm summer months, flounder are found throughout inshore estuaries in waters less than 40 m in depth (Hildebrand 1954). In the winter months, cold fronts trigger mass migrations of adult flounder to offshore waters. These migrations have led to reports of both gulf and southern flounder being collected in as much as 128 m of water (Gutherz 1967). It has been suggested by Stokes (1977) that a number of older male flounder may remain offshore year-round.

4.8.2.5 Vegetation

In the northern Gulf, southern flounder are typically collected in highly turbid bays with little rooted vegetation, brackish or saltwater marshes, and small tidal creeks dominated by cordgrass (*Spartina alterniflora*), needlerush (*Juncus roemerianus*), wiregrass (*Spartina patens*), and three-square grass (*Scirpus olneyi*) (Reid 1955, Darnell 1958, Fox and White 1969, Perret et al. 1971, Livingston 1976, Subrahmanyam and Coultas 1980). Of the two gigging sites chosen by Stokes (1977) in Aransas Bay, Texas, southern flounder were taken more frequently at the site where cordgrass lined the shore and extended out into the water; gulf flounder were taken more frequently at the site with an unvegetated shoreline. Reid (1954) reported during warm weather, most gulf flounder (>70 mm SL) were caught from sparsely vegetated channels or coves with muddy bottoms near Cedar Key, Florida. However, during winter months they were collected over shallow flats devoid of thick plant growth. Gulf flounder inhabited sandy areas in marine grass beds (Springer and Woodburn 1960) and in depths of less than 1.8 m (Goodell and Gorsline 1961) in studies of fish communities near Tampa Bay, Florida.

4.8.2.6 Substrate

Powell and Schwartz (1977) believed benthic substrate and salinity to be the two most important factors affecting paralichthid distribution. According to Ginsburg (1952), southern flounder prefer mud bottoms, and gulf flounder prefer hard or sandy bottoms. Nall (1979) collected 152 southern flounder on mud bottoms—25 on mud and sand bottoms and none on sand bottoms. The substrate preference of gulf flounder was not as definitive as that for southern flounder, but Chi-square analysis indicated a significant ($P<0.05$) relation between bottom type and species (Nall 1979). Only five gulf flounder were collected on mud bottoms—16 were collected on mud and sand bottoms and 12 on sand bottoms (Nall 1979). In Aransas Bay, Texas, most southern flounder were taken over finer sediments; whereas most gulf flounder were taken over more coarse sediments (Stokes 1977).

Although most studies report southern flounder to be most abundant on soft bottoms composed of rich organic mud, clay, or silt; Tabb and Manning (1961) collected southern flounder in southwestern Florida on shell and firm marl bottoms. The identity of the specimens collected by Tabb and Manning (1961), however, was questioned by Topp and Hoff (1972) on the basis of a range map. Dahlberg and Odum (1970) collected southern flounder in Georgia from bays with primarily sand bottoms.

Gulf flounder are occasionally found on muddy bottoms; however, they seem to prefer firmer bottoms which may consist of sand or shell. Springer and Woodburn (1960) reported collecting several gulf flounder while pushnetting and seining over grass beds but suggested they may have been picked up from sandy areas adjacent to the grass. They reported gulf flounder from all habitats in the Tampa Bay area of Florida except freshwater and rocky reefs offshore (Springer and Woodburn 1960); however, Moe and Martin (1965) collected a few gulf flounder near offshore reefs. Springer and McErlean (1962) reported gulf flounder on a grass flat in the Florida Keys. Naughton and Saloman (1978) collected several gulf flounder in the St. Andrews Bay, Florida, area and did not report any southern flounder in their study of this sandy, north Florida estuary.

Enge and Mulholland (1985) suggested that since the two species are morphologically similar and prey upon similar food items, salinity preference probably contributes more to the observed difference in substrate preference. The amount of flushing that occurs in an estuary results in varying substrate compositions. A high inflow of freshwater into an estuary results in low salinities, and high sediment loads from rivers result in high turbidity and muddy substrates. Estuaries with low freshwater inflow and correspondingly high salinity are usually characterized by low turbidity and firmer substrates (Enge and Mulholland 1985).

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

The general knowledge of the importance of habitat and nursery areas to the survival of many nearshore fish species is well known, although the specific interactions of various biotic and abiotic factors is less understood. A better understanding of estuarine-dependent species is necessary to assess the relative importance of abiotic factors, food resources, predation, and habitat quality (Allen and Baltz 1997).

Gulf and southern flounder possess pelagic eggs which are found near the surface, and most of the early larvae are present in the upper portions of the water column (Hoss and Thayer 1993). Maximum survival of larvae depends, in part, upon the availability of adequate food sources, minimal predation, and a quality habitat within the nearshore coastal waters. As postlarvae transform into juveniles, they become more benthic in nature and spend a majority of their lives on or near the bottom, therefore requiring a suitable substrate and appropriate water quality for survival.

Christmas (1973) thought that human population growth and industrial pollution exceeded the assimilative capacity of some Mississippi estuaries and was partly responsible for fish kills along its coasts. Sindermann (1979) cited pollution and habitat degradation associated with cases of vibriosus and fin erosion in summer flounder. Overstreet and Howse (1977) believed that fin rot syndrome described several non-specific lesions on southern flounder, attributing some of the lesions to pollution:

> “Pollutants can affect animals directly by causing acute to chronic diseases or they can affect the animals indirectly by stressing them and thus allowing them to be vulnerable to parasites or other disease agents, forming synergistic or other-type relationships between the pollutant and another chemical or disease-causing agent, permitting predators to become affected by feeding on exposed animals, or destroying the environment so that animals can no longer live, grow, or reproduce.”

Physical alterations to vegetated and non-vegetated estuarine habitats that either remove or modify such a habitat will have a negative impact on most life stages of animals that utilize the habitat for feeding, growth, predator avoidance, and/or reproduction (Hoss and Thayer 1993).

According to Dahl and Johnson (1991) estuarine vegetated wetlands decreased in the United States by 28,734 ha from the mid 1970s through the mid 1980s with the majority of these losses occurring in Gulf coast states. Most of this loss was due to the shifting of emergent wetlands to open saltwater bays. The most dramatic coastal wetland losses in the United States are in the northern Gulf of Mexico. This area contains 41% of the national inventory of coastal wetlands and has suffered 80% of the nation's total wetlands loss (Turner 1990, Dahl 1990). These wetlands support 28% of the national fisheries harvest, the largest fur harvest in the United States, the largest concentration of overwintering waterfowl in the United States, and provide the majority of the recreational fishing landings (Turner 1990).

4.9.1 Hypoxia

Anoxic bottom conditions have not been reported for most of the eastern Gulf with the exceptions of local hypoxic events in Mobile Bay and several bay systems in Florida (Tampa, Sarasota, and Florida bays). However, extensive areas (1,820,000 ha) of low DO (<2 ppm) occur in offshore Louisiana and Texas waters during the warmer summer months (Rabalais et al. 1997). Increased levels of nutrient influx from freshwater sources coupled with high summer water temperatures, strong salinity-based stratification, and periods of reduced mixing appear to contribute to what is now referred to in the popular press as "the dead zone" (Justic et al. 1993). Flounder appear to be only moderately susceptible to low DOs and generally move out of the area, resulting in displacement rather than mortality. The close association that flounder has with estuaries during the hot summer months tends to decrease the effects these offshore hypoxic areas have on the population. Minor inshore hypoxic events have been documented in several estuaries in the Gulf of Mexico (Gunter and Lyles 1979).

4.9.2 Algal Blooms

Algal blooms are a frequent occurrence throughout most estuarine systems including those in the Gulf of Mexico and can affect flounder in adverse ways both indirectly (contributing to hypoxia and habitat changes) and directly (toxification). Hundreds of species of phytoplankton and cyanobacteria affect our waters every year. For example, perturbations affecting the Florida Bay, the shallow lagoon separating mainland Florida and the Florida Keys, include extensive cyanobacteria and phytoplankton (Butler et al. 1994) which led to the loss of sponge communities over hundreds of square kilometers (Butler et al. 1995). The causes of these environmental disturbances are not clear. A number of researchers have shown evidence that phosphorus-rich water being transported through advective processes from the Gulf of Mexico into Florida Bay are at least partially responsible (Fourqurean et al. 1992, 1993; Lapointe et al. 1994). Alternatively, the cyanobacteria blooms may have been initiated by nutrients liberated from the decomposition of dead seagrass that have coincided with the algal blooms (Butler et al. 1995). Although the causes of the disturbances are unclear, the results of these changes to the environment have profound effects on the organisms that live there. Sponge and seagrass habitats in the Florida Bay have been documented nursery and foraging grounds for shrimp, lobster, fish (including flounder), sea turtles, and wading birds.

Most algal blooms are not typically toxic to marine organisms but, as illustrated above, large blooms can change the environment in such a way as to negatively impact particular organisms. There are, however, a few blooms which are very toxic to many of the organisms that come into contact with them. These events are often referred to as "red tides."

Red tide events in the Gulf of Mexico are not uncommon, particularly along Florida's west coast. Outbreaks along the western Gulf of Mexico waters off southern Texas and northern Mexico have been reported by Wilson and Ray (1956). The earliest record of a red tide event (i.e., streaks of discolored water and associated marine mortalities) in Florida goes back as far as 1844 (Ingersoll 1882), and events have been recorded at least 24 times from 1854 to 1971 (Steidinger et al.1973). The areas of greatest severity and frequency in Florida are from Apalachee Bay to the Florida Keys (Steidinger et al.1973). Both Springer and Woodburn (1960) and Finucane et al. (1964) have included *Paralichthys* sp. in the list of marine species found dead during red tide outbreaks.

There are 85 species of toxic algae in the world, and 70% of those are dinoflagellates. Of that 70%, half occur in the Gulf of Mexico (Steidinger 1998, Steidinger et al. 1998). Algae only bloom when particular chemical-physical conditions occur precisely, thus great variability exists in the frequency of occurrence, distribution, and potential impact these blooms may have on the fishery in any given year. This additional contribution to natural mortality is difficult to quantify and perhaps impossible to predict.

In the fall and winter of 1996, an unprecedented occurrence of toxic algal blooms occurred in the Northern Gulf of Mexico resulting in a significant number of finfish deaths from Texas to Florida. The best estimates indicate three to four million finfish were killed in 1996 and 22 million in 1997 in Texas waters alone by the "red tide" and included commercial species such as red drum, flounder, black drum, and Atlantic croaker (McEachron et al. 1998). Additional fish kills were documented in the other Gulf states as well. This particular algal bloom was a naturally occurring organism named *Gymnodinium breve* which is found annually in very low amounts in the Gulf. Brevetoxin is the toxic compound produced and released by red tide cells and affects flounder and other organisms at different thresholds.

There are other hazardous algal blooms including *Pfiesteria*-like organisms, blue-green algaes, flagellates, and other dinoflagellates (Steidinger 1998). Some of these produce *breve*-like toxins, domoic acids, and other compounds which affect fish or organisms. Algal blooms may also affect finfish with their propensity to shade out ambient light and greatly reduce DO, thus contributing to hypoxic conditions often leading to death in fishes that are already under neurotoxic stress. The latter, *Pfiesteria*-like species, has been documented to have been responsible for fish kills near Indian River, Florida, between April and June 1998. All diseased flounder examined by researchers with FWC/FMRI were southern flounder (three of 13 examined were diseased), and no gulf flounder were reported to have been affected (J. Burnstein personal communication).

Another longstanding non-toxic algal bloom, *Aureumbra lagunensis*, has occurred in Texas since 1990 and may affect larval growth and flounder distribution due to low nutritional value and increased turbidity (Boesch et al. 1997).

4.9.3 El Niño and La Niña

El Niño [also referred to as El Niño Southern Oscillation (ENSO)] is a change in the eastern Pacific's atmospheric system which contributes to major changes in global weather. El Niño is characterized by a dwindling or sometimes reversal of equatorial trade winds causing unusually warm ocean temperatures along and on both sides of the equator in the central and eastern Pacific. The change in ocean temperature affects global atmosphere and causes unusual weather patterns around the world. In the southeastern United States, winter droughts are sometimes followed by summer floods. These conditions may have an impact on freshwater inflow patterns into the Gulf of Mexico and could ultimately affect flounder distribution. In many parts of the world, fish migration has been attributed to El Niño.

The effects of La Niña are nearly opposite that of El Niño and are characterized by a warmer than normal winter in the southeast. This provides favorable conditions for a strong hurricane season. Likewise, these abnormal conditions may influence fish migration and occurrence in the Gulf of Mexico.

4.9.4 Anthropogenic Habitat Impacts

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

4.9.4.1 Habitat Alteration

Estuarine-dependent species are susceptible to negative impacts on their populations because of the dynamic nature of the estuary and its close proximity to human activities. Human population growth in southeastern coastal regions, accompanied by industrial growth, is responsible for the alteration or destruction of approximately 1% of estuarine habitats important to commercial and recreational species (Klima 1989). Louisiana marshes are disappearing at a rate of about 6,500 ha per year (USEPA 1994). Except in terms of lost habitat, the effects of perturbations on overall estuarine productivity in the Gulf are largely undocumented. Human activities in inshore and offshore habitats of flounder which may affect recruitment and survival of stocks include: 1) ports and maintenance dredging for navigation projects; 2) discharges from wastewater plants and industries; 3) dredge and fill for land use conversion including commercial and residential development; 4) agricultural runoff; 5) ditching, draining, or impounding wetlands; 6) oil spills; 7) thermal discharges; 8) petroleum and mineral extraction; 9) entrainment and impingement from electrical power plants and other water-dependent industries; 10) dams; 11) marinas; 12) alteration of freshwater inflows to estuaries; 13) saltwater intrusion; and, 14) point and nonpoint source discharges of contaminants (Lindall et al. 1979). Erosion and subsidence also contribute to loss of coastal wetland habitats.

4.9.4.2 Dredge and Fill

Shallow water dredging for sand, gravel, and clam and oyster shell not only alters the bottom directly but may also change local current patterns leading to erosion or siltation of productive habitats. Destruction of wetlands by development of waterfront properties results in loss of productive habitat and the reduction of detrital production. Channeling or obstruction of water courses emptying into estuaries can result in loss of wetland and change salinities in the estuaries. Lowered flow rates of drainage systems can reduce the amount of nutrients that are washed into estuaries and permanently alter the composition of shoreline communities.

Degradation of estuarine habitats in the Gulf from human impacts can be traced as far back as the early 1900s. The quality of many wetlands continues to decline due to urban and agricultural run-off and oil and gas development. Exploration for and production of oil and gas, with its concomitant development of infrastructure, began along the northern Gulf (Texas and Louisiana) in the 1930s and 1940s. Alterations of marshes and coastal waters for oil exploration were caused by seismic blasting, dredging of canals, construction of storage tanks and field buildings, and other types of development. These activities may cause a number of problems for juvenile flounder through saltwater intrusion into brackish water areas and direct reductions in the amount of low salinity (5‰-15‰) nursery habitat. Levees built in 1927 to protect urban and agricultural areas from flooding along the Mississippi River have also deprived marshlands of needed water and sediments.

In Louisiana, there were 7,360 km of canals dredged south of the Intracoastal Waterway by 1970 (Barrett 1970). Canal construction results in wetland degradation far beyond the direct loss of habitat seen at dredge sites. Additional marsh loss is produced through secondary hydrologic effects: increased erosive energy, salinity intrusion, and disruption of natural flow effects. Some affected areas experience excessive sediment drying, while others undergo extended flood periods (Turner and Cahoon 1988); both effects produce loss of vegetative cover and increased conversion to open water. Freshwater storage effects where freshwater inputs are held for gradual release through the seaward marshes are also disrupted (Gagliano 1973). Direct wetland loss from canal dredging accounted for 120 km^2 of the total loss (about 16%) between 1955 and 1978; the combined contribution of direct and indirect effects from canal building is estimated at 30% to 59% of the total marsh loss in Louisiana in this period (Turner and Cahoon 1988).

4.9.4.3 Thermal Discharge

Thermal pollution is now recognized as a major factor contributing to habitat alteration. Industrial wastewater often produces large quantities of heated effluent. For instance, Roessler and Zieman (1970) found all aquatic plants and animals were greatly reduced near a nuclear plant outflow within the +4°C isotherm.

4.9.4.4 Industrial and Agricultural Run-off

Recent algal blooms in the Gulf of Mexico have caused problems for many of the Gulf fisheries including flounder (Section 4.9.2). Although these blooms are naturally occurring, it has been suggested by many researchers that these blooms have been 'fed' by additional nutrient inputs resulting from agricultural run-off. The high prevalence of *Pfiesteria* and *Pfiesteria*-like organisms along the Atlantic coast has been attributed to multiple sources—high coastal human population growth, intensive agricultural operations, aerial deposition, and other sources of cultural eutrophication (Maiolo and Tschetter 1981, Steel 1991, Burkholder and Glosgow 1997). Excessive waste in combination with favorable meteorologic and environmental conditions have elevated the densities of these organisms to near critical levels. Other events prevalent in the Gulf which can be linked, in part, to the increased influx of nutrients in the form of run-off include the red tide events of 1996-1997 and the persistent 'dead zone' off the Louisiana and Texas coasts (Section 4.9.1).

4.9.4.5 Wetland Impoundment and Water Management

Marsh loss, wetland impoundments, and salinity intrusion are critical topics with regard to management of estuarine-dependent species such as flounder. Wetland loss of approximately 6,500 ha per year in Louisiana is approaching crisis proportions (USEPA 1994). Impoundment activities include levee and canal construction and dredge and fill activities. Salinity levels may have increased in portions of coastal Louisiana in association with marsh loss and canal construction. Approximately 30% of the total wetland area in the Louisiana coastal zone was intentionally impounded before 1985 (Day et al. 1990). Herke and Rogers (1989) predicted that impoundment of marshes may increase in the future through the development of marsh management units in an effort to minimize coastal marsh loss. Marsh management by means of levees and weirs or other water control structures is usually detrimental to fisheries in the short term because of interference with migratory cycles of estuarine dependent species (Herke 1979, Rogers and Herke 1985, Herke et al. 1987, Herke and Rogers 1989).

In Louisiana a unique situation occurs. Although total land loss is high statewide, there are discrete basins which contribute more to the overall loss than others (i.e., Barataria Basin). The Sabine-Calcasieu and Mississippi River basins exhibited the highest percentage of total loss from 1956-1978 but exhibited marked decreases in percentage of total land area loss from 1978-1990 (Barras et al. 1994). This may indicate a stabilization in the loss rates within these basins. Unfortunately, some "stabilization" is probably due to the fact that many of the most susceptible marshes have already converted to open water (Thomas 1999). Louisiana is still losing some 9,000 ha of coastal wetlands every year (Barras et al. 1994).

The Atchafalaya Basin is another area which exhibits a unique situation. Delta development in Atchafalaya Bay began in the 1950s as major features of the Atchafalaya Basin Floodway were being completed. The Atchafalaya River flow began to increase in the mid 1800s, after removal of a massive log jam in the upper reaches of the river that restricted flow (Latimer and Schweizer 1951). Atchafalaya River flow increased this century from 17% of the Mississippi River flow in 1910 to 30% in 1963 when the Old River Control Structure was completed. The gradual increase has resulted in reduced tidal influence in Atchafalaya Basin wetlands to such an extent that they are now fresh and dominated by riverine processes. Mainland wetland losses are minimal (0.1% yr), and more than 23,000 acres of wetlands are projected to develop in the active delta over the next 50 years [Louisiana Coastal Wetlands Conservation and Restoration (C.W.C.R.) Task Force 1993].

Although deltaic wetlands are forming in Atchafalaya Bay, the full potential of delta development is not being realized, largely because of the Atchafalaya River navigation channel, which extends from the river mouth through the delta and terminates well offshore. The channel has impaired growth in the main subdelta such that recent growth rates for the subdelta of the smaller Wax Lake Outlet now exceed that of the main delta (Louisiana C.W.C.R. Task Force 1993). Restoration projects to maximize nearshore deposition of main channel sediments have been completed, and others are planned.

4.9.4.6 Freshwater Diversion

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

Agricultural development and urban expansion in Florida have caused similar negative effects on the Everglades that may have affected Florida Bay. Florida Bay has undergone substantial ecological change over the past 20 years, particularly within the last few years (Boesch et al. 1993). Although still insufficiently understood, one of the most well-documented changes is the death of thousands of hectares of seagrass *Thalassia testudinum* which was first documented in 1987 (Zieman et al. 1988). In addition, extensive cyanobacteria and phytoplankton blooms which have frequented Florida Bay (Butler et al. 1994) and the loss of sponge communities occurring over hundreds of square kilometers (Butler et al. 1995) may be further hampered by water diversion and agricultural run-off. A number of researchers have shown evidence that phosphorus-rich water being transported through advective processes from the Gulf of Mexico into Florida Bay are at least partially responsible (Fourqurean et al. 1992, 1993; Lapointe et al. 1994). As mentioned in Section 4.9.2, additional perturbations may be contributing to the blooms. The cyanobacteria blooms may have been initiated by nutrients liberated from the decomposition of dead seagrass that have coincided with the algal blooms (Butler et al. 1995).

4.9.4.7 Point and Nonpoint Source Pollution

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

4.9.4.8 Sea Level Rise

Increasing atmospheric levels of carbon dioxide and other gases released by human activities are believed to contribute to the greenhouse effect whereby the sun's radiant heat is retained within the atmosphere at higher levels. Such a warming could expand oceans and their sea level through global melting of mountain glaciers and polar ice sheets. Estimates of rising sea level rates vary considerably and are extremely controversial (Titus 1987). As sea level rises, wetland habitats may be impacted by inundation, erosion, and saltwater intrusion. Such impacts could contribute to serious wetland losses along the relatively flat coastlines of the Gulf of Mexico, depending on magnitude of sea level rise and amount of shoreline hardening which would minimize wetland retreat inland.

4.9.4.9 Urban Development

The nation's coastlines continue to be one of the most desirable areas in which to live. Coastal areas across the United States have population increases five times the national average. According to the United States Geological Survey (Williams et al. 1991), 50% of the nation's population live within 75 km of a coast, and this figure is projected to increase to 75% by the year 2010. Dredge and fill activities result in the creation of dry land used for urban development in coastal areas nationwide. Indirect effects from urban development also impact the quality and quantity of estuarine habitat utilized by flounder. Hopkinson and Day (1979) suggest that processing occurring at the uplands-estuary interface can have direct ecological effects such as nutrient runoff and eutrophication. While some of the direct impacts to estuaries have been somewhat curbed in recent years by coastal zone management regulations, indirect and cumulative impacts continue to be a major concern.

4.9.4.10 Introductions of Non-native Flora and Fauna

Invasive non-indigenous species are non-native plants or animals which become established and replace native species. Plant species can become monocultures, out competing all other vegetation. Aquatic plant species that may be present in the lower salinity habitats of flounder may include plants such as Eurasian water milfoil (*Myriophllum spicatum*), hydrilla (*Hydrilla verticillata*), torpedo grass, water lettuce (*Pistia stratiotes*), and water hyacinth (*Eichhornia crassipes*). Most of these species occur in wetland or aquatic habitats and may potentially impact flounder resources. Nutria, a large rodent, may be the most notable non-indigenous animal species and is known to cause destruction in estuarine habitats along the Gulf of Mexico. The degree to which these exotic species directly impact flounder or their habitat is uncertain.

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

Flounder are somewhat unusual among the more important marine fish species in the Gulf because they are not highly migratory. They are usually associated with estuaries and Gulf waters and have been referred to as a "euryhaline, estuarine-dependent bottom fish" (Benson 1982). Although their local range is perhaps more limited than other Gulf species, they are nonetheless both directly and indirectly affected by numerous state and federal management institutions because of their wide-spread distribution. The following is a partial list of some of the more important agencies and a brief description of the laws and regulations that could potentially affect flounder and their habitat. Individual Gulf States and federal agencies should be contacted for specific and up-to-date state laws and regulations, which are subject to change on a state-by-state basis.

5.1 Federal

5.1.1 Management Institutions

Flounder are found in the exclusive economic zone (EEZ) of the Gulf of Mexico, but they are most abundant in state waters. The commercial and recreational fisheries are almost exclusively conducted in state management jurisdictions; consequently, laws and regulations of federal agencies primarily affect flounder populations by maintaining and enhancing habitat, preserving water quality and food supplies, and abating pollution. Federal laws may also be adopted to protect consumers through the development of regulations to maintain the quality of flounder as seafood.

5.1.1.1 Regional Fishery Management Councils

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

The councils must operate under a set of standards and guidelines, and to the extent practicable, an individual stock of fish shall be managed as a unit throughout its range. Management shall, where practicable, promote efficiency, minimize costs, and avoid unnecessary duplication (MFCMA Section 301a).

The GMFMC has not developed a management plan for flounder. Furthermore, there is no significant fishery for flounder in the EEZ of the United States Gulf of Mexico.

5.1.1.2 National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Department of Commerce (DOC)

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

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

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

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

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

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

5.1.1.4 National Park Service (NPS), Department of the Interior (DOI)

The NPS under the DOI may regulate fishing activities within park boundaries. Such regulations could affect the harvest of flounder if implemented within a given park area. The NPS has regulations preventing commercial fishing within one mile of the barrier islands in the Gulf Islands National Seashore off Mississippi and in regulating various fishing activities in Everglades National Park in Florida.

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

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

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

5.1.1.6 United States Environmental Protection Agency (USEPA)

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

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

5.1.1.7 United States Army Corps of Engineers (USACOE)

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

5.1.1.8 United States Coast Guard

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

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

5.1.1.9 United States Food and Drug Administration (FDA)

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

5.1.2 Treaties and Other International Agreements

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

5.1.3 Federal Laws, Regulations, and Policies

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

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

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

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

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

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

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

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

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

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

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

5.1.3.6 Clean Water Act of 1981 (CWA)

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

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

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

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

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

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

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

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

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

5.1.3.10 National Environmental Policy Act of 1970 (NEPA)

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

5.1.3.11 Fish and Wildlife Coordination Act of 1958

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

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

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

5.1.3.13 Lacey Act of 1981, as amended

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

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

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

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

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

5.1.3.16 Fish and Wildlife Act of 1956

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

5.2 State

Table 5.1 outlines the various state management institutions and authorities.

5.2.1 Florida

5.2.1.1 Florida Fish and Wildlife Conservation Commission

Florida Fish and Wildlife Conservation Commission
620 South Meridian Street
Tallahassee, FL 32399
Telephone: (904) 487-0554

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

The FWC, a ten-member board (that will eventually be seven members) appointed by the governor and confirmed by the senate, was created by constitutional amendment in November 1998, effective July 1, 1999. This commission was delegated rule-making authority over marine life in the following areas of concern: gear specification, prohibited gear, bag limits, size limits, quotas and trip limits, species that may not be sold, protected species, closed areas, seasons, and quality control codes.

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

Table 5.1. State management institutions–Gulf of Mexico.

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

5.2.1.2 Legislative Authorization

Prior to 1983, the Florida Legislature was the primary body that enacted laws regarding management of flounder in state waters. Chapter 370 of the Florida Statutes, annotated, contained the specific laws directly related to harvesting, processing, etc. both statewide and in specific areas or counties. In 1983, the Florida Legislature established the Florida Marine Fisheries Commission and provided the commission with various duties, powers, and authorities to promulgate regulations affecting marine fisheries. Title 46, Chapters 46-48 contains regulations regarding flounder. On July 1, 1999 the Florida Marine Fisheries Commission (including the Florida Marine Patrol) and the Florida Game and Freshwater Fisheries Commission were merged into one commission. Marine fisheries rules of the new Florida Fish and Wildlife Conservation Commission are now codified under Chapter 68B, Florida Administrative Code.

5.2.1.3 Reciprocal Agreements and Limited Entry Provisions

5.2.1.3.1 Reciprocal Agreements

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

5.2.1.3.2 Limited Entry

Florida has no statutory provisions for limited entry in the flounder fishery with the exception of a $5,000/year restricted species license.

5.2.1.4 Commercial Landings Data Reporting Requirements

Florida requires wholesale dealers to maintain records of each purchase of saltwater products by filling out a Marine Fisheries Trip Ticket (Chapter 370.02 of the Florida Statutes grants rule making authority and Chapter 62R-5.002 of the Administrative Code specifies the requirements). Information to be supplied for each trip includes Saltwater Products License number; vessel identification; wholesale dealer number; date; time fished; area fished; county landed; depth fished; gear fished; number of sets; whether a head boat, guide, or charter boat; number of traps; whether aquaculture or lease number; species code; species size; amount of catch; unit price; and total dollar value which is optional. The wholesale dealer is required to submit these trip tickets weekly if the tickets contain quota-managed species such as Spanish mackerel, otherwise every month.

5.2.1.5 Penalties for Violations

Penalties for violations of Florida laws and regulations are established in Florida Statutes, Section 370.021. Additionally, upon the arrest and conviction of any license holder for violation of such laws or regulations, the license holder is required to show just cause as to reasons why his saltwater license should not be suspended or revoked.

5.2.1.6 Annual License Fees

Resident wholesale seafood dealer	
· county	$300.00
· state	450.00
Nonresident wholesale seafood dealer	
· county	500.00
· state	1,000.00
Alien wholesale seafood dealer	
· county	1,000.00
· state	1,500.00
Resident retail seafood dealer	25.00
Nonresident retail seafood dealer	200.00
Alien retail seafood dealer	250.00
Saltwater products license	
· resident-individual	50.00
· resident-vessel	100.00
· nonresident-individual	200.00
· nonresident-vessel	400.00
· alien-individual	300.00
· alien-vessel	600.00
Recreational saltwater fishing license	
· resident	
ten day	11.50
annual	13.50
· nonresident	
three day	6.50
seven day	16.50
annual	31.50
Annual commercial vessel saltwater fishing license (recreational for hire)	
· 11 or more customers	801.50
· five-ten customers	401.50
· four or less customers	201.50
Optional pier saltwater fishing license (recreational users exempt from other licenses)	501.50
Optional recreational vessel license (recreational users exempt from other licenses)	2,001.50

5.2.1.7 Laws and Regulations

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

5.2.1.7.1 Size Limits

A minimum size limit of 12 inches TL.

5.2.1.7.2 Gear Restrictions

Flounder may be harvested with a beach or haul seine (under 500 ft^2), cast net (under 500 ft^2), hook and line gear, gig, and spear or lance. All other gears (e.g., purse seines, gill nets, trammel nets, pound nets, and other entangling nets) are prohibited throughout Florida territorial waters. Additionally, possession of flounder aboard any vessel carrying gill nets or other entangling nets is prohibited.

5.2.1.7.3 Closed Areas and Seasons

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

5.2.1.7.4 Quotas and Bag/Possession Limits

No person shall harvest in or from state waters more than a total of ten flounder per day, nor possess while in or on state waters more than ten such fish.

5.2.1.7.5 Other Restrictions

Flounder must be landed in a whole condition. The use of any multiple hook (e.g., treble hook) with live or dead natural bait and snagging (snatch hooking) to catch flounder is prohibited.

5.2.1.8 Historical Changes to Flounder Regulations in Florida

February 12-May 13, 1991:

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

March 20, 1991:

- Prohibited to use gill nets in state waters with a mesh size greater than six inches stretched mesh

January 1, 1993:

- Set a maximum mesh size for seines at two inches stretched mesh, excluding wings
- Set a minimum mesh size for gill and trammel nets at three inches stretched mesh beginning January 1, 1995
- Set a maximum length of 600 yards for all gill and trammel nets and seines

- Allowed only a single net to be fished by any vessel or individual at any time
- Prohibited the use of longline gear

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

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

July 1, 1995:
- Prohibited the use of any gill or entangling net in Florida waters
- Prohibited the use of any net with a mesh area greater than 500 square feet

January 1, 1996:
- 12 inch TL minimum size for all flounders (commercial and recreational fishermen)
- Ten fish daily limit (recreational fishermen only)
- Allowed only hook and line, cast net, beach, haul seine, spears and gigs
- 50 lbs commercial daily vessel bycatch allowed
- Daily harvest of no more than ten fish allowed by spearfishing
- Prohibited use of multiple (treble) hook in conjunction with natural bait and snagging

5.2.2 Alabama

5.2.2.1 Alabama Department of Conservation and Natural Resources

Alabama Department of Conservation and Natural Resources
Marine Resources Division
P.O. Box 189
Dauphin Island, Alabama 36528
(205) 861-2882

Management authority of fishery resources in Alabama is held by the Commissioner of the Alabama Department of Conservation and Natural Resources (ADCNR). The Commissioner may promulgate rules or regulations designed for the protection, propagation, and conservation of all seafood. He may prescribe the manner of taking, times when fishing may occur, and designate areas where fish may or may not be caught; however, all regulations are to be directed at the best interest of the seafood industry.

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

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

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

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

5.2.2.2 Legislative Authorization

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

5.2.2.3 Reciprocal Agreements and Limited Entry Provisions

5.2.2.3.1 Reciprocal Agreements

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

5.2.2.3.2 Limited Entry

Alabama law provides that commercial net and seine permits shall only be issued to applicants who purchased such licenses in two of five years from 1989 through 1993 and who show proof (in the form of both federal and Alabama state income tax returns) that they derived at least 50% of their gross income from the capture and sale of seafood species in two of the five years; or applicants that purchased such licenses in all five years and who (unless exempt from filing Alabama income tax) filed Alabama income tax returns in all five years. Other restrictions are applicable, and the ADCNR, MRD should be contacted for details.

5.2.2.4 Commercial Landings Data Reporting Requirements

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

5.2.2.5 Penalties for Violations

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

5.2.2.6 Annual License Fees

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

Commercial hook and line	
· resident	$101.00
· nonresident	201.00
Commercial gill nets, trammel nets, seines* (up to 2,400 ft)	
· resident	301.00
· nonresident	1,501.00
Recreational gill net	
· resident	51.00
· nonresident	variable
Roe mullet/Spanish mackerel endorsement**	
· resident	501.00
· nonresident	2,501.00
Seafood dealer***	
· resident	201.00
· nonresident	variable
Seafood dealer vehicle	
· resident	101.00
· nonresident	101.00
Recreational saltwater fishing license	
· resident	16.00
· nonresident	variable
Spearfishing	
· resident	6.00
· nonresident	8.50
· nonresident seven day	3.50

*Seines 25 ft or less in length are exempt from licensing
**Required in addition to gill net license
*** Required for cast nets and gigging if used commercially

5.2.2.7 Laws and Regulations

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

5.2.2.7.1 Size Limits

Alabama has no minimum or maximum size limit for gulf or southern flounder in either the commercial or recreational fishery.

5.2.2.7.2 Gear Restrictions

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

During the period January 1 through October 31 of each year, gill nets, trammel nets, and other entangling nets used to catch any fish in Alabama coastal waters under the jurisdiction of the MRD must have a minimum mesh size of 1.75 inch bar (knot to knot). A minimum mesh size of 1.875 inch bar is required for such nets used to take mullet during the period October 24 through December 31 of each year for all Alabama coastal waters under the jurisdiction of the MRD as provided in Rule 220-2-42 and defined in Rule 220-3-04(1), and any person using a 1.875 inch or larger bar net during the period October 24 through December 31 of each year shall be considered a roe mullet fisherman and must possess a roe mullet permit. Only strike nets may be used in certain waters of Bon Secour Bay during this period These net-size restrictions do not apply to coastal rivers, bayous, creeks, or streams. In these areas, the minimum mesh size shall be six inch stretch mesh.

The use of purse seines to catch flounder is prohibited. Commercial and recreational gill net fishermen may use only one net at any time; however, commercial fishermen may possess more than one such net. No hook and line device may contain more than five hooks when used in Alabama coastal waters under the jurisdiction of the MRD.

5.2.2.7.3 Closed Areas and Seasons

Gill nets, trammel nets, seines, purse seines, and other entangling nets are prohibited in any marked navigational channel, Theodore Industrial Canal, Little Lagoon Pass, or any man-made canal; within 300 ft of any man-made canal or the mouth of any river, stream, bayou, or creek; and within 300 ft of any pier, marina, dock, boat launching ramp, or certain "relic" piers. Recreational gill nets may not be used beyond 300 ft of any shoreline, and they may not extend into the water beyond the end of any adjacent pier or block ingress or egress from any of the aforementioned structures.

From January 1 through October 1 of each year, gill nets, trammel nets, seines, haul seines, and other entangling nets are prohibited within 0.46 km of the Gulf shore line. However, subject to other provisions, waters east of longitude 87˚59' will be open from 6:00 p.m. to 6:00 a.m. each day from March 15 through the Thursday before Memorial Day. Additionally, from October 2 through December 31 these waters will be open to the taking of mullet only with 1.875 inch knot to knot minimum mesh nets.

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

5.2.2.7.4 Quotas and Bag/Possession Limits

There are no quotas or bag/possession limits for the recreational or commercial flounder fishery.

5.2.2.7.5 Other Restrictions

All nets must be constantly attended by the licensee, and no dead fish or other dead seafood may be discarded within 5.6 km of Gulf beaches; within 500 ft of any shoreline; or into any river, stream, bayou, or creek.

5.2.3 Mississippi

5.2.3.1 Mississippi Department of Marine Resources

Mississippi Department of Marine Resources
1141 Bayview Avenue, Suite 101
Biloxi, Mississippi 39530
(228) 374-5000

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

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

5.2.3.2 Legislative Authorization

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

Title 49, Chapter 15 of the Mississippi Code of 1972 §49-15-2 "Standards for fishery conservation and management; fishery management plans," was implemented by the Mississippi

Legislature on July 1, 1997 and sets standards for fishery management as related to the Magnuson-Stevens Act (1996).

5.2.3.3 Reciprocal Agreements and Limited Entry

5.2.3.3.1 Reciprocal Agreements

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

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

5.2.3.3.2 Limited Entry

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

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

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

5.2.3.4 Commercial Landings Data Reporting Requirements

Ordinance Number 9.001 of the MDMR establishes data reporting requirements for marine fisheries' operations, including confidentiality of data and penalties for falsifying or refusing to make the information available to the MDMR.

5.2.3.5 Penalties for Violations

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

5.2.3.6 Annual License Fees

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

Shrimp (vessel less than 30 ft in length)	$60.00
Shrimp (vessel 30 to 45 ft in length)	85.00
Shrimp (vessel more than 45 ft in length)	110.00
Nonresident shrimp (vessel less than 30 ft in length)	100.00
Nonresident shrimp (vessel 30 to 45 ft in length)	150.00
Nonresident shrimp (vessel more than 45 ft in length)	200.00
Commercial hook and line	100.00
Charter boats and party boats	200.00
Gill nets, trammel nets and seines*	
· resident	100.00
· nonresident	300.00
Seafood dealer	100.00
Seafood processor	200.00
Recreational hook and line	4.00

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

5.2.3.7 Laws and Regulations

Mississippi laws which regulate the harvest of flounder are primarily limited to gear restrictions for the use of nets.

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

Title 49, Chapter 15 of the Mississippi Code of 1972 section §49-15-96 allows licensed shrimpers to retain, clean, or filet for personal consumption only flounder which are caught in shrimp trawls.

5.2.3.7.1 Size limits

Currently there are no commercial or recreational size limits for flounder in Mississippi.

5.2.3.7.2 Closed Areas and Seasons

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

The nets must not be used in a manner to block any of these bays, bayous, rivers, streams, or other tributaries.

No gill or trammel nets, seines, or like contrivance may be used within an area formed by a line running 1.85 km from the shoreline of Cat, Ship, Horn, Petit Bois, and Round islands, or from the shoals of Telegraph Keys and Telegraph Reef (Merrill Coquille) during the period from May 15 to September 15 of each year.

______There are no closed seasons for the harvest of flounder. However, gear restrictions include: from 6:00 a.m. to 6:00 p.m., no trammel nets shall be set or otherwise used for the taking of aquatic life within 0.93 km of the shoreline or any manmade structure attached to the shoreline from Bayou Caddy in Hancock County to Marsh Point in Ocean Springs, Jackson County. From 6:00 p.m. to 6:00 a.m., no trammel nets shall be set or otherwise used for the taking of aquatic life within 0.46 km of the shoreline or any manmade structure attached to the shoreline from Bayou Caddy in Hancock County to Marsh Point in Ocean Springs, Jackson County.

Section 49-15-78 states gill nets cannot be set within 0.93 km of shoreline in the state of Mississippi.

It is illegal to use a gill or trammel net in the marine waters of Mississippi or to possess fish in, or in contact with, a gill or trammel net in a boat in the marine waters of Mississippi between 6:00 a.m. on Saturday mornings and 6:00 p.m. on Sunday evenings or on any legal holidays established by the Mississippi Legislature and as set forth in Mississippi Code Annotated §3-3-7. No gill or trammel net shall be set within 0.46 km of another gill or trammel net. Gill and trammel nets must be attended at all times from a distance of no greater than the length of the boat in use. All gill and trammel nets must be constructed of an approved degradable material. An approved degradable materials list will be on file with the Executive Director of the MDMR or his designee.

5.2.3.7.3 Quota and Bag/Possession Limits

There are no quotas, bag limits, or possession limits for the commercial or recreational flounder fisheries in the state of Mississippi.

5.2.3.8 Historical Changes to the Regulations

Flounder are not regulated in Mississippi either commercially or recreationally.

5.2.4 Louisiana

5.2.4.1 Louisiana Department of Wildlife and Fisheries

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

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

Within the administrative system, an Assistant Secretary is in charge of the Office of Fisheries. In this office, a Marine Fisheries Division (headed by the Division Administrator) performs:

> "the functions of the state relating to the administration and operation of programs, including research relating to oysters, water bottoms and seafood including, but not limited to, the regulation of oyster, shrimp, and marine fishing industries." (Louisiana Revised Statutes 36:609).

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

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

5.2.4.2 Legislative Authorization

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

Sections 320, 325.4, and 326.3 of Title 56 (L.R.S.) authorize the LWFC to promulgate rules for the harvest of flounder including seasons, daily take and possession limits, permits, and other aspects of harvest, and provide authority to adopt interim rules until the LWFC can implement permanent rules. Additionally, Sections 325.4 and 326.3 of Title 56 (L.R.S.) give the LWFC the legislative authority to set possession limits, quotas, places, season, size limits, and daily take limits for all freshwater and saltwater finfishes based upon biological and technical data. However, section 492 of Title 56 (L.R.S.) establishes that all southern flounder harvested by any commercial shrimping vessel as bycatch may be retained and sold.

5.2.4.3 Reciprocal Agreements and Limited Entry Provisions

5.2.4.3.1 Reciprocal Agreements

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

Residents of Texas 65 years of age or under 17 years of age may fish in all Louisiana/Texas border waters without a fishing license. Reciprocally, Louisiana residents 60 years of age or older or those under 16 years of age may fish in all Texas/Louisiana border waters, excluding the Gulf of Mexico, without a fishing license.

5.2.4.3.2 Limited Entry

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

5.2.4.4 Commercial Landings Data Reporting Requirements

Wholesale/retail seafood dealers who purchase flounder from fishermen are required to report those purchases by the tenth of the following month. Commercial fishermen who sell flounder directly to consumers must be licensed as a wholesale/retail seafood dealer and comply with the same reporting requirements.

5.2.4.5 Penalties for Violations

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

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

5.2.4.6 Annual License Fees

The following list of licenses fees is current to the date of this publication. They are subject to change any time thereafter.

5.2.4.6.1 Commercial

Commercial fisherman's license	
· resident	$55.00
· nonresident	460.00
Charter boat fishing guide (up to six passengers)	
· resident	250.00
· nonresident	1,000.00
Charter boat fishing guide (more than six passengers)	
· resident	500.00
· nonresident	2,000.00
Vessel license	
· resident	15.00
· nonresident	60.00
Gear license (rod and reel)	
· resident	250.00
· nonresident	1,000.00
Gear licenses (hoop nets, cast nets, set lines, flounder gigs, spear guns)	
· resident	25.00
· nonresident	100.00

5.2.4.6.2 Recreational

Basic recreational fishing license	
· resident	5.50
· nonresident	15.00
Saltwater angling license	
· resident	5.50
· nonresident	40.00
Temporary basic recreational fishing license (three day)	
· nonresident	40.00
Temporary saltwater recreational license (three day)	
· nonresident	55.00
Temporary combination basic and saltwater fishing license	
· nonresident	23.00
Nonresident charter trip fishing license	2.50

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

5.2.4.7 Laws and Regulations

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

5.2.4.7.1 Size Limits

No size limits currently exist on flounder taken either commercially or recreationally.

5.2.4.7.2 Gear Restrictions

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

Licensed recreational fisherman may take flounder recreationally with a bow and arrow, barbless spear, gig, scuba gear, hook and line, and rod and reel.

5.2.4.7.3 Closed Areas and Seasons

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

5.2.4.7.4 Quotas and Bag/Possession Limits

There is no quota on flounder. The daily bag limit for recreational and commercial fisherman is ten fish per day. Additionally, any commercial shrimping vessel may retain and any commercial fisherman may sell all southern flounder caught as bycatch.

5.2.4.7.5 Other Restrictions

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

5.2.4.8 Historical Changes in Regulations

The decline in Louisiana southern flounder landings can be attributed, at least in part, to the following chronology of legislative events.

1995: The Louisiana Legislature eliminated the use of all set nets and provided for the use of strike nets only during specified seasons through 1997. Southern flounder was designated a "restricted" species and could only be harvested during the strike net season, eliminating a gill net fishery. Permit criteria were established requiring that 50% of the applicants income over two of the previous three years had to be derived from commercial fishing to qualify. In addition, possession of a saltwater gill net license and no Class 3 or greater fisheries violations were required. Net fishing was restricted to daylight, weekday hours.

1996: From May 1996 to May 1997, the commercial harvest of flounder was closed due to low SPR estimates. The closure was later modified and allowed the current daily possession limit of ten fish per person per day. The same bag limit was applied to recreational anglers.

In November, the declaration of emergency closure was followed by a permanent rule which continued the original closure.

1997: The Legislature provided for the incidental bycatch of flounder on commercial vessels not to exceed 100 lbs per trip. This action also reopened the flounder season at the current bag and possession limits and added a reporting requirement for all transactions including flounder.

1999: The Legislature changed the incidental bycatch of flounder on commercial vessels to read that any commercial shrimping vessel may retain and any commercial fisherman may sell all southern flounder caught as bycatch.

5.2.5 Texas

5.2.5.1 Texas Parks and Wildlife Department

Texas Parks and Wildlife Department
Coastal Fisheries Division
4200 Smith School Road
Austin, Texas 78744
(512) 389-4863

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

Texas has habitat protection and permitting programs and a federally-approved CZM program. The Texas General Land Office (TGLO) is the lead agency for the Texas Coastal Management. The Coastal Coordination Council monitors compliance of the state Coastal Management Program and reviews federal regulations for consistency with that plan. The Coastal Coordination Council is an eleven-member group whose members consist of a chairman (the head of TGLO) and representatives from Texas Natural Resource Conservation Commission, TPWC, the Railroad Commission, Texas Water Development Board, Texas Transportation Commission, and the Texas Soil and Water Conservation Board. The remaining four places of the council are appointed by the governor and are comprised of an elected city or county official, a business owner, someone involved in agriculture, and a citizen. All must live in the coastal zone.

5.2.5.2 Legislative Authorization

Chapter 11, Texas Parks and Wildlife Code, established the TPWC and provided for its make-up and appointment. Chapter 12, Texas Parks and Wildlife Code, established the powers and duties of the TPWC, and Chapter 61, Texas Parks and Wildlife Code, provided the commission with responsibility for marine fishery management and authority to promulgate regulations. Chapter 47, Texas Parks and Wildlife Code, provided for the commercial licenses required to catch, sell, and transport finfish commercially, and Chapter 66, Texas Parks and Wildlife Code, provided for the sale, purchase, and transportation of protected fish in Texas. All regulations pertaining to size limits, bag and possession limits, and means and methods pertaining to finfish are adopted by the TPWC and included in the Texas Statewide Hunting and Fishing Proclamations.

5.2.5.3 Reciprocal Agreements and Limited Entry Provisions

5.2.5.3.1 Reciprocal Agreements

Texas statutory authority allows the TPWC to enter into reciprocal licensing agreements in waters that form a common boundary, i.e., the Sabine River area between Texas and Louisiana. Texas has no statutory authority to enter into reciprocal management agreements.

5.2.5.3.2 Limited Entry

Chapter 47, Texas Parks and Wildlife Code, provides that no person may engage in business as a commercial finfish fisherman unless a commercial finfish fisherman's license has been obtained. In order to qualify for a commercial finfish fisherman's license, a person must file an affidavit with the department at the time the license is applied for that states:

1) the applicant is not employed at any full-time occupation other than commercial fishing; and,
2) during the period of validity of the commercial finfish fisherman's license, the applicant does not intend to engage in any full-time occupation other than commercial fishing.

5.2.5.4 Commercial Landings Data Reporting Requirements

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

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

5.2.5.5 Penalties for Violations

Penalties for violations of Texas' proclamations regarding flounder are provided in Chapter 61, Texas Parks and Wildlife Code, and most are Class C misdemeanors punishable by fines ranging from $25 to $500. Under certain circumstances, a violation can be enhanced to a Class B misdemeanor punishable by fines ranging from $200 to $1,000; confinement in jail not to exceed 180 days; or both.

5.2.5.6 Annual License Fees

The following is a list of licenses and fees that are applicable to flounder harvest in Texas. They are current to the date of this publication and are subject to change at any time thereafter.

5.2.5.6.1 Recreational

General fishing license	
· resident	$19.00
· nonresident	30.00
Temporary fishing license (three-day) resident	10.00
Temporary fishing license (14-day) resident	12.00
Temporary fishing license (five-day) nonresident	20.00
Lifetime fishing license	600.00
Saltwater sportfishing stamp[1]	7.00
Special resident fishing[2]	6.00
Combination hunting and fishing	32.00
"Super Combo" license package resident[3]	49.00
"The Texan" all-purpose license package resident[4]	100.00
Lifetime combination hunting and fishing license resident	1,000.00

[1] Required in addition to recreational licenses when fishing in saltwater.

[2] Required of residents who reach 65 years of age after September 1, 1995, who are legally blind or are resident commercial fishermen fishing for sport.

[3] Package includes Resident Combination Hunting and Fishing License and seven state stamp fees (five hunting, two fishing) at a discount price ($82.00 value if items purchased separately).

[4] Package adds free park entry (Gold Texas Conservation Passport) to Super Combo above and may include preferred customer opportunities.

5.2.5.6.2 Commercial

Senate Bill 1303 authorizes the Texas Parks and Wildlife Commission under Parks and Wildlife Code 47, to establish a license limitation plan for the Texas commercial finfish fishery. The Finfish License Management Program became effective September 1, 2000.

General commercial fisherman's license	
· resident	$20.00
· nonresident	150.00
Commercial finfish fisherman's license	
· resident	75.00
· nonresident	150.00
Commercial fishing boat license	
· resident	15.00
· nonresident	60.00

5.2.5.7 Laws and Regulations

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

5.2.5.7.1 Size Limits

A minimum size limit of 14 inches TL has been established for flounder in Texas.

5.2.5.7.2 Gear Restrictions

Gill nets, trammel nets, seines, purse seines, and any other type of net or fish trap are prohibited in the coastal waters of Texas. Flounder may be legally taken by pole and line, trotline, sail line, and gig. Flounder taken incidental to legal shrimp trawling operations may be retained provided the total weight of aquatic products retained, in any combination, does not exceed 50% by weight of shrimp on a shrimping vessel. The bag limit for flounder retained incidental to a legal shrimping operation is equal to a recreational bag limit.

5.2.5.7.3 Closed Areas and Seasons

There are no closed areas or seasons for the taking of flounder in Texas.

5.2.5.7.4 Quotas and Bag/Possession Limits

5.2.5.7.4.1 Recreational

Bag limit - ten
Possession limit - 20

5.2.5.7.4.2 Commercial

The daily bag and possession limit for the holder of a valid Commercial Finfish Fisherman's License is 60. Non-game fish and other aquatic products taken incidental to legal shrimp trawling operations may be retained provided the total weight of aquatic products retained, in any combination, does not exceed 50% by weight of shrimp on a shrimping vessel. The bag limit for flounder retained incidental to a legal shrimping operation is equal to a recreational bag limit.

5.2.5.7.5 Other Restrictions

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

5.2.5.8 Historical Changes to Regulations

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

1981: House Bill 1000, prohibition of red drum and spotted seatrout sale (game fish status), therefore pressure on flounder would have been increased.

1988: Net ban, affecting immediate commercial as well as future commercial and recreational landings.

1988: Size restrictions were previously implemented on flounder in some counties in Texas (i.e., 1983, Cameron County, 12 inch minimum); however, the first coast wide size and bag limits were passed for flounder September 1, 1988. The minimum size for recreational and commercial anglers was 12 inches. Recreational anglers were also restricted to a 20 bag limit, 40 possession on flounder. No bag limit on commercial finfisherman, other than those landed by shrimp trawls, where the bag limit was the same as recreational fisherman.

1995: Senate Bill 750, limited entry for shrimpers may have redistributed commercial pressure.

1996: On September 1, 1996, the minimum size of flounder increased from 12 to 14 inches for both recreational and commercial fisherman. The bag/possession limit for recreational fisherman decreased from 20 bag/40 possession to 10 bag/20 possession. A bag limit of 60 flounder was established for commercial fisherman. (Flounder taken from commercial trawls are subjected to same restrictions as recreational anglers, 14 inch size and ten bag/20 possession.)

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

5.3 Regional/Interstate

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

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

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

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

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

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

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

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

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

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

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

6.0 DESCRIPTION OF THE FISHERY

The relative importance of flounders in the commercial catch has increased substantially in comparison to most other commercially-important marine food fishes (Gilbert 1986). This increase in landings occurred primarily in the south Atlantic and to a lesser degree in the Gulf of Mexico; commercial landings in the Gulf of Mexico have ranged from a low of approximately 192,000 lbs in 1888 to a high of approximately 2,582,500 lbs in 1972.

Although flounder are not harvested in the same quantity as other popular commercial and recreational species, they are still an important component of Gulf fisheries. Their popularity is primarily due to their excellent quality as food fish (Gilbert 1986) (Table 6.1). Numerous authors have indicated the importance of southern flounder, in particular, to both commercial and recreational fishermen (Kelly 1965, Franks et al. 1972, Christmas and Waller 1973, Jackson and Timmer 1976, McIlwain 1978, Benson 1982, Matlock 1982). Southern and gulf flounders are the dominant flatfish in commercial and recreational landings for the Gulf.

The southern flounder is a valuable recreational species on the Gulf coast where it is harvested mainly by hook and line and gigs (Reagan and Wingo 1985). Flounder gigging occurs mainly at night, with fishermen wading in shallow water using a bright light to illuminate the bottom. According to Warlen (1975), this technique has been used since the time of the ancient Greeks and Romans and could go back 10,000 years to a time when early man used spears for self protection, hunting, and fishing.

6.1 Commercial Fishery

6.1.1 History

There are more than two dozen species of flatfish in the family Bothidae found in the Gulf of Mexico, many of which are captured by commercial shrimp trawlers (Reagan and Wingo 1985). Most flatfishes have little or no commercial value, however. In addition, flatfishes make up a small component of the industrial bottomfish catches in the Gulf of Mexico. Commercially-valuable flatfishes (gulf and southern flounder) are typically removed from these catches and sold separately, rather than leaving them in the groundfish catch to be processed as pet food or fish meal.

Fourteen species of flatfish (Bothidae) are regularly captured in the annual SEAMAP sampling program in the Gulf of Mexico. They include the southern, ocellated (*Ancylopsetta quadrocellata*), three-eye (*Ancylopsetta dilecta*), Mexican *(Cyclopsetta chittendeni*), spiny (*Engyophrys senta*), sash (*Trichopsetta ventralis*), shelf (*Etropus cyclosquamus*), fringed (*Etropus crossotus*), shoal (*Syacium gunteri*), dusky *(Syacium papillosum*),broad (*Paralichthys squamilentus*), and gulf flounders, as well as the spotted whiff (*Citharichthys macrops*) and bay whiff (*Citharichthys spilopterus*). Gear types used to incidentally harvest flounders are basically the same as those used to commercially harvest other marine species and include butterfly nets, shrimp trawls, gill nets, trammel nets, handlines, longlines, and haul seines. Although spears and/or spearing are normally associated with the harvest of flounders, commercial landings for flounders attributed to this method are rarely reported for most states. Gigging (spearing) accounts for a large portion of the total commercial landings for flounder in Texas. Likewise, it is estimated that as much as 25%

of the flounder landings in Mississippi come from gig fishermen (MDMR unpublished data); however, since flounder are not regulated commercially in Mississippi, these landings are unreported.

Trammel nets are a gear used for harvesting commercial marine species during cooler months along beaches or inshore waters. Trammel nets are normally fished by one or two fishermen in small to moderate sized vessels up to 12 m in length. In the last ten years, however, most entanglement type nets (gill and trammel) have been banned or greatly restricted in the Gulf States.

Handlines and longlines are normally fished in offshore waters from 36.5-71.3 m near offshore oil platforms (Gutherz et al. 1975). Handlines employ a weighted cord with hooks spaced along its length and can be fished near the bottom or at any depth fish are encountered. They are usually operated by hand or with the use of downriggers. Longlines may be as much as 1-3 km long and have several floats and weights attached periodically and hooks along its length. This gear is used to fish waters of any depth to approximately 330 m, depending on the target species (Horst and Bankston 1987). Only a small percentage of commercially harvested flounders are landed with handlines or longlines. Butterfly nets generally harvest flounders incidentally to the targeted shrimp catch. However, butterfly nets have been used to target flounders when large flounder runs occur, normally during the fall months of October and November.

Butterfly nets are used mainly in bayous, channels, and passes to harvest shrimp along with incidental species during periods of strong falling tides and during declining temperatures. In the Gulf of Mexico; October, November, and December are the months during which most flounders are commercially landed due to the flounder's habit of moving to offshore areas as water temperatures decline.

Flounder landings in the Gulf of Mexico remained relatively stable after peaking in 1972 (Table 6.2), although the price per pound has increased significantly (see Table 7.1). Landings declined in 1996 following the implementation of laws and regulations either banning or severely restricting the use of entanglement nets in inshore waters. Whether the demand for flounder can be satisfied by means of harvest other than nets is unknown.

6.1.2 State Commercial Fisheries

The flounder commercial fishery varies widely among Gulf States in historical landings, gear, vessels, and traditions. Table 6.2 gives flounder landings from the Gulf States from 1965 to 1997. Because identification of flounders to species has not been attempted by the various port agents collecting the data, most of the landings are for flounder in general. The states have limited data separated by species.

6.1.2.1 Florida

The information on the commercial fishery is collected by the FWC’s Trip Ticket Program. Wholesale dealers are required to report the purchase of saltwater products from commercial harvesters on trip tickets, and these harvesters are required to have Saltwater Products Licences. They, in turn, must sell only to licenced wholesale dealers.

Table 6.1. Percent of recreational fishermen targeting selected species of fish in Louisiana (Luquet et al. 1998). The flounder group includes all species of flounders. Omission of some species for some years could lead to underestimation of the overall group for those years.

Species	Year															
	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
None	43.56	55.15	58.58	50.70	45.89	31.30	27.03	28.84	28.79	29.68	21.16	21.90	21.61	19.18	22.69	30.16
Spotted Seatrout	24.00	20.10	12.85	15.26	20.67	41.19	48.78	39.99	37.72	32.40	48.73	39.66	33.50	43.75	34.78	29.64
Red Drum	12.59	10.51	11.33	20.45	25.74	22.12	16.19	24.18	24.92	27.64	19.65	30.02	34.30	27.99	33.52	34.77
Snappers	6.37	3.46	6.46	4.93	2.07	1.81	4.84	0.87	2.22	2.41	3.75	3.17	2.39	1.83	2.70	1.47
Other Seatrout	3.26	2.47	0.24	0.33	1.22	0.36	0.40	0.07	0.31	0.82	0.77	0.42	1.22	1.63	1.18	0.52
Total Other Species	2.96	1.69	1.52	1.93	0.94	0.82	0.68	0.64	1.29	2.35	1.93	2.04	2.85	2.49	2.20	1.28
Sea Catfishes	2.07	0.71	1.20	0.67	0.52	0.10	0.32	0.81	0.18	0.56	0.27	0.16	0.43	0.07	0.17	0.13
Flounders	1.93	1.48	1.04	0.80	0.61	0.54	0.52	2.48	1.38	2.20	1.47	1.18	1.59	0.95	0.94	0.47
Atlantic Croaker	1.19	0.71	1.28	0.47	0.52	0.56	0.20	0.77	0.36	0.77	0.42	0.18	0.54	0.27	0.39	0.10
Black Drum	0.74	1.13	2.31	1.80	1.32	0.41	0.64	0.40	0.71	0.10	0.27	0.35	0.37	0.27	0.28	0.16
Other Jacks	0.59	0.28	0	0.07	0	0.05	0	0	0	0	0.04	0.02	0.03	0.02	0.06	0
Sheepshead	0.44	0.99	2.71	0.93	0.05	0.15	0.04	0.27	0.49	0.10	0.15	0.20	0.20	0.27	0.30	0.13
Bluefish	0.15	0.07	0	0.07	0	0	0	0.07	0	0	0	0	0	0	0	0
King Mackerel	0.15	0.21	0.08	0.33	0.19	0.18	0	0.34	0.71	0.05	0.23	0.22	0.14	0.29	0.03	0.16
Freshwater Catfishes	0	0.56	0.08	0.20	0.23	0.21	0.32	0.03	0.27	0	0.12	0.11	0.37	0.41	0.19	0.03
Spanish Mackerel	0	0.21	0.24	0	0	0	0	0.03	0.09	0.20	0	0.02	0.06	0	0	0
Groupers	0	0.14	0	0.73	0	0.03	0	0	0.09	0	0	0	0	0.02	0	0
Cobia	0	0.07	0.08	0.27	0.05	0.07	0.04	0.20	0.44	0.72	0.69	0.16	0.17	0.49	0.50	0.71
Greater Amberjack	0	0.07	0	0.07	0	0.11	0	0	0.04	0	0.35	0.18	0.23	0.05	0.08	0.26

Table 6.2. Total commercial landings (X 1,000 lbs) of flounders (NMFS unpublished data).

Year	Florida (West Coast)	Alabama	Mississippi	Louisiana	Texas
1965	272.5	300.8	69.4	261.7	292.5
1966	209.1	483.4	105.9	274.5	188.1
1967	182.8	479.5	138.0	350.0	456.0
1968	222.6	533.0	137.8	271.0	365.8
1969	268.7	539.8	123.4	306.8	288.2
1970	290.2	780.7	152.5	480.3	131.2
1971	296.5	950.8	172.0	463.4	163.9
1972	304.0	1169.8	153.1	501.8	453.8
1973	263.2	709.0	97.2	281.4	341.9
1974	226.5	916.5	97.7	315.4	507.1
1975	219.3	832.0	104.8	242.2	492.6
1976	232.5	803.4	80.7	327.3	434.5
1977	270.9	598.5	81.4	292.5	310.9
1978	298.3	638.5	80.0	306.0	237.1
1979	322.4	671.2	53.5	195.4	232.4
1980	355.6	501.2	42.1	160.9	194.9
1981	313.1	588.2	28.6	136.9	130.4
1982	395.7	624.5	50.6	199.7	535.9
1983	322.4	509.9	49.7	276.1	474.3
1984	224.6	308.5	43.5	353.2	380.0
1985	184.8	379.5	88.2	529.9	443.5
1986	173.1	386.4	28.1	825.0	560.3
1987	179.8	288.3	57.3	938.0	551.3
1988	152.3	154.4	34.0	510.2	273.8
1989	166.7	189.2	77.8	492.0	154.2
1990	187.9	167.2	62.4	455.7	144.0
1991	233.9	228.8	85.0	692.3	275.6
1992	182.9	170.5	40.5	784.6	297.6
1993	163.8	175.4	44.7	898.9	212.6
1994	142.8	196.6	40.8	974.7	211.0
1995	131.8	207.5	56.9	533.2	274.2
1996	80.3	148.8	37.2	61.7	217.6
1997	98.4	146.8	37.5	94.8	112.0

Identification of flounders at the species level in the Florida commercial landings data is not reliable. However, based on Fisheries Independent Monitoring Program data and limited reporting of landings at the species level the majority of Gulf coast landings of flounder are gulf flounder (Murphy et al. 1994, M. Johnson personal communication) (Table 6.3). Commercial landings of flounder have been historically higher on the east coast, compared to those on the west coast. Atlantic coast annual landings averaged 337,985 lbs between 1978-1993, compared to 241,696 lbs on the Gulf coast during the same years. Flounder commercial landings from the west coast of Florida have decreased steadily between 1985 and 1997 (Murphy et al. 1994) (Table 6.2). Landings remained somewhat steady from 1978 to 1984, averaging 248,802 lbs per year. Beginning in 1985, landings declined from 184,844 lbs (Murphy et al. 1994) to 128,038 lbs in 1997 (Figure 6.1). The commercial fishing effort on the Gulf coast increased steadily beginning in 1986 and reached a peak of 19,500 trips in 1991 (Murphy et al. 1994). The number of trips has steadily declined since 1992, with only 4,979 trips in 1997. The lowest landings and effort were reported in 1996, with 83,976 lbs and 3,958 trips, respectively. Commercial license sales are provided in Table 6.4.

Table 6.3. Total landings (lbs) for Florida west coast by species 1991-1996 (FWC/FMRI unpublished data).

Year	Gulf	Southern	Mixed
1991	22,981	2,569	191,300
1992	34,606	160	150,211
1993	28,792	227	141,677
1994	39,664	604	110,435
1995	33,894	856	100,702
1996	31,292	610	47,492

Table 6.5 lists landing and effort for various gear types with reported flounder landings. The most important gears used to harvest flounder in Florida between 1991-1997 are gig/spear, gill/trammel nets, trawls, and hook and line. A category for missing gear type descriptions for trip tickets has been added and represents the third most important gear type. However, most of these unreported gear types are from the 1991-1993 landings data and are less important in recent years.

Some changes in the landings and effort could have been affected by gear restrictions or size limits. For example, a number of gears were illegal after the July 1995 net ban in Florida, including any gill or entangling net and any net with a mesh area greater than 500 square feet. This made most gill and trammel nets, trawls, and beach or haul seines illegal. Gill/trammel net landings decline from 48,383 lbs in 1994 to 19,485 following the net ban in state waters in July 1995 (Table 6.5). The landings for this gear dropped to 147 lbs in 1996. Coincidentally, the landings for cast nets and gig/spears increased in 1995. Cast net annual landings averaged 165 lbs between 1991 and 1994. The reported landings rose sharply to 1,160 lbs in 1995; 4,706 lbs in 1996; and 8,078 lbs in 1997. Gig/spear annual landings averaged nearly 30,000 lbs from 1991 to 1994. Landings for this gear increased to 66,918 in 1995 and have remained high since then. Landings for trawl gear increased by nearly twofold in the early 1990s, increasing from 15,608 lbs in 1991 to 29,926 lbs in 1992. Annual trawl landings for flounder averaged about 28,000 lbs from 1992 to 1995, before falling to 16,583 lbs in 1996. Longline gear was prohibited in Florida state waters in 1993 which is reflected by a decrease from 7,362 lbs in 1993 to 20 lbs in 1996 (Table 6.5). It is unknown why landings for longline gear increased to 3,580 lbs in 1997.

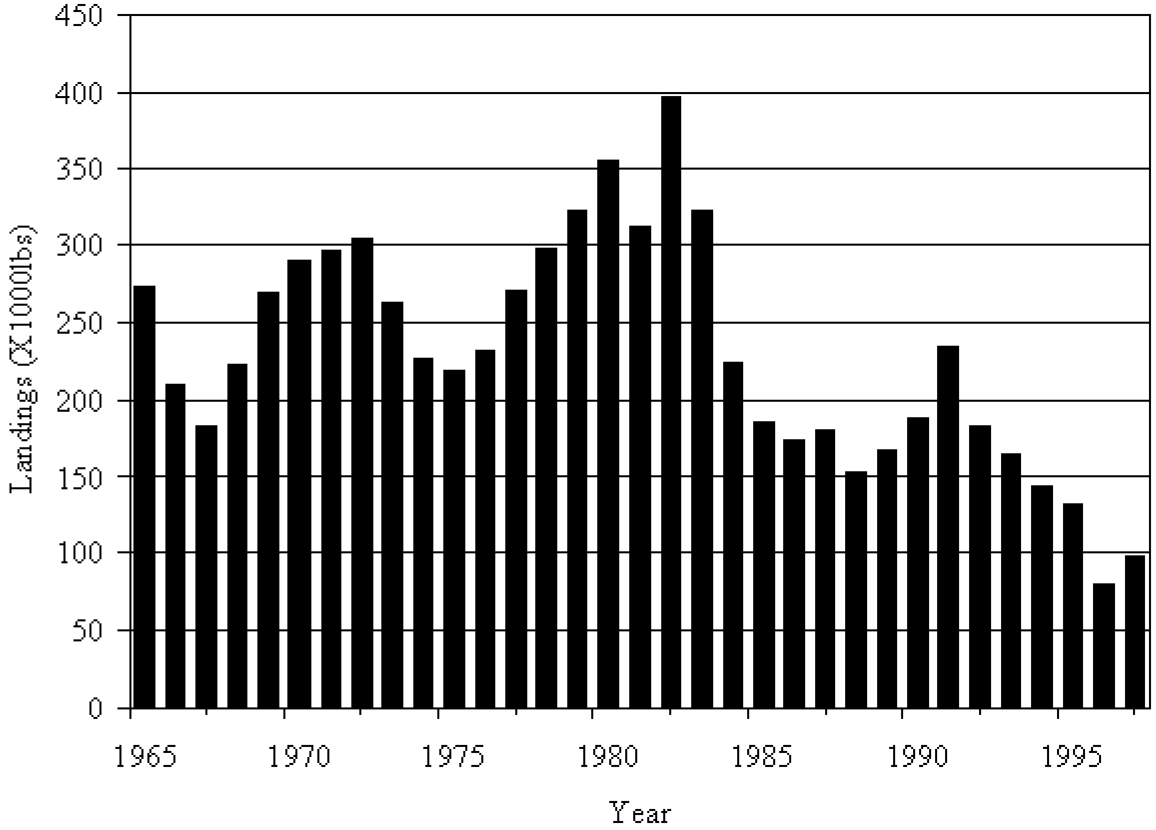

Figure 6.1. Florida (west coast) commercial landings from 1965-1997 for flounder (NMFS unpublished data).

The total decline in landings from all gears declined from 136,198 lbs in 1995 to 83,976 lbs in 1996 along with the number of trips reported (Table 6.5). These reduced numbers of trips and landings were probably a combined result of the 1995 net ban and the inception of size and bag limits for flounder in 1996 (i.e., 12 inch TL minimum size for all flounders and a 50 lb commercial daily vessel bycatch allowance). However, landings and number of trips increased again in 1997 to 128,038 lbs and 4,979 trips, respectively, which may indicate the flounder fishing industry underwent a reallocation of gear types following the regulation changes.

Table 6.4. Commercial fishing license sales in Florida from 1986-1997.

Year	**Saltwater Products**	**Restricted Species**	**Purse**	**Blue Crab**	**Stone Crab**	**Lobsters**	**Marine Life**
1986	10407		60	1542	2819	2499	
1987	11321		82	1727	2874	2716	
1988	14556		88	2091	3335	2530	
1989	14702	1488	87	2295	3649	2606	
1990	15458	4533	97	2734	4197	2689	
1991	12778	5440	104	2721	4103	2593	128
1992	11958	5711	114	2833	4157	2317	228
1993	11451	5662	127	2962	4189	2107	273
1994	11800	5808	128	3480	4571	1888	339
1995	11391	6281	147	3777	5044	1504	418
1996	10362	6178	169	3486	4270	1569	488
1997	10163	6088	170	3612	3844	1715	510

6.1.2.2 Alabama

There are no size limits for flounders in Alabama and no length at capture information available for the commercial fishery. A summary of commercial landings in Alabama is provided in Table 6.2 and Figure 6.2, and landings by gear from 1990-1997 are provided in Table 6.6. Swingle (1976) reported more than 95% of the flounder harvested in Alabama were caught in shrimp trawls offshore with 4%-5% taken with fish gigs and spears and only a negligible amount with gill and trammel nets. Commercial landings of flounder declined steadily from 1972 to 1987. In 1988, the closure to nets on the south shore of Bon Secour Bay further reduced the landings to under 200,000 lbs. Since 1988, Alabama's flounder landings have remained consistent. Commercial license sales in Alabama from 1995/1996 to 1997/1998 are provided in Table 6.7.

Table 6.5. Total landings (lbs) and number of trips (in parentheses) for Florida west coast 1991-1997. All species combined (FWC/FMRI unpublished data).

Year	Gear Type												
	Gig/ Spear	Gill/ Trammel Net	Trawls	Hook and Line	Scuba/ Tropicals	Traps	Longline	Cast Net	Beach/ Haul Seine	Purse/ Lampara Net	Missing	Other	Total
1991	16,834 (337)	50,404 (6,867)	15,608 (938)	10,254 (308)	1,694 (37)	3,083 (484)	7,356 (7)	65 (7)	4,091 (54)	118 (22)	124,130 (10,264)	2,761 (227)	236,398 (19,552)
1992	30,517 (473)	64,762 (10,967)	29,926 (1,413)	9,945 (348)	2,854 (50)	1,871 (346)	1,495 (8)	128 (31)	59 (22)	0	34,746 (1,731)	9,627 (1,151)	185,930 (16,540)
1993	36,813 (606)	54,860 (9,673)	28,238 (1,459)	10,712 (481)	7,633 (85)	7,737 (650)	7,362 (11)	274 (26)	562 (14)	2 (1)	13,865 (512)	5,109 (440)	173,167 (13,958)
1994	35,218 (505)	48,383 (7,577)	32,081 (1,663)	11,651 (464)	6,794 (81)	3,641 (653)	382 (10)	191 (25)	73 (16)	153 (3)	5,676 (165)	8,066 (374)	152,309 (11,536)
1995	66,918 (871)	19,485 (2,743)	23,772 (1,713)	8,328 (388)	711 (26)	5,064 (983)	645 (7)	1,160 (214)	640 (39)	5 (2)	4,904 (153)	4,566 (513)	136,198 (7,652)
1996	41,198 (558)	147 (61)	16,583 (1,463)	6,225 (306)	5,211 (45)	3,096 (571)	20 (9)	4,706 (600)	56 (2)	0	1,768 (44)	4,966 (299)	83,976 (3,958)
1997	64,711 (950)	153 (50)	18,047 (1,571)	7,882 (420)	4,497 (30)	2,121 (488)	3,580 (5)	8,078 (864)	920 (133)	2 (1)	1,499 (22)	16,548 (445)	128,038 (4,979)

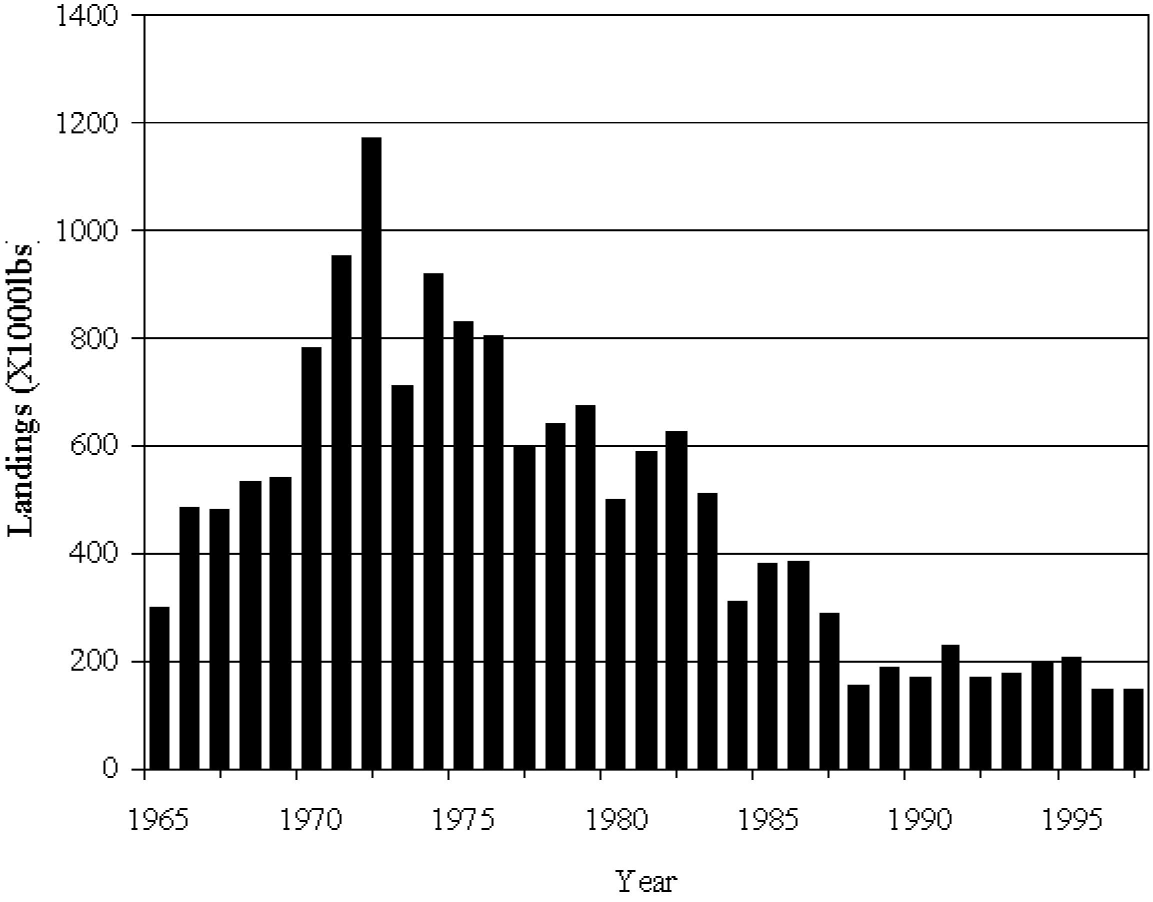

Figure 6.2. Alabama commercial landings from 1965-1997 for flounder (NMFS unpublished data).

Table 6.6. Commercial flounder landings by gear in Alabama from 1990 to 1997 (NMFS unpublished data). Blanks indicate no reported landings.

Year	**Otter Trawl**	**Gill Nets (Drift & Run-around)**	**Gill Nets (other)**	**Trammel Nets**	**Spears**	**Total**
1990	97,693	21,668	31,707	4,404	11,226	166,698
1991	151,829	54,372		11,239	11,379	179,919
1992	103,345	50,340		9,507	6,971	124,853
1993	62,480	78,081	15,190		9,151	103,062
1994	99,313	76,725			10,381	97,019
1995	89,064	89,513			21,036	199,613
1996	29,947	93,490			19,438	142,875
1997	27,041	87,389			28,638	143,068

Table 6.7. Resident commercial license sales in Alabama from 1995/1996 to 1997/1998 (ADCNR/MRD unpublished data). Spearfishing endorsements are not included here.

License	Number Sold		
	1995/1996	1996/1997	1997/1998
Party Boat* (7-25)	12	12	12
Party Boat (<7)	72	82	74
Party Boat (>25)	5	5	6
Crab	220	177	176
Hook & Line	35	65	46
Live Bait	35	34	17
Mackerel & Mullet	128	139	123
Net or Seine	188	180	162
Shrimp <30'	775	699	625
Shrimp 30'-45'	215	196	186
Shrimp >45'	201	189	187

*Number of fishermen allowed onboard is indicated in parenthesis.

6.1.2.3 Mississippi

The commercial harvest of flounder in Mississippi has traditionally been as bycatch in the shrimp trawl fishery. Southern flounder is the predominate species of flounder landed in Mississippi. Landings' information (collected by port agents from local seafood dealers) is not collected by species; gulf flounder do occur in Mississippi but not in large numbers. Total landings in Mississippi have fluctuated from a high of 172,000 lbs in 1971 to a low of 29,065 lbs in 1981 (Table 6.2 and Figure 6.3). Over the last ten years landings have been somewhat stable averaging approximately 51,000 lbs per year. Although the majority of flounder harvested from 1988-1997 were caught in shrimp trawls (52%), the percentage has declined dramatically from 81% in 1991 to only 15% in 1996 (Table 6.8). A federal law which was implemented in December 1992 required most shrimp vessels fishing in the EEZ and state waters to have turtle excluder devices (TEDs) installed in their nets. Use of TEDs in shrimp trawls is one possible explanation for the reduced number of flounder landed as bycatch. According to Burrage (1997), the mean finfish exclusion rates of five TEDs tested ranged from 7.33% to 43.56%. In May 1998, a law which requires bycatch reduction devices (BRDs) be installed in shrimp trawls was enacted for all waters of the EEZ. Although not currently required in state waters, this device could further decrease flounder catches.

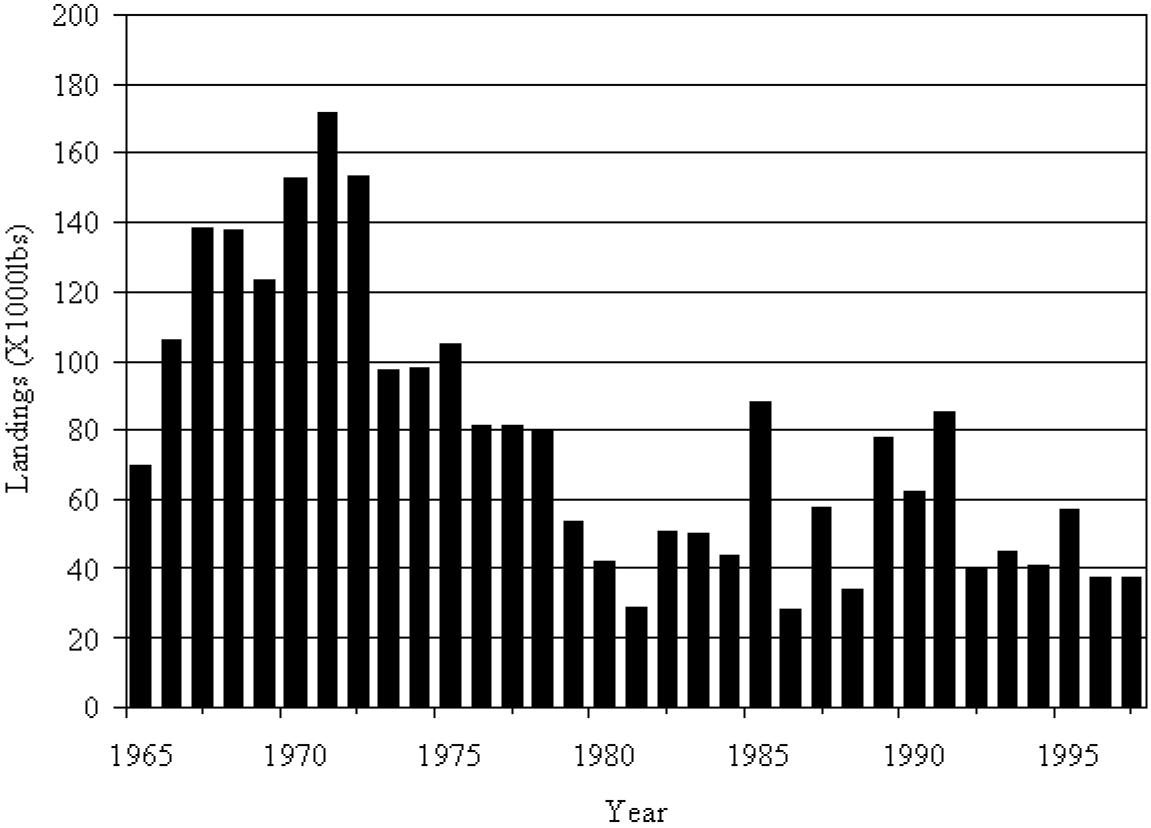

Figure 6.3. Mississippi commercial landings from 1965-1997 for flounder (NMFS unpublished data).

Table 6.8. Total commercial flounder landings (lbs) in Mississippi by gear, 1988-1997.

Year	Trawls	Entanglement Nets	Hook & Line	Gigs/Spears	Other	Totals
1988	25,197	3,821	1,567	3,494	0	34,079
1989	54,093	17,551	2,038	4,130	2	77,814
1990	47,126	8,716	3,903	2,709	22	62,476
1991	69,126	10,787	1,062	4,052	0	85,027
1992	31,022	6,084	1,108	2,305	0	40,519
1993	19,161	16,305	1,171	8,133	0	44,770
1994	9,963	25,493	421	4,876	0	40,753
1995	19,610	25,333	2,151	9,853	0	56,947
1996	5,422	10,910	2,313	18,590	0	37,235
1997	15,813	4,816	4,327	12,104	508	37,568

On January 1, 1997, a regulation was instituted requiring that all gill and trammel nets used in state waters must be constructed of a degradable material (currently cotton or linen). The definition of degradable material as specified in the ordinance is a material which after one year of immersion in water loses at least 50% of its tensile strength. There is very limited availability of cotton or linen entanglement nets, and this regulation has greatly reduced the number of commercial net fishermen in Mississippi from 222 in 1988 to 58 in 1997 (Table 6.9). Gill and trammel nets accounted for an average of 26% of the flounder landed in Mississippi over the last ten years. The overall use and availability of legal gill and trammel nets are steadily decreasing in the state. The requirement for a degradable material has resulted in a change in the types of gear used to harvest flounder. The use of gigs to harvest flounder has been increasing, with a two-year average (1996 and 1997) of 41% of the flounder landed in Mississippi being gigged. Mississippi does not require a specific license for gigs, and there is no information as to the number of commercial gig fishermen in the state. The percentage of flounder caught by commercial hook and line fishermen in Mississippi has also increased over the last ten years. Mississippi has no minimum size or quota limits for commercial flounder fishing.

Table 6.9. Number of resident commercial licenses issued, by gear, 1987-1998 in Mississippi (MDMR unpublished data). Mississippi commercial fishing license year is May 1 through April 30 of the following year. NA indicates the license was not available.

Year	Shrimp Vessel <30'	Shrimp Vessel 30'-45'	Shrimp Vessel >45'	Gill/ Trammel Net	Commercial Hook & Line
1986/1987	836	509	332	153	NA
1987/1988	942	555	356	194	NA
1988/1989	940	622	531	213	NA
1989/1990	950	569	495	222	NA
1990/1991	726	564	520	185	51
1991/1992	494	536	490	182	89
1992/1993	457	428	464	190	64
1993/1994	428	447	459	233	73
1994/1995	347	389	449	220	86
1995/1996	324	380	473	167	86
1996/1997	339	370	457	168	75
1997/1998	327	361	410	58	85

6.1.2.4 Louisiana

Commercial flounder landings in Louisiana were relatively stable from 1965-1984. Beginning in 1985, Louisiana led the Gulf States in total commercial landings for flounder until 1996 (Table 6.2 and Figure 6.4). In Louisiana, an average of 77.2% of flounders landed during the ten-year period from 1980-1989 were caught in shrimp trawls (Table 6.10).

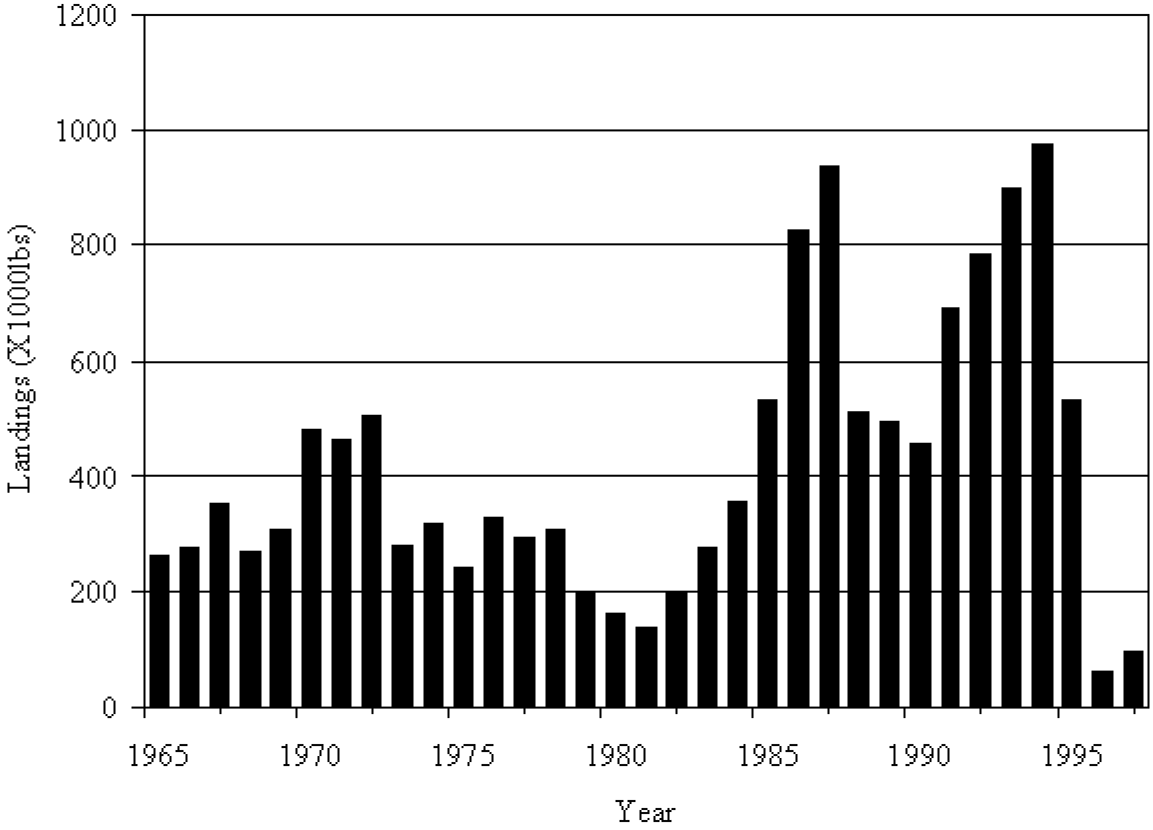

Figure 6.4. Louisiana commercial landings from 1965-1997 for flounder (NMFS unpublished data).

In a Louisiana diel trawling study, Dugas (1975) found 89% of southern flounder were caught at night. Based on a tank study conducted by Dugas (1975), southern flounder were more active at night and as a result more vulnerable to trawling activity. Flounder caught in shrimp trawls are normally part of the incidental catch and are rarely targeted by trawlers. During the ten-year period from 1980-1989, gill nets and drift/runaround gill nets accounted for 19.3% of Louisiana commercial flounder landings (Table 6.10).

Haul seines were another of the less important gear types used to commercially harvest flounders in Louisiana waters. They were used in near offshore and inshore waters to surround schools of fish to be harvested and were also used in conjunction with spotter planes. They were usually deployed from small to medium-sized boats and normally targeted species such as black drum and sheepshead (Luquet et al. 1998). Seines were also used in Louisiana waters for the commercial harvest of saltwater fish and were limited to 1,200 ft in length. From 1980-1989, butterfly nets averaged 2.1% of the annual flounder harvest in Louisiana (Table 6.10).

Table 6.10. Total landings (lbs) in Louisiana by gear, 1980-1989 (LDWF unpublished data).

Year	Shrimp Trawl	Gill Net	Gill Net[1]	Butterfly Net	Trammel Net	Handline	Haul Seine	Longline	Purse Seine
1980	153,579	2,716	2,454	0	2,210	0	0	0	0
1981	132,135	2,898	1,456	0	65	408	0	0	0
1982	167,463	13,577	12,042	2,848	3,782	30	0	0	0
1983	248,242	7,253	19,949	0	707	0	0	0	0
1984	271,258	48,214	23,687	9,512	81	308	200	0	3
1985	483,913	7,828	22,750	9,401	5,698	0	352	7	30
1986	653,302	131,635	8,269	654	17,530	1,235	1,988	421	0
1987	609,771	159,449	119,561	32,418	10,752	5,899	15	211	0
1988	334,928	117,868	25,776	28,614	2,881	128	7	83	0
1989	363,061	110,035	5,537	12,711	17	686	0	0	0
% Total Catch	77.2	13.6	5.7	2.1	1.0	0.2	0.1	0.1	0

[1] Drift, Runaround

Since 1988, a commercial gear license has been required for flounder gigs and spears in Louisiana as well as other legal gear types not previously requiring a license. No resident commercial flounder gig licenses were sold in 1989, and only 66 were sold for the eight-year period 1990-1997. The number of commercial licenses by gear sold to Louisiana commercial fishermen from 1980 through 1997 is shown in Table 6.11. In Louisiana and other states, the majority of flounder landed commercially were historically harvested from inshore waters seaward to 5.6 km from shore.

From 1965 through 1997 reported landings in Louisiana range from a low of 61,755 lbs in 1996 to a high of 974,700 lbs in 1994 (Table 6.2 and Figure 6.4). The 33-year average commercial harvest for flounder was approximately 417,800 lbs, ranking Louisiana second among the five Gulf States. Although catches peak during the fall, flounder composed a major component of the bycatch kept and sold from the commercial black drum gill net fishery in Louisiana during April, May, and June 1986 (Russell et al. 1986).

Table 6.11. Number of resident commercial licenses issued from 1980-1997 in Louisiana (LDWF unpublished data). NA indicates license not available.

Year	Shrimp Trawl	Gill Net	Butterfly Net	Trammel Net	Handline	Longline	Haul Seine	Purse Seine	Gig
1980	16,307	1,602	NA	319	NA	NA	445	0	NA
1981	19,280	1,786	NA	334	NA	NA	425	4	NA
1982	19,648	2,552	NA	429	NA	NA	472	18	NA
1983	19,163	2,780	NA	483	NA	NA	596	40	NA
1984	17,843	2,252	123	414	NA	NA	609	33	NA
1985	15,927	2,031	3,941	423	NA	NA	442	34	NA
1986	16,311	2,118	5,088	377	NA	NA	345	26	NA
1987	24,358	3,271	10,785	826	NA	NA	281	NA	NA
1988	20,578	2,476	9,812	605	NA	NA	281	NA	NA
1989	18,752	2,717	8,351	619	180[1]		265	73	NA
1990	16,736	2,565	8,142	594	1,055[1]		257	71	9
1991	14,959	2,646	7,982	536	1,012[1]		249	63	8
1992	13,866	1,960[2]	4,746	493	995[1]		218	53	9
1993	11,349	1,948[2]	3,809	486	1,016[1]		184	53	7
1994	10,231	2,059[2]	3,294	489	1,053[1]		196	58	8
1995	10,095	1,781[2]	3,050	467	1,185[1]		162	57	8
1996	9,847	2,089[3]	2,776	409	1,369[1]		177	54	8
1997	9,048	1,059[3]	2,442	372	1,457[1]		136	53	9

[1] Includes handlines, longlines, etc.

[2] Includes freshwater and saltwater gill net licenses

[3] Includes freshwater gill net, saltwater mullet strike net and pompano strike net licenses

6.1.2.5 Texas

Prior to 1988, Texas had limited regulation on flounder harvest. A few counties had a 12 inch minimum size limit imposed during the 1980s. Texas instituted a coast wide 12-inch minimum size limit in 1988 which was increased to 14 inches in September 1996. In a study conducted by Stokes (1977) during 1974-1975, 74% of the Texas commercial flounder catch consisted of age-2 and age-3 female southern flounder. According to Stokes (1977), both the southern and gulf flounder are harvested commercially and recreationally in Texas waters, with southern flounder usually accounting for more than 95% of the total catch. Under the 14-inch minimum size, the majority of the commercial flounders landed after 1996 should be female southern flounder.

Prior to the Texas net ban in 1988, commercial fishermen used set nets as their gear of choice during the fall and winter for flounder. From 1980 to 1987, landings from legal gill nets were estimated to range from 56,000-384,400 lbs, and illegal gill net landings were estimated from 800-13,200 lbs (Weixelman et al. 1992a). Since 1981, gigs have become the gear of choice for the directed flounder fishery. Flounder are landed by commercial fishermen using other gear (i.e., shrimp trawls, trotlines, hook and line), but the catches are generally insignificant compared to the gig fishery. Commercial interest in flounder increased since 1981 with the ban on the sale of native red drum and spotted seatrout. The price/lb of flounder in Texas makes these fish second only to red snapper in value. Even though commercial landings of flounder are reported as 'flounder,' at least 90% of the commercial landings are southern flounder (TPWD unpublished data).

Several types of licenses will allow commercial fishermen to land flounder in Texas. The commercial finfish fisherman's license is required for catches of finfish from coastal areas and includes giggers and trotliners. Other commercial licenses are specific to the gear types used (e.g., shrimp trawls) and whether vessels are used. The number of commercial licenses sold in Texas is shown in Table 6.12. No division was made to the general commercial fishing license until 1980, but this license was subdivided to include a commercial finfish license. The number of residential and nonresidential finfish licenses sold fluctuated since the formation of this license ranged from 2,131 licenses sold in 1981 to 463 licenses sold in 1984. This decline followed 1981 legislation banning native red drum and spotted seatrout sales. Even after the gill net ban in 1988, the number of finfish licenses sold remained around 500-800 until 1994 and 1995 when the sales rose to 1,288 and 1,536, respectively. These increases were probably due to the increased number of commercial trotline fishermen during this time and not to the number of fishermen targeting flounder with gigs. The number of shrimping vessel licenses sold has fluctuated with currently less than 2,000 each of gulf shrimp boat and bay shrimp boat licenses sold in 1997.

During a special night flounder gig fishery study from July 15-December 15, 1991 (TPWD unpublished data), sport and commercial giggers were interviewed at boat ramps and at selected wade/bank areas. Of the 176 interviews conducted, 22 were commercial fishermen. The amount of time each commercial fisherman spent fishing varied from 80 to 360 nights/year. At least 50% of the fishermen gigged more than 180 nights/year.

Table 6.12. Texas commercial license sales from 1978-1997 (TPWD unpublished data). Blanks indicate license availability; N and R indicate nonresident and resident licenses respectively. All commercial netting was prohibited September 1988. Total annual sales are not additive due to multiple license holders. No division was made in the General license prior to 1980. Seine tags include both fresh and saltwater privileges.

Year	General (R)	General (N)	Finfish (R)	Finfish (N)	Saltwater Trotline Tags	Seine Tags	Fishing Boat (R)	Fishing Boat (N)	Gulf Shrimp (R)	Gulf Shrimp (N)	Bay Shrimp (R)	Bay Shrimp (N)	Bait Shrimp (R)	Bait Shrimp (N)
1978	28,425				14,488	14,738	1,379		3,168		3,765		1,521	
1979	4,379				16,371	17,312	1,755		3,363		4,444		1,751	
1980	19,660	2,291	1,989	46	16,866	13,971	1,504		3,311		4,467		2,026	
1981	14,205	3,581	1,678	444	17,947	9,510	1,254		3,738		5,215		2,218	
1982	13,427	3,870	632	16	16,702	8,096	787		4,027		4,477		2,277	
1983	13,591	4,775	670	31	15,943	8,498	1,095		4,139		4,771		2,724	
1984	12,357	5,503	452	11	9,323	6,325	1,100		3,824		4,724		2,837	
1985	11,244	5,352	466	28	7,818	7,164	917		3,630		4,456		2,713	
1986	10,803	1,742	486	46	8,318	7,184	947		3,946		3,660		2,445	
1987	10,885	1,725	479	24	8,849	6,528	1,042		3,083		3,340		2,454	
1988	10,429	1,348	596	20	9,841	7,264	1,233	68	2,427	540	3,037	6	2,376	2
1989	9,036	1,309	506	54	9,538	2,859	1,181	71	2,233	508	2,779	7	2,135	4
1990	8,018	1,008	619	67	10,587	2,545	994	7	2,170	586	2,503	4	1,882	5
1991	7,446	309	637	7	9,930	2,060	879	2	2,006	568	2,338	5	1,707	2
1992	6,410	316	825	2	9,692		1,252	92	1,852	699	1,960	7	1,551	2
1993	5,829	124	803	3	9,170		1,242	12	1,627	473	1,800	4	1,512	1
1994	4,733	43	1282	6	9,796		1,459	27	1,421	403	1,589	0	1,475	0
1995	4,564	45	1525	11	10,795		1,561	35	1,376	466	1,841	0	1,787	0
1996	3,201	61	986	4	12,575		1,681	59	1,343	495	1,643	2	1,588	1
1997	2,582	31	865	6	12,586		1,466	37	1,253	483	1,539	1	1,472	1

Flounder are sold primarily to fish markets, restaurants, or other retail outlets. Only 70% of the commercial giggers interviewed during the flounder gig study sold at least some of their catch to a fishhouse: 65% sold 95%-100% of their catch and 5% sold 25% of their catch. The remaining 30% sold their catch to other retail outlets (i.e., probably not reported). Commercial landings are underestimated because restaurant and other outlet sales are not recorded on the Marine Aquatic Products Report. Possibly 35% of commercial flounder landings may go unreported (TPWD unpublished data).

Commercial flounder landings in Texas have fluctuated from 130,000 lbs in 1981 to 560,300 lbs in 1986 (Table 6.2 and Figure 6.5). Only three years (1974, 1986, and 1987) had more than 500,000 lbs of flounder landed. Gulf landings ranged from 4,400 lbs (1997) to 331,900 lbs (1972). The Gulf of Mexico landings made up the largest portion of Texas landings until 1976 when they dropped to less than 50% of the total flounder landings. Bay landings ranged from 81,600 lbs in 1990 to 493,300 lbs in 1986. After the decline in Gulf landings, bay landings made up 57% (1990) to 96% (1997) of the total flounder landings.

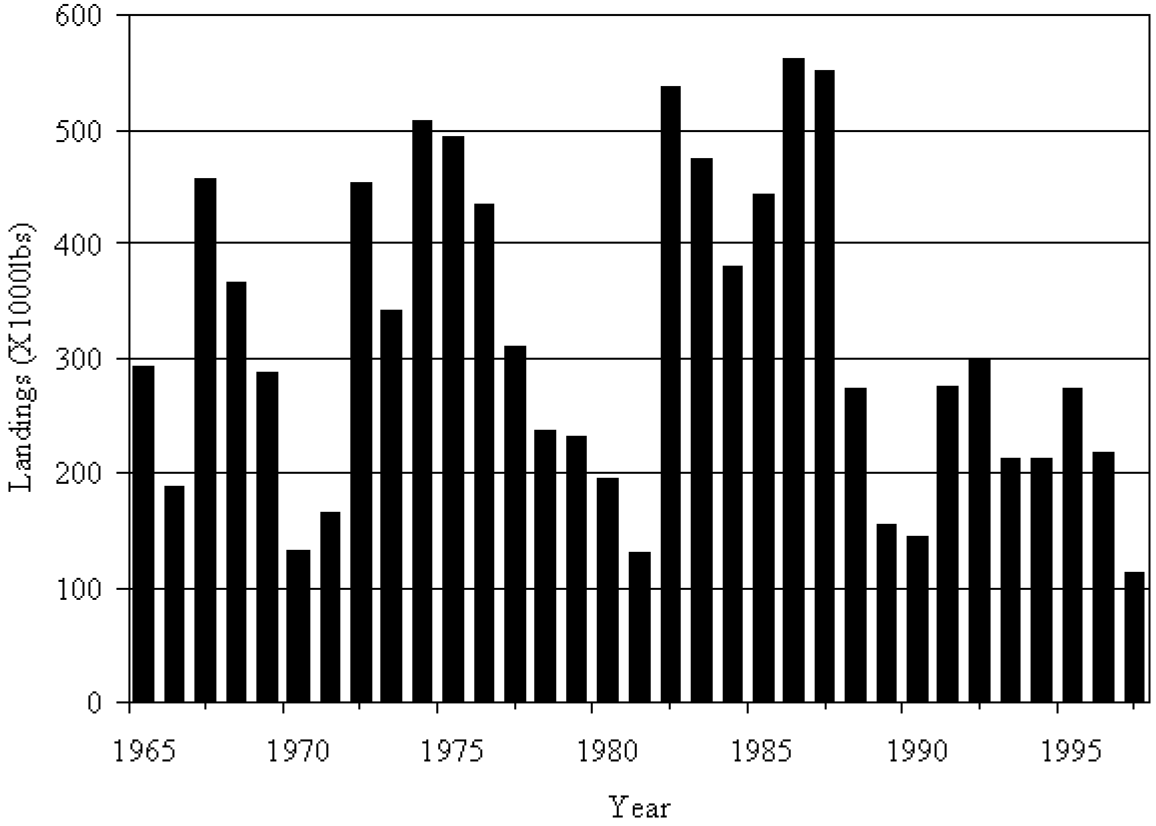

Figure 6.5. Texas commercial landings from 1981-1997 for flounder (NMFS unpublished data).

Commercial fishermen landed flounder throughout the year, but landings were highest from October through December (1988-1994) where the mean monthly landings were more than 2,500 lbs. Landings for May through September averaged 1,000-2,000 lbs per month, while less than 1,000 lbs per month were landed the remainder of the year. Until 1981, Aransas Bay flounder landings made up the majority of the flounder landings (up to 39%). Galveston Bay landed more flounder than any bay system from 1982-1987. Since that time, the lower coast bays of Texas have had the most flounders landed by commercial fishermen.

Regulatory measures probably account for the observed declines in commercial landings of flounder. The commercial ban on native red drum and spotted seatrout sales in 1981, the net ban and minimum size limits imposed in 1988, and the bag and size limits in 1996 coincide with the declines in 1981, 1988-1989, and 1997 (Table 6.2 and Figure 6.5). A redirected effort of the red drum and spotted seatrout commercial fishermen toward flounder is shown by the increase in 1982 flounder landings. After the prohibition of sales of red drum and spotted seatrout and prior to the net ban, total flounder landings for Texas averaged 491,000 lbs. Along with a change in size limits, flounder landings dropped to 43% (average 214,000 lbs) from 1989-1997. Additional fluctuations may be due in part to freezes, red tides, and market variations but are difficult to discern with the major regulatory changes that took place during this time period.

6.2 Recreational Fishery

Flounder are a very popular recreational species because of the quality of the flesh and its accessibility due to its preferred habitats. Being euryhaline, flounders are commonly taken along beaches and barrier islands, inshore lakes and bays, and even in some freshwater areas. Southern flounder ranked ninth in percent composition of the 81 total species caught by recreational anglers (Adkins et al. 1990). They were surpassed by red drum; hardhead catfish; spotted seatrout; "silver" seatrout (combined *Cynoscion arenarius*, sand seatrout, and *C. nothus*, silver seatrout); Atlantic croaker; sheepshead; black drum; and largemouth bass *(Micropterus salmoides*). These species accounted for more than 90% of the catch. During the survey, southern flounder (when caught) were kept more than 85% of the time.

A study in Barataria Bay, Louisiana, revealed the most productive baits used included live bait, dead/cut bait, and a combination of artificial and dead/cut baits (Guillory and Hutton 1990). Small artificial grubs are commonly fished near the bottom or jigged around pilings, bulkheads, piers, and rock jetties to catch flounder. Small spoons and plastic jigs fished over shallow, sandy bottoms catch flounder buried in sand waiting to ambush their prey. Usually, the most productive fishing times are during ebb tides, which drain shallow flats and force prey species through channels into the surf zone and along beaches.

The peak catches of flounder with rod and reel were recorded from September to November. Jackson and Timmer (1976) suggested October and November were also the best months for flounder gigging. Probably the most commonly used gear for flounder fishing is the gig. Warlen (1975) gave a comprehensive description of conditions and equipment necessary for a successful night of flounder gigging and pointed out that tide, wind, moon phase, water clarity, and bottom type play an important role in gigging success.

Flounder gigs range from a simple sawed-off mop handle with a sharpened nail in the end to an aluminum or steel rod sharpened at one end for stabbing the flounder. Often, a hole drilled at the opposite end allows attaching a stringer. The flounder can then be slid along the pole onto the string, reducing handling and minimizing loss. Although barbless gigs are required in Louisiana, other states allow the use of single or multi pronged gigs which have barbs. Multi-pronged gigs may cause more damage to fish but ensure a better chance of capture. It is possible to gig 100 fish or more per night, especially during late summer to early fall.

6.2.1 History

Texas and Louisiana have historically yielded the majority of southern flounder landed by marine recreational fishermen in the Gulf of Mexico. Southern and gulf flounders dominate the marine recreational catch of flounder in the Gulf of Mexico. The IGFA all-tackle world record southern flounder as of 1990 weighed 20 lbs 9 oz and was caught in 1983 at Nassau Sound, Florida (IGFA 2000). The Texas state record for southern flounder on rod and reel was 28 inches, weighed 13 lbs, and was caught in Sabine Lake in February of 1976. The IGFA all-tackle world record for gulf flounder is 533 mm TL, 2.8 kg 1996 caught on Dauphin Island (IGFA 2000). The state records for gulf and southern flounder are summarized in Table 6.13.

Table 6.13. State records (lbs and inches) for gulf and southern flounder, where applicable. Bold indicates current world record (IGFA 2000, TPWD unpublished data, LDWF unpublished data, MDMR unpublished data, ADCNR/MRD unpublished data, FWC/FMRI unpublished data). NA indicates not available.

	Gulf Flounder				**Southern Flounder**			
State	**Weight**	**TL**	**Year**	**Location**	**Weight**	**TL**	**Year**	**Location**
FL statewide	NA	NA	NA	NA	20.56	NA	1983	Nassau Sound
AL	7.51	20.9	1996	Dauphin Island	13.25	NA	1975	Dog River
MS					9.9	NA	1986	Rig 133
LA					12.13	NA	1969	Lake of Second Trees
TX	NA	NA	NA	NA	13.00	28.0	1976	Sabine Lake

6.2.2 State Recreational Fisheries

The Gulfwide landings are typically reported as general flounder or flatfish. Tables 6.14 and 6.15 separate the recreational landings (lbs) by species. However, most of the landings throughout the recreational section will be discussed as a combined species group unless otherwise stated.

Table 6.14. Recreational landings (lbs) for the Gulf States from 1981-1997 for gulf flounder (NMFS unpublished data). Texas landings are provided by TPWD (unpublished data) and are not based on calendar year. NA indicates data are not yet available; dashes (---) indicate that no fish were intercepted by samplers in those years. Landings enclosed in parenthesis ( ) are likely misidentified or were caught elsewhere; the gulf flounders range generally does not extend into Mississippi and Louisiana inshore waters (Section 3.1).

Year	Florida (west coast)	Alabama	Mississippi	Louisiana	Texas[1]
1981	36,427	---	(1,074)	(20,229)	0
1982	47,165	40,011	---	(123,477)	0
1983	121,015	6,762	---	(11,030)	33,498
1984	194,554	---	---	(21,621)	7,078
1985	134,505	---	---	(7,013)	10,244
1986	429,084	6,193	---	(66,506)	31,370
1987	219,338	26,100	(7,180)	(12,352)	58,898
1988	319,272	26,991	(4,147)	(25,895)	30,190
1989	212,982	34,220	(4,912)	(32,853)	17,359
1990	107,778	22,436	(1,739)	(2,154)	12,681
1991	313,754	34,244	(6,861)	(11,363)	42,786
1992	179,609	6,124	(2,809)	(1,810)	42,067
1993	141,229	19,043	---	(6,314)	13,075
1994	159,340	14,343	(780)	(3,823)	22,928
1995	96,129	3,801	---	(4,129)	18,021
1996	132,523	19,824	(159)	(816)	18,893
1997	359,766	3,684	(4,817)	(7,064)	20,678

[1] Weights for Texas were extrapolated using Florida's TL-weight formula.

Table 6.15. Recreational landings (lbs) for the Gulf States from 1981-1997 for southern flounder (NMFS unpublished data). Texas landings are provided by TPWD (unpublished data) and are not based on calendar year. NA indicates data are not yet available.

Year	Florida (west coast)	Alabama	Mississippi	Louisiana	Texas
1981	117,380	287,081	201,730	213,075	591,691
1982	148,211	172,470	16,153	464,364	736,054
1983	113,641	132,113	8,587	2,714,729	527,902
1984	104,791	52,004	7,366	182,759	461,849
1985	70,214	65,682	14,328	664,973	571,178
1986	269,230	54,284	159,875	2,115,391	567,669
1987	92,150	10,745	104,172	179,860	757,943
1988	212,230	3,856	75,763	559,426	547,639
1989	37,882	7,077	115,032	336,259	434,547
1990	73,224	95,309	218,657	450,062	521,737
1991	107,474	25,924	171,915	598,974	671,295
1992	23,856	45,790	171,013	563,447	779,442
1993	63,892	91,711	102,214	387,161	733,173
1994	16,680	57,033	140,867	438,953	595,312
1995	29,323	129,293	209,851	324,522	553,648
1996	41,868	25,845	266,893	417,419	559,238
1997	46,596	37,381	170,226	389,264	445,896

6.2.2.1 Florida

Information on the recreational fishery in Florida is collected by the NMFS' Marine Recreational Fisheries Statistics Survey (MRFSS). Unlike commercial landings information, the reported recreational landings include both kept and released fish. These data are less affected by regulations than are commercial landings data.

The proportion of gulf and southern flounder in the recreational landings from Florida's west coast are most likely similar to that of the commercial landings, in that the majority are gulf flounder

(Murphy et al. 1994). All recreational landings from the Gulf coast reported here are for mixed flounder species, including gulf, southern, and ocellated flounder and have fluctuated without any apparent trends between 1982 and 1997 (Murphy and Muller 1998) (Table 6.14, Table 6.15, and Figures 6.6a and 6.6b). The number of fish landed along the Gulf coast was highest in 1986 at 586,939, while the fewest number landed was in 1995 at 103,859. The number of fish landed in 1996 and 1997 have steadily increased (Figures 6.6a and 6.6b). The number of flounder landed per hour was highest in 1994 at 0.57, while the lowest reported catch rate was in 1995 at 0.22. The total number of recreational licenses sold between 1989 and 1997 are provided in Table 6.16.

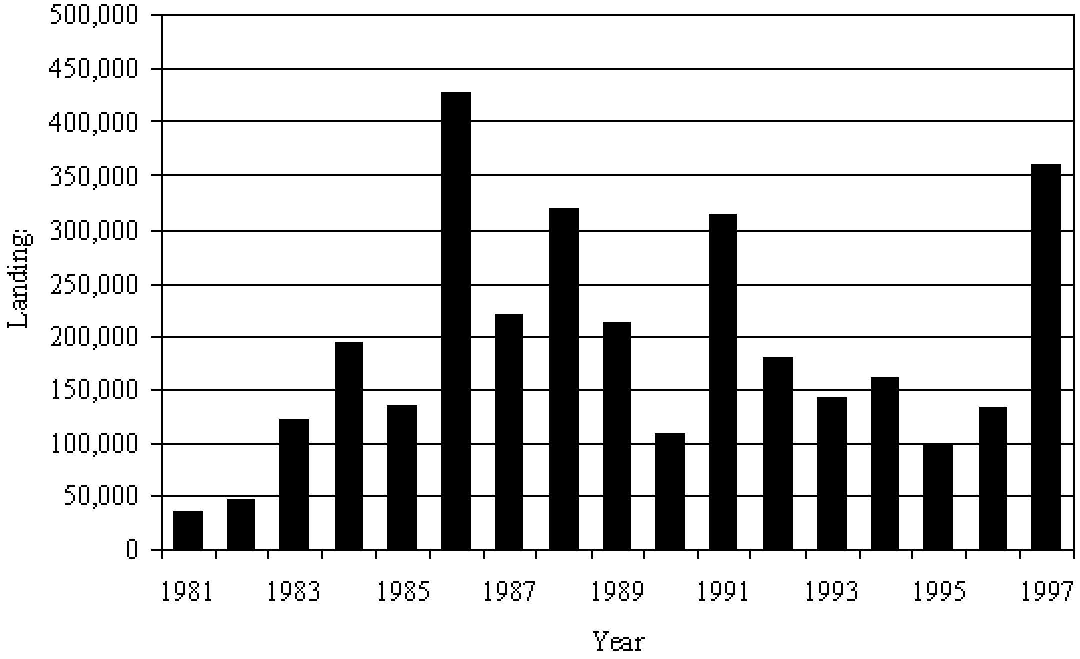

Figure 6.6a. Gulf flounder landings (lbs) in Florida (west coast) from 1981-1997 (NMFS unpublished data).

6.2.2.2 Alabama

The Alabama recreational landings are summarized in Tables 6.14 and 6.15 and Figures 6.7a and 6.7b. According to Swingle (1976), 57% of the total sport catch of flounder from 1965-1975 in Alabama was taken by gigging in shallow bays at night. A 1985-1986 recreational creel survey in Alabama found only 3.5% of those interviewed were specifically targeting flounder. However, this percentage was exceeded only by spotted seatrout, sand seatrout, king mackerel (*Scomberimorus cavalla*), and Spanish mackerel (*Scombermorus maculatus*) among marine fish recreationally targeted (ADCNR/MRD unpublished data). The survey estimated a total of 40,966 angler hrs were directed annually at flounder. The average size flounder seen in the survey was 330 mm and average weight was 464 g. Resident Alabama recreational fishing licenses from 1995 to 1997 are summarized in Table 6.17.

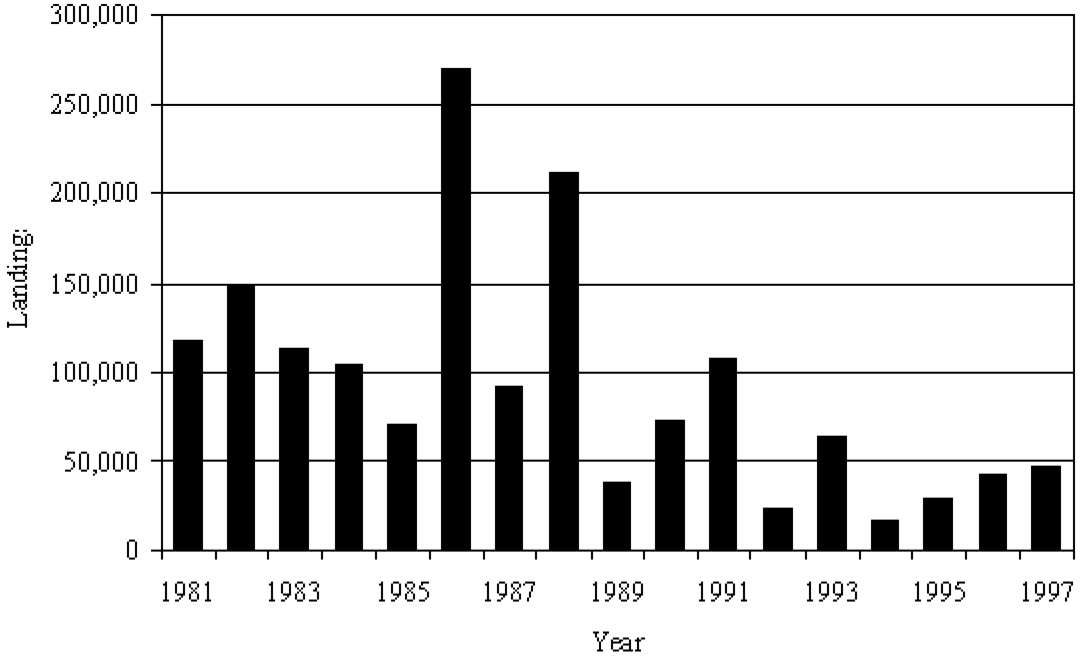

Figure 6.6b. Southern flounder landings (lbs) in Florida (west coast) from 1981-1997 (NMFS unpublished data).

6.2.2.3 Mississippi

The southern flounder has historically been a very popular fish species in Mississippi. From May through November, the shallow waters of the mainland beach and barrier islands are illuminated by the lights of gig fishermen. Flounder are also targeted by hook and line fishermen from boats, piers/jetties, and wade fishing using natural and artificial bait.

On July 1, 1993, the Mississippi Legislature established a recreational saltwater fishing license. This license applies only to hook and line fishermen and by omission exempts gig fishermen from any recreational licensing requirements. The number of saltwater recreational licenses sold has increased each year since 1993 (Table 6.18). However, a fisherman fishing north of Highway 90 and south of Interstate 10 has the option of using either a saltwater fishing license or a freshwater fishing license and is not counted strictly as a Mississippi saltwater angler. This affects the ratio of saltwater/freshwater anglers in the state and the distribution various funds used to enhance sportfishing.

Table 6.16. Annual resident and nonresident Florida recreational saltwater fishing license sales from 1989-1997 (FWC/FMRI unpublished data).

Year	Annual Resident	Ten Day Resident	Annual Nonresident	Three Day Nonresident	Seven Day[2] Nonresident
1989-1990[1]	203,254	281	63,349	67,190	0
1990-1991	244,178	104	67,853	78,167	59,884
1991-1992	261,245	7	61,264	40,561	140,472
1992-1993	250,530	8	59,270	39,330	148,822
1993-1994	272,183	5	58,992	40,199	161,236
1994-1995	276,468	8	60,339	41,699	169,749
1995-1996	267,423	5	57,160	41,327	154,829
1996-1997	278,597	167	61,159	43,518	154,496

[1] License sales in 1989 did not begin until December 1989.
[2] This license was unavailable the first year.

Flounder landings have averaged approximately 128,000 lbs per year or 4.3% by weight of the total recreational harvest in Mississippi over the last ten years (Tables 6.14 and 6.15 and Figures 6.8a and 6.8b). The MDMR has conducted a point access creel survey since 1987. Interviews are conducted at selected boat launch sites on completed fishing trips. Southern flounder is the predominate species of flounder harvested by recreational fishermen with only two gulf flounder encountered during the eleven years of the creel survey. The state survey found flounder accounts for approximately 12.5% of the total recreational harvest by boat fishermen in Mississippi. The mean weight/length ranged from a low of 0.40 kg/330 mm in 1989 to a high of 0.58 kg/360 mm in 1993 (Table 6.19). Mississippi has no minimum size or possession limits for recreational flounder fishing.

6.2.2.4 Louisiana

Recreational flounder catches in Louisiana are summarized in the MRFSS reports (Luquet et al. 1998) (Tables 6.14 and 6.15 and Figures 6.9a and 6.9b). Only 1.2% of recreational anglers surveyed from 1981-1996 targeted flounder as a preferred species.

Duffy (1977) suggested that the peak flounder run may begin in June and last for four months with the best fishing in July, August, and September. Most recreational fishermen harvest flounder with rods and reels or flounder gigs. In Louisiana, peak catches occurred during September, October, and November with an average size of 345 mm recorded (Adkins et al. 1990). In Louisiana, the majority of southern flounder were harvested from marsh and lake/bay areas: average sizes taken in those areas were 340 mm and 363 mm, respectively, with little variation in size on a monthly basis (Adkins et al. 1990). However, during October and November, flounder ranging in size from 406-457 mm are commonly taken from the spillways leading west from Southwest Pass and South Pass of the Mississippi River, and specimens exceeding 500 mm are caught routinely (P. Cooper, Jr. personal communication).

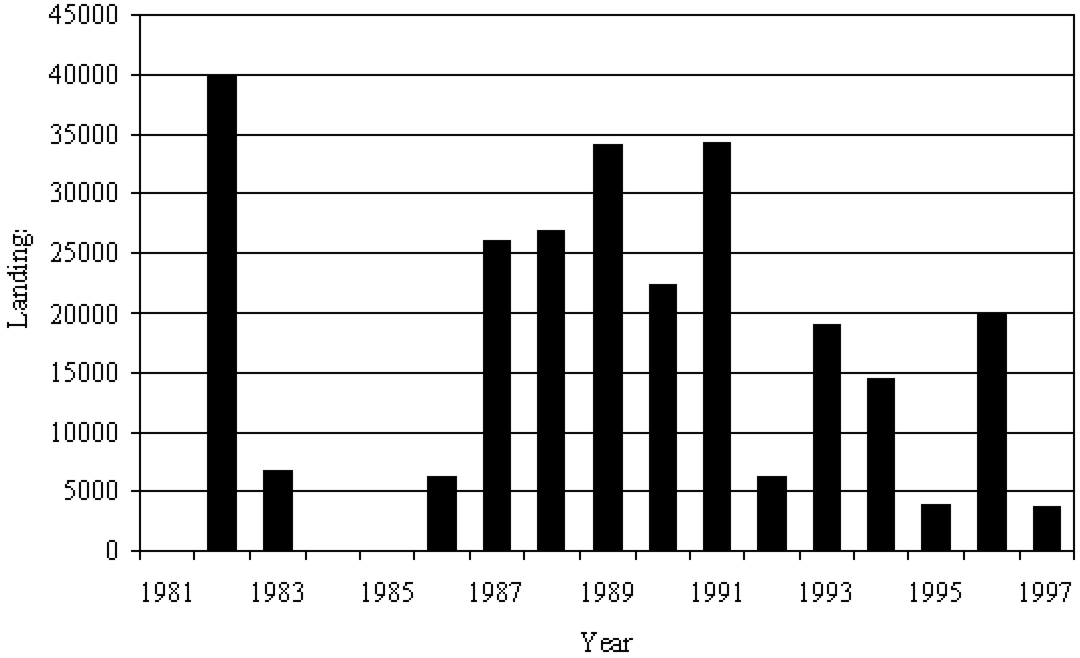

Figure 6.7a. Gulf flounder landings in Alabama from 1981-1997 (NMFS unpublished data).

Recreational saltwater angling in Louisiana has generally increased over the 13 years from 1984/1985 through 1996/1997 as reflected in numbers of licenses sold (Table 6.20). There was a 62% increase in the number of resident recreational saltwater licenses sold during this period.

A 1984 Louisiana creel survey reported that southern flounder were not targeted as were spotted seatrout, red drum, croakers, mackerels (Scombridae), and snappers (Lutjanidae). Less than 1% of anglers interviewed expressed a preference for southern flounder as a targeted species. Although not specifically targeted, a 1993 survey indicated that they ranked third in angler preference when caught, following spotted seatrout and red drum which ranked first and second, respectively (Kelso et al. 1994)

6.2.2.5 Texas

The number of recreational fishing licenses sold in Texas are shown in Table 6.21. The estimated number of saltwater anglers ranged from 816,728 in 1978 to a high of 1,133,226 in 1983. The estimated numbers of saltwater anglers exceeded 900,000 for all other years. Since 1976, sport boat fishing pressure (man-hours) and finfish landings (number of fish) have fluctuated (Tables 6.22). Fishing pressure showed an upward trend while the number of fish landed was lower in 1997 than in 1976. Many of the fluctuations seen in landings were in response to fish killing freezes and TPWD regulation changes. In response to concerns over both overfishing and declining population and recruitment, more restrictive limits have been placed on recreational and commercial fisheries.

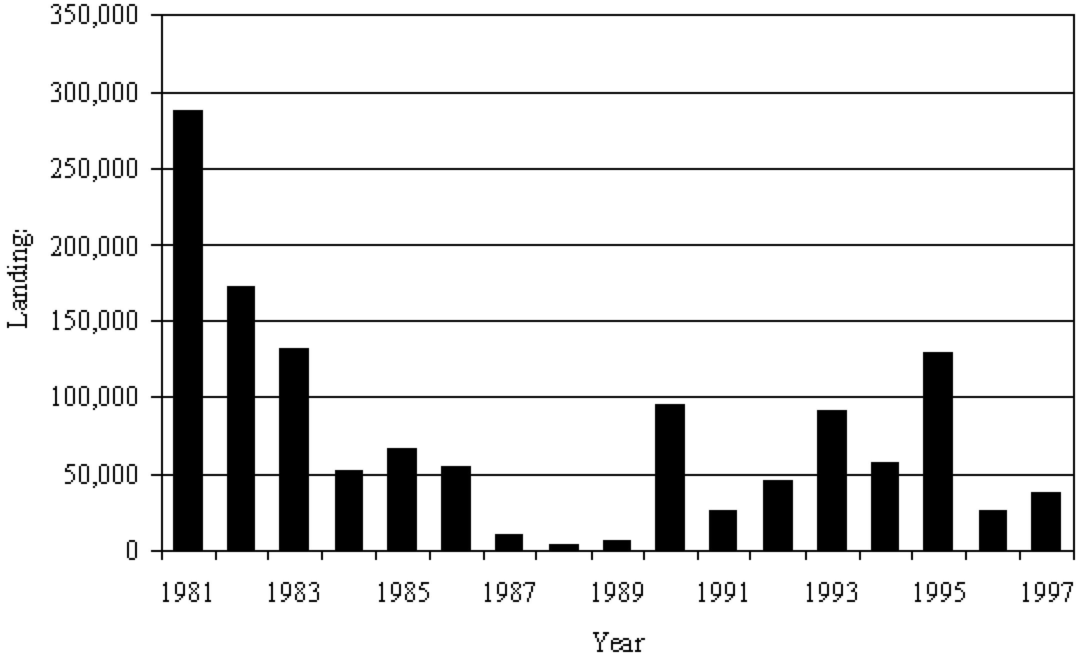

Figure 6.7b. Southern flounder landings (lbs) in Alabama from 1981-1997 (NMFS unpublished data).

During 1981-1991 in Texas bays, the top five species landed by private boat fishermen were spotted seatrout, sand seatrout, Atlantic croaker, southern flounder, and red drum and made up 83% of the number of fish landed (Weixelman et al. 1992b). In 1997, the top five species landed were only 68% of the total landings, and southern flounder had dropped to the fifth most-landed species (Green unpublished data). As in Louisiana, two good months for flounder gigging in Texas were October and November (Stokes 1977).

Flounder are caught by Texas anglers primarily nearshore in bays and passes. Some are caught offshore but are generally reported around times of spawning migrations. About 11% of the sport boat anglers indicated they target flounder. Anglers that target flounder have a catch rate seven to ten times higher than fishermen not targeting flounder. Flounder, however, are not the most sought recreational species in Texas. Ditton and Hunt (1996) reported flounder as the third species of choice, following spotted seatrout and red drum, among saltwater anglers. Green et al. (1991) showed the same order of preference, although they reported 30% of the anglers had no preference.

Table 6.17. Alabama resident recreational license sales from 1995/1996 to 1997/1998 (ADCNR/MRD unpublished data). Combination angler endorsement includes both fresh and saltwater privileges.

	Number Sold		
License	**1995/1996**	**1996/1997**	**1997/1998**
Recreational net	615	664	699
Recreational shrimp	1,744	1,433	1,700
Saltwater angler	18,429	17,523	17,761
Combination angler	16,841	17,408	19,753
Seven-day trip	5,949	7,736	7,275
Pier	950	798	867

Table 6.18. Number of annual recreational saltwater licenses issued in Mississippi from 1993 through 1998 (MDMR unpublished data). The recreational fishing year in Mississippi is from July 1 through June 31 of the following year.

	Number Sold				
License	**1993/1994**	**1994/1995**	**1995/1996**	**1996/1997**	**1997/1998**
Resident	44,529	46,815	54,295	58,004	58,099
Nonresident - three day	2,125	1,746	1,712	1,978	1,986
Nonresident - eight day	6,375	6,445	7,444	8,452	8,529
Total	53,029	55,006	63,451	68,434	69,399

A 1994 survey of the flounder fishery found 29% of the 1,047 respondents reported making a trip specifically for flounder in the past 12 months (TPWD unpublished data). The respondents indicated that they fished for flounder using rod and reel (69%), gig (11.4%), both rod and reel and gig (18.0%), and other gear (0.9%).

During a special night flounder gig fishery study from July 15 to December 15, 1991 (TPWD unpublished data), sport giggers were interviewed at boat ramps and selected wade/bank areas. Of the 176 interviews conducted, 162 were sport fishermen (82 at boat ramps and 80 at wade/banks). Sport boat giggers (N=162) reported that 55.4% gig from a boat, 38.6% wade, and 6% do both. The number of gigging trips per year for sport boat giggers ranged from one to 100. Only 12.2% of the sport boat giggers fished one trip per year. Approximately 75% of the anglers went on 24 gig trips per year. The amount of expenditures for these anglers/trip ranged from $0 to $1,000; but 50% spent around $20.

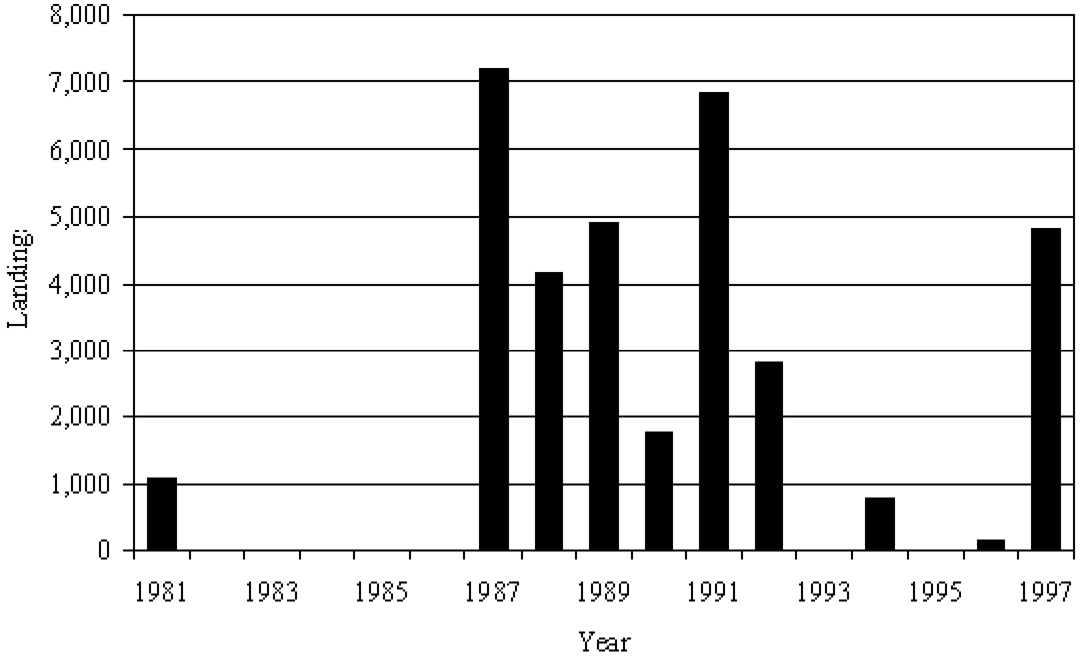

Figure 6.8a. Gulf flounder landings (lbs) in Mississippi from 1981-1997 (NMFS unpublished data). Landings are likely misidentified or were caught elsewhere.

Some differences were noted for the wade/bank giggers. The number of gigging trips per year for sport wade/bank giggers ranged from one to 75. Only 17.3% of the wade/bank giggers fished one trip a year. Seventy-five percent of the anglers gigged only 15 nights per year. The amount of expenditures for these wade/bank giggers per trip ranged from $0 to $2,000; but 50% spent around $15. Seventeen percent of sport boat giggers spent more than $100 while only 9% of the wade/bank giggers spent more than $100.

Annual sportfishing pressure, landings, mean lengths, and catch rates for flounder were estimated using data from the TPWD Harvest Survey Program which began in 1974. These surveys monitored the activities and landings of private sport-boat fishermen, head boat and party boat fishermen (since 1983), and wade/bank and pier fishermen (periodically since 1974). The harvest survey year runs from May 15 to May 14 of the following year. The harvest year includes a high use season and a low use season and for the purposes here, is reported as the year in which the survey was initiated. For years when groups of anglers were not interviewed (i.e., wade/bank, pier), landings were estimated using proportionality between those strata and sport boat landings calculated for years in which both were available. Since 1990 sport boat fishermen account for 75% of recreational flounder landings, with 25% caught by bay, wade/bank, and lighted pier fishermen (Table 6.23 and Figure 6.10). Data on size, number, and landings per unit effort were obtained.

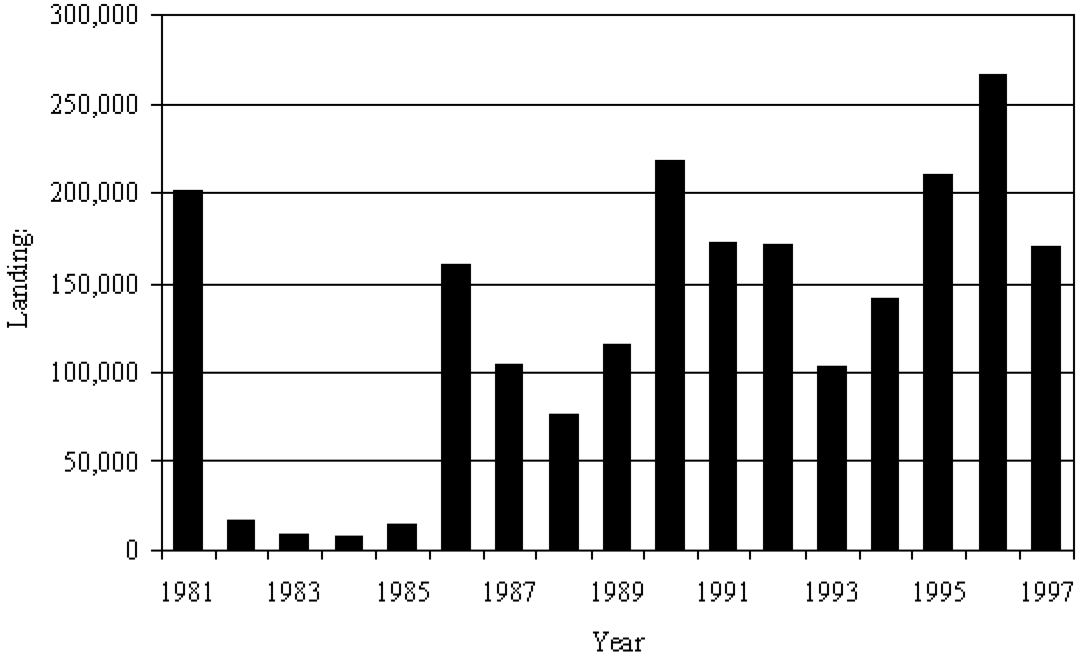

Figure 6.8b. Southern flounder landings (lbs) in Mississippi from 1981-1997 (NMFS unpublished data).

Table 6.19. Mean weight (kg) and length (mm TL) of flounder landed in Mississippi from 1988 through 1997 (MDMR unpublished data).

Year	Mean Weight	Mean Length
1988	0.54	352
1989	0.40	330
1990	0.49	337
1991	0.45	333
1992	0.54	351
1993	0.58	360
1994	0.49	358
1995	0.45	332
1996	0.49	359
1997	0.49	349

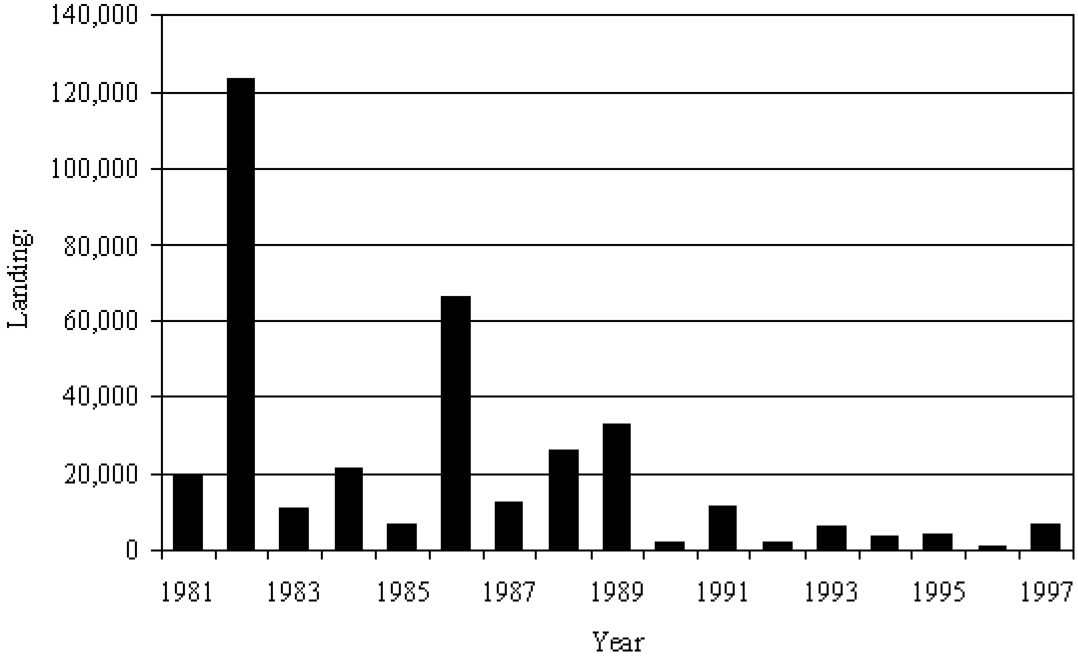

Figure 6.9a. Gulf flounder landings (lbs) in Louisiana from 1981-1997 (NMFS unpublished data). Landings are likely misidentified or were caught elsewhere.

Southern flounder is the most frequent recreationally landed flounder. Other species reported in the landings include gulf and ocellated flounder. Because of the regulations on size (minimum size changed to 14 inches in 1996), most of the future flounder landings should consist of female, southern flounder. Since 1974, southern flounder landings were reported primarily from bay and pass private sport boat fishing with less than 2,000 fish landed from Gulf areas (Texas Territorial Sea and EEZ). Approximately 25% of the landings were from wade/bank and lighted piers. The number of southern flounder landed ranged from 112,942 (1976) to 665,294 (1979) fish (Table 6.23). Southern flounder landings have remained relatively stable since 1979 (140,000-240,000 fish), except for 1987 and 1997 where 266,602 and 126,681 flounder were landed, respectively. The mean size of southern flounder landed ranged from 348-395 mm TL and 1.5-2.0 lbs.

Recreational catches of southern flounder vary geographically. During 1982-1992, 45% of southern flounder landed were from Galveston Bay. The composition of southern flounder landings in other bays ranged from 3% (San Antonio Bay) to 15% (Sabine Lake) of the total finfish landings. The majority of coast-wide flounder landings were concentrated along the upper Texas coast in Galveston Bay from 1982 to 1987 (28%-47% of total bay landings). After 1987, more southern flounder were landed on the lower coast with 28%-37% of the total landings caught fluctuating between the lower Laguna Madre and Corpus Christi bays.

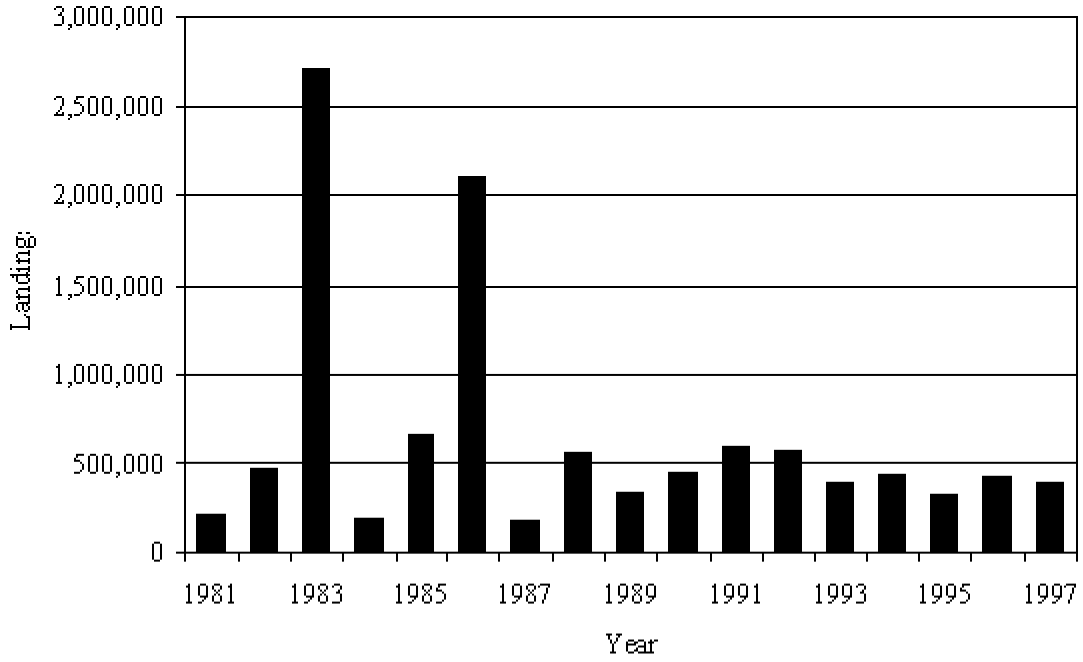

Figure 6.9b. Southern flounder landings (lbs) in Louisiana from 1981-1997 (NMFS unpublished data).

Table 6.20. Resident recreational saltwater angler licenses issued, 1984/1985 through 1996/1997 in Louisiana (LDWF unpublished data).

Season	Number Sold
1984-1985	102,125
1985-1986	168,149
1986-1987	198,852
1987-1988	195,099
1988-1989	204,686
1989-1990	208,292
1990-1991	206,088
1991-1992	230,043
1992-1993	246,694
1993-1994	267,323
1994-1995	282,490
1995-1996	299,867
1996-1997	274,728

Table 6.21. Total number of recreational fishing licenses sold in Texas from 1978-1996 (L. Green personal communication). Recreational licenses included fresh and saltwater fishing privileges. Fiscal year is from September 1 to August 31. NA indicates license was not available.

Fiscal Year	Resident Combo [1]	Resident Fishing	Nonresident Fishing	Resident Temporary	Nonresident Temporary	Special Resident Fishing [2]	Lifetime Combo [3]	Lifetime Resident Fishing [3]	Total Fishing	Saltwater Stamp Sales	Estimated Saltwater Anglers [4]
1978	447,740	857,978	30,492	62,236	40,366	1,208	NA	NA	1,440,020	NA	816,728
1979	523,830	1,036,538	37,071	70,454	45,119	2,139	NA	NA	1,715,151	NA	972,772
1980	572,149	1,019,481	32,753	76,443	41,949	2,693	NA	NA	1,745,468	NA	989,967
1981	609,118	1,022,644	34,262	84,709	44,036	3,187	NA	NA	1,797,956	NA	1,019,736
1982	673,212	1,069,370	29,582	74,141	76,378	3,424	NA	NA	1,926,107	NA	1,092,419
1983	724,990	1,098,271	28,486	66,429	75,997	3,883	NA	NA	1,998,056	NA	1,133,226
1984	690,937	981,870	31,123	51,770	56,125	3,950	NA	NA	1,815,775	NA	1,029,843
1985	694,409	988,046	31,432	55,820	55,180	3,865	NA	NA	1,828,752	NA	1,037,203
1986	663,660	1,056,587	34,234	46,898	52,602	4,084	NA	NA	1,858,065	390,545	1,053,828
1987	661,010	1,031,021	37,561	41,145	54,193	3,812	376	6	1,829,124	520,699	1,037,414
1988	681,349	1,067,584	39,647	39,282	56,172	6,445	521	18	1,891,018	569,648	1,072,518
1989	670,735	1,018,684	44,881	40,185	60,874	5,806	636	28	1,841,829	566,132	1,044,619
1990	668,895	1,058,814	48,621	39,984	65,192	5,914	750	34	1,858,204	585,391	1,070,922
1991	656,527	1,077,717	50,750	43,097	69,170	5,667	1,332	75	1,904,335	576,199	1,080,071
1992	527,669	1,002,095	45,740	89,004	72,426	6,195	1,677	95	1,744,901	561,412	989,645
1993	528,003	984,141	47,360	132,513	75,516	6,505	1,758	105	1,775,901	574,376	1,007,227
1994	510,524	1,012,031	49,802	152,184	81,185	6,737	1,942	130	1,814,535	615,713	1,029,139
1995	512,820	1,066,712	47,668	39,531	58,187	7,103	2,055	144	1,734,220	609,460	983,587
1996	500,375	1,018,192	47,673	37,884	57,536	13,765	2,885	289	1,678,599	608,401	952,041

[1] Includes hunting and fishing privileges.

[2] Available to any resident who was legally blind, a qualified disabled veteran, or a licensed commercial fisherman. Beginning FY 1996, persons becoming 65 on or after 15 September 1995 were required to obtain this license.

[3] Totals are cumulative.

[4] Estimated number of Saltwater fishermen based on Green et al. (1982), equals ((Total/0.67) x 0.38) where 0.67 adjusts for those that fish without a license and 0.38 adjusts for those that fish in saltwater.

Table 6.22. Sport boat pressure and landings by recreational anglers in Texas waters from 1976 through 1998. Texas waters include bays/passes, Texas Territorial Sea and EEZ; landings include sport boat, wade/bank, and lighted pier landings. Fishing year = May 15 through May 14.

Year	**Sport Boat Pressure** (man-hours X 1,000)	**Sport Boat Finfish Landings** (X 1,000)	**Total Finfish Landings** (X 1,000)
1976/1977	3,415.70	3,698.90	4,914.83
1977/1978	4,486.00	3,504.00	4,655.86
1978/1979	4,383.20	3,009.90	3,999.34
1979/1980	4,146.80	2,701.80	3,589.95
1980/1981	5,245.00	3,933.50	5,226.55
1981/1982	4,550.50	2,504.80	3,328.20
1982/1983	4,809.20	2,861.30	3,801.89
1983/1984	4,676.00	2,952.70	3,923.33
1984/1985	4,304.90	1,565.20	2,079.72
1985/1986	5,253.70	2,680.30	3,561.39
1986/1987	5,064.00	2,095.50	2,784.35
1987/1988	6,384.00	2,654.00	3,526.44
1988/1989	5,538.10	2,098.90	2,788.87
1989/1990	5,138.30	1,597.90	2,123.17
1990/1991	4,819.90	1,377.80	1,830.72
1991/1992	5,130.50	1,826.60	2,427.05
1992/1993	5,896.00	2,348.50	3,120.52
1993/1994	6,073.80	2,154.50	2,862.74
1994/1995	6,785.70	2,437.50	3,238.77
1995/1996	6,258.60	2,101.90	2,792.85
1996/1997	6,362.30	2,519.30	3,347.46
1997/1998	6,369.00	2,333.00	3,099.92

Two other species of flounder were landed by sport boat anglers. Southern flounder comprised 2%-19% of the total finfish landings while gulf and ocellated flounder made up <1% of the total finfish landings. Gulf flounder were landed more often than ocellated flounder. The range of gulf flounder landings was from zero (several years) to 17,795 fish (1987) (Table 6.23). In most years gulf flounder landings were below 5,000 fish; generally, <100 ocellated flounder were landed (Table 6.23). Gulf flounder were landed primarily along the mid to lower Texas coast (in San Antonio, Aransas, and Corpus Christi bays, as well as the Laguna Madre). Ocellated flounder were rare but were landed occasionally from Galveston and Aransas bays and the Laguna Madre. These flounder landings, composition, mean size, and weights have been affected by the size restrictions placed on this species through the years. Other factors affecting the landings are environmental fluctuations and perturbations (e.g., cold fronts and algal blooms, see Sections 4.8.2.2 and 4.9.2, respectively).

Table 6.23. Total number of flounder landed by all recreational anglers in Texas waters from 1976 through 1998. Texas waters include bays/passes, Texas Territorial Sea, and EEZ; landings include sport boat, wade/bank, and lighted pier landings. Fishing year = May 15 through May 14.

Year	Southern Flounder	Gulf Flounder	Ocellated Flounder	Unidentified Bothids	Total "Flatfish"
1976/1977	112,942	0	0	0	112,942
1977/1978	135,796	171	0	0	135,967
1978/1979	140,579	0	0	0	140,579
1979/1980	665,294	0	0	0	665,294
1980/1981	239,437	0	0	0	239,437
1981/1982	193,197	0	0	0	193,197
1982/1983	240,367	0	0	0	240,367
1983/1984	177,910	10,121	74	0	188,105
1984/1985	174,825	2,218	64	0	177,106
1985/1986	210,959	3,095	0	0	214,054
1986/1987	170,763	8,995	262	0	180,021
1987/1988	266,602	17,795	0	0	284,397
1988/1989	183,757	9,122	0	0	192,879
1989/1990	136,422	5,245	0	0	141,667
1990/1991	166,780	3,831	18	103	170,732
1991/1992	224,151	12,927	290	0	237,368
1992/1993	218,607	12,709	0	0	231,317
1993/1994	202,832	3,950	81	0	206,862
1994/1995	178,089	6,927	73	0	185,088
1995/1996	175,758	5,445	0	0	181,203
1996/1997	152,953	5,708	62	0	158,723
1997/1998	126,681	6,247	0	0	132,928

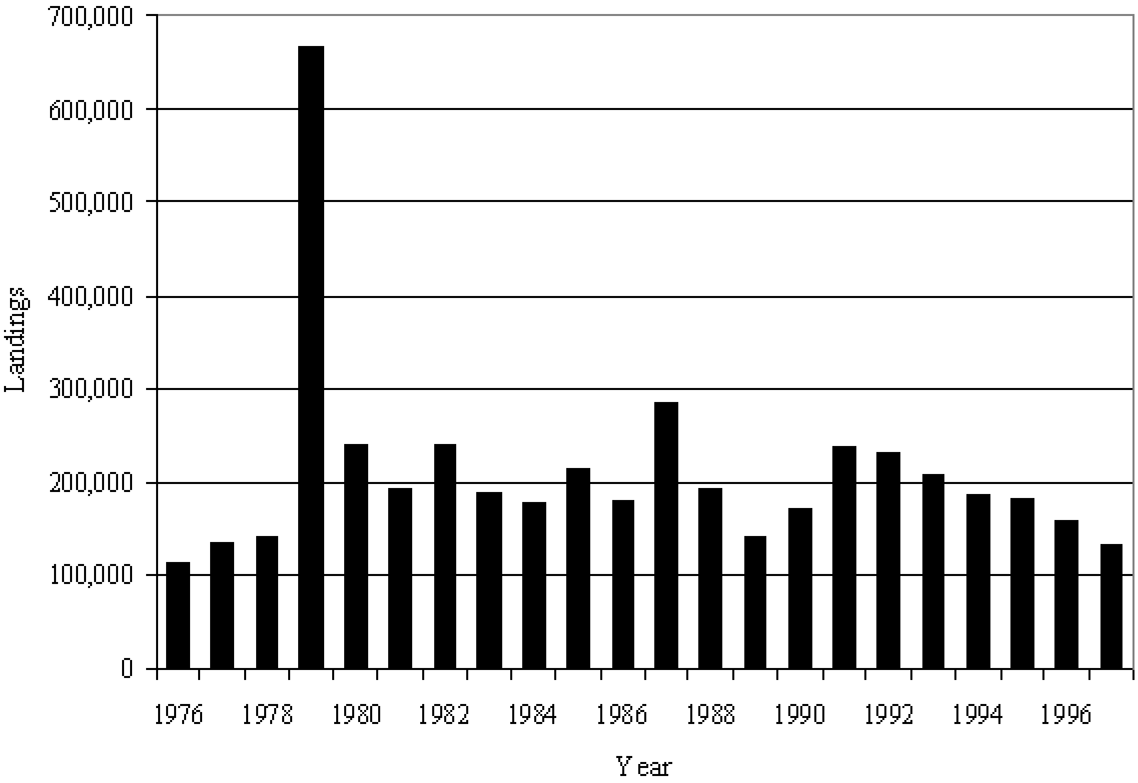

Figure 6.10. Total number of flatfish (gulf, southern, ocellated, and other unidentified bothids) landed in Texas from 1976-1997 (TPWD unpublished data).

6.3 Incidental Catch

There is a substantial number of flounder which occur as bycatch in the commercial shrimp industry. In an eight-month study during 1978, Matlock (1982) estimated 9,741,000 southern flounder (82-385 mm TL) and 195,700 gulf flounder (94-311 mm TL) were caught by commercial shrimp trawlers in Texas. Most of the southern flounder caught were juveniles, and the number caught by trawlers was estimated to be 13 times higher than the directed fishery (commercial and recreational). Eight other species of flatfish were caught during the sample period and include: bay whiff, hogchoker, ocellated flounder, blackcheek tonguefish, lined sole, spiny flounder, fringed flounder, and shoal flounder.

In a more recent study in Texas, it was estimated that more than one million southern flounder were caught by bay shrimpers during the 1992-1994 spring and fall bay shrimp seasons (estimates of Galveston Bay: 181,000 in 1992, Corpus Christi Bay 28,000 in 1993). In 1994, it was estimated that 590,000 southern flounder were caught in three bays by bay shrimpers: Matagorda Bay (27%), San Antonio Bay (36%), and Aransas Bay (47%). Most of the flounder were nine to 11 inches TL (0.5-1.0 yrs old) and did not survive (TPWD unpublished data). The number of flounder occurring in bait shrimp bycatch is unknown. Based on techniques used by bait shrimpers; however, flounder captured in this fishery may have a better chance of survival.

Because most studies have dealt with commercial bycatch species, little information is known about incidental recreational catch. The incidental recreational catch may include any species caught and returned to water. The magnitude and composition of the incidental catch is influenced by local size and bag limits, anglers' species preference, and time of year. Knowing numbers of fish caught and released is one of the elements required to evaluate the mortality of released fish and thus aid in the evaluation of harvest limiting regulations.

From 1984-1986, Saul (1992) estimated that 1.85 fish were caught and released for every fish retained in Texas. Campbell and Choucair (1995) estimated incidental catches of more than three million fish during a period where 1,800,200 fish were retained (i.e., for every fish kept, 2.25 to 2.49 fish were released). In the bays and passes, flounders (all flounder) were the tenth highest unretained species preceded by spotted seatrout, hardhead catfish (*Arius felis*), red drum, Atlantic croaker, silver perch (*Bairdiella chrysoura*), black drum, sand seatrout, ladyfish (*Elops saurus*), and sheepshead. Spotted seatrout made up about 36% of total incidental catch, whereas flounders (southern and gulf flounder grouped) comprised only 1%. In the Gulf, flounders constituted less than 1% of incidental catches (Campbell and Choucair 1995). During this study, flounders occurred in 6% and less than 1% of the bays and passes and the Gulf interviews, respectively.

6.4 Mariculture

Various researchers studied southern flounder under laboratory conditions that have implications for management. Lasswell et al. (1978) successfully induced spawning of southern flounder by utilizing carp pituitary hormone. Arnold et al. (1977) regulated photoperiod and temperature to simulate seasonal variations which induced adult southern flounder to spawn (Table 3.16). Deubler (1960) experimented with the effects of salinity on growth of postlarval southern flounder. Since southern flounder adapt physiologically to salinity both seasonally and with age, rapid growth in an aquaculture operation could be expected if the proper salinity regimes were adjusted to meet optimum requirements (Stickney and White 1974a).

In laboratory studies, Lasswell et al. (1977) noted low fecundity and a low percentage of fertilization and hatching success and did not recommend this species for mass culture. However, Arnold et al. (1977) proved southern flounder could be successfully raised and maintained to fingerling size under laboratory conditions. Henderson (1972) considered southern flounder a hardy species for freshwater stockings and introduced fingerlings into freshwater reservoirs. Recaptured fish exhibited growth equal to or exceeding that recorded in coastal waters.

White and Stickney (1973) indicated the presence of a hierarchical structure in flatfish populations in early life. Larvae and early juveniles became dominant and may be out competing smaller fish for a sufficient amount of food even at low stocking densities. They suggested food (and its presentation) and disease control as the two areas of major concern to all larval fish development. Decay of food remnants could promote bacterial and ammonia accumulation; being sight feeders, flounder must be trained to accept nonliving food. Feeding of live brine shrimp (*Artemia salina*) to postlarvae and larvae could alleviate some of these problems. In preliminary aquaculture studies, Stickney and White (1974b) described the presence of the viral disease "lymphocystis." Although not often fatal, the presence of whitish nodules on fins and body could reduce marketability. This problem was seemingly solved by use of secondary tank filters and soft ultraviolet light sterilization.

Another condition common to fish reared in fiberglass tanks lacking a natural substrate was ambicoloration (Section 3.2.1.2.5). This condition could also affect marketability.

7.0 DESCRIPTION OF PROCESSING, MARKETING, AND ECONOMIC CHARACTERISTICS OF THE FISHERY

This section will discuss some of the underlying economic characteristics of the commercial and recreational flounder (gulf and southern) fisheries in the Gulf of Mexico region. Initially, trends in the overall commercial dockside value will be discussed. Although this report attempts to address gulf and southern flounder, the NMFS reported landings are for "flatfish," which includes all species of flounder (Section 6.1.1 and Table 6.2). Commercial dockside value represents the total amount paid by the first handler to the harvester during the initial offloading of the fish. Markups that might occur in subsequent market levels are not included. Annual and monthly nominal (not adjusted for inflationary changes) values will be discussed for each state and the Gulf in general. Annual and monthly nominal exvessel prices (i.e., the price per lb received by the harvester for whole fish) will be discussed for the region, by state where appropriate, and by gear type. Information on prices and dockside value provides basic insight into the economic importance and performance of the commercial flounder harvest sector.

The sources and uses of flounder by finfish wholesale distributors and processors in the Gulf States will be discussed. This information provides insight into the importance of the Gulf of Mexico stocks to flounder purveyors in the region, as compared to flounder obtained from other domestic sources and foreign suppliers. Unfortunately, volume and wholesale value of flounder sold by this market sector, as well as exvessel to wholesale markups, are not readily available. Limited data on consumption estimates will be discussed to provide some insight into the importance of flounder to retail consumers in the region.

The economic importance of flounder as a recreationally targeted species will also be addressed. Unfortunately, there are few studies that furnish information that provides a direct measure of the value recreational anglers place on flounder in the Gulf. These studies provide for only a partial assessment of the economic importance of this species to recreational fishing activities in the Gulf. Measurements of trip expenditures are discussed and provide insight into the economic value that recreational fishers place on flounder in the Gulf.

Finally, the replacement costs associated with flounder are discussed. These estimates utilize both recreational and commercial values and provide fishery managers and law enforcement agencies with the economic values associated in replacing fish potentially lost through natural phenomena, man-induced habitat destruction, pollution events, and regulatory violations.

7.1 Commercial Sector

The following section will focus on reported estimates for dockside value. References to landings volume are also made but not specifically reported in accompanying tables. The reader should refer to Table 6.2 for reported landings volumes.

7.1.1 Annual Commercial Dockside Value

7.1.1.1 Gulfwide Dockside Value

The dockside value for flounder in the Gulf exhibited a somewhat steady upward trend from 1970 to 1982 (Table 7.1). Nominal dockside value (e.g., not adjusted for changes in inflation) increased from $373,000 in 1970 to $1.2 million in 1982. During this same period, landings followed a declining trend. From 1983 to 1997, dockside value became somewhat erratic, and value declined to less than $1 million in 1984. In 1987, value increased to $1.7 million. In 1989, value declined to $1.1 million, increased to $2.0 million in 1993, and finally decreased again to $901,000 in 1997. Landings followed a similar pattern of peaks and troughs in volumes during this same period. From 1975 to 1984, average annual dockside value was $771,000. From 1985 to 1995, average annual dockside value doubled to $1.6 million. Dockside value decreased by almost a half from 1996 to 1997.

7.1.1.2 Dockside Value by State

Annual landings of flounder in Texas averaged 354,000 lbs from 1970 to 1984 with an average annual dockside value estimate of $190,000 (Table 7.1). During this period, dockside value varied from a low of $65,000 in 1970 to a high of $521,000 during 1982. The prohibition of red drum and spotted sea trout commercial sales in 1981 resulted in redirected effort in 1982 toward flounder by the commercial sector. However, commercial landings of flounder declined following implementation of the Texas net ban in 1988. Dockside value declined to $181,000 in 1990 before increasing to $484,000 in 1995. By 1997, dockside value decreased to $237,000.

Landings of flounder in Louisiana averaged 284,000 lbs from 1970 to 1984 with an average annual nominal dockside value of $94,000 (Table 7.1). From 1970 to 1984, dockside value exhibited an upward trend from $85,000 in 1970 to $219,000 in 1984. Dockside value continued an increasing trend that reached $738,000 in 1987 then remained less than $500,000 for three years. In 1994, dockside value increased to $1.3 million before decreasing again to $757,000 in 1995. Dockside value decreased dramatically to $70,000 and $124,000 during 1996 and 1997, respectively. The trend in dockside value from 1985 to 1997 mirrored the trends seen for landings.

Flounder landings in Mississippi exhibited a downward trend from 1970 to 1984 declining from 172,000 lbs in 1971 to 44,000 lbs in 1984. In contrast, dockside values remained steady at an average $20,000 during the same period (Table 7.1). Landings became somewhat erratic from 1985 to 1995. For example, landings increased to 88,000 lbs in 1985, declined to 28,000 lbs in 1986, increased again to 85,000 lbs in 1991, and decreased to 57,000 lbs in 1995. Dockside value followed a similar pattern but exhibited an increasing trend from 1985 to 1995. Dockside value increased from $15,000 in 1986 to $78,000 in 1995 then decreased again to $54,000 in 1997. As with landings, dockside value varied considerably during this period.

Landings of flounder in Alabama exhibited a decreasing trend from 1970 to 1984. Landings decreased from 1.2 million lbs in 1972 to 309,000 lbs in 1984. Dockside value followed an increasing trend during this same period, increasing from $136,000 in 1970 to about $300,000 in 1981 and 1982 (Table 7.1). From 1983 to 1997, dockside value of flounder in Alabama remained fairly steady with an average annual value of $215,000. Flounder landings also remained relatively steady from 1985 to 1997.

Table 7.1. Annual flounder dockside value for the Gulf States, 1970-1997 (units of 1,000) (NMFS unpublished data). Values are nominal, i.e., not adjusted for inflation.

Year	Texas	Louisiana	Mississippi	Alabama	Florida (west coast)	Gulf
1970	65	85	20	136	68	373
1971	76	77	23	155	77	408
1972	120	89	21	188	81	499
1973	105	56	17	136	79	393
1974	149	65	16	180	66	476
1975	176	62	23	174	69	504
1976	180	96	19	196	80	572
1977	171	102	23	163	110	571
1978	173	123	28	210	145	679
1979	190	86	19	272	201	768
1980	154	85	15	226	189	668
1981	138	88	12	306	182	724
1982	521	104	22	303	250	1,200
1983	446	162	22	248	222	1,099
1984	351	219	22	173	163	927
1985	445	336	41	209	140	1,172
1986	540	576	15	237	149	1,517
1987	539	738	43	227	164	1,709
1988	338	469	29	138	151	1,125
1989	187	490	73	176	172	1,112
1990	181	490	64	187	227	1,150
1991	319	706	82	225	276	1,608
1992	378	940	42	175	209	1,744
1993	328	1,219	54	209	218	2,028
1994	356	1,278	56	228	198	2,116
1995	478	757	78	287	215	1,815
1996	407	70	62	253	137	929
1997	237	124	54	253	233	901

Landings for flounder on the Florida west coast remained somewhat steady (less than 300,000 lbs) from 1970 to 1978. From 1979 to 1983, however, average annual landings increased to 367,000 lbs. Landings then decreased to an average annual volume of 174,000 lbs from 1985 to 1995. Dockside value exhibited an increasing trend from 1970 to 1982 (Table 7.1). Nominal dockside value for flounder increased from $68,000 in 1970 to $250,000 in 1982. Dockside value fell to $140,000 in 1985 and increased to $276,000 in 1991. Dockside value maintained an average annual value of $208,000 through 1995 but decreased to $137,000 in 1996. However, dockside value increased in 1997 to $233,000, the third highest amount exhibited between 1970 to 1997 for the Florida flounder fishery.

7.1.2 Monthly Commercial Dockside Value

Nominal dockside values are examined from 1993 to 1997 (Table 7.2). The five-year average dockside value was estimated for each month by state. Average monthly landings and dockside values for the Gulf States followed similar patterns; dockside values of flounder landed in Louisiana exceeded all other states. Monthly reported dockside values typically peak in the fall months, and the lowest values occurred during late winter or early spring months. Dockside values generally exhibit an upward trend beginning early in the year until a peak is reached in late summer or the fall. An exception to this specific pattern was for the Florida west coast which exhibited a peak in dockside values during May but also had an increase in dockside value during the fall months.

Table 7.2. Average flounder monthly dockside value for the Gulf States, 1993-1997 (NMFS unpublished data). Values in thousands of dollars are nominal (i.e., not adjusted for inflation) and averaged over the 1993-1997 period.

Month	Texas	Louisiana	Mississippi	Alabama	Florida (west coast)
January	7.5	21.1	0.8	6.3	6.8
February	8.4	14.1	0.6	4.6	6.0
March	13.1	21.1	1.2	6.5	9.7
April	17.1	38.8	2.4	12.2	16.6
May	22.1	61.5	4.8	22.0	27.8
June	30.1	61.7	6.2	25.8	22.9
July	39.7	61.3	9.3	22.8	15.6
August	38.4	72.7	11.9	35.5	16.7
September	37.2	58.1	8.0	31.6	22.5
October	41.6	65.5	6.3	27.6	19.9
November	75.5	157.1	6.8	27.5	22.6
December	30.7	56.4	2.5	23.4	13.1

7.1.3 Annual Exvessel Prices for Flounder

7.1.3.1 Gulfwide Exvessel Prices

Nominal exvessel prices ($/lb) for flounder increased steadily from $0.19 in 1970 to $1.13 in 1990 (Table 7.3). Price then fell by 6% to $1.06 in 1991, partly in response to a 50% increase of landings in 1991. Although landings from 1992 to 1994 continued to remain well above the landings volumes reported for 1988-1990, Gulfwide exvessel prices continued to exhibit an upward trend. Gulfwide exvessel prices reached $1.50 in 1995 as the landings volume fell by 37% the same year. Prices continued to increase to $1.71 in 1996, while decreasing slightly to $1.66 in 1997.

Real exvessel prices of flounder were adjusted by using the producer price index (PPI) for all foods with 1985 as the base year (United States Bureau of Labor Statistics 1997). These real prices have also exhibited a general upward trend, particularly during 1974 to 1997. Real prices have mirrored the pattern for nominal prices, with the exception that real prices initially fell in 1980 and again in 1989, as opposed to an initial decline in 1991 for nominal prices. Real prices have recently increased at a lesser rate than what was exhibited by nominal prices. For example, nominal exvessel prices increased almost 7.4% per year during 1985-1995. Real prices increased by an average annual rate of 5.3% during the same period. Real prices for flounder increased by 17% during 1996, then fell 2.8% during 1997.

7.1.3.2 Exvessel Prices by State

Although variability in exvessel prices is likely found on a regional or offloading site basis, existing data do not allow disaggregation beyond the state level. Nominal exvessel prices for flounder exhibited increasing trends from 1985 to 1997 for the Gulf States (Table 7.3). Prices for flounder landed in Texas typically exceeded those for all other states (except Florida during 1991 and 1997). In 1997, nominal exvessel prices for Florida flounder were $1.83; flounder prices for the other states ranged from $1.31 (Louisiana) to $1.75 (Texas). Prior to 1990, exvessel flounder prices for each state increased at a relatively stable pace. However, beginning in 1990 exvessel prices became more variable on an annual basis with a price decrease occurring for all states in 1991. Exvessel flounder prices for most Gulf States began increasing dramatically in 1992. Differences in real price trends between states are unknown since state-specific PPI indices are not readily available. However, it is assumed these differences would be minimal since harvesting and processing methods are quite similar within the region. Therefore, real price trends would approximate the nominal price trend previously discussed for the region in general.

7.1.4 Monthly Exvessel Prices for Flounder

Average monthly exvessel prices for flounder were estimated from 1993 to 1997 for each state (Table 7.4). In general, flounder prices were the lowest during the winter months. The lower prices are associated with higher landings volumes which occur during late fall and winter months. Prices typically peaked during the late spring and summer months. During the months when they peaked, the exvessel prices for Texas exceeded the prices for all other states. The pattern of monthly prices in the exvessel markets of all states are generally similar, with somewhat higher prices exhibited by the Alabama market in the spring and the Florida market in the fall.

Table 7.3. Nominal (not adjusted for inflation) annual exvessel prices for flounder in the Gulf States, 1970-1997 (NMFS unpublished data). Values are dollars per pound whole weight and nominal unless otherwise stated.

Year	Gulf		Texas	Louisiana	Mississippi	Alabama	Florida (west coast)
		Real[1]					
1970	0.19	0.52	0.22	0.18	0.13	0.17	0.24
1971	0.19	0.50	0.24	0.17	0.14	0.16	0.26
1972	0.19	0.50	0.26	0.18	0.14	0.16	0.27
1973	0.23	0.53	0.31	0.20	0.18	0.19	0.30
1974	0.23	0.45	0.29	0.21	0.17	0.20	0.29
1975	0.27	0.47	0.36	0.26	0.22	0.21	0.31
1976	0.30	0.51	0.42	0.30	0.23	0.24	0.34
1977	0.37	0.59	0.55	0.35	0.29	0.27	0.41
1978	0.44	0.64	0.73	0.40	0.35	0.33	0.49
1979	0.49	0.65	0.82	0.44	0.35	0.41	0.50
1980	0.53	0.61	0.79	0.50	0.36	0.45	0.53
1981	0.61	0.64	1.06	0.64	0.42	0.52	0.58
1982	0.67	0.69	0.97	0.52	0.43	0.49	0.63
1983	0.67	0.69	0.94	0.59	0.45	0.49	0.69
1984	0.70	0.70	0.92	0.62	0.50	0.56	0.72
1985	0.72	0.72	1.00	0.63	0.47	0.55	0.76
1986	0.77	0.79	0.96	0.70	0.53	0.61	0.86
1987	0.85	0.85	0.97	0.79	0.75	0.79	0.91
1988	1.00	0.97	1.23	0.92	0.85	0.89	0.99
1989	1.02	0.94	1.20	1.00	0.94	0.93	1.03
1990	1.13	1.00	1.25	1.08	1.03	1.12	1.21
1991	1.06	0.94	1.16	1.02	0.97	0.99	1.18

Year	Gulf		Texas	Louisiana	Mississippi	Alabama	Florida (west coast)
		Real[1]					
1992	1.17	1.04	1.27	1.20	1.03	1.03	1.19
1993	1.35	1.17	1.55	1.36	1.22	1.19	1.28
1994	1.33	1.14	1.69	1.31	1.38	1.15	1.31
1995	1.50	1.18	1.77	1.42	1.37	1.38	1.58
1996	1.71	1.38	1.87	1.13	1.65	1.70	1.76
1997	1.66	1.34	1.75	1.31	1.43	1.72	1.83

[1] Adjusted by the Producer Price Index for all foods base year = 1983 (USBLS).

Table 7.4. Average monthly exvessel prices for flounder in the Gulf States, 1993-1997 (NMFS unpublished data). Values are dollars per pound whole weight, nominal (i.e., not adjusted for inflation) and averaged over 1993-1997.

Month	Texas	Louisiana	Mississippi	Alabama	Florida (west coast)
January	1.66	1.06	0.93	0.97	1.09
February	1.88	1.20	1.06	1.18	1.07
March	1.88	1.33	1.29	1.42	1.28
April	1.88	1.58	1.49	1.59	1.42
May	1.93	1.79	1.53	1.70	1.58
June	2.01	1.65	1.52	1.64	1.68
July	1.99	1.71	1.58	1.68	1.63
August	2.08	1.65	1.70	1.59	1.68
September	1.91	1.44	1.56	1.44	1.72
October	1.56	1.19	1.27	1.44	1.55
November	1.45	1.17	1.06	1.18	1.50
December	1.44	1.00	0.88	0.99	1.37

7.1.5 Exvessel Prices by Type of Harvest Gear

Factors such as seasonal shifts in landings and demand, supply of closely substitutable species, and region of harvest may affect the per pound exvessel price for flounder in general or on a species-specific basis. In addition, the harvest gear used may have some influence on the exvessel price received. For example, a gear which allows the individual harvested fish to be handled more gently (less damage through crushing, tearing, etc.) may result in a perceived higher quality product. If buyers recognize these quality attributes and a market for these attributes exists, then a higher per unit price may result.

Real exvessel prices ($/lb) were computed for landings of flounder by gear type (Table 7.5). These prices represent exvessel prices for flounder across all Gulf States. The prices were computed by dividing total nominal exvessel value for each gear type by the respective landings for each gear type. The resulting nominal prices were then adjusted for inflation with the PPI for all food items. The gear types selected for comparison included those that accounted for the majority of landings reported on a specified gear type basis. The gear types selected included drift/runaround gill nets, other gill nets, bottom otter trawls (shrimp), hand lines, and spears. The reported landings for these gear types represented approximately 80% of the total landings of flounder reported by gear type in the Gulf of Mexico region during 1988. The total for these gear types declined to approximately 33% of the total landings in 1997, due to a dramatic increase in the share of total reported landings for which no gear type is specified.

Table 7.5. Real exvessel flounder prices (dollar/lb) by gear type (gear code) for the Gulf of Mexico, 1988-1997. Values in italics are the *higher* relative annual prices. Values underlined are the lower relative annual prices. Prices are adjusted by the Producer Price Index for all foods; base year =1983 (NMFS unpublished data).

Year	Handlines, Other (610)	Spears (760)	Gill Nets, Drifts, Runaround (475)	Gill Nets, Other (425)	Otter Trawl Bottom, Shrimp (215)
1988	1.07	*1.25*	0.96	0.03	0.85
1989	0.99	*1.16*	0.95	1.01	0.90
1990	1.26	1.25	*1.53*	1.26	0.84
1991	*1.14*	1.03	*1.14*	0.86	0.80
1992	*1.27*	1.11	1.09	0.98	0.93
1993	1.27	*1.33*	1.13	1.21	0.73
1994	1.31	*1.39*	1.26	1.14	0.70
1995	1.37	1.44	*1.45*	0.96	0.73
1996	1.33	1.49	*1.57*	1.10	0.74
1997	1.23	1.54	*1.55*	1.31	0.78

Higher exvessel prices are generally associated with flounder landed with spears, runaround gill nets, and hand lines; whereas, the lower prices are associated with trawls from 1988 to 1997 (Table 7.5).

7.1.6 Processing and Marketing

7.1.6.1 Market Channels

Few studies have been conducted to describe the processing and marketing of flounder in the Gulf of Mexico. In particular, no studies have attempted to describe the marketing channels associated with flounder in the region. Degner et al. (1989) examined the marketing channels for mullet in Florida. However, the variety of products derived from mullet (i.e., fillets, smoked, roe, split carcasses for bait, and gizzards) provided for a more complex market channel system than would be anticipated for flounder.

To better understand the market system for flounder in the Gulf of Mexico region, a brief market survey was designed and conducted by the GSMFC in 1996. This survey solicited information on sources of flounder supply, product forms, and disposition of flounder products in and out of the Gulf States. The relative importance of various product forms demanded by wholesalers, retailers, restaurants, and retail consumers was also solicited. Information of this nature will allow a better understanding of the economic values associated with the flounder resource as the various products derived from it move from vessel to final consumer. A brief mail-out survey instrument was designed, field tested, and mailed to 538 seafood wholesale distributors. Of the total number of surveys sent out, 348 went to Florida firms, 32 to Texas firms, 99 to Louisiana firms, 18 to Mississippi firms, and 41 to Alabama firms. A cover letter and questionnaire were initially sent out, followed up three weeks later with a reminder letter and another copy of the questionnaire. A total of 79 responses was obtained. Of these, 67 usable responses were returned providing for a 12.5% overall return rate. The returns by state were 31 (Florida), nine (Texas), 16 (Louisiana), five (Mississippi), and six (Alabama). A copy of the survey instrument is located in Appendix 14.2.

During 1996, respondents were initially asked about the source of their supply. Approximately two-thirds of the flounder purchased by wholesalers in the Gulf were obtained directly from local harvesters (Table 7.6a). Another 27% were obtained from other wholesalers. Less than 10% were obtained from other domestic sources and foreign imports. Of the supply obtained directly from local harvesters and other wholesalers, respondents indicated that most were obtained in fresh, round/whole form. Only for imports were fillets (62%) or frozen (50%) flounder a relatively important product form.

Respondents were then asked to describe the product forms into which the initial supplies were converted. The majority of flounder product (66%) sold by wholesalers remained in round/whole form, of which over 80% was fresh. Approximately 28% of the flounder sold by wholesalers was processed into fillets (approximately 80% fresh), with the remainder sold in some other fresh or frozen product form (i.e., steaked, stuffed, etc.)

Respondents were asked to describe how their sales were distributed across buyers (both in and out of state) and product forms demanded by these buyers. The distribution of sales across types of domestic buyers was somewhat uniform (Table 7.6b). For example, sales to other wholesale distributors/processors represented 28% of total sales. Sales to retailers accounted for 18% of total sales, while sales to restaurants and retail consumers accounted for 25% and 29% of total sales, respectively. For all types of buyers, in-state sales represented the majority of volumes sold. For sales to other wholesale distributors/processors, out-of-state sales accounted for approximately one-third of the total. Respondents indicated that there were no sales of flounder to foreign buyers during 1996.

Table 7.6a. Sources of flounder supply and product form for flounder wholesalers in the Gulf States, 1996 (GSMFC unpublished data).

Supply Source and Form					
		Product Form Purchased (%)[1]			
Source of Supply	%	Round/Whole	Fillets	Fresh	Frozen
Fishermen	66	99	1	96	14
Other Wholesalers	27	85	15	78	22
Other Domestic Sources	5	100	0	83	17
Importers	2	38	62	50	50
Total	100				

Table 7.6b. Sales by product form for flounder wholesalers in the Gulf States, 1996 (GSMFC unpublished data).

Sales by Sector and Product Forms								
	Destination Percent			Product Form Sold (%)[1]				
Market Sector	In-State	Out-of-State	Total	Whole	Fillets	Other	Fresh	Frozen
Wholesalers	19	9	28	89	9	2	81	19
Retailers	17	1	18	79	14	7	78	22
Restaurants	24	1	25	48	45	7	67	33
Retail Consumers	29	-	29	53	45	2	83	17
Foreign Buyers	0	-	0	0	0	0	0	0
Total	89	11	100					

[1] These values represent indices of importance relative to each product form for the respective market sector. Percentages given by respondents (see survey instrument in Appendix 15.2) are summed and divided by the total number of responses, including zero (0) responses. Missing values are excluded. Percentages are computed only for those market channels utilized by respondents.

Whole product represented the most important product form for wholesale and retailer buyers. However, fillets were almost as important as whole product for sales to restaurants and retail consumers. In addition, all types of buyers apparently preferred fresh product although frozen product was more important to restaurant buyers (33%). Finally, although sales among states within the Gulf are likely an important component of the regional market, less than 10% of total flounder sales went to buyers outside of the five states.

7.1.6.2 Other Commercial Sources of Flounder Supply

Although the market channel analysis indicates that the most important source of flounder is from domestic producers, other sources of flounder exist. As suggested by the market channel analysis, less than 2% of the total supply is obtained from foreign sources. However, it is unknown how much of the supply obtained from other wholesalers may have been originally obtained from foreign sources or from states outside the Gulf. The flounder which originates outside the Gulf may or may not be gulf or southern flounder; however, these unidentified flounder may serve as close substitutes in the marketplace.

During 1996, 79.6 million lbs of flatfish were imported into the United States. Of this total, 42.5 million lbs were identified as either halibut, sole, plaice, or turbot. The remaining volume (37.1 million lbs) were identified only as "flounder" or "flatfish." Of this latter amount, imports from Canada, Argentina, and New Zealand accounted for 29.1 million lbs. A total of 2.14 million lbs of flounder or flatfish was imported from Latin American sources from within the Gulf of Mexico and Caribbean (NMFS unpublished data). Of this total volume, 2.07 million lbs originated from Mexico, and Costa Rica accounted for 53,000 lbs. Lesser amounts (in declining order of importance) originated from Nicaragua, Honduras, Panama, and El Salvador. The data do not indicate whether the product originated from the Pacific or Gulf/Caribbean coast of each country of origin. Most reported flounder and flatfish imports from countries in the Gulf of Mexico and Caribbean arrived as fresh product (1.8 million lbs). The species that comprise these imports are unknown.

Domestic production of various flounder species also occurs along the southeast Atlantic coast of the United States. A total of 164,000 lbs of flounder was harvested off Georgia and the east coast of Florida during 1997 (USDOC 1997). These supplies of flounder may also be directly substituted in local and regional markets for flounder caught in the Gulf.

7.1.6.3 Consumption Estimates

Few studies exist that indicate the importance of flounder to consumers. Published per capita seafood consumption estimates do not identify species-specific, fresh, finfish products and are not provided on a regional basis (USDOC 1997). A recent study by Degner et al. (1994) estimated weekly and annual per capita consumption (edible meat weight) by Florida residents for 34 saltwater and freshwater finfish species and 11 shellfish species. In addition, per capita consumption estimates for a number of processed products were also derived. Among all finfish species likely consumed in fresh or frozen form, the per capita consumption estimate for flounder was exceeded only by grouper. The study found that resident, adult Floridians consume approximately 2.4 lbs of flounder each year. This represented about 10% of all finfish consumed, including canned and further processed products. The consumption estimate for flounder was not disaggregated into species of flounder or source (i.e., domestic and imported). Of the total amount consumed, approximately 12% was obtained via recreational fishing. A recent study of seafood consumption in Louisiana found that 8.7% of that state's residents prefer to eat "flounder" (Research Strategies, Inc. 1996).

7.2 Recreational Sector

Saltwater recreational fishing represents an important industry to the Gulf States. The economic importance of recreational fishing arises from the benefits that individuals accrue from consumptive and nonconsumptive uses of the resources as well as the economic activities set in motion by the supportive industries dependent upon recreational fishing expenditures. Saltwater recreational fishing for all species results in angler expenditures alone of $888 million in Texas, $205 million in Louisiana, $155 million in Mississippi, $124 million in Alabama, and $2,214 million in Florida (both coasts) (Maharaj and Carpenter 1997). Unfortunately, expenditures specifically associated with effort targeting flounder have not been measured. The one exception is a survey conducted by the TPWD (unpublished data) of the nighttime flounder gig fishery in Texas. This study indicates that approximately 90% of the fishery participants, whether fishing from boats or wading, spent less than $100 per trip. Similar studies for flounder fishing in other areas of the Gulf, as well as for other modes of fishing, do not exist. No studies have attempted to estimate the economic importance of activities associated with recreational fishing for flounder in the Gulf. Therefore, the relative importance of flounder as a recreationally-targeted species must be inferred from the degree in which recreational anglers specifically target flounder as discussed in Section 6.2.

Several studies as described in Section 6.2 have attempted to measure the amount of targeted effort associated with recreational fishing for flounder at the local or state level. These studies provide some insight into the popularity and preference associated with this important Gulf of Mexico finfish resource. However, the true economic values associated with flounder, such as recreational angler's willingness to pay for access to the resource and the economic impact to local economies resulting from resident and non-resident recreational angler expenditures, is currently unknown.

7.3 Civil Restitution Values and Replacement Costs

Some states have assigned monetary values wherein they assess damage for the loss of finfish resulting from negligence or illegal activities. These values are determined in a variety of ways for both recreationally and commercially important species. Cost of replacement may be assessed based on the costs associated with hatchery production, willingness to pay by users and non-users, or travel cost expenditures by recreational users. The individual states may utilize additional methods for estimating the value associated with an individual fish for the purpose of damage assessment, such as utilizing existing market prices for commercially important species and estimated hourly valuation of fishing for recreationally-important species (LDWF 1989; TPWD 1996). The American Fisheries Society (1982; 1992) has estimated replacement values for certain species (primarily freshwater) and provides the methods for determining these values. State civil restitution values may be linked directly with these published estimates and methods.

Restitution values vary considerably by state. Values for flounder in Texas and Louisiana are a function of size (Table 7.7). For example, values for flounder in Louisiana range from $0.42,

$10.21, to $24.94 for a one inch, 14 inch, and 28 inch fish, respectively (LDWF 1989). Values for the same sizes of southern flounder in Texas are $0.12, $7.49, and $36.97, respectively (TPWD 1996). In Florida, a fixed value ($16.80) is assessed for all sizes of southern flounder (FDEP 1995). These values provide at least some means for assessing the damage to stocks of flounder.

Table 7.7. Civil restitution values for individual flounder by size of fish (inches). Value reported as dollars per individual fish (TPWD 1996, LDWF 1989). NA = not available.

Size	Texas	Louisiana
1	$ 0.12	$ 0.42
2	0.24	0.74
3	0.36	1.13
4	0.48	1.64
5	0.60	1.88
6	1.26	2.20
7	1.91	3.20
8	2.60	4.20
9	3.29	5.21
10	3.99	6.21
11	4.68	7.21
12	5.37	8.21
13	6.38	9.21
14	7.49	10.21
15	8.70	11.06
16	10.01	11.91
17	11.44	12.80
18	12.98	13.71
19	14.66	14.66
20	16.48	15.64
21	18.44	16.66
22	20.56	17.71
23	22.84	18.80
24	25.29	19.94
25	27.92	21.12
26	30.74	22.34

Size	Texas	Louisiana
27	33.75	23.82
28	36.97	24.94
29	40.41	NA
30	44.07	NA

8.0 SOCIAL AND CULTURAL FRAMEWORK OF DOMESTIC FISHERMEN AND THEIR COMMUNITIES

The social aspect of the flounder fishery in the northern Gulf of Mexico has not been investigated like some of the other fisheries (e.g., black drum, blue crab, mullet). This may be due to the fact that the commercial fishery is predominantly a bycatch fishery. In 1996, it was estimated that 19.9% of the total landings in Florida, Alabama, and Mississippi came from the shrimp and groundfish trawl fisheries. In addition, the remnant gill and trammel net fisheries landed an estimated 40.1% of the flounder, and another 35.5% was taken by gig, hook and line, and spear fishers (NMFS unpublished data). Presumably, flounder in Louisiana were landed in similar proportions by gear type even though gears have not been specified since 1990. Flounder landings in Texas are categorized into three gear types: trawl, hook and line, and gig. Based on a 1994 recreational survey of Texas anglers, 69.6% fish with hook and line while 11.4% gig for flounder; an additional 18% use both gears (TPWD unpublished data). Subsequently, a great social overlap exists between fisheries and user groups which implies that information regarding the flounder fishery can be inferred from other net and hook and line fisheries in the Gulf. This would also suggest that changes in regulations pertaining to bycatch reduction efforts could strongly impact the overall flounder landings in the Gulf of Mexico and drastically change the makeup of harvesters contributing to those landings.

8.1 Commercial Harvesters

8.1.1 Trawl Harvesters

The shrimp fishery contributes a large percentage to the total flounder landings in the Gulf. Consequently, this sector is probably one of the best characterized groups of all the fishing sectors and most widely studied since the advent of TEDs and BRDs. A study by Thomas et al. (1995) described social and cultural features of the Alabama shrimping community and suggest that the results for Alabama were generally true for the entire Gulf. Thomas et al. (1995) found commercial shrimpers, on average, to be around 43 years of age. Generally, as the older fisherman left the fishery, they were not being replaced by younger fishermen. This contributed to an older, average age. Similarly, the number of years fishing was relatively high among commercial shrimpers at a mean of 21.9 yrs of experience Gulf-wide. Shrimpers in the Gulf of Mexico in 1994 and 1995 reported a mean of 10.4 yrs of education. Approximately 78% of those responding were married, 84% had children, and 40% of the captains interviewed had family members working as crew. In addition, around 80% of those surveyed were full-time fisherman and did not have a second job, and 73% indicated that they fished primarily inshore or nearshore waters.

8.1.2 Other Net Harvesters

The gill net sector contributed much less to the overall flounder landings in the Gulf over the last five years due to sweeping regulations on gill nets Gulf-wide. Entanglement nets are still used in Alabama and Mississippi, but material requirements have further reduced their contribution to the Gulf flounder landings. In 1986, entanglement nets contributed 345,843 lbs of flounder which was 17.5% of the total Gulf landings (NMFS unpublished data). In 1997, Alabama and Mississippi were the only two states reporting entanglement net landings at 92,205 lbs, or 26.7% of the estimated total flounder landings (NMFS unpublished data). Although this sector has been greatly reduced in the Gulf, it still contributes a substantial amount to the flounder landings, thereby justifying its characterization.

A report by Wagner et al. (1990) provides insight into the Texas commercial net fishery as it existed prior to the ban of all entanglement nets in 1988. Their study surveyed all commercial saltwater finfish fisherman in Texas and estimated that 160 of the roughly 400 license holders in 1985 and 1986 were gill net/trammel net fishermen (43% of respondents). Texas net fishermen averaged 74 fishing days per year and fished five nets per fisherman. Of these 160 net fishermen, approximately 62% indicated that they participated in other fisheries in 1985 and 1986. It was estimated that 71% of the net fishermen also participated in shrimping, 19% participated in crabbing, and 13% participated in oystering. These net fishermen did not directly target flounder but likely contributed a significant amount to the overall Texas landings prior to the 1988 net ban.

In Alabama, a net fishery still exists and targets a variety of species. In Louisiana and Mississippi, however, net fisheries have been greatly reduced due to restrictions on the use of monofilament nets. With this in mind, gill net fishermen in the central Gulf of Mexico still manage to contribute significantly to the landings for drums, mullet, and flounder.

Considering the variety of species which net fishermen target, it can be assumed that many of the individuals participating in the mullet fishery are the same, with the exception of Louisiana which has a zero bycatch retention regulation, as those contributing to the commercial landings of flounder in the northern Gulf of Mexico (Degner et al. 1989). Therefore, a few broad generalizations can be made regarding the net fishermen in the Gulf based on the information compiled in the striped mullet FMP (Leard et al. 1995) and other literature characterizing the mullet fishery. For example, in a study characterizing mullet fishermen in Florida, Thunberg et al. (1994) found that most of those in the commercial mullet industry are family based and multi-generational. Based on seasons and availability, most net fishermen targeted multiple species. In Florida, most of the net fishermen surveyed never completed their high school education and at the time of the study were approaching middle age. The combination of these two factors made the net fishermen surveyed reluctant to consider entering non-fishing occupations prior to the Florida net ban referendum (Leard et al. 1995).

8.1.3 Gig Harvesters

Texas made the largest contribution of any state to the 1992 gig landings of flounder, producing 176,690 lbs of flounder which was 59% of the total landings for flounder in Texas waters for all gear types (NMFS unpublished data). With the elimination of the gill net fishery in 1988 and bag limits for flounder imposed on the commercial shrimping fishery, it is estimated that the Texas gig fishery produces over half of the all flounder landings in the state (NMFS unpublished data). Gig harvesters exist in Mississippi, Louisiana, and Florida but contribute little to the total reported flounder landings. In particular, Louisiana's commercial bag limit for flounder is the same as that imposed on the recreational anglers making an almost negligible contribution. Because gigs and spears are unregulated gears in Mississippi, most of the gigged flounder that occur in local markets do not come from commercial fishermen but instead are sold by recreational anglers (MDMR unpublished data). In Mississippi alone, it has been suggested that close to 25% of the state's flounder landings come from the recreational and commercial gig fishery and is the preferred source for flounder due to the freshness of the product (MDMR unpublished data).

8.1.4 Hook and Line Harvesters

Most of the sociologic studies related to hook and line fishing exists based on the recreational sector. Little or no information exists on the makeup of the commercial harvesters in the Gulf, even though hook and line anglers have increased their commercial catches in recent years. Commercial harvesters in Texas contribute even greater numbers of flounder since the sportfish designation of red drum and spotted seatrout which eliminated those fisheries and since the 1988 net ban eliminating any gill net fisheries. Many commercial harvesters switched to other harvesting techniques including commercial hook and line.

8.1.5 Dealers and Processors

Dealers and processors handling flounder in the Gulf of Mexico are multi-species operations. Therefore, as before, we can briefly describe this group using information from the FMP for black drum as an informed proxy (Leard et al. 1993). It should be noted that these generalizations do not address the Florida dealers and processors, because no viable market exists for black drum. Generally, dealers and processors were an ethnically, monocultural group. C. Dyer (personal communication) found them to be white, middle-class males between the ages of 25-55 yrs old who owned their businesses. Work in Texas by Osburn et al. (1990) indicated that individuals of Vietnamese, Cambodian, and Laotian decent comprised less than 9% of all licensed seafood dealers in 1985 and were concentrated adjacent to the Galveston Bay system.

8.2 Ethnic Characteristics

Ethnic profiles of flounder fishermen in the Gulf do not exist; however, much can be extracted from the literature on ethnicity in other fisheries such as the commercial shrimp fishery and other net fisheries.

Within the trawl fishery, two ethnic groups stand out: white Americans (Greeks, Slavs, Scandinavians, Italians, and Nova Scotians) and those of southeast Asian origins (Starr 1981). In his description, Starr (1981) points out that several groups have been lumped into a Vietnamese category for simplicity but include individuals of Laotian and Cambodian decent. Since the mass exodus of Vietnamese in 1975 to the United States, southeast Asians have played an integral role in Gulf coastal fisheries. Durrenberger (1994) pointed out that within a ten year period (1975-1985), the Vietnamese who arrived in Mississippi as refugees had evolved into a strong, effective competitor in the United States fishing fleet. At this time, roughly 50% of the shrimpers and boats operating in Mississippi waters are of Vietnamese descent. In a recent LDWF survey of shrimp boat captains, 4.6% of the respondents identified themselves as Vietnamese (Deseran 1997). Due to a low response rate from the Vietnamese-American fishermen, this figure is probably under-representative of their participation in the fishery. In the same survey, 69.9% of the respondents considered themselves primarily Cajun/Creole/French, and 18.7% of the respondents selected the "white" category.

Vietnamese-American fishermen make up a large portion of the commercial fishing sector in the northern Gulf of Mexico (Starr 1981, Osburn et al. 1990, Moberg and Thomas 1993, Durrenberger 1994). A few, broad characterizations have been made regarding Vietnamese-American fishermen in the Gulf, describing them as industrious, frugal, and hard working. As a result, they have gained an unspoken respect from many for their energy and ingenuity; although as Durrenburger (1994) points out, admiration is not always the case. Many less successful American fishermen continue to unfairly blame the Vietnamese-American fishermen for most of the problems in the fishery. Clashes occurred frequently between the two groups during the resettlement of the first Vietnamese to the coast in the mid 1970s. Most of these conflicts were due to cultural differences, language barriers, and unwritten local rules and customs (Starr 1981, Osburn et al. 1990).

Typically, southeast Asian fishermen rely on kinship ties for success. Vietnamese-American shrimpers, crabbers, and gill netters off the coast of Mississippi operate using family members or neighbors as crew. Often, several family members will share ownership and responsibility for a vessel. Loans of money and equipment are commonly made between neighbors; likewise, the profits resulting from these relationships are shared as well (Durrenberger 1994). In many cases, catch which is considered to have little or no value is consumed by family (Starr 1981) allowing Vietnamese-American fishermen to operate at a lower bottom line. These close ties have contributed greatly to the work ethic so often attributed to their fishing communities — nothing goes to waste so nothing is lost.

Other regions of the Gulf are made up of various ethnic groups and are frequently localized such that ethnic stratification can occur. In Texas waters, commercial fishermen who target black drum, flounder, and sheepshead have preferred to utilize trotlines even prior to the net ban in 1988 (Leard et al. 1993). Two fishing groups differentiated by location exist in Texas: those who fish the Laguna Madre and those who fish Galveston Bay. The ethnic makeup of these groups varies within regions as well. Although overall, commercial fishing in the Laguna Madre is dominated by Anglo-fishermen and a few Hispanics; the lower Laguna Madre is dominated by nearly 90% Hispanic fishermen. In Galveston Bay, recently-immigrated Vietnamese makeup roughly half of the fishing population with transgenerational Anglos occupying the other half in the black drum trotline fishery (Leard et al. 1993).

Many of the Vietnamese fishermen who settled in the panhandle of Florida first entered the Gulf fishery as gill net fishermen (Starr 1981). In 1978, recently immigrated Vietnamese net boats made up one-eighth of the gill net fleet in Pensacola Bay. Concern was raised, however, by the American net fishermen over the use of non-traditional lengths of net, failure to properly mark nets, and the longer duration of net sets practiced by the new Vietnamese fisherman. Through both legislation and regulations, the immigrants were forced to comply with local standards (Starr 1981). The new constraints and regulations directed at the Vietnamese immigrants eventually drove them into the shrimp fishery where they remain today.

8.3 Recreational Anglers

The recreational fishing sector is probably the best described group today. Socio-economic profiles of this sector are viewed as critical to communities attempting to enhance their recreational fishing appeal and bring in recreational dollars. Studies describing those anglers specifically targeting flounder, however, do not exist. This is due in part to the fact that most coastal fishermen show a higher preference for spotted seatrout and red drum. Many studies have described flounder as a common non-target, yet highly-desired species by anglers which have been studied previously (Deegan 1990, Ditton et al. 1990, Donaldson et al. 1991, Kelso et al. 1991), allowing us to formulate an acceptable description of this sector in the flounder fishery.

A survey of the Texas saltwater fishing community was conducted in 1986 by the TPWD (Ditton et al. 1990). The authors determined that the majority of individuals participating in saltwater fishing were middle-class males between the ages of 20-49 yrs from urban areas along the Texas coast. It was reported that 20% of the recreational anglers responding were female. Although surnames could give a remedial indication of ethnicity, no questions posed in the survey addressed ethnic background. In a 1996 study of Texas anglers, Ditton and Hunt (1996) collected data on race and ethnicity. Most (89%) were white or Anglo, 5% were African-American, and 6% were Asian-American, Native American, or other. When asked about their ethnic origin, 10% indicated they were of Spanish/Hispanic origin.

In Louisiana waters, approximately 68% of the saltwater anglers surveyed targeted spotted seatrout and red drum in 1992-1996 (LDWF 1997). Of those who applied for recreational saltwater fishing licenses, 34% indicated an age of 35-44 yrs. An additional 27% of licensed anglers fell between the ages of 25-34 yrs. On average, Louisiana recreational anglers earn between $40,000-$44,000 per year. Little is known regarding the ethnicity of these individuals.

Deegan (1990) reported that in Mississippi the typical saltwater recreational angler was a 50 yr old male earning approximately $40,000 per year who had been fishing recreationally for nearly 30 yrs. Education level of respondents was not addressed in this survey. In addition, no questions regarding ethnic background were posed to respondents.

8.3.1 Social and Cultural Framework for Flounder Recreational Fisheries

Unlike commercial harvesters who usually live and work in coastal communities, most marine anglers live in urban or metropolitan statistical areas adjacent to the coast (USFWS 1996, Ditton and Hunt 1996). Recreational anglers travel to coastal communities to use the fishing-related infrastructures. These include facilities and services provided by state fisheries management agencies such as piers, launch ramps, and access areas and those provided by the private sector: guides, boat rentals, marinas, private launch facilities, retail stores, restaurants, hotels, motels, campgrounds, and the rest of the tourism support system. Many of the aforementioned elements have important relationships at the interpersonal level, in that individuals work together at the local area to make their fishing destination more desirable than others in the region. There are communities of individuals that serve recreational anglers just as there are commercial fishing communities that can be impacted deleteriously by certain regulatory actions. These individuals are an important part of flounder fishing in that little recreational fishing would occur without their services regardless of high quality fish stocks. They are all a part of the flounder fishery when this term is used to denote a social system that includes the fish as well as harvesters and the entire support industry whose long term success rests with sustainable fish populations.

In addition to coastal communities of individuals working in support of recreational fisheries, anglers are a part of their own social world. A contemporary definition of a social world is "an internally recognizable constellation of actors, organizations, events, and practices which have coalesced into a perceived sphere of interest and involvement for participants" (Unruh 1979). This definition would include anglers, groups of anglers or their representatives, tournaments and their participants, and various fishing practices that are used by different groups of anglers. Clearly, the social world of saltwater fishing goes beyond licensed anglers.

Within the recreational fishing social world, there are various subworlds. One of these subworlds includes salt water anglers who target or catch flounder. Social worlds and their subworlds are not defined by formal boundaries or membership lists and generally lack a powerful, centralized authority structure. Participants in the flounder social world do so voluntarily, and many are involved in other angling and non-angling social worlds as well. They are not exclusively flounder anglers. Individuals can identify with multiple social worlds and get their information about flounder fishing from various media including television, radio, and print.

Likewise, there are flounder anglers who focus their activity in different ways such as anglers who use artificial lures while others use live bait. Likewise there are flounder anglers who make use of emerging technologies to fish in certain locations using particular gear such as fly rods. There are also flounder subworlds based on ideology — where anglers practice catch and release and have the requisite skills to do so while others keep all legal fish caught. What is important here is the diversity of anglers and their experiences within the flounder fishing social world (Ditton et al. 1992). Hopefully, this will put survey results regarding fishing practices in better perspective.

Anglers vary in terms of knowledge about the social world and the activities therein. Unruh (1979) described four subworlds (strangers, tourists, regulars, and insiders) along a theoretical dimension having four characteristics (orientation, experience, relationships, and commitment). For example, strangers are naive in orientation; most of their fishing experiences are disoriented. Their relationships within their fishing groups are rather superficial, and they are pretty detached in terms of their commitment toward fishing. Insiders, on the other hand, identify with their fishing activity, find ways to create new fishing experiences, maintain close and intimate relationships with their fishing groups, and are so committed that they recruit new people to recreational fishing. There is no evidence to suggest that this process is linear or inevitable; in other words, not all strangers will become insiders.

8.3.2 Basic Understanding and Information Needs

In order to understand the potential impacts of fisheries management and related regulations, it will be necessary for fisheries managers to have a basic understanding of these systems in order to make the appropriate efforts to involve all relevant parties in fisheries decisions. Fisheries managers must also understand the potential social impacts associated with new or changing regulations. Through licensing records, most Gulf States are able to identify recreational fishing guides who operate in their state waters. State lists of guides need to be maintained on a regular basis so they can be queried as to their interests in particular decisions. Other elements of the private sector support-structure are more general in their support of coastal tourism and are more difficult to monitor on a regular basis. Managers should understand that these businesses have a legitimate stake in fisheries management decision making, since their livelihoods are likely to be impacted by any new rules which are implemented.

The limited extent of angler surveys currently available which specifically focus on flounder anglers provide little insight into this recreational fishery and the various subworlds within. There is an important social and cultural framework for understanding the flounder fishery and the diversity of anglers and experiences found therein, but current studies focus only on documenting the extent of flounder anglers and their activity as well as their catch and effort. Elements of the social and cultural framework need to be viewed as high priority items for data collection and subsequent management efforts as a means of understanding and dealing with the diversity found in flounder angling.

8.4 Organizations Associated with the Fishery

8.4.1 National

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

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

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

Coastal Conservation Association (CCA)
Walter Fondren, Chairman
4801 Woodway, Suite 220W
Houston, TX 77056

8.4.2 Regional

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

Southeastern Fisheries Association
Robert Jones, Executive Director
1118B Thomasville Road
Mt. Vernon Square
Tallahassee, FL 32303

8.4.3 Local (State)

The following organizations are concerned with finfish-related legislation and regulations, and they are consequently interested in their effects on flounder.

8.4.3.1 Florida

Florida Conservation Association (Florida CCA)
Dave Lear
905 East Park Avenue
Tallahassee, FL 32301-2646

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

Florida League of Anglers
534 North Yachtsman
Sanibel, FL 33957

Organized Fishermen of Florida
Jerry Sansom, Executive Director
P.O. Box 740
Melbourne, FL 32902

8.4.3.2 Alabama

Coastal Conservation Association - Alabama
David Dexter
P.O. Box 16987
Mobile, AL 36616
(334) 478-3474

Alabama Seafood Association
Pete Barber
P.O. Box 357
Bayou LaBatre, AL 36509

8.4.3.3 Mississippi

Mississippi Charterboat Association
Jim Twigg
3209 Magnolia Lane
Ocean Springs, MS 39564

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

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

United Fisheries Cooperative
Earl Fayard
400 Front Beach Drive
Ocean Springs, MS 39564

8.4.3.4 Louisiana

Louisiana Seafood Management Council
Peter Gerica, President
Rt. 6 Box 285 K
New Orleans, LA 70129
(504) 254-0618
(504) 254-6185 (fax)

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

Coastal Conservation Association - Louisiana
Jeff Angers, Executive Director
P.O. Box 373
Baton Rouge, LA 70821-0373

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

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

Louisiana Seafood Processors Council
Mike Voisin
P.O. Box 3916
Houma, LA 70361-3916
(504) 868-7191
(504) 868-7472 (fax)

Louisiana Wildlife Federation
Randy Lanctot, Executive Director
P.O. Box 65239
Baton Rouge, LA 70896-5239

8.4.3.5 Texas

Coastal Conservation Association - Texas
Kevin Daniels, Director
4801 Woodway, Suite 220 W
Houston, TX 77056

Finfish Producers of Texas
Carroll and Ruth West
P.O. Box 60-B
Riviera, TX 78379

Tournament Directors Foundation of Texas (TDF of TX)
Pam Basco
P.O. Box 75231
Houston, TX 77034

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

9.0 MANAGEMENT CONSIDERATIONS

9.1 Definition of the Fishery

This fishery includes several species in the United States Gulf of Mexico. All bothid flounders which are caught in the Gulf of Mexico are generally referred to as flounder or flatfish. Two species, southern flounder (*Paralichthys lethostigma*) and gulf flounder (*P. albigutta*), make up the majority of landings in the fishery. Several other flounder species are occasionally included in the Gulf landings: ocellated flounder *(Ancylopsetta quadrocellata)*, Mexican flounder (*Cyclopsetta chittendeni*), spotfin flounder (*C. fimbriata*), shoal flounder (*Syacium gunteri*), and broad flounder (*P. squamilentus*). Additional flounder which are impacted as incidentals in the shrimp industry bycatch include juveniles of the above-mentioned species as well as four members of the genus *Etropus* and two additional members of the genus *Syacium*.

9.2 Management Unit

The management unit consists of many species included in the general category of flounder or flatfish. These species include the entire population of gulf and southern flounder as well as other species belonging to the family Bothidae in the United States Gulf of Mexico.

9.3 Stock Assessment and Status of the Stock

The development of a complete Gulf-wide stock assessment for flounder was not possible due to a lack of speciated flounder data for the Gulf of Mexico. However, limited data are available on the southern flounder roughly by region. Therefore, we will provide a superficial approach with the Texas stock assessment representing the western Gulf (Appendix 14.3.1), the Louisiana stock assessment representing the northern central Gulf (Appendix 14.3.2), and the Florida stock assessment representing the eastern Gulf (Appendix 14.3.3).

9.3.1. Western Gulf

Sequential population analysis (SPA) was used to assess the effect of fishing on the southern flounder stock in Texas from 1984-1997 (Appendix 14.3.1). Fishery-independent monitoring data indicate low recruitment from 1991-1995, with the 1996-1997 year classes the largest since 1990. Adult flounder abundance has been on a downward trend since 1984. Since 1988, commercial landings have been declining, while recreational landings are relatively steady. Bycatch from the shrimp trawl fishery has been variable with reduced levels from 1991-1997 corresponding with the smaller year classes. Sex ratios have probably changed over time, resulting from the higher vulnerability of males to bycatch. Results from the SPA indicate adult female flounder have been declining in number and are currently about half their 1984 abundance. Fishing mortality and low recruitment from 1991-1995 are the primary causes. Overall flounder landings have been greatly reduced since the 1988 ban on gill nets, while newly enacted minimum size limits and bag limits have had a small but positive effect on reducing fishing mortality. Bycatch accounted for 84% of the total female harvest and almost 100% of the male harvest in 1997, so any further management of the resource should include bycatch. Unweighted transitional spawning potential ratios (SPRs) for females are currently at 0.27, with SPRs ranging from 0.20 to 0.27 for the 1990s. Biological reference points (F_{max}, $F_{0.1}$) indicate that female flounder are heavily exploited but are probably not overfished. Males are subject to much higher fishing mortality. Because high numbers of males may be necessary for successful mass spawning (R.L. Colura personal communication) and sex ratios have changed over time, results should be interpreted with caution.

9.3.2 Northern Central Gulf

Louisiana's assessment (Appendix 14.3.2, Shepard 1999) uses yield-per-recruit (YPR), SPR, and catch curve analyses to estimate the impact of fishing pressure on potential yield and the spawning potential of the southern flounder stock in Louisiana waters. Von Bertalanffy growth parameters were calculated for female southern flounder in Louisiana by using aged samples collected by Thompson (B. Thompson unpublished data) combined with juveniles assigned to age-0 (<100 mm total length) by length frequency analysis from LDWF fishery-independent trawl samples. Estimated rates of disappearance were derived using data from two sources. The first source is the commercial data collected through the Trip Interview Program for 1994-1996, and the second source is data from the recreational fishery (NMFS Marine Recreational Fishery Statistics Survey 1994-1996). The data from both surveys did not distinguish between sexes; therefore, it was assumed for this assessment that all fish sampled were female. Fish were aged by using an age-length key developed from otolith aging of fish by Thompson (unpublished data) and LDWF's ongoing aging study. Disappearance rates were calculated from the commercial and recreational data by year where length frequency data was available. The calculated disappearance rates ranged from 1.1 to 1.3.

Commercial landings fluctuated from 1950 to 1996 with highest landings in the mid 1980s and mid 1990s at 0.94 and 0.97 million lbs, respectively. Regulatory measures implemented in 1995 and 1996 had much to do with the reduction in commercial harvest to 61,755 and 94,898 lbs in 1996 and 1997, respectively. Recreational landings were equal to or greater than those of the commercial fishery until 1991 when the commercial fishery began harvesting a greater percentage of the total harvest.

Regulations implemented since 1995 have significantly reduced harvest and likely reduced fishing mortality rates from those currently estimated. SPRs that will result from current regulations will likely be above 30%.

9.3.3 Eastern Gulf

Available information is not adequate for a traditional assessment of the status of flounder in Florida (Appendix 14.3.3, Murphy et al. 1994). However, a rough characterization of the population dynamics of gulf flounder suggests that it is unlikely that gulf flounder (*Paralichthys albigutta*) are being fished at a maximum level of YPR. Little can be determined about the spawning stock biomass of gulf flounder, but the production of juveniles showed a peak in 1992 in Tampa Bay. In theory, southern flounder (*P. lethostigma*) and summer flounder (*P. dentatus*) should be more susceptible to growth and recruitment overfishing than gulf flounder. This can be inferred from their longer life spans (lower natural mortality), slower relative growth rates, and older ages at maturity.

Female southern flounder mature at age-3 or age-4; female gulf flounder mature at age-2. Southern flounder get larger and older than gulf flounder. Female southern flounder reach at least 700 mm TL (27.5 inches) and seven years of age; female gulf flounder reach about 450 mm TL (18 inches) and three years of age. Males of both the southern and the gulf do not get as large or as old as females.

Landings of flounder in Florida are about equally split between the recreational and commercial fisheries. In 1993, statewide landings were 1,008,000 lbs with about two-thirds occurring on the Atlantic coast. Flounder landings are greatest during the fall and are made most often using shrimp trawls, hook and line, or gill nets. Only in northwest and northeast Florida does flounder rank in the top three species landed, by weight, during commercial trips that reported flounder landings. Most commercial trips landing flounder land fewer than 50 lbs per trip. The bycatch of small juvenile flounders appears to be significant in the shrimp fishery in the St. Johns River. Elsewhere in the state, flounders were a relative small portion of the discarded bycatch. About 85% of the anglers targeting flounder catch less than two flounder per trip on either the Atlantic or Gulf coasts.

Flounder landings did not show an overall trend between 1980 and 1993. Within this time frame, Atlantic coast landings were lowest in 1987 and increased through 1992. Gulf coast landings were high in 1986-1988 but have recently returned to levels only slightly less than those made in the early 1980s. Recent fishing effort has declined in the commercial fishery since reaching a peak number of trips in 1991. The number of trips taken by anglers has increased on the Atlantic coast but decreased on the Gulf. Catch-per-unit-effort in the commercial fishery has declined on both coasts. Catch-per-angler-hour has remained steady except for a decline for southern flounder on the Atlantic coast. Changes in catch-per-unit-effort have generally offset changes in effort so that overall harvest has fluctuated but without a long-term trend.

9.3.4 Management Goal

Biological reference points are one of the most commonly used standards to evaluate minimum values of SPR. The most widely used reference points are F0.1, Fmax, F20%, and F35%. In the absence of information on the spawning stock and recruitment, Goodyear (1989) suggested that a working, critical minimum SPR of about 20% was appropriate; whereas, Mace and Sissenwine (1993) suggested that a conservative strategy would be to maintain at least a 30% SPR as a default "threshold," and Clark (1991) recommended a SPR of 35% as a management "target."

Although limited, the available information for southern flounder in the Gulf does not cause immediate concern. The Texas stock assessment for southern flounder (Section 14.3.1) indicates a transitional SPR of 27%. Results from Louisiana's assessment (Section 14.3.2) indicates that although the disappearance rate for southern flounder is high (1.1 - 1.3 per year based on catch rates from 1994-1996), recent regulations (Section 5.2.4.7) should allow them to achieve a 30% SPR. These limited data suggest that without large increases in effort, southern flounder stocks should be able to be maintained at current levels in the western and central Gulf. More data are required to make that determination in the eastern Gulf (Section 10.1).

In lieu of any assessment for gulf flounder, setting target or threshold management goals is not possible at this time. Several "proactive" measures (Section 10.2) could be initiated concurrent with improvements in fishery-dependent and -independent data collection (Section 10.1).

9.4 Problems and Perceived Problems in the Fishery

Problems in the Gulf of Mexico flounder fishery, whether real or perceived, are difficult to identify and quantify. The majority of the commercial and recreational take of flounder occurs while targeting other species, and the increasing gig component of the directed fishery is under represented in the landings data. Not all the states have adopted bag limits and size restrictions on the flounder fishery. Additional problems arise from the lack of speciated data making evaluation of the status of the fishery difficult because several species are lumped under one generalized "flounder" category.

9.4.1 Unspeciated Data

Recreational anglers and commercial dealers typically lump most species of flounder into a general flounder category. This is primarily due to the difficulty in identifying individual species. In addition, requirements for reporting flounder landings do not demand speciation and are inconsistent between state and federal agencies.

9.4.2 Mortality and Discards from the Shrimp Fishery

Bycatch of flounder is high in the Gulf of Mexico and is a result of gear efficiency in the shrimp and groundfish industries. Flounder are one of the more vulnerable fish to capture in a trawl due to their close association with the substrate. In several states, the discarding of legal size flounder may have increased due to the imposition of daily limits on the commercial trawl industry. Refer to Section 5 for commercial and recreational bag limits for each state . Discards with high mortality primarily include undersized southern and gulf flounder (Matlock 1982, Fuls 1996) and those additional species which never achieve a marketable size such as those included in the genus *Etropus* and *Syacium*.

9.4.3 Inconsistent Interstate Management

Variation exists among states ranging from recently-imposed regulations to no regulations of both commercial and recreational catches of flounder. Inconsistent bag and size limits and quotas for commercial harvesters and recreational anglers contribute to confusion for all participants and enforcement officials. Legal harvesting gears vary from state to state, and additional problems exist in identifying modified gear types which may or may not be allowable in the fishery. Florida, Louisiana, and Texas have implemented size or bag limits on flounder). Alabama and Mississippi have no specific restrictions on flounder harvest.

Enforcement may be impeded due to several factors including inconsistent interstate regulations, limited number of conservation officers, and blatant disregard of fishery regulations.

9.4.4 Increased Harvest of Spawning Stock

The increased concentration of flounder as they migrate through passes and aggregate for spawning increases their vulnerability to commercial and recreational gears. The potential for a marked impact on spawning stocks is due to the high number of fish moving through restricted passes. Commercial shrimp fishermen who target concurrently migrating white shrimp throughout the bay systems incidentally capture and release large numbers of flounder. Recreational fishermen target flounder migration through passes and release flounder with respect to local size and bag limits. Questions have been raised regarding the survivability of these flounder (Section 9.4.5).

Spear and gig fishermen who target these large aggregations can further reduce spawning stocks. Evidence for this includes higher exvessel prices for spear and gig caught flounder, higher landings in winter months during the spawning season, and an increase in the percent contribution to landings over the past few years by spear and gig fishermen.

9.4.5 Release Mortality of Bycatch

Questions remain regarding survivability of discarded flounder. Seasonality, trawl duration, salt box usage, effectiveness of bycatch reduction devices, culling techniques, and volume of catch may affect survivability.

9.5 Habitat Quantity, Quality, and Degradation

The identification of critical habitat which support the fishery is now recognized as key in continuing to effectively manage flounder in the Gulf of Mexico. Problems arise when those critical and necessary habitats are impacted whether by natural or man-made causes. The quality and quantity of nearshore habitat are of major importance in determining fishery stocks. Naturally occurring physical and biological processes impact the quality of coastal wetland habitats, including subsidence, erosion, sea level rise, plankton blooms, diseases, major storm events, and freshwater inflow. Human activities which may adversely impact nearshore habitats are dredging, filling, construction of canals and channels, spoil disposal, impoundments, draining, point and nonpoint discharges, and thermal discharges. While there are no adequate quantitative data available to rank the causes of fishery habitat losses, changes in sedimentation patterns, hydrologic modifications, subsidence, and dredging and filling activities are causes of the majority of losses in Gulf habitats (Duke and Kruczynski 1992). These topics are discussed in detail in Section 4.

9.6 Fishery Information Network (FIN) Activities

The Gulf of Mexico and Caribbean coastal states (Texas, Louisiana, Mississippi, Alabama, Florida, Puerto Rico, and U.S. Virgin Islands), the National Marine Fisheries Service, the U.S. Fish and Wildlife Service, the National Park Service, the Gulf of Mexico and Caribbean Fishery Management Councils, and the Gulf States Marine Fisheries Commission have initiated a state-federal cooperative program to collect, manage, and disseminate statistical data and information on the marine commercial and recreational fisheries of the Southeast Region called the Fisheries Information Network (FIN). The goals of the program are to plan, manage, and evaluate commercial and recreational fishery data collection activities; to implement a marine commercial and recreational fishery data collection program; to establish and maintain a commercial and recreational fishery data management system; and to support the establishment of a national data collection and management program.

Under this program, the GSMFC, the Gulf States, and the NMFS have begun and will continue to conduct activities to improve the quantity and quality of data available for fisheries management. The data collection and management activities conducted under the FIN are designed to collect data for the various modules outlined in Figures 9.1a and 9.1b.

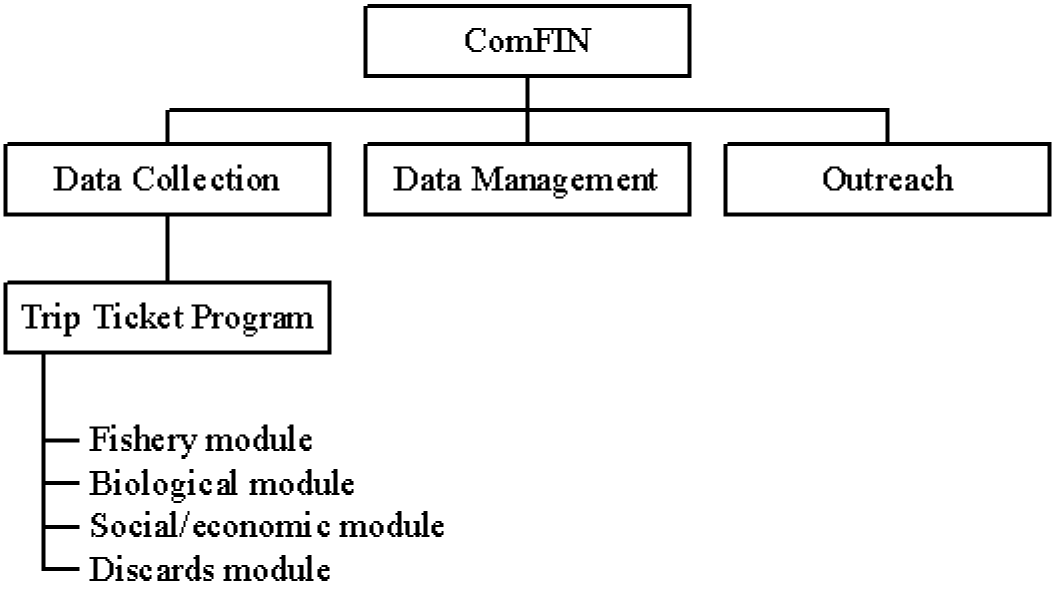

Figure 9.1a. Commercial Fishery Information Network (ComFIN) structure and modules.

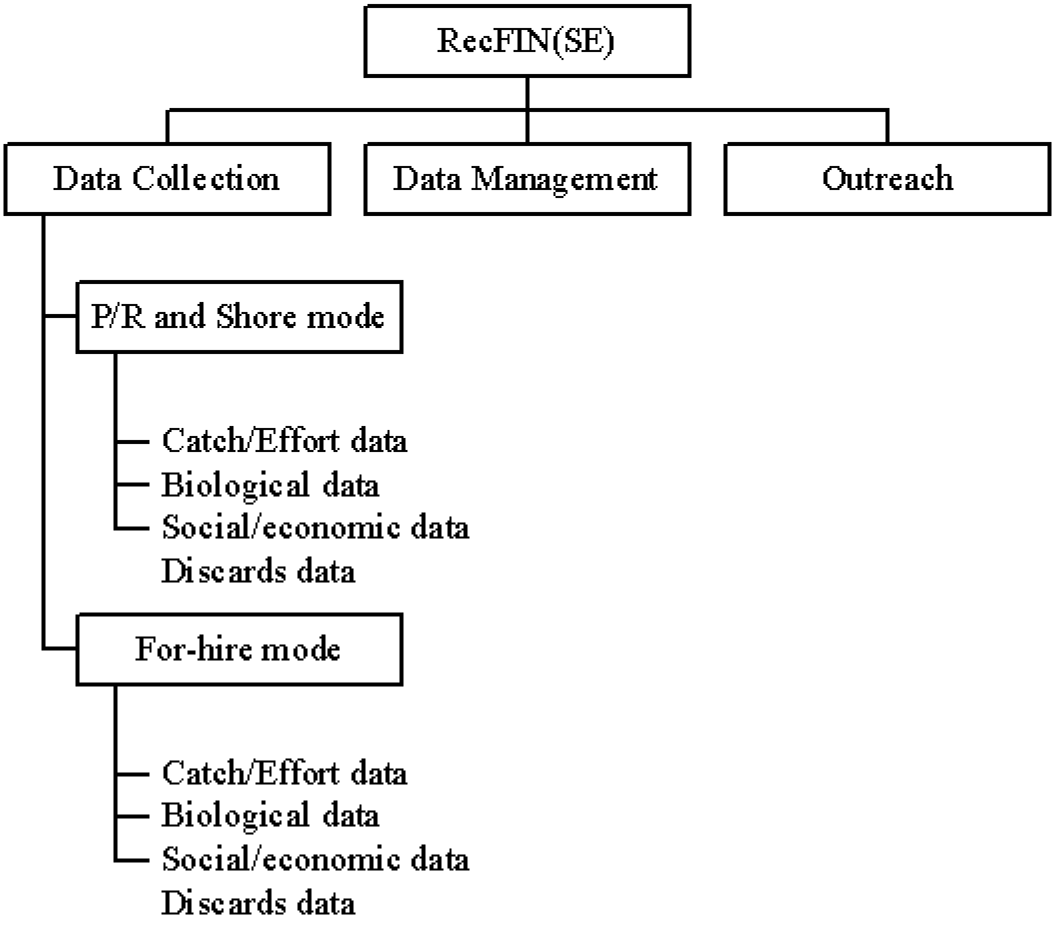

Figure 9.1b. Recreational Fishery Information Network (RecFIN) structure and modules.

10.0 MANAGEMENT RECOMMENDATIONS

Management recommendations should be made based upon the best biological, social, and economic data available for a particular species and fishery. In the case of flounders in the Gulf of Mexico, a multi species fishery recorded as a single unit, a Gulf-wide assessment of flounder could not be completed because many of the traditional stock assessment parameters are either unavailable or unreliable. Fitzhugh et al. (1999) identified the major deficiencies in the gulf and southern flounder data which have hindered the completion of a Gulf-wide stock assessment for either species due to inadequate or biased data. The lack of data on age and growth, species, sex and size composition, and CPUE by species have prevented the estimation of population size, mortality rates, empirical and back-calculated growth curves, and population age structure. Without this information, especially age and growth, landing trends are the only indicator available on the health of the stocks. The growth data which are available in the Gulf are also subject to additional aging problems such as sexual dimorphism and high variability even within year classes (Fitzhugh et al. 1999). Therefore, management agencies should commit to the improvement of both fishery dependent and independent data. Until a regional stock assessment is completed using appropriate data, the following management recommendations may help to facilitate cooperation among state agencies while data collection programs for flounder are improved.

10.1 Data and Data Collection

Priority should be given to the data necessary for stock assessment purposes. These recommendations attempt to identify deficiencies in the data and simplify future assessments by providing a format for the data which needs to be collected.

The states should pursue full implementation of the FIN (Section 9.6), which will meet the monitoring and reporting requirements of this FMP. A transition or phased-in approach should be adopted to allow for full implementation of the FIN. Until such time as the FIN is implemented, the states should initiate implementation of specific FIN modules, and/or pursue pilot and evaluation studies to assist in development of reporting programs to meet the FIN standards. The complete *FIN Program Design* document is available through the GSMFC office.

10.1.1 Standardization of Fishery-Independent Monitoring

States should evaluate and compare the existing programs and provide standardization among states with regards to sampling protocol and modify existing programs to improve experimental design for better statistical analysis.

Most of the state fishery-independent monitoring programs utilize a wide array of gear types at both random/predetermined sampling sites or permanent stations. As a result of this diversity, assessors must spend considerable time and effort reformatting each state's data to account for differences in gear type and size, gear tow time and/or soak time, number of samples, number of stations, etc. Standardization of these programs would facilitate comparison of data among states resulting in a more regional approach to fishery independent monitoring.

10.1.2 Fishery-Dependent Monitoring

All states are collecting recreational fishery-dependent data through state monitoring programs which include roving creel surveys, dockside intercepts, charter boat surveys, the Cooperative Statistics Program (Texas), and/or through the MRFSS. Commercial landings data are collected by all states through trip tickets, fish house surveys, dock intercepts, etc. The data (which are presently collected in these programs) are not adequate for a Gulf-wide stock assessment and minimally should be speciated by states and programs (Section 9.4.1). Additional improvements to these programs are identified below.

10.1.2.1 Catch Data

States should expand data collection efforts and establish uniform collection programs to identify gulf and southern flounders as target species. States should review existing requirements for reporting of data by harvesters, dealers, processors, and others. Where such reporting is determined to be inadequate, modifications to laws, regulations, and policies could be sought to improve the quantity and quality of data received. Simplification of reporting forms, as well as assessing the number and frequency of reports, could enhance the quality and accuracy of data and lead to better management. Additional efforts could be made in the reporting of flounder sales to restaurants, initiating a gear-specific license system, and follow with the reporting of gear-specific landings data.

10.1.2.2 Effort Data

States should evaluate their protocols for collecting effort data from the commercial and recreational flounder fisheries. Commercial fishermen targeting flounder could be specifically identified in order to better monitor landings. This could be accomplished either by a trip ticket system or through special permits, such as species endorsements. Recreational effort could be more accurately determined through licensing or enumeration of all recreational anglers and/or through harvest surveys.

10.1.3 Habitat Monitoring

Flounder spend most of their lives in nearshore or estuarine areas and are indirectly affected by numerous human activities (Section 4.9.4). Several management options exist in relation to the protection and monitoring of critical flounder habitats. The states could develop more specific programs to monitor changes to estuarine and marine fisheries habitat through review of coastal development/wetland permit applications. Appropriate action could then be taken by states to support projects that enhance critical habitat and deny those projects that would further degrade estuarine habitats.

The states could pursue development of a habitat management program and include habitat that is critical for flounders. Efforts could be made by state and federal agencies for more consistent interpretation and enforcement of wetland policies. Many habitat protection efforts are ongoing; however, a more focused and coordinated effort directed at marine fisheries habitat could provide increased protection of flounder stocks.

The states could implement monitoring programs to address the issue of habitat loss due to fishing activity. Certain gear usage (e.g., trawls and skimmers) and activities (e.g., prop dredging and groundings) could negatively impact critical flounder habitat.

The states could increase their involvement with marine debris programs, especially those directed at educating the general public about the effects of debris on fishery resources. A collective and coordinated effort by the Gulf States could help increase solidarity and credibility of the projects.

10.1.4 Tracking Flounder Imports and Exports

States should quantify the volume and value of imports and exports of flounders. Data should describe monthly trade by species, product form (i.e., whole, fillets, fresh, frozen), country of origin (destination), volume, and value.

10.1.5 Monitoring of Guide Services

Lists of fishing guides by state should be maintained on a regular basis so they can be queried as to their interests in particular decisions. Other elements of the private sector support-structure are more general in their support of coastal tourism and are more difficult to monitor on a regular basis.

10.2 Proactive Measures

As flounder fisheries continue to expand, the states could implement additional management measures as necessary. These management recommendations should be considered proactive in the absence of a regional stock assessment. Such measures, if enacted, would assist stock assessors in the future as fishery dependent and independent data improve as well as assist law enforcement when dealing with interstate catches and landings.

10.2.1 Fishing Year

Individual states could establish compatible/uniform fishing years as necessary to effectuate data collection, quota management, and for other purposes. Fishing years should be consistent among states to the greatest extent possible.

10.2.2 Limitations on Catch

Catch limitations could be established by setting size and bag/possession limits in each state until the stocks can be assessed adequately.

10.2.2.1 Size Restrictions

In an effort to prevent or reduce potential overfishing, states could establish minimum and/or maximum size limits for flounders with consideration of no tolerance for undersized or oversized fish. Such size restrictions should consider biological needs for stock recruitment as well as the social and economic needs of the users. Uniform size criteria would increase enforceability of such regulations especially with regard to interstate transport of catch. At this time, only Florida and

Texas have minimum size limits (12 and 14 inches, respectively) which work well for the predominate species of flounder on each coast, but size limits should be specific for individual species and their requirements.

10.2.2.2 Bag and Possession Limits

States could establish uniform bag and/or possession limits for flounders. As with size, bag limits should consider the biological needs of the fishery as well as social and economic factors. Current bag and possession limits are not consistent across the Gulf States. Alabama and Mississippi have no commercial or recreational restrictions on flounder in state waters, while Florida and Louisiana currently have a ten fish/day [with the exception of flounder harvested as incidental bycatch by commercial shrimping vessels (Section 5.2.4.7.4)]. Texas has a ten fish and 60 fish/day bag for recreational and commercial fishermen, respectively.

10.2.2.3 Gear Restrictions

All states have gear restrictions that impact the catch of flounder (i.e., gill nets, purse seines, etc.). States should review existing regulations to prevent the overfishing of flounder stocks until a regional assessment can be completed. States could also develop more uniform gear-use regulations in the process. Gear use could also be restricted spatially and seasonally, such as in nursery areas where juveniles are abundant. Such restrictions could help increase recruitment to adult populations (Section 4.6 and 4.7).

10.2.2.4 Bycatch Reduction

States should investigate ways of reducing juvenile mortality for flounders and other non-target species in non-directed fisheries (Section 9.4.2). States could establish daily bag limits and/or catch quotas for flounders captured in shrimp trawls. Further reduction in bycatch may occur with the use of BRDs in trawls.

10.2.2.5 Area and Seasonal Closures

Based on best available data, no area or seasonal closures are deemed necessary at this time. However, should future research indicate that overfishing of spawning aggregations is occurring (Section 9.4.4), area and/or seasonal closures may be necessary.

10.2.3 Funds in Support of Management

States should review the current level of management effort in conjunction with the level of financial support being received for management of flounders in order to determine the adequacy of current funding levels required to meet the needs of resource management. If financial support is determined to be inadequate, states could pursue increased license fees, inspection fees, or other support from users. Additionally, states could seek additional support from state and federal funding sources while reviewing management needs and priorities of other species and fisheries.

10.2.4 Habitat Loss, Degradation, and Alteration

States should support those programs that identify, preserve, and/or restore essential flounder habitat and assess and discourage projects which negatively alter flounder habitat or impede access by flounder to essential habitats. In addition, states should support efforts to reduce estuarine/marine pollution. Essential marine/estuarine habitats (Section 4.9) of the Gulf of Mexico have undergone dramatic changes. Substantial marsh habitats across the Gulf of Mexico have been lost or altered. In addition, chronic pollution of estuarine habitats from urban and agricultural runoff and industrial discharges is present, although not quantified.

11.0 REGIONAL RESEARCH PRIORITIES AND DATA REQUIREMENTS

Research and data needs of the flounder fishery encompass a wide range of biological, social, economic, and environmental studies. Additional research and data collection programs are needed, and the following is a partial list of some of the more important needs.

11.1 Biological

- Improve speciation of flounder by fishery-dependent samplers.
- Collect additional age frequency data to better understand the age structure of both gulf and southern flounder.
- Improve estimates of natural mortality and predation especially on early life stages.
- Continue and expand mark/recapture studies where appropriate.
- Increase intercept studies to determine the nature and size of catches as well as effort on a state or areal basis.
- Quantify the impacts of habitat change including the effects of varying salinities (freshwater inflow and seasonality), marsh degradation, loss of seagrass beds, etc. on all flounder life history stages.
- Continue and expand genetic studies on variability of both species across the Gulf and relate the results of those studies to the effectiveness of management actions.
- Investigate ecosystem dynamics and their relation to gulf and southern flounder stocks.

11.2 Environmental

- Determine optimum environmental requirements for both gulf and southern flounder especially on early life stages.
- Assess the effects of flooding and periods of high salinity on reproduction and survival.
- Determine how the loss of vegetated wetlands and the increase in shallow waterbottom habitat have affected flounder populations.

11.3 Industrial/Technological

- Identify existing processing and marketing activities for flounder and evaluate alternative methods.

11.4 Economic and Social

- Qualitative and quantitative information is needed regarding the composition, motivating factors, satisfaction, and desires of various user groups.
- Quantitative data are needed on the values of the commercial and recreational fisheries.

11.5 Resource Management

- Evaluate existing management programs to determine their effectiveness in meeting management goals and objectives.

12.0 REVIEW AND MONITORING OF THE PLAN

12.1 Review

The State-Federal Fisheries Management Committee of the Gulf States Marine Fisheries Commission will review, as needed, the status of the stock, condition of the fishery and habitat, the effectiveness of management regulations, and research efforts. Results of this review will be presented in the GSMFC for approval and recommendation to the management authorities in the Gulf States.

12.2 Monitoring

The GSMFC, the NMFS, states, and universities should document their efforts at plan implementation and review these with the S-FFMC.

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14.0 APPENDIX

14.1 Glossary

14.2 Market Channel Survey

14.3 Stock Assessment

14.3.1 Assessment of the Western Gulf Stocks

14.3.2 Assessment of the Northern Central Gulf Stocks

14.3.3 Assessment of the Eastern Gulf Stocks

14.1 Glossary

(Modified from Roberts, K.J., J.W. Horst, J.E. Roussel, and J.A. Shepard. 1991. Defining Fisheries: A User's Glossary. Louisiana Sea Grant College Program. Louisiana State University. *as amended in* Wallace, R.K., W. Hosking, and S.T. Sxedlmayer. 1994. Fisheries Management for Fishermen: A manual for helping fishermen understand the federal management process. Auburn University Marine Extension & Research Center. Sea Grant Extension.)

*Added by Wallace et al. 1994.

A

A - See annual mortality.

ABC - See allowable biological catch.

Absolute Abundance - The total number of kind of fish in the population. This is rarely known, but usually estimated from relative abundance, although other methods may be used.

Abundance - See relative abundance and absolute abundance.

Age Frequency or Age Structure - A breakdown of the different age groups or individuals.

Allocation - Distribution of the opportunity to fish among user groups or individuals. The share a user group gets is sometimes based on historic harvest amounts.

Allowable Biological Catch (ABC) - A term used by a management agency which refers to the range of allowable catch for a species or species group. It is set each year by a scientific group created by the management agency. The agency then takes the ABC estimate and sets the annual total allowable catch (TAC).

Anadromous - Fish that migrate from saltwater to fresh water to spawn.

Angler - A person catching fish or shellfish with no intent to sell and typically represents the recreational fishermen. This includes people releasing the catch.

Annual Mortality (A) - The percentage of fish dying in one year due to both fishing and natural causes.

Aquaculture - The raising of fish or shellfish under some controls. Ponds, pens, tanks, or other containers may be used. Feed is often used. A hatchery is also aquaculture, but the fish are released before harvest size is reached.

Artisanal Fishery - Commercial fishing using traditional or small scale gear and boats.

Availability - Describes whether a certain kind of fish of a certain size can be caught by a type of gear in an area.

B

Bag Limit - The number and/or size of a species that a person can legally take in a day or trip. This may or may not be the same as a possession limit.

Benthic - Refers to animals and fish that live on or in the water bottom.

Biomass - The total weight or volume of a species in a given area.

Bycatch - The harvest of fish or shellfish other than the species for which the fishing gear was set. Examples are blue crabs caught in shrimp trawls or sharks caught on a tuna longline. Bycatch is also often called incidental catch. Some bycatch is kept for sale.

C

CPUE - See catch per unit of effort.

Catch - The total number or poundage of fish captured from an area over some period of time. This includes fish that are caught but released or discarded instead of being landed. The catch may take place in an area different from where the fish are landed. Note: Catch, harvest, and landings are different terms with different definitions.

Catch Curve - A breakdown of different age groups of fish, showing the decrease in numbers of fish caught as the fish become older and less numerous or less available. Catch curves are often used to estimate total mortality.

Catch Per Unit of Effort (CPUE) - The number of fish caught by an amount of effort. Typically, effort is a combination of gear type, gear size, and length of time gear is used. Catch per unit of effort is often used as a measurement of relative abundance for a particular fish.

Charter Boat - A boat available for hire, normally by a group of people for a short period of time. A charter boat is usually hired by anglers.

Cohort - A group of fish spawned during a given period, usually within a year.

Cohort Analysis - See virtual population analysis.

Commercial Fishery - A term related to the whole process of catching and marketing fish and shellfish for sale. *It refers to and includes fisheries resources, fishermen, and related businesses directly or indirectly involved in harvesting, processing, or sales.

Common Property Resource - A term that indicates a resource owned by the public. It can be fish in public waters, trees on public land, and the air. The government regulates the use of a common property resource to ensure its future benefits.

Compensatory Growth - An increase in growth rate shown by fish when their populations fall below certain levels. This may be caused by less competition for food and living space.

Compensatory Survival - A decrease in the rate of natural mortality (natural deaths) that some fish show when their populations fall below a certain level. This may be caused by less competition for food and living space.

Condition - A mathematical measurement of the degree of plumpness or general health of a fish or group of fish.

Confidence Interval - The probability, based on statistics, that a number will be between an upper and lower limit.

***Controlled Access** - See limited entry.

Cumulative Frequency Distribution - A chart showing the number of animals that fall into certain categories, for example, the number of fish caught that are less than one pound, less that three pounds, and more than three pounds. A cumulative frequency distribution shows the number in a category, plus the number in previous categories.

D

Demersal - Describes fish and animals that live near water bottoms. Examples are flounder and croaker.

Directed Fishery - Fishing that is directed at a certain species or group of species. This applies to both sport fishing and commercial fishing.

Disappearance (Z) - Measures the rate of decline in numbers of fish caught as fish become less numerous or less available. Disappearance is most often calculated from catch curves.

E

EEZ - See exclusive economic zone.

EIS - See environmental impact statement.

ESO - See economics and statistics office.

Economic Efficiency - In commercial fishing, the point at which the added cost of producing a unit of fish is equal to what buyers pay. Producing fewer fish bring the cost lower than what buyers are paying. Producing more fish would raise the cost higher than what buyers are paying. Harvesting at the point of economic efficiency produces the maximum economic yield. See maximum economic rent.

Economic Overfishing - A level of fish harvesting that is higher than that of economic efficiency, harvesting more fish than necessary to have maximum profits for the fishery.

Economic Rent - The total amount of profit that could be earned from a fishery owned by an individual. Individual ownership maximizes profit, but an open entry policy usually results in so many fishermen that profit higher than opportunity cost is zero. See maximum economic yield.

Economics and Statistics Office (ESO) - A unit of the National Marine Fisheries Service (NMFS) found in the regional director's office. This unit does some of the analysis required for developing fishery policy and management plans.

Effort - The amount of time and fishing power used to harvest fish. Fishing power includes gear size, boat size, and horsepower.

Electrophoresis - A method of determining the genetic differences or similarities between individual fish or groups of fish by using tissue samples.

Environmental Impact Statement (EIS) - An analysis of the expected impacts of a fisheries management plan (or some other proposed action) on the environment.

Escapement - The percentage of fish in a particular fishery that escape from an inshore habitat and move offshore, where they eventually spawn.

Euryhaline - Fish that live in a wide range of salinities.

Exvessel - Refers to activities that occur when a commercial fishing boat land or unloads a catch. For example, the price received by a captain for the catch is an exvessel price.

Exclusive Economic Zone (EEZ) - All waters from the seaward boundary of coastal states out to 200 natural miles. This was formerly called the Fishery Conservation Zone.

F

F - See fishing mortality

Fmax - The level of fishing mortality (rate of removal by fishing) that produces the greatest yield from the fishery.

FMP - See fishery management plan.

Fecundity - A measurement of the egg-producing ability of a fish. Fecundity may change with the age and size of the fish.

Fishery - All the activities involved in catching a species of fish or group of species.

Fishery Dependent Data - Data collected on a fish or fishery from sport fishermen, commercial fishermen, and seafood dealers.

Fishery Independent Data - Data collected on a fish by scientists who catch the fish themselves, rather than depending on fishermen and seafood dealers.

Fishery Management Plan (FMP) - A plan to achieve specified management goals for a fishery. It includes data, analyses, and management measures for a fishery.

Fishing Effort - See effort.

Fishing Mortality (F) - A measurement of the rate of removal of fish from a population by fishing. Fishing mortality can be reported as either annual or instantaneous. Annual mortality is the percentage of fish dying in one year. Instantaneous is the percentage of fish dying at any one time. The acceptable rates of fishing mortality may vary from species to species.

Fork Length (FL) - The length of a fish as measured from the tip of its snout to the fork in the tail.

G

GSI - See gonosomatic index.

Gonosomatic Index (GSI) - The ratio of the weight of a fish's eggs or sperm to its body weight. This is used to determine the spawning time of species of fish.

Groundfish - A species or group of fish that lives most of its life on or near the sea bottom.

Growth - Usually an individual fish's increase in length or weight with time. Also may refer to the increase in numbers of fish in a population with time.

Growth Model - A mathematical formula that describes the increase in length or weight of an individual fish with time.

Growth Overfishing - When fishing pressure on smaller fish is too heavy to allow the fishery to produce its maximum poundage. Growth overfishing, by itself, does not affect the ability of a fish population to replace itself.

H

Harvest - The total number or poundage of fish caught and kept from an area over a period of time. Note that landings, catch, and harvest are different.

Head Boat - A fishing boat that takes recreational fishermen out for a fee per person. Different from a charter boat in that people on a head boat pay individual fees as opposed to renting the boat.

I

ITQ - See individual transferable quota.

Incidental Catch - See bycatch.

Individual Transferable Quota (ITQ) - A form of limited entry that gives private property rights to fishermen by assigning a fixed share of the catch to each fishermen.

Instantaneous Mortality - See fishing mortality, natural mortality, and total mortality.

Intrinsic Rate of Increase (z) - The change in the amount of harvestable stock. It is estimated by recruitment increases plus growth minus natural mortality.

Isopleth - A method of showing data on a graph which is commonly used in determining yield-per-recruit.

J

Juvenile - A young fish or animal that has not reached sexual maturity.

L

Landings - The number or poundage of fish unloaded at a dock by commercial fishermen or brought to shore by recreational fishermen for personal use. Landings are reported at the points at which fish are brought to shore. Note that landings, catch, and harvest define different things.

Latent Species - A species of fish that has the potential to support a directed fishery.

Length Frequency - A breakdown of the different lengths of a kind of fish in a population or sample.

Length-Weight Relationship - Mathematical formula for the weight of a fish in terms of its length. When only one is known, the scientist can use this formula to determine the other.

Limited Entry - A program that changes a common property resource like fish into private property for individual fishermen. License limitation and the ITQ are two forms of limited entry.

M

M - See natural mortality.

MSY - See maximum sustainable yield.

Mariculture - The raising of marine finfish or shellfish under some controls. Ponds, pens, tanks, or other containers may be used, and feed is often used. A hatchery is also mariculture but the fish are released before harvest size is reached.

Mark-Recapture - The tagging and releasing of fish to be recaptured later in their life cycles. These studies are used to study fish movement, migration, mortality, growth, and to estimate population size.

Maximum Sustainable Yield (MSY) - The largest average catch that can be taken continuously (sustained) from a stock under average environmental conditions. This is often used as a management goal.

Mean - Another word for the average of a set of numbers. Simply add up the individual numbers and then divide by the number of items.

Meristics - A series of measurements on a fish, such as scale counts, spine counts, or fin ray counts which are used to separate different populations or races of fish.

Model - In fisheries science, a description of something that cannot be directly observed. Often a set of equations and data used to make estimates.

Morphometrics - The physical features of fish, for example, coloration. Morphometric differences are sometimes used to identify separate fish populations.

Multiplier - A number used to multiply a dollar amount to get an estimate of economic impact. It is a way of identifying impacts beyond the original expenditure. It can also be used with respect to income and employment.

N

National Standards - The Fishery Conservation and Management Act requires that a fishery management plan and its regulations meet seven standards. The seven standards were developed to identify the nation's interest in fish management.

Natural Mortality (M) - A measurement of the rate of removal of fish from a population from natural causes. Natural mortality can be reported as either annual or instantaneous. Annual mortality is the percentage of fish dying in one year. Instantaneous is the percentage of fish dying at any one time. The rates of natural mortality may vary from species to species.

O

Open Access Fishery - A fishery in which any person can participate at any time. Almost all fisheries in federal waters are open to anyone with a fishing boat.

Opportunity Cost - An amount a fisherman could earn for his time and investment in another business or occupation.

Optimum Yield (OY) - The harvest level for a species that achieves the greatest overall benefits, including economic, social, and biological considerations. Optimum yield is different from maximum sustainable yield in that MSY considers only the biology of the species. The term includes both commercial and sport yields.

Overfishing - Harvesting at a rate greater than which will meet the management goal.

P

Pelagic - Refers to fish and animals that live in the open sea, away from the sea bottom.

Population - Fish of the same species inhabiting a specified area.

Population Dynamics - The study of fish populations and how fishing mortality, growth, recruitment, and natural mortality affect them.

Possession Limit - The number and/or size of a species that a person can legally have at any one time. Refers to commercial and recreational fishermen. A possession limit generally does not apply to the wholesale market level and beyond.

Predator - A species that feeds on another species. The species being eaten is the prey.

Predator-Prey Relationship - The interaction between a species (predator) that eats another species (prey). The stage of each species' life cycle and the degree of interaction are important factors.

Prey - A species being fed upon by other species. The species eating the other is the predator.

Primary Productivity - A measurement of plant production that is the start of the food chain. Much primary productivity in marine or aquatic systems is made up of phytoplankton which are tiny one-celled algae that float freely in the water.

Pulse Fishing - Harvesting a stock of fish, then moving on to other stocks or waiting until the original stock recovers.

Q

q - See catchability coefficient.

Quota - The maximum number of fish that can be legally landed in a time period. It can apply to the total fishery or an individual fisherman's share under an ITQ system. Could also include reference to size of fish.

R

Recreational Fishery - Harvesting fish for personal use, fun, and challenge. Recreational fishing does not include sale of catch. *The term refers to and includes the fishery resources, fishermen, and businesses providing needed goods and services.

Recruit - An individual fish that has moved into a certain class, such as the spawning class or fishing-size class.

Recruitment - A measure of the number of fish that enter a class during some time period, such as the spawning class or fishing-size class.

Recruitment Overfishing - When fishing pressure is too heavy to allow a fish population to replace itself.

Regression Analysis - A statistical method to estimate any trend that might exist among important factors. An example in fisheries management is the link between catch and other factors like fishing effort and natural mortality.

Relative Abundance - An index of fish population abundance used to compare fish population from year to year. This does not measure the actual numbers of fish but shows changes in the population over time.

Rent - See economic rent.

S

s - See survival rate.

SPR - See spawning potential ratio.

SSBR - See spawning stock biomass per recruit.

Selectivity - The ability of a type of gear to catch a certain size or kind of fish, compared with its ability to catch other sizes or kinds.

Simulation - An analysis that shows the production and harvest of fish using a group of equations to represent the fishery. It can be used to predict events in the fishery if certain factors changed.

Size Distribution - A breakdown of the number of fish of various sizes in a sample or catch. The sizes can be in length or weight. This is most often shown on a chart.

Slot Limit - A limit on the size of fish that may be kept. Allows a harvester to keep fish under a minimum size and over a maximum size but not those in between the minimum and maximum. *Can also refer to size limits that allow a harvester to keep only fish that fall between a minimum and maximum size.

Social Impacts - The changes in people, families, and communities resulting from a fishery management decision.

Socioeconomics - A word used to identify the importance of factors other than biology in fishery management decisions. For example, if management results in more fishing income, it is important to know how the income is distributed between small and large boats or part-time and full-time fishermen.

Spawner-Recruit Relationship - The concept that the number of young fish (recruits) entering a population is related to the number of parent fish (spawners).

Spawning Potential Ratio (SPR) - *The number of eggs that could be produced by an average recruit in a fished stock divided by the number of eggs that could be produced by an average recruit in an unfished stock. SPR can also be expressed as the spawning stock biomass per recruit (SSBR) of a fished stock divided by the SSBR of the stock before it was fished

Spawning Stock Biomass - The total weight of the fish in a stock that are old enough to spawn.

Spawning Stock Biomass Per Recruit (SSBR) - *The spawning stock biomass divided by the number of recruits to the stock or how much spawning biomass an average recruit would be expected to produce.

Species - A group of similar fish that can freely interbreed.

Sport Fishery - See recreational fishery.

Standing Stock - See biomass.

Stock - A grouping of fish usually based on genetic relationship, geographic distribution, and movement patterns. *Also a managed unit of fish.

Stock-Recruit Relationship - See spawner-recruit relationship.

Stressed Area - An area in which there is special concern regarding harvest, perhaps because the fish are small or because harvesters are in conflict.

Surplus Production Model - A model that estimates the catch in a given year and the change in stock size. The stock size could increase or decrease depending on new recruits and natural mortality. A surplus production model estimates the natural increase in fish weight or the sustainable yield.

Survival Rate(s) - The number of fish alive after a specified time, divided by the number alive at the beginning of the period.

T

TAC - See total allowable catch.

TIP - See trip interview program.

Territorial Sea - The area from average low-water mark on the shore out to three miles for the states of Louisiana, Alabama, and Mississippi and out to nine miles for Texas and the west coast of Florida. The shore is not always the baseline from which the three miles are measured. In such cases, the outer limit can extend further than three miles from the shore.

Total Allowable Catch (TAC) - The annual recommended catch for a species for species group. The regional council sets the TAC from the range of the allowable biological catch.

Total Mortality (Z) - A measurement of the rate of removal of fish from a population by both fishing and natural causes. Total mortality can be reported as either annual or instantaneous. Annual mortality is the percentage of fish dying in one year. Instantaneous mortality is that percentage of fish dying at any one time. The rate of total mortality may vary from species to species.

Trip Interview Program (TIP) - *A cooperative state-federal commercial fishery dependent sampling activity conducted in the Southeast region of NMFS, concentrating on size and age information for stock assessments of federal, interstate, and state managed species. TIP also provides information on the species composition, quantity, and price for market categories, and catch-per-unit effort for individual trips that are sampled.

U

Underutilized Species - A species of fish that has potential for large additional harvest.

Unit Stock - A population of fish grouped together for assessment purposes which may or may not include all the fish in a stock.

V

VPA - See virtual population analysis.

Virgin Stock - A stock of fish with no commercial or recreational harvest. A virgin stock changes only in relation to environmental factors and its own growth, recruitment, and natural mortality.

Virtual Population Analysis (VPA) - A type of analysis that uses the number of fish caught at various ages or lengths and an estimate of natural mortality to estimate fishing mortality in a cohort. It also provides an estimate of the number of fish in a cohort at various ages.

Y

Year-Class - The fish spawned and hatched in a given year, a "generation" of fish.

Yield - The production from a fishery in terms of numbers or weight.

Yield Per Recruit - A model that estimates yield in terms of weight (but more often as a percentage of the maximum yield) for various combinations of natural mortality, fishing mortality, and time exposed to the fishery.

Z

z - See intrinsic rate of increase.

Z - See total mortality.

Z' - See disappearance.

14.2 Market Channel Survey

SPOTTED SEATROUT and FLOUNDER MARKET CHANNEL SURVEY FOR THE GULF OF MEXICO REGION

******* PLEASE RESPOND TO THE FOLLOWING QUESTIONS WITH YOUR "BEST GUESS" ESTIMATES *******

(The following questions pertain only to spotted seatrout. Please do not include other species of seatrout in your responses. Also, "flounder" is defined as Gulf or Southern flounder.

1. FROM WHOM AND WHERE DID YOUR SUPPLY COME FROM?

A. Of the total volume of whole spotted seatrout and flounder you handled in 1995, what <u>percent</u> (estimate) were obtained <u>directly</u> from each of the following sources?

	Spotted Seatrout	Flounder
1. In-state Fishermen	_______ %	_______ %
2. Out-of-state Fishermen	_______ %	_______ %
3. In-state Wholesale Distributor/Processor	_______ %	_______ %
4. Out-of-state Wholesale Distributor/Processor	_______ %	_______ %
5. Other In-state Source (please describe ____________________)	_______ %	_______ %
6. Other Out-of-state Source (please describe ____________________)	_______ %	_______ %
TOTALS ——>	100 %	100 %

B. Of the total volume of spotted seatrout and flounder you handled in 1995, what <u>percent</u> (estimate) of each originated from foreign sources (i.e. imported from Mexico, Costa Rica, etc). 1. Spotted Seatrout _______ % 2. Flounder _______ %

2. DID YOU CUT IT, LEAVE IT WHOLE, FREEZE IT, OR WHAT?

A. Of the total volume of <u>whole</u> spotted seatrout and flounder you acquired in 1995, what <u>percent</u> (estimate) were processed into the following product forms prior to final sale by your firm?

	Spotted Seatrout	Flounder
1. Whole form (gutted, headed, eviscerated)	_______ %	_______ %
2. Fillets	_______ %	_______ %
3. Other (please describe ____________________)	_______ %	_______ %
TOTALS ——>	100 %	100 %

B. What <u>percent</u> (estimate) of the spotted seatrout and flounder you handled in 1995 were sold by your firm in frozen or fresh form?

	Spotted Seatrout	Flounder
1. Fresh	_______ %	_______ %
2. Frozen	_______ %	_______ %
TOTALS ——>	100 %	100 %

3. WHO DID YOU SELL IT TO AND HOW DID THEY WANT IT?

A. Of the total volume of spotted seatrout you handled in 1995, what percent (estimate) were sold to each of the following buyers?

	Spotted Seatrout	Flounder
1. In-state Wholesale Distributor/Processor	_______ %	_______ %
2. Out-of-state Wholesale Distributor/Processor	_______ %	_______ %
3. In-state Retailer (grocery, seafood market, etc)	_______ %	_______ %
4. Out-of-state Retailer	_______ %	_______ %
5. In-state Restaurant	_______ %	_______ %
6. Out-of-state Restaurant	_______ %	_______ %
7. Retail Consumer	_______ %	_______ %
TOTALS ——>	100 %	100 %

B. For each of the following types of buyers that you sell spotted seatrout and flounder to, please indicate the percentage of each product form bought in a typical year. Also, for each type of buyer, show the percentages of fresh versus frozen purchased.

SPOTTED SEATROUT - Product Forms

Buyers	Whole	Fillets	Other ——>	Total		Fresh	Frozen —>	Total
Example: Retailer	*(25%)*	*(50%)*	*(25%)*	*100%*	.	*(75%)*	*(25%)*	*100%*
Wholesale Distributor/Processors	( )	( )	( )	100%	.	( )	( )	100%
Retailers	( )	( )	( )	100%	.	( )	( )	100%
Restaurants	( )	( )	( )	100%	.	( )	( )	100%
Retail Consumers	( )	( )	( )	100%	.	( )	( )	100%
Others (please describe ____________)	( )	( )	( )	100%	.	( )	( )	100%

FLOUNDER - Product Forms

Buyers	Whole	Fillets	Other ——>	Total		Fresh	Frozen —>	Total
Example: Restaurants	*(50%)*	*(50%)*	*(0%)*	*100%*	.	*(100%)*	*(0 %)*	*100%*
Wholesale Distributor/Processors	( )	( )	( )	100%	.	( )	( )	100%
Retailers	( )	( )	( )	100%	.	( )	( )	100%
Restaurants	( )	( )	( )	100%	.	( )	( )	100%
Retail Consumers	( )	( )	( )	100%	.	( )	( )	100%
Others (please describe ____________)	( )	( )	( )	100%	.	( )	( )	100%

4. WHERE ARE YOU LOCATED?

In what states do you operate fish houses where spotted seatrout and/or flounder are handled? Indicate the number operated in each of the states listed.

	Number
Texas	_________
Louisiana	_________
Mississippi	_________
Alabama	_________
Florida	_________

THAT'S IT!!

PLEASE FOLD COMPLETED QUESTIONNAIRE AND PLACE IN POSTAGE-PAID RETURN ENVELOPE IMMEDIATELY. THANKS

14.3 Stock Assessment

14.3.1 Assessment of the Western Gulf Stocks - Stock Assessment of Southern Flounder (*Paralichthys lethostigma*) in Texas Waters, prepared by Dr. Mark R. Fisher, Texas Parks and Wildlife, Coastal Resources Division

Introduction

This assessment utilizes sequential population analysis (SPA) to assess the effects of commercial and recreational fishing on the southern flounder stock in Texas waters from 1984-1997. Sequential population analysis, like virtual population analysis (VPA), uses catch at age data to provide estimates of stock sizes and fishing mortality rates by age and year, but differs by using indices of abundance to "tune" the results. I used FADAPT (Restrepo 1996) to perform the SPA, which is a FORTRAN version of the assessment framework known as ADAPT (Gavaris 1988). Data from TPWD's commercial landings (e.g., Robinson et al. 1997), recreational landings (e.g., Warren et al. 1994), fishery-independent monitoring programs (e.g., Fuls and McEachron 1997), and age and growth studies (Stunz et al. 1996) were used in the assessment.

Fishery-Independent Data

Seasonal (February-April) bag seine catch rates were used as an index of abundance for age-0 flounder, which become vulnerable at about 20 mm TL, are fully recruited at about 30 mm TL, and become less available to the gear above 100 mm. Recruitment increased during the 1980s, peaked in 1990, and was reduced in the following years, although the 1996-1997 catch rates were the highest since 1990 (Figure 1).

Annual gill net catch rates were used as an index of abundance for age-1+ flounder (Figure 2). Adult flounder abundance has been steadily declining, with lowered abundance during years with severe winter freezes (1984 and 1989). The large 1990 year class is detected in the 1991 gill net samples. The increase in abundance during 1996 and 1997 is probably due to the stricter ten-fish bag and 355 mm minimum size limits imposed in September 1996 and the large 1996 year class.

Fishery Dependent Data

Commercial landings were converted from pounds to numbers by dividing total weight by mean weight, estimated from length-frequency samples taken from commercial fish houses. Commercial landings increased from 1984-1987, probably as displaced red drum and spotted seatrout fishers targeted flounder but decreased after 1988 as gill nets were banned and a 305 mm minimum length was established (Figure 3). Recreational landings have been relatively stable, except for a small decrease after the January 1984 freeze and the February and December freezes of 1989 (Figure 3). Decreased landings in 1997 are probably a result of the stricter bag and minimum size limit imposed in September 1996. The directed fishery is largely female, composing 94% of the landings in 1997.

Bycatch was estimated for 1992-1995 using CPUE data from our bycatch characterization studies and from coast wide shrimp effort data from NMFS (Fuls 1996). For years other than 1992-1995, bycatch was estimated seasonally by adjusting the 1992-1995 data with the percent difference in fall gill net catch rates between that year and 1992-1995 and with the percent difference in spring bag seine catch rates between that year and 1992-1995, and shrimp effort data from NMFS. Flounder bycatch was assumed to be 33% female, based on length-frequencies and growth rates. All females were assigned age-0. Shrimp trawl bycatch has been variable (Figure 4) with peaks in 1987, 1990, and 1997 corresponding with peaks in flounder recruitment (Figure 1). A reduction in bycatch during the 1990s probably resulted from the low recruitment during those years, but increased recruitment in 1996-1997 resulted in increased bycatch.

Age and Sex Composition

As male and female southern flounder exhibit different growth characteristics (Stunz et al. 1996), a potential problem arises when assigning age and sex to length-frequency data. Females grow faster and larger than males, so the use of an age-length key can introduce considerable error, as young females cannot be distinguished from older males because of overlapping lengths. An accurate sex ratio by length can alleviate this problem by first categorizing the total catch by sex and length class, then using a sex-specific age-length key to assign age.

Unfortunately, it appears flounder sex ratios have been changing over the past 20 years. I estimated sex ratios by length using data from Stunz et al. (1996), Stokes (1977), and from a simulated population generated from sex-specific von Bertalanffy growth equations subject to natural mortality only (M=0.6). Results are presented in Table 1.

Data from Stunz et al. (1996) were collected from May 1992 to January 1995, while data from Stokes (1977) were collected from January 1974 through September 1975. The simulated population was generated for the middle of the year (June) with the youngest flounder at 0.5 years of age and the oldest at 5.5 years. Size at age was assumed to be normally distributed with the same coefficient of variation for length at age as observed in Stunz et al (1996). Assumptions underlying the virtual population are: 1) equal numbers at birth, 2) equal mortality by sex, and 3) equal life spans by sex. The simulated population was not subjected to fishing mortality.

Sex ratios were smoothed using logistic regression. The simulated population indicates males comprise the majority of the population under 11 inches, while females dominate over 11 inches (equal mortality yields equal numbers at age but not necessarily at length). Stokes (1977) results were similar with males dominating the ten inch and under size classes, while Stunz et al. (1996) found females as the majority >6 inches. The data from Stokes (1977) indicate males were subject to a higher mortality rate than females (Z=1.61 and Z=0.83 estimated from a Chapman-Robson catch curve). No males older than two years were reported. Mortality rates from Stunz et al. (1996) also indicate males were subject to a higher mortality rate than females (Z=2.15 and Z=1.65). Males are afforded greater protection under TPWD's minimum length restrictions, so the directed fishery is not the primary source of male mortality. Shrimp trawl bycatch is the likely source as small (male) flounder are a common component (Fuls 1996).

I used sex ratios at length and a female age-length key from Stunz et al (1996). Although the sex ratios from this study may introduce a significant source of error into the earlier years, it will accurately sex flounder for the recent years. Also, the single age-length key may also introduce aging errors as there were probably more older fish in the earlier years than this age-length key indicates and also because of differences in cohort sizes.

Sequential Population Analysis

Natural mortality was set to M=0.6 based on Hoenig's (1983) method of estimating mortality from longevity. For M=0.6, 99% of the flounder population would be expected to die by age-7. Although flounder older than age-5 have not been collected in Texas, age-7 fish have been collected in Louisiana (Adkins et al. 1996).

Terminal year selectivity, a required input for FADAPT, was estimated with a separable VPA (Pope and Shepherd 1982). Selectivity was set to 0.7 for age-0 and 1.0 for age-1+ females. Maturity schedules for computing SPR were set to 0 for age-0 and age-1, 0.5 for age-2, and 1.0 for age-3+ based on Stunz et al. (1996).

Age-0 flounder were tuned using seasonal bag seine catch rates. A good correlation was obtained between observed and predicted catch rates from the SPA results, r=0.74. Age-1 to age-5 flounder were tuned using annual gill net catch rates resulting in a very good correlation between observed and predicted catch rates, r=0.85.

Results from the SPA indicate the age-1+ female flounder population has been decreasing, and is currently about half the size it was in 1984 (Table 2). The largest estimated population was observed in 1985, probably resulting from reduced fishing pressure after the severe winter freeze in 1984. The decrease in the population is largely due to low recruitment from 1991-1996. Fishing mortality (Table 3) was lowest in 1984 and highest in 1987 which was the last year before gill nets were banned from Texas waters. The second highest fishing mortality rate was observed in 1990 mostly due to bycatch.

Unweighted transitional spawning potential ratios ranged from 0.41 in 1984 to 0.13 in 1987 with the 1990s ranging from 0.20 to 0.28 (Table 3). F_{max}=0.76 with a corresponding static % SPR of 8.4 while $F_{0.1}$=0.45 and a % SPR of 21.2. Using 1997 as an example, a 25 % reduction in bycatch would result in an increase in SPR from 0.27 to 0.31; a 50% reduction in bycatch would result in an increase in SPR from 0.27 to 0.36. Also, a 25% reduction in bycatch would result in a 13% increase in the total number of flounder landed by the directed fisheries; a 50% reduction would yield 28% more fish assuming F=0.5. As bycatch accounted for 84% of the total harvest of females in 1997, any further management of the stock should consider bycatch.

Male flounder, because of their slower growth and smaller size, are afforded greater protection under minimum length limits and comprise a small fraction (<5%) of the 1997 commercial and recreational landings as a result. However, they remain vulnerable to shrimp trawls longer than females and comprise a much larger fraction (66%) of flounder bycatch. As a result, the total fishing mortality of males exceeds female fishing mortality, even though there is no significant directed fishery for males. The higher male mortality rate is probably the cause for the changing sex ratios of flounder over time. While fish reproduction rates are typically limited by egg production (Goodyear 1980), flounder may represent a case where sperm production becomes the limiting factor. Stunz et al (1996) sampled a total of 892 flounder. Of those specimens that could be sexed, 17% were male resulting in a female:male ratio of 6:1. No males older than age-1 were collected from Matagorda Bay which supports one of the largest shrimp fisheries in Texas (Robinson et al. 1997). It seems possible that the number of mature male flounder may be limiting reproduction in some bays and warrants further investigation. Here, males may respond by maturing at an earlier age, for example.

Finally, results from the SPA should be used with caution. First, these results are sensitive to variation in the relative proportion of age classes harvested. For example, if bycatch is actually 50% higher than we estimated, then the true F for age-0 females increases by 0.15-0.20 which reduces SPR by 0.04-0.05. Similarly, if bycatch is 50% lower than estimated then F for age-0 females decreases by 0.15-0.20 and increases SPR by 0.04-0.05. Second, changes in sex ratios over the period of this assessment may have caused large males to be misclassified as females in the earlier years, thus overestimating the female harvest (F) and underestimating SPR. Lastly, the use of a single age-length key can also introduce error as there were probably more, older fish in the earlier years than the age-length key indicates. This is the least significant source of error, however.

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Table 1. Proportion of females by length, estimated by logistic regression.

Length class (mm)	Simulated population (n=1,877 males, 1,877 females)	Stokes (1977) (n=102 males, 162 females)	Stunz et al. (1996) (n=118 males, 714 females)
152	0.26	0.14	0.49
178	0.31	0.20	0.59
203	0.35	0.28	0.64
229	0.41	0.39	0.69
254	0.46	0.48	0.75
279	0.51	0.60	0.80
305	0.57	0.69	0.85
330	0.62	0.79	0.89
356	0.67	0.85	0.92
381	0.72	0.90	0.94
406	0.76	0.93	0.96
432	0.80	0.96	0.97
457	0.83	0.97	0.98
483	0.86	0.98	0.99
508	0.88	0.99	0.99
533	0.90	0.99	0.99

Table 2. Estimated population of female southern flounder, by age and year. Estimates are for the beginning of the year, M=0.6.

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Age-0	2,282,766	2,228,464	2,511,184	3,031,998	2,302,278	2,361,752	3,333,471	1,947,109	1,784,449	1,578,364	1,943,605	1,418,135	1,849,395	2,397,156
Age-1	976,038	996,474	922,559	884,272	732,010	685,812	737,573	770,571	723,636	628,833	590,781	646,981	486,345	647,620
Age-2	405,870	417,859	388,365	335,716	277,979	265,253	296,633	312,869	288,163	259,931	232,734	199,123	229,761	164,169
Age-3	156,868	170,032	164,121	130,424	105,450	101,590	111,375	126,024	115,028	101,366	91,511	76,246	61,384	74,142
Age-4	57,945	62,826	66,113	52,818	39,594	38,474	41,378	46,485	46,561	39,841	34,399	30,478	23,888	12,867
Age-5	18,755	20,421	21,297	17,787	13,851	13,099	14,524	16,262	15,529	14,651	12,245	10,473	8,651	4,467
Age-1-5	1,615,476	1,667,612	1,562,455	1,421,017	1,168,884	1,104,228	1,201,483	1,272,211	1,188,917	1,044,622	961,670	963,301	810,029	903,265

Table 3. Estimated fishing mortality of female southern flounder, by age and year, M=0.6. Mean F was weighted by population size. F_{max}=0.76, $F_{0.1}$=0.45 and $F_{20\%}$=0.47, with corresponding static % SPR's of 8.4%, 21.2%, and 20%.

Age	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Age-0	0.2289	0.2819	0.4437	0.8212	0.6111	0.5638	0.8646	0.3898	0.443	0.3827	0.5	0.4702	0.4493	0.587
Age-1	0.2484	0.3423	0.4109	0.5572	0.4151	0.2381	0.2576	0.3836	0.4239	0.394	0.4875	0.4353	0.486	0.1609
Age-2	0.2289	0.3345	0.4912	0.558	0.4066	0.2678	0.256	0.4006	0.4448	0.444	0.5159	0.5768	0.5311	0.437
Age-3	0.315	0.3446	0.5338	0.5921	0.4083	0.2982	0.2738	0.3957	0.4603	0.4807	0.4995	0.5606	0.9625	0.437
Age-4	0.4429	0.4818	0.7129	0.7385	0.5061	0.3742	0.3339	0.4964	0.5562	0.5798	0.5892	0.6594	1.0766	1.7707
Age-5	0.4429	0.4818	0.7129	0.7385	0.5061	0.3742	0.3339	0.4964	0.5562	0.5798	0.5892	0.6594	1.0766	1.7707
Mean F	0.2457	0.3100	0.3100	0.7409	0.5456	0.4661	0.7050	0.3917	0.4416	0.3994	0.5001	0.4758	0.4826	0.4988
SPR	**0.409**	**0.337**	**0.233**	**0.132**	**0.213**	**0.299**	**0.220**	**0.276**	**0.241**	**0.263**	**0.204**	**0.211**	**0.197**	**0.265**

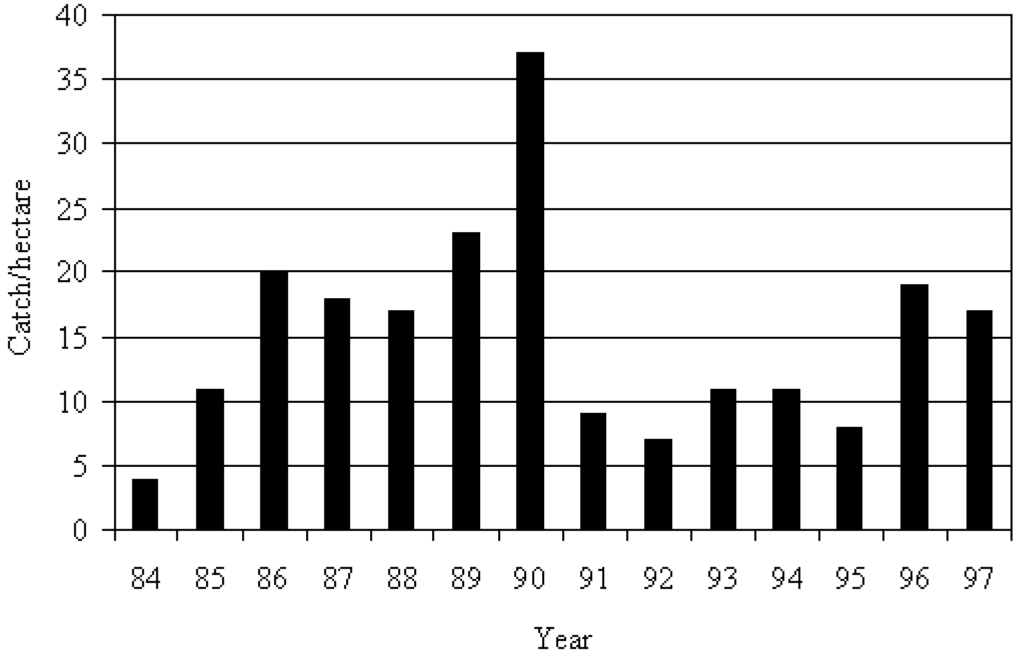


Figure 1. Seasonal bag seine catch rates of southern flounder, by year.

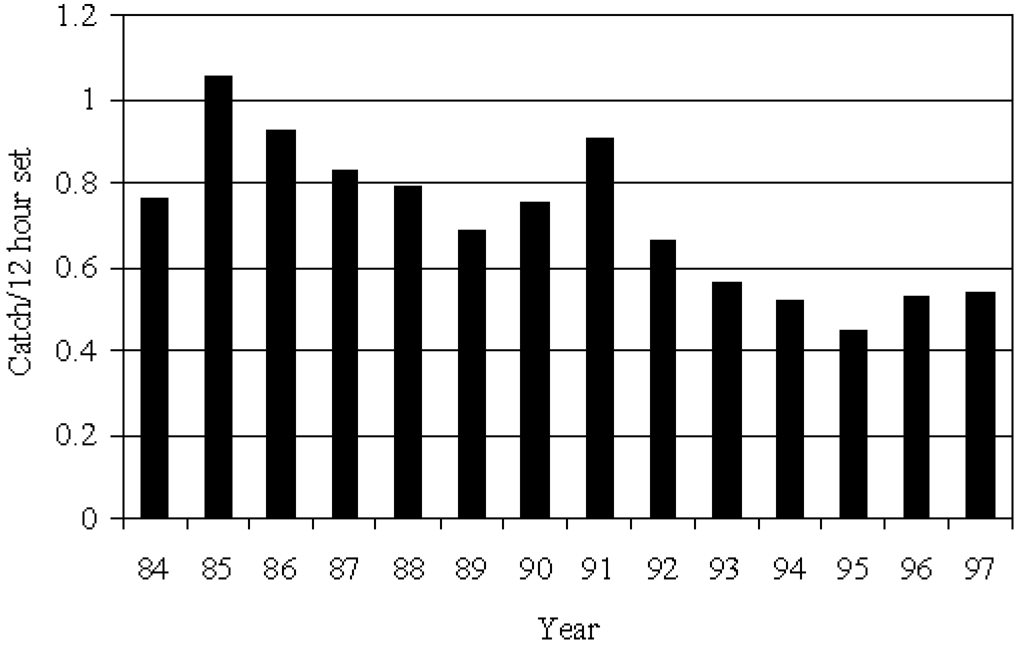


Figure 2. Gill net catch rates of southern flounder, by year.

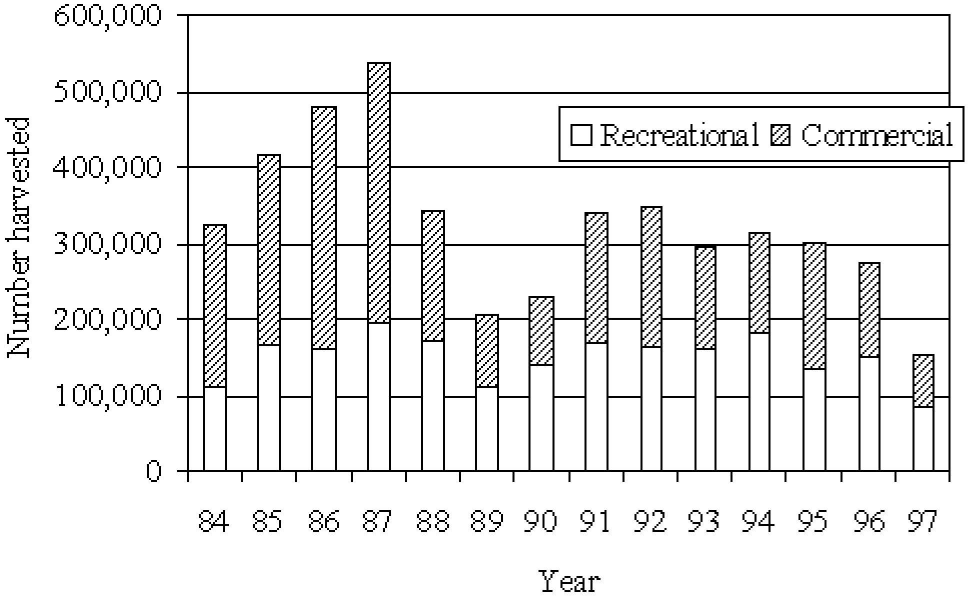


Figure 3. Commercial and recreational landings of female southern flounder, by year (TPWD unpublished data).

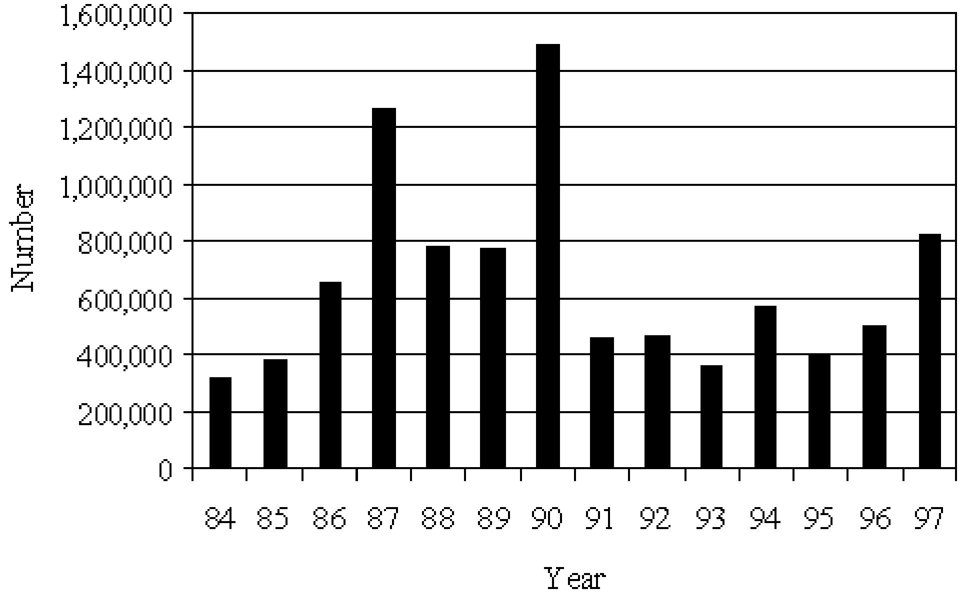


Figure 4. Estimated bycatch of age-0 female southern flounder.

14.3.2 Assessment of the Northern Central Gulf Stocks - Louisiana Southern Flounder 1999 Stock Assessment, prepared by J. Shepard, Louisiana Department of Wildlife and Fisheries

(The original table and figure number sequence has been retained for this portion of the appendix.)

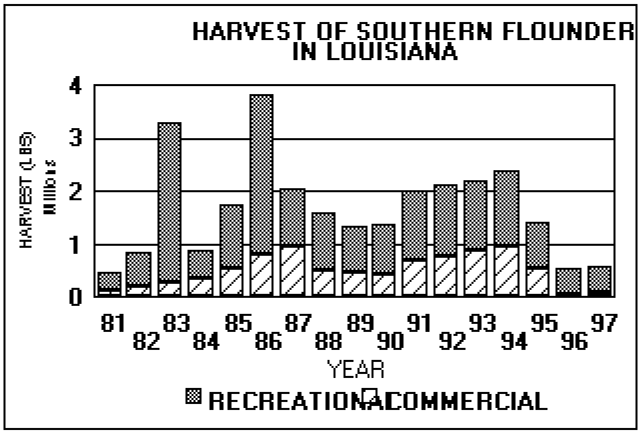
SUMMARY OF CHANGES FROM 1998 ASSESSMENT

This summary is intended to provide a quick reference of substantive changes in methods or corrections in this year's assessment from the 1998 assessment conducted for southern flounder.

- There are no substantive changes in methods from the 1998 assessment.

1999 DOCUMENT HIGHLIGHTS

- 1997 combined commercial and recreational harvest of 582,690 pounds is the third lowest harvest for the years examined.
- The results of YPR analysis indicate that if M=0.5 (the most conservative value within the range of estimates), the fishery prior to existing regulations was operating between $F_{0.1}$ and F_{MAX}, with yields of 93% to 94% of maximum and SPR at 27% to 28%. An M of 0.8 (the highest value within the range examined) would produce yields of 65% to 67% of maximum with SPR at 51% to 52%.



- Regulations implemented since 1995 have significantly reduced harvest and have likely reduced fishing mortality rates from those currently estimated. SPRs that will result from current regulations will likely be above 30%.

This assessment uses yield-per-recruit (YPR), Spawning Potential Ratio (SPR), and catch curve analyses to estimate the impact of fishing pressure on potential yield and the spawning potential of the southern flounder stock in Louisiana waters. Estimates derived from YPR and SPR are based on information regarding the growth rate and spawning potential of the fish and on estimates of the natural mortality rate (M) and fishing mortality rate (F) on the stock. Catch-curve analysis estimates disappearance rates (Z') from the fishery based on the relative abundance of each age class in the harvest. The results from this assessment provide a generalized approach towards estimating the impact of fishing on the spawning potential and potential yield of the fish stock. The spawning biomass of females is assumed to be the factor limiting the spawning potential of the stock; therefore, where possible, only data on female southern flounder are used. Yield-per-recruit and SPR analysis, as with many other generalized assessments, should be used only as a guide until a more comprehensive assessment can be conducted.

In developing a stock assessment, the unit stock must be defined. While a unit stock is often represented by that portion of the population which is genetically similar, for our purpose, the most applicable definition seems to be one which considers the unit stock as that portion of the population which is either dependent on Louisiana waters or which is available to Louisiana fishermen.

Growth

Von Bertalanffy growth parameters were calculated for female southern flounder in Louisiana by using aged samples collected by Thompson (B. Thompson, Coastal Fisheries Institute, Louisiana State University, unpublished data) combined with juveniles assigned to age-0 (<100 mm total length) by length frequency analysis from LDWF fishery-independent trawl samples. From the combined data, a three-parameter von Bertalanffy growth equation was estimated using nonlinear approximation (SAS 1987). The equation is as follows:

$$\text{Female } L_t = 509(1-e^{-0.8846(t-0.0954)})$$

where, L_t = length at age t. A plot of the data and predicted growth is provided in Figure 5.1. A length-weight regression for female southern flounder was derived using fish collected in Louisiana by Thompson (unpublished data) and the LDWF fishery-independent surveys. The resulting output of the SAS regression analysis is presented in Table 5.1. The length-weight regression used is as follows:

$$\log W = 3.18369 * \log L - 5.386116$$

where, W = body weight in grams and L = total length in millimeters. A plot of the data and predicted weight-at-length is provided in Figure 5.2.

Natural Mortality

Natural mortality is one part of total mortality (Z) and is the mortality due to all causes other than fishing. These include predation, disease, spawning stress, starvation, and old age. Typically, natural mortality is estimated as it is difficult to directly measure, especially on exploited fish stocks where natural mortality and fishing mortality occur simultaneously. No direct measure of natural mortality for southern flounder is available; therefore, several established estimation procedures were used to derive an estimate. The procedures are presented below and are taken from Sparre and Venema (1992).

Pauly (1980) provides a method of estimating natural mortality from a set of parameters including the asymptotic length and growth rate of the fish, and the average water temperature of the environment. The growth parameters from the von Bertalanffy growth equation and the mean annual water temperature, derived from readings from a set of four constant recorders located throughout the Barataria Bay system, were used in the calculation. The mean water temperature was 22.7°C for the period 1989-1992 (M. Kasprzak personal communication). These values were incorporated into the length-based function of Pauly (1980):

$$\ln(M) = -0.0152 - 0.279 * \ln(L_\infty) + 0.6543 * \ln(K) + 0.463 * \ln(T).$$

where, ln(M) = natural log of natural mortality, $\ln(L_\infty)$ = natural log of the asymptotic length, ln(K) = natural log of the growth coefficient, and ln(T) = natural log of the mean annual temperature in degrees Celsius.

Use of Louisiana data on growth and water temperature applied to Pauly's function results in a natural mortality estimate of M=1.33.

Alagaraja (1984) and Hoenig (1983) provide methods of estimating M based on the fish's lifespan or longevity with the assumption that M=Z. Longevity is also difficult to determine for exploited fish stocks, since the age distribution is usually truncated by fishing, but these methods are as useful as any in providing provisional estimates of natural mortality. The functions described by Alagaraja (1984) are:

$$M1\% = -\ln(0.01)/Tm$$
$$M0.1\% = -\ln(0.001)/Tm$$

where, M1% and M0.1% are the natural mortality rates corresponding to 99% and 99.9% mortality, respectively, given a fish's lifespan (Tm) in years. Female southern flounder in Louisiana have been aged to seven-years-old (Thompson personal communication). If it is assumed that 99% or 99.9% of the fish die by age-7 then corresponding natural mortality rates for M1% and M0.1% would be 0.66 and 0.99, respectively.

The function described by Hoenig(1983) is :

$$\ln(Z) = 1.46 - 1.01 * \ln(Tm)$$

where, when M=Z, longevity (Tm) can be defined as the maximum survival age. If we assume that the maximum age of southern flounder has been truncated due to fishing from nine to seven years, the resulting estimate of natural mortality, given Tm=9, would be 0.47. However, if our assumption is incorrect and the maximum age is seven years then the estimate of natural mortality would be 0.60.

Another method of estimating M is described by Rikhter and Efanov (1976) and utilizes population age at sexual maturity. The function is:

$$M = 1.521/(Tm50\%^{0.720}) - 0.155$$

where, Tm50% is the age at which 50% of the population is mature. Age-1 is assumed to be the age at 50% maturity, based on the length at sexual maturity found by several researchers (Adkins et al. 1996) and results in an M of 1.37. However, if 50% maturity occurs at age-2 rather than age-1, the estimate of natural mortality would be 0.77.

In summary, the estimated rates of natural mortality for southern flounder in Louisiana using a variety of estimation procedures are as follow:

Pauly (1980)	0.68
Alagaraja (1984)	0.66 and 0.99

Hoenig (1983)	
1) Longevity 9 years	0.47
2) Longevity 7 years	0.60
Rikhter and Efanov (1976)	
1) 50% maturity age 1	1.37
2) 50% maturity age 2	0.77

Disappearance Rates and Fishing Mortality

The disappearance rate (Z') from the fishery comprises total mortality (natural + fishing) and some unknown rate of decreasing availability of the fish to the fishery. If the unknown rate of availability is small or nonexistent, then the disappearance rate will be a reasonable estimate of total mortality. However, if a large portion of the disappearance rate is due to fish not being available to the fishery, then assuming Z'=Z will overestimate the impact of fishing.

We estimated rates of disappearance using data from two sources. The first source is the commercial data collected through the Trip Interview Program (TIP) for 1994-1996 and the second, data from the recreational fishery (NMFS Marine Recreational Fishery Statistics Survey 1994-1996). The data from both of the surveys did not distinguish between sexes; therefore, we assumed for this assessment that all fish sampled were female. Fish were aged by using an age-length key developed from otolith aging of fish by Thompson (unpublished data) and LDWF's ongoing aging study. Eleven hundred and seventy nine aged fish were used in the development of the age-length key (Table 5.2). To calculate disappearance rates, we regressed the natural log of the catch-per-unit-effort against age, beginning with the age at full recruitment to the fishery. This method assumes that recruitment is constant and the fishery is in equilibrium. Disappearance rates were calculated from the commercial and recreational data by year where length frequency data was available. The calculated disappearance rates ranged from 1.1 to 1.3 (Table 5.3 and Figures 5.3A-C and 5.4A-C).

Catch-at-age from the commercial and recreational fishery in 1995 was used to derive age-specific selectivities to be used in yield-per-recruit analysis. The method presented in Sparre and Venema (1992) was used to develop selectivities. This method uses a linearized catch curve to determine the selectivity of fish not yet fully recruited to the fishery. The ratio of the observed catches to the expected catches at each age is the probability of capture or selectivity of the fishery at age. This selection is then regressed in the equation:

$$\ln(1 / S_t - 1) = T1 - T2 * t$$

where, S_t = the selectivity at age t and T1 and T2 are constants corresponding to the intercept and slope of the regression. To develop theoretical or estimated selectivities at age the following equation is used:

$$S_t \text{ (estimate)} = 1 / (1 + \exp(T1 - T2 * t)$$

Selectivities for ages up to full age-at-recruitment were used to describe the relative fishing mortality to that point; for age at full recruitment and older, selectivities are assumed to be one or 100% selected. Selectivities are as follows:

age-0 = 0.012
ages-1 and older = 1.

Yield per Recruit

Yield-per-recruit and SPR analysis provides basic information about the dynamics of a fish stock by estimating the impact of mortality on yield and the spawning potential of the stock. The results can be examined as to the sensitivity of natural and fishing mortality rates on yield and spawning potential.

The growth parameters, sexual maturity, and the age-specific selectivities were incorporated into the yield-per-recruit and spawning potential analysis. Fecundity estimates were not available; therefore, mean weight at age was used in the estimation of spawning potential. Natural mortality rates of 0.5 to 0.8 by 0.1 were used in the analysis because they are on the lower end of the range of estimates and would provide the most conservative results. These rates are also used to describe the sensitivity of M on yield and spawning potential. The results are presented in Table 5.4 which contains estimates of F_{MAX} (fishing mortality rate that produces maximum yield), $F_{0.1}$ (fishing mortality rate representing 10% of the slope at the origin of a yield-per-recruit curve), $F_{20\%SPR}$ (fishing mortality that produces 20% SPR), $F_{30\%SPR}$ (fishing mortality that produces 30% SPR), and annual estimates of F from the disappearance rates.

Conservation Standards

Conservation standards are intended to protect the viability of a fish stock for future generations. These standards have historically been based on a number of biological measures of the dynamics of fish stocks, depending on the availability and adequacy of data. Conservation standards should be separated into two types: a conservation threshold which is entirely biologically based and a conservation target which considers biological measures modified by relevant social, economic, and ecological factors. A conservation threshold is a biological baseline for the harvest of a fish stock and should not be exceeded. It is the highest level of fishing mortality that will ensure that recruitment overfishing will not occur. Beyond the conservation threshold, a conservation target may be set providing for other management goals in the fishery. Such goals may include maximizing yield in weight or numbers of fish, economic benefits or profit, employment, or some other measurable goal. These targets should be set at a fishing mortality rate below that of the conservation threshold in order to ensure that the biological integrity of the stock is not damaged by fishing.

The SPR concept described by Goodyear (1989) is a species specific value expressed as the ratio of the spawning stock biomass (or egg production) per recruit (SSB/R) in a fished condition to the SSB/R in an unfished condition. The concept is based on the premise that below some level of SPR, recruitment will be reduced. Goodyear (1989) recommends that in the absence of sufficient data to provide a value specific to the stock in question an SPR of 20% be used as a threshold. Work on North Atlantic ground fisheries also resulted in the calculation of a threshold SPR of 20% (Gabriel et al. 1984, Gabriel 1985). An SPR of 20% has been recommended for Spanish and king mackerel in the Gulf of Mexico (National Oceanic and Atmospheric Administration/National Marine Fisheries Service 1995); an SPR of 8%-13% has been demonstrated to be sufficient for gulf menhaden (Vaughan 1987). In earlier analyses of Louisiana spotted seatrout fisheries (Louisiana Department of Wildlife and Fisheries 1991), an SPR threshold of 15% was recommended based on several years of data. Mace and Sissenwine (1993) examined 90 stocks of 27 species and reported that the average replacement SPR for all these stocks was 18.7%, while the most resilient quarter of the stocks required a maximum of only 8.6%. These authors recommended that an SPR of 30% be maintained when there is no other basis for estimating the replacement level as this level was sufficient in maintaining recruitment for 80% of the stocks examined. However, they noted that 30% may be overly conservative for an "average" stock and reiterated the need for stock-specific evaluations of standards to enhance both safety and benefits in the fishery.

Sufficient information is not available to directly estimate a conservation threshold for southern flounder in Louisiana. However, the conservation target of 30% SPR established by the 1995 Regular Session of the Louisiana Legislature for black drum, southern flounder, sheepshead, and striped mullet appears to be adequate to maintain the southern flounder stock and prevent recruitment overfishing.

The use of any measure of the health of a fish stock as a perfect index is arguable. It is logical to conclude that growth overfishing should occur at a much lower fishing rate than that which would threaten recruitment. However, Mace and Sissenwine (1993) provide information to suggest that some stocks may have reduced recruitment at levels of fishing that would not reduce yield-per- recruit. The preferable position for making recommendations on appropriate levels of fishing for a stock is to base those recommendations on actual measures of spawning stock size and recruitment for both the species and fishery in question. This requires a base of information resulting from monitoring of both the stock and the fishery over a variety of conditions. Without this information, conservation standards may either underestimate or overestimate the potential of a fishery. If the potential is underestimated, society loses the economic and social benefits of the harvest. If the potential is overestimated and the fishery is allowed to operate beyond sustainable levels society loses the benefits of a sustainable fishery and recovery will require some period of rebuilding, when effort must be reduced from the non-sustainable levels (Hilborn and Walters, 1993). Some researchers have speculated that overharvest of some stocks may lead to their replacement in the ecosystem by other, often less preferred, stocks. The frequency of such replacements is unknown, and the cause of shifts in species predominance in an ecosystem are difficult to ascertain even after the fact. Such a shift has been reported in the Georges Bank area where prolonged, intense harvest of cod and haddock has been implicated in gradual increases in skate and spiny dogfish populations (National Oceanic and Atmospheric Administration 1993).

Status of the Stock

Rules for the harvest of southern flounder have changed substantially over the last three years. Commercial harvest methods were changed on August 15, 1995 during the 1995 Regular Legislative Session when the Marine Resources Conservation Act of 1995 became effective. This act outlawed the use of "set" gill nets or trammel nets in saltwater areas of Louisiana and restricted flounder harvest by the use of "strike" nets between the third Monday in October to March 1 of the following year. A "Restricted Species Permit" was required in order to harvest flounder, and several criteria were established in order to qualify for that permit. After March 1, 1997, all harvest by gill or trammel nets was banned, and commercial harvesters must utilize other legal commercial gear to harvest flounder. The affect from this set of regulations substantially reduced the harvest of flounder by this segment of the commercial fishing industry.

A second set of regulations became effective on May 1, 1996. Recreational harvesters were restricted to a creel limit of ten southern flounder, with one day's limit in possession. At the same time, the use of strike nets for the harvest of southern flounder was outlawed, and other commercial harvesters were limited to a possession limit of ten fish per person aboard a commercial vessel. This set of regulations reduced the ability of some recreational harvesters to retain southern flounder and also reduced the harvest potential of the commercial fishing industry.

In 1997, regulations were again changed by Acts 1163 and 1352 of the 1997 Regular Legislative Session. Recreational and commercial harvesters continued to have a daily take limit of ten fish but were allowed that take the limit for each day on the water. Additionally, commercial shrimping vessels are limited to 100 pounds of southern flounder per shrimping trip.

Commercial landings have fluctuated over the period 1950-1996 with the highest landings in the mid 1980s and mid 1990s at 0.94 and 0.97 million pounds, respectively (Figure 5.5). Regulatory measures implemented in 1995 and 1996 had much to do with the reduction in commercial harvest of 61,755 and 94,898 pounds in 1996 and 1997, respectively. Recreational landings were equal to or greater than those of the commercial fishery until 1991 when the commercial fishery began harvesting a greater percentage of the total harvest (Figure 5.6). As a result of the regulatory measures described above, the recreational harvest was greater than the commercial harvest in 1996 and 1997. Harvest from the recreational fishery has fluctuated for the years examined (1981-1997) but has been relatively stable since 1988. Mean catch-per-trip from the recreational fishery was calculated by selecting those trips that had southern flounder in the catch. The means with 95% confidence limits are presented in Figure 5.7. The CPUE indices seem to cycle over the years examined with 1987 having the lowest mean CPUE. Since 1990, CPUE has shown a declining trend with 1997 being significantly lower then 1982, 1983, 1988,1990 and 1991. CPUE data from the department's fishery-independent trammel net (750' - 1⅝" inner, 6" outer wall) and 16-foot flat otter trawl samples were calculated as follows:

$$\text{Mean CPUE} = (\exp (\sum \ln (\text{catch} + 1) / N)) - 1$$

where, catch is the total number caught in each set, and N is the number of samples taken annually. Trammel net data were used for 1986-1998, and 16-foot trawl data were used for 1967-1998. Trammel net samples are collected from October through March. In order to use the most recent data available in this report, trammel net CPUE was estimated for two periods (January-March and October-December). This allowed the use of 1998 data through December. The CPUE estimates from trammel nets fluctuated without any indication of a downward trend (Figure 5.8A-C). The large amount of variation in January-March samples for 1987 is due to small sample size (Figure 5.8A). Standardized CPUE estimates presented in Figure 5.8C indicate better than average catches in the latter half of the years examined with five of the last six years being above average. Trawl data was used to provide an index of young-of-the-year recruitment. The long-term data base provided by 16-foot trawl data shows how CPUE cycles over time and represent natural fluctuations in recruitment. Whatever the cause of the cyclic nature of the indices, no evidence from the 16-foot trawl data indicates a long-term downward trend in CPUE for southern flounder (Figure 5.9).

It should be noted that the following results of YPR and SPR analysis do not reflect the impact of current regulations described above. With this type of general assessment, it will take several years before the impact of regulations will be observed in the disappearance rates from the fishery.

The results of YPR analysis indicate that if $M=0.5$ (the most conservative value within the range of estimates), the fishery prior to existing regulations was operating between $F_{0.1}$ and F_{MAX}, with yields of 93% to 94% of maximum and SPR at 27% to 28%. An M of 0.8 (the highest value within the range examined) would produce yields of 65% to 67% of maximum with SPR at 51% to 52% (Table 5.4).

Regulations implemented since 1995 have significantly reduced harvest and have likely reduced fishing mortality rates from those currently estimated. SPRs that will result from current regulations will likely be above 30%.

Research and Data Needs

Estimates of natural mortality used in the present assessment show wide variation. This variation reduces the reliability of the present assessment in providing an accurate prediction of the potential yield of the stock, and also reduces the confidence level of the present estimate of SPR. A more precise estimate of natural mortality would assist in both of these problems.

Annual age-length keys should continue to be developed to provide catch-at-age data necessary to conduct age-based population assessments. The department is in the process of collecting otoliths for development of annual age-length keys.

The relationship between wetlands losses or modifications and the continuation of fishery production within the state has been discussed by many authors. However, this relationship is likely to be different for the various fishery species. Understanding of this relationship for southern flounder should be an ongoing priority.

In the presence of changing regulations, fishery-dependent information is not a reliable source of data necessary to assess the status of a fish stock. However, such data is necessary to measure the effects of fishing on that stock. Consistent fishery-dependent and fishery-independent data sources, in a comprehensive monitoring plan, are essential to understanding the status of fishery stocks, and to identifying causes of changes in stock abundances. Present programs should be assessed for adequacy with respect to their ability to evaluate stock status and modified or enhanced to optimize their capabilities.

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Table 5.1. SAS output from length-weight regression analysis.

```
The SAS System

Model: MODEL1
Dependent Variable: LOG_W

                       Analysis of Variance

                           Sum of        Mean
        Source      DF    Squares       Square      F Value      Prob>F

        Model        1   54.62048     54.62048    14726.405      0.0001
        Error      966    3.58291      0.00371
        C Total    967   58.20339

          Root MSE     0.06090     R-square      0.9384
          Dep Mean     2.90704     Adj R-sq      0.9384
          C.V.         2.09497

                       Parameter Estimates

                        Parameter      Standard    T for H0:
       Variable    DF    Estimate         Error   Parameter=0    Prob > |T|

       INTERCEP     1   -5.386116    0.06836746     -78.782        0.0001
       LOG_L        1    3.183690    0.02623508     121.352        0.0001
```

Age-at-length distribution of fish used in age-length key development.

Length (inches)	AGE								
	0	1	2	3	4	5	6	7	Total
5		1							1
6									
7		1							1
8	6	4							10
9	2	10							12
10	12	17							29
11	10	21	3	2					36
12	5	40	8	2					55
13	8	57	8	3					76
14	4	94	29	1					128
15	1	139	38	5			1		184
16		122	48	7	1				178
17	1	87	53	14	3				158
18		64	45	13	2	3			127
19		34	33	7	5	2		1	82
20		10	16	2	6	1			35
21		10	15	8	5				38
22			3	4	1		1		9
23			5	2	3	1			12
24				3	1	2			6
25					1				1
26				1					1
Total	49	712	304	74	28	9	2	1	1,179

Table 5.4 Results of Yield per Recruit and SPR Analysis for Southern Flounder

M=0.5

	F Ratio	YPR	SPR	%SPR	%YPR	
F-max =	2.0000	0.6437	0.3218	11.70%	100.00%	Benchmarks
F0.1 =	0.5521	0.5600	1.0143	36.86%	87.00%	
F30% =	0.7207	0.5950	0.8256	30.00%	92.44%	
F20% =	1.1450	0.6302	0.5504	20.00%	97.90%	
1994 Commercial=	0.6000	0.5721	0.9535	34.65%	88.88%	Estimates
1995 Commercial=	0.7700	0.6020	0.7818	28.41%	93.52%	
1996 Commercial=	0.7300	0.5964	0.8170	29.69%	92.65%	
1997 Commercial=	0.3666	0.4867	1.3276	48.24%	75.61%	
1994 Recreational=	0.8000	0.6057	0.7571	27.51%	94.09%	
1995 Recreational=	0.7700	0.6020	0.7818	28.41%	93.52%	
1996 Recreational=	0.8000	0.6057	0.7571	27.51%	94.09%	
1997 Recreational=	0.7656	0.6014	0.7855	28.54%	93.43%	

M=0.6

	F Ratio	YPR	SPR	%SPR	%YPR	
F-max =	2.0000	0.5608	0.2779	14.06%	100.00%	Benchmarks
F0.1 =	0.6678	0.4757	0.7099	35.91%	84.83%	
F30% =	0.8460	0.5038	0.5931	30.00%	89.84%	
F20% =	1.3629	0.5422	0.3954	20.00%	96.68%	
1994 Commercial=	0.5000	0.4332	0.8638	43.70%	77.24%	Estimates
1995 Commercial=	0.6700	0.4762	0.7082	35.82%	84.91%	
1996 Commercial=	0.6300	0.4679	0.7401	37.44%	83.42%	
1997 Commercial=	0.2666	0.3213	1.2027	60.84%	57.29%	
1994 Recreational=	0.7000	0.4818	0.6858	34.69%	85.92%	
1995 Recreational=	0.6700	0.4762	0.7082	35.82%	84.91%	
1996 Recreational=	0.7000	0.4818	0.6858	34.69%	85.92%	
1997 Recreational=	0.6656	0.4753	0.7116	36.00%	84.75%	

M=0.7

	F Ratio	YPR	SPR	%SPR	%YPR	
F-max =	2.0000	0.4858	0.2405	16.49%	100.00%	Benchmarks
F0.1 =	0.7970	0.4105	0.5126	35.13%	84.49%	
F30% =	0.9842	0.4332	0.4377	30.00%	89.16%	
F20% =	1.6064	0.4726	0.2918	20.00%	97.28%	
1994 Commercial=	0.4000	0.3140	0.7826	53.63%	64.63%	Estimates
1995 Commercial=	0.5700	0.3671	0.6416	43.97%	75.55%	
1996 Commercial=	0.5300	0.3566	0.6705	45.95%	73.40%	
1997 Commercial=	0.1666	0.1819	1.0896	74.67%	37.44%	
1994 Recreational=	0.6000	0.3742	0.6213	42.58%	77.03%	
1995 Recreational=	0.5700	0.3671	0.6416	43.97%	75.55%	
1996 Recreational=	0.6000	0.3742	0.6213	42.58%	77.03%	
1997 Recreational=	0.5656	0.3660	0.6446	44.18%	75.33%	

M=0.8

	F Ratio	YPR	SPR	%SPR	%YPR	
F-max =	2.0000	0.4218	0.2086	18.93%	100.00%	Benchmarks
F0.1 =	0.9435	0.3596	0.3788	34.37%	85.25%	
F30% =	1.1347	0.3777	0.3306	30.00%	89.56%	
F20% =	1.8747	0.4174	0.2204	20.00%	98.98%	
1994 Commercial=	0.3000	0.2134	0.7089	64.33%	50.59%	Estimates
1995 Commercial=	0.4700	0.2742	0.5812	52.74%	65.02%	
1996 Commercial=	0.4300	0.2622	0.6074	55.12%	62.16%	
1997 Commercial=	0.0666	0.0659	0.9870	89.57%	15.62%	
1994 Recreational=	0.5000	0.2826	0.5629	51.08%	67.00%	
1995 Recreational=	0.4700	0.2742	0.5812	52.74%	65.02%	
1996 Recreational=	0.5000	0.2826	0.5629	51.08%	67.00%	
1997 Recreational=	0.4656	0.2730	0.5840	52.99%	64.72%	

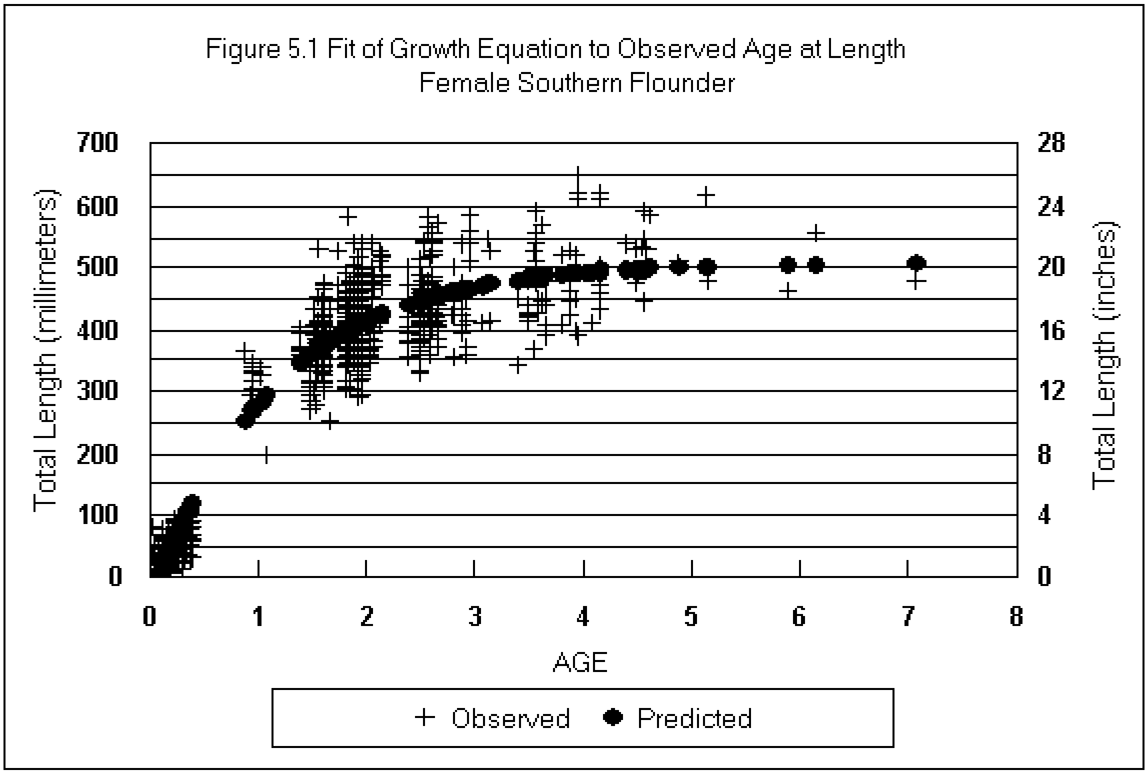


Figure 5.1 Fit of Growth Equation to Observed Age at Length
Female Southern Flounder

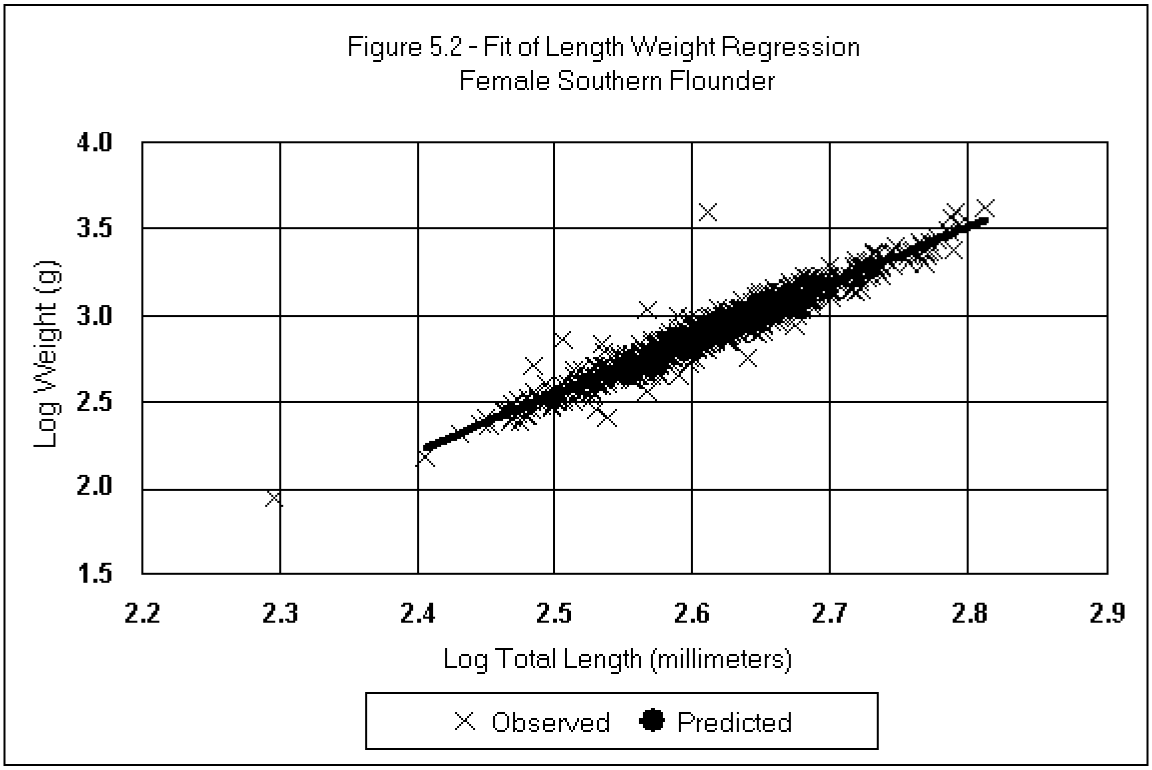


Figure 5.2 - Fit of Length Weight Regression
Female Southern Flounder

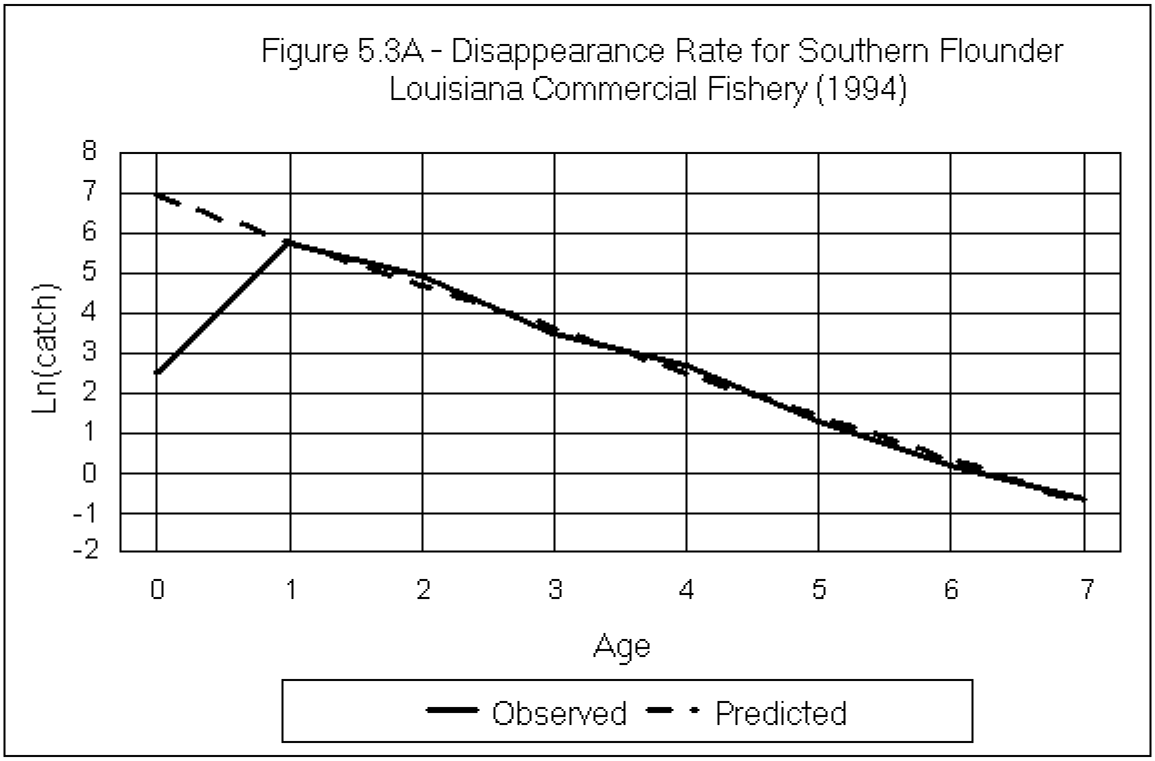


Figure 5.3A - Disappearance Rate for Southern Flounder Louisiana Commercial Fishery (1994)

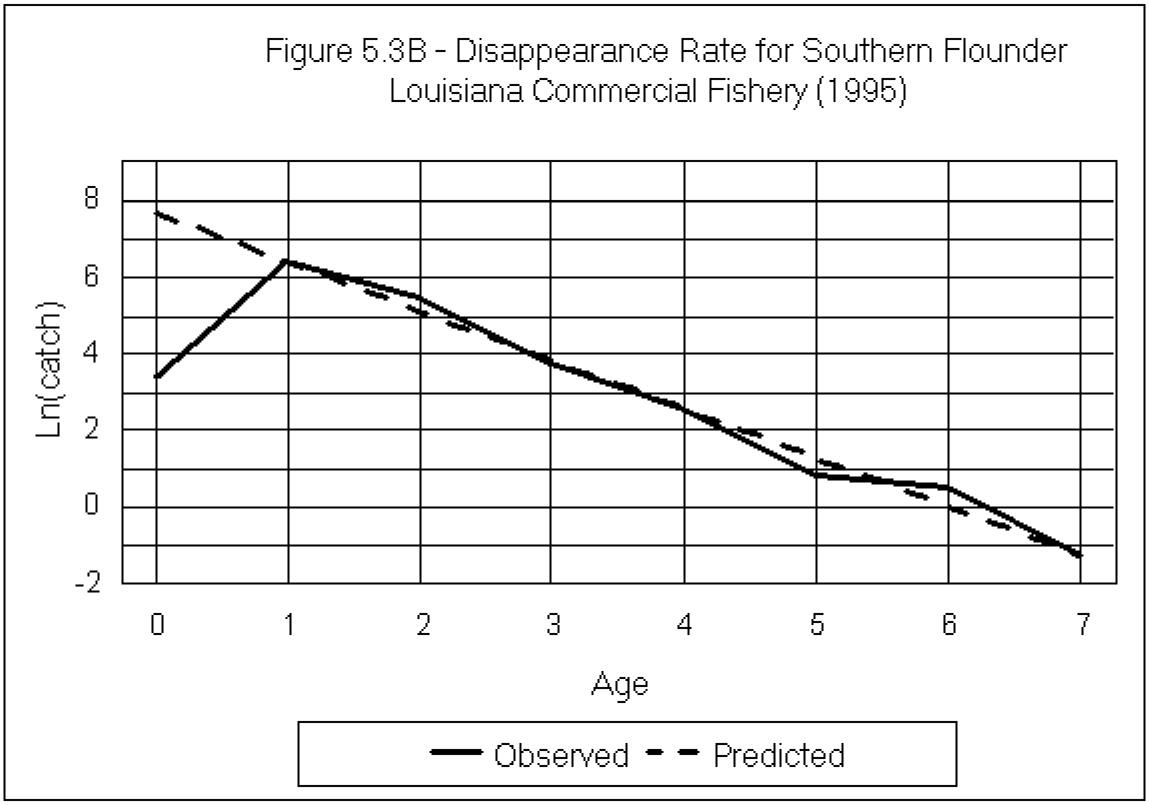


Figure 5.3B - Disappearance Rate for Southern Flounder Louisiana Commercial Fishery (1995)

Figure 5.3C - Disappearance Rate for Southern Flounder
Louisiana Commercial Fishery (1996)

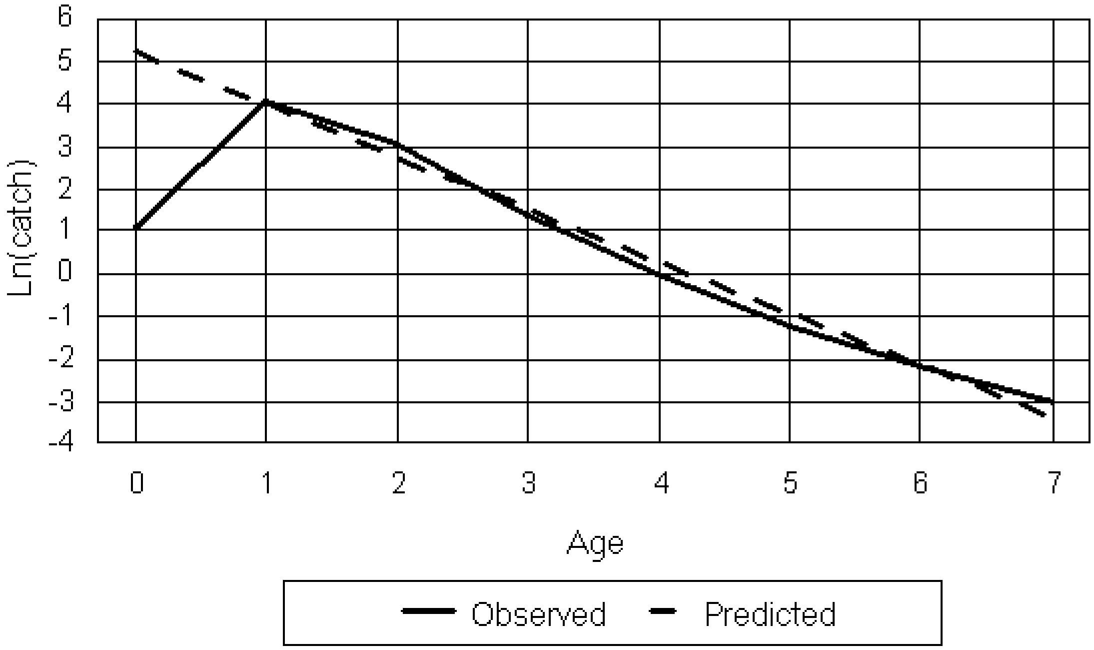


Figure 5.3D - Disappearance Rate for Southern Flounder
Louisiana Commercial Fishery (1997)

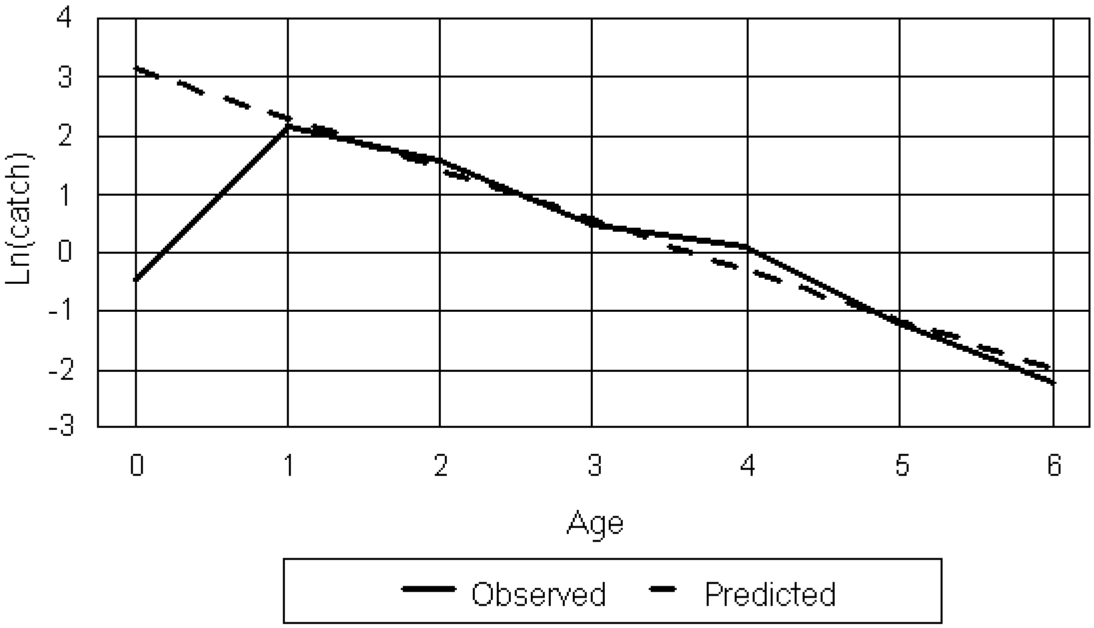


Figure 5.4A - Disappearance Rate for Southern Flounder
Louisiana Recreational Fishery (1994)

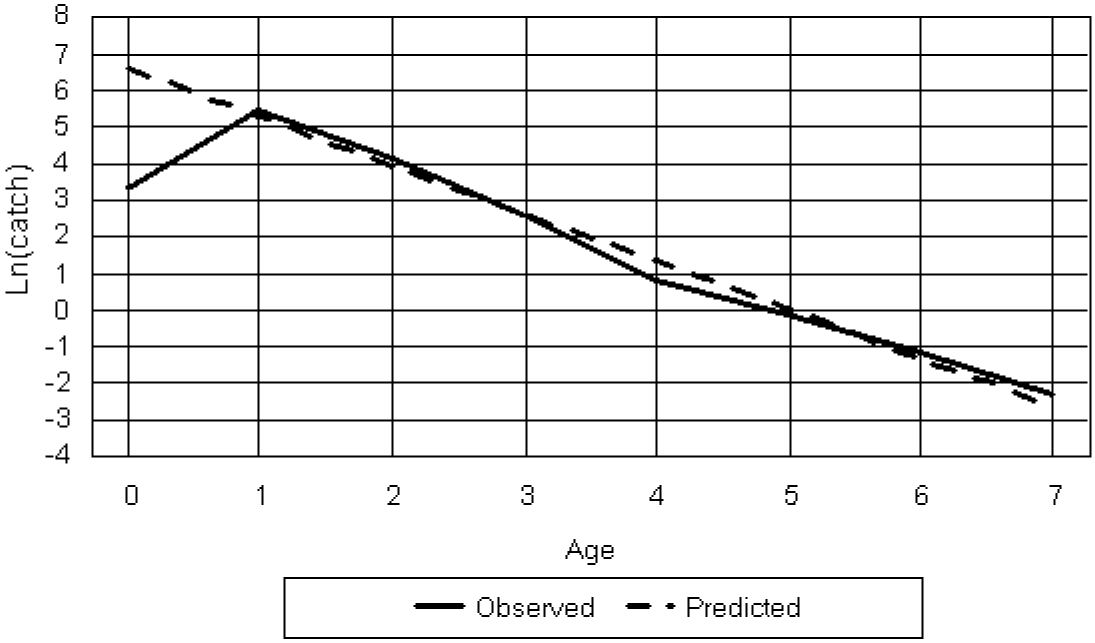


Figure 5.4B - Disappearance Rate for Southern Flounder
Louisiana Recreational Fishery (1995)

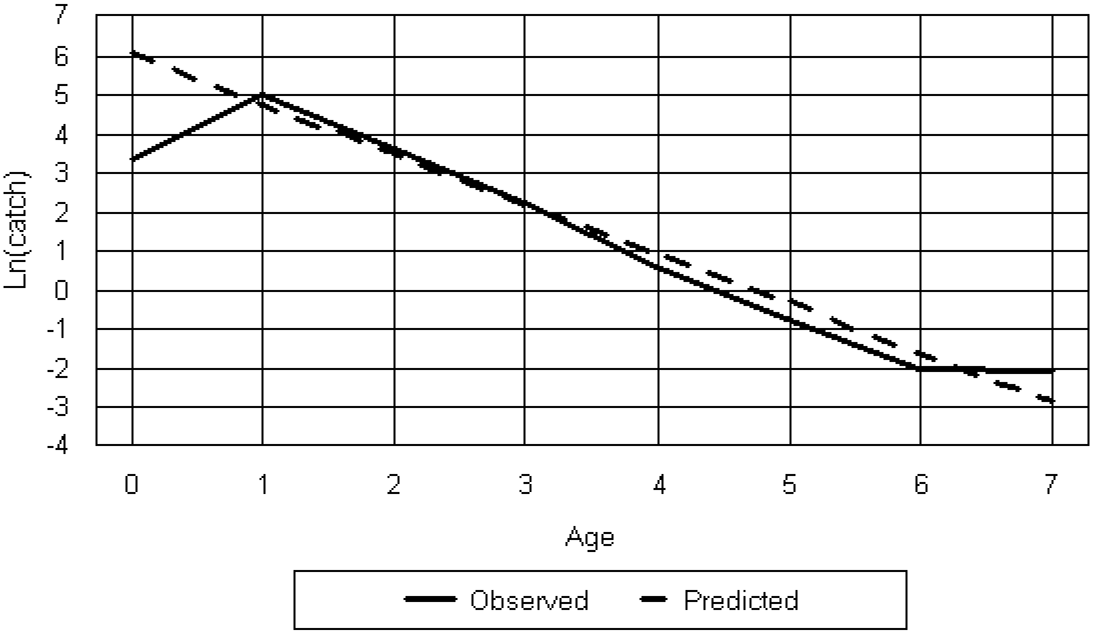


Figure 5.4C - Disappearance Rate for Southern Flounder
Louisiana Recreational Fishery (1996)

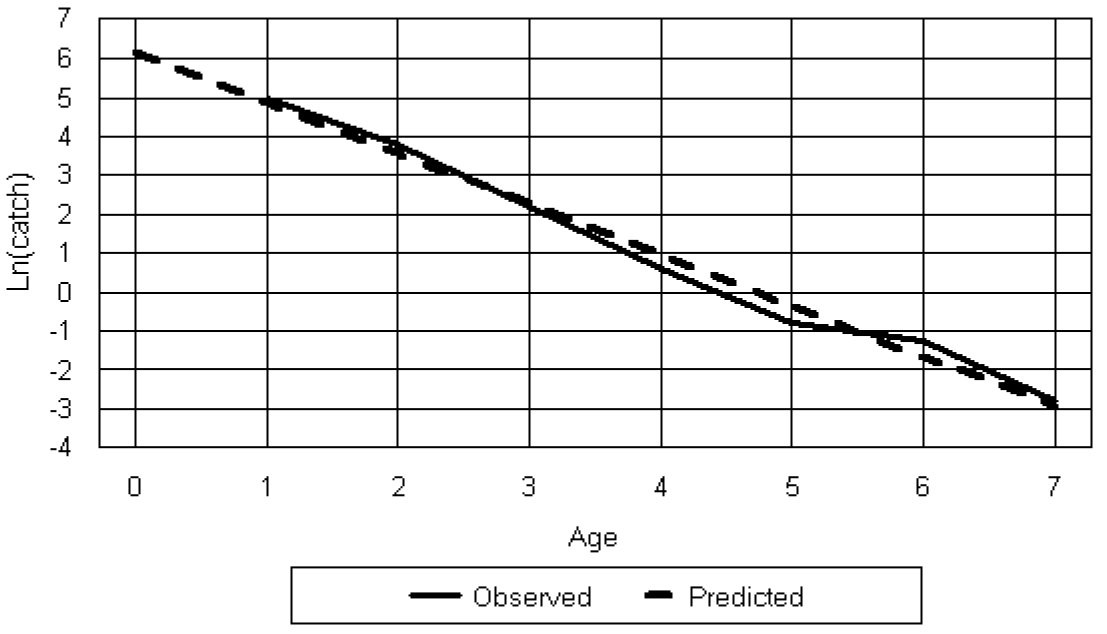


Figure 5.4D - Disappearance Rate for Southern Flounder
Louisiana Recreational Fishery (1997)

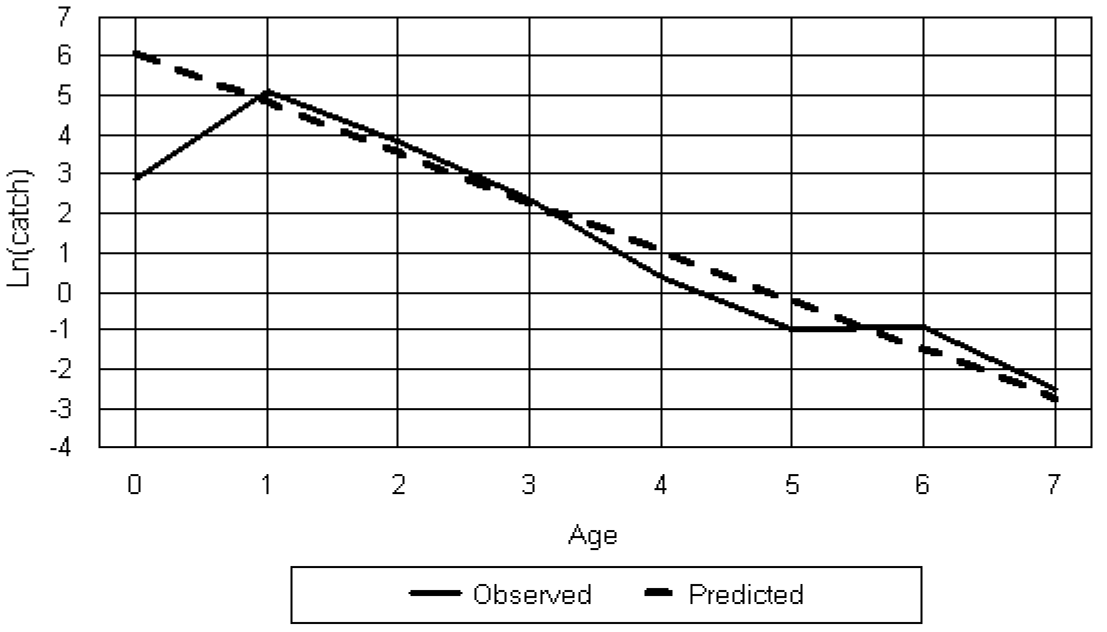


Figure 5.5 - Commercial Harvest of Southern Flounder in Louisiana

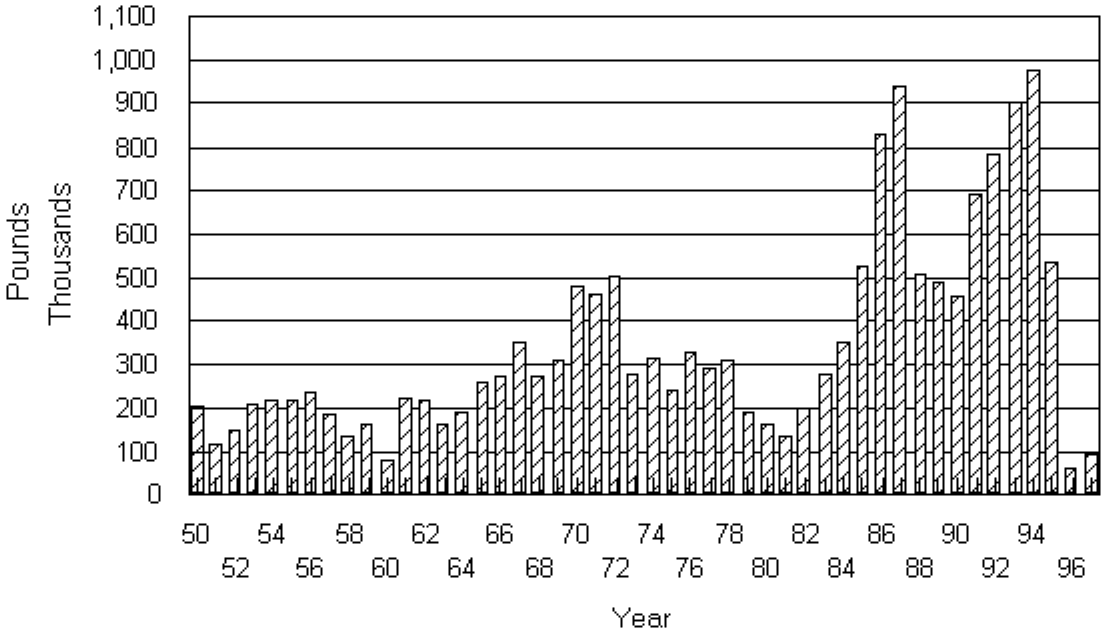


Figure 5.6 - Louisiana Commercial and Recreational Harvest of Southern Flounder

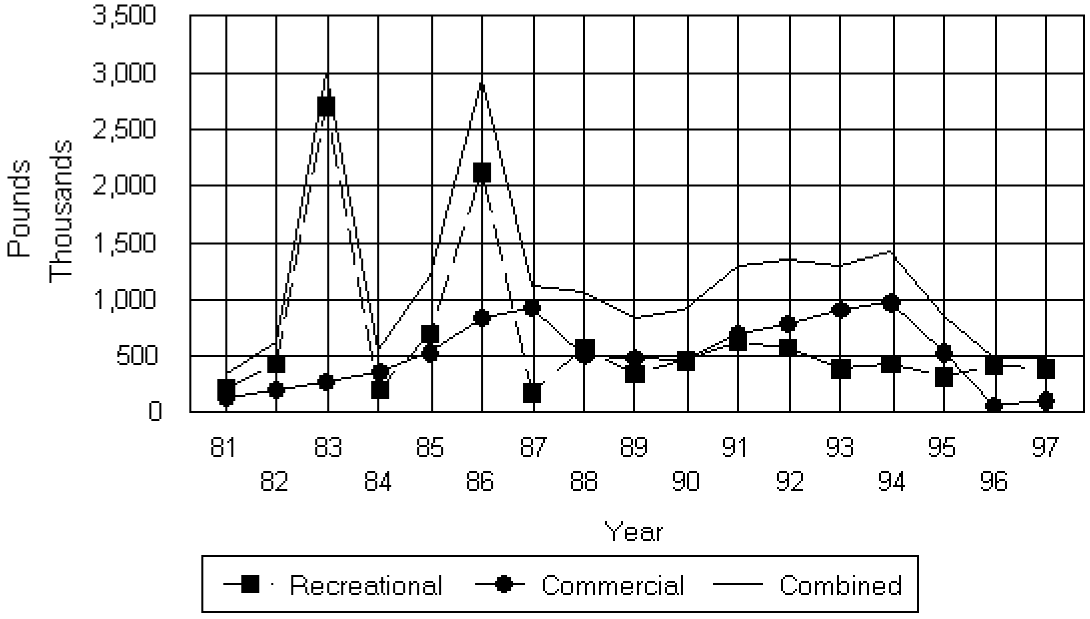


Figure 5.7 - Catch per Effort of Southern Flounder in Louisiana
NMFS Marine Recreational Fishery Statistics Survey

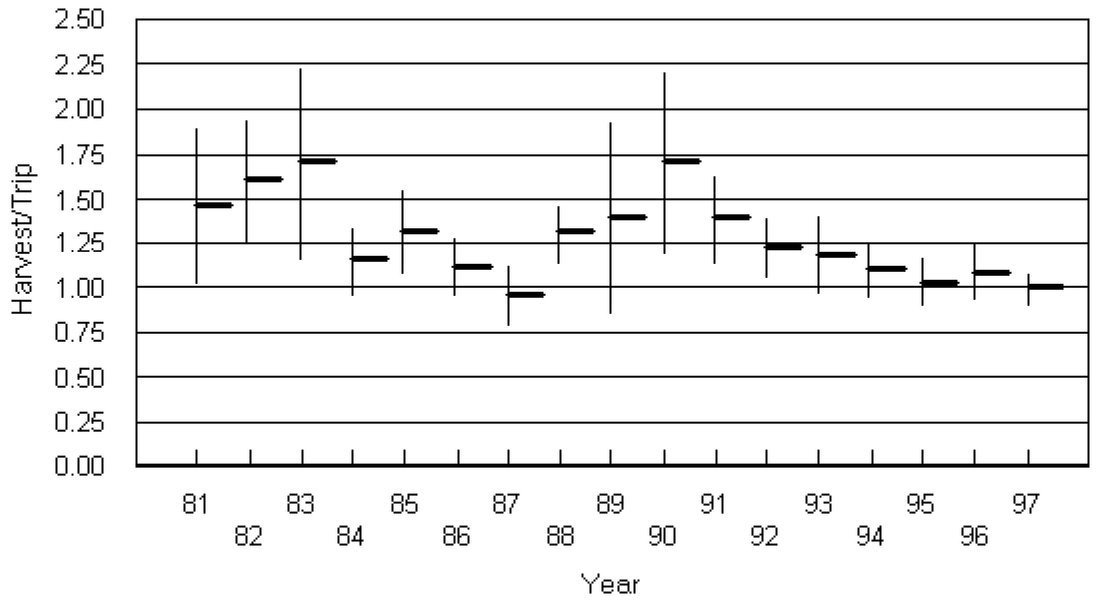


Figure 5.8A - Catch per Effort of Southern Flounder in Trammel Nets
Marine Fisheries Division, Monitoring Program (January - March)

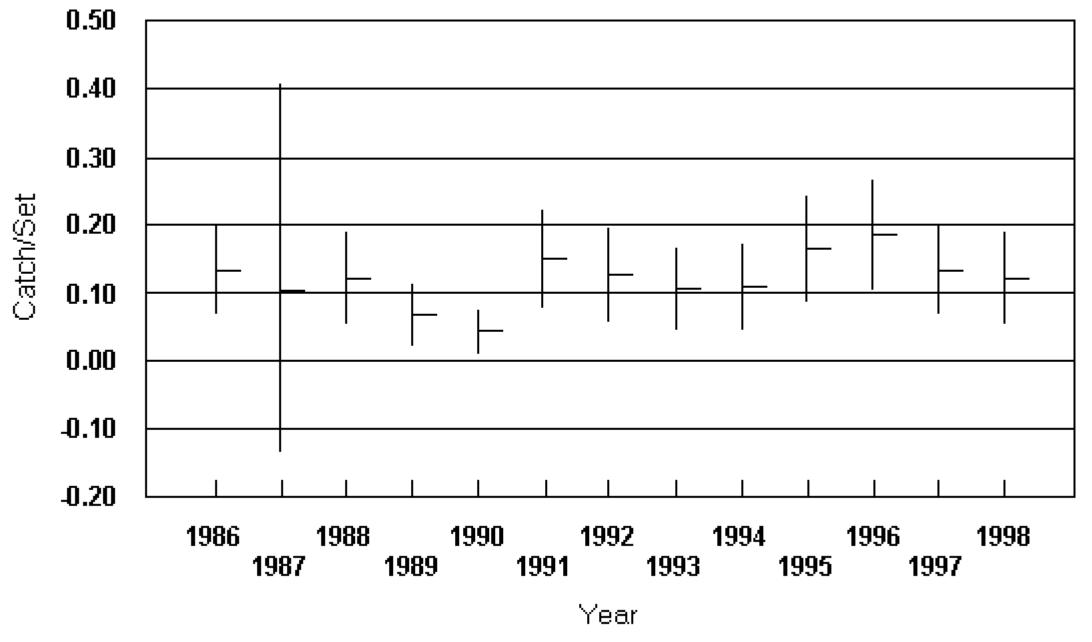


Figure 5.8B - Catch per Effort of Southern Flounder in Trammel Nets
Marine Fisheries Division, Monitoring Program (October - December)

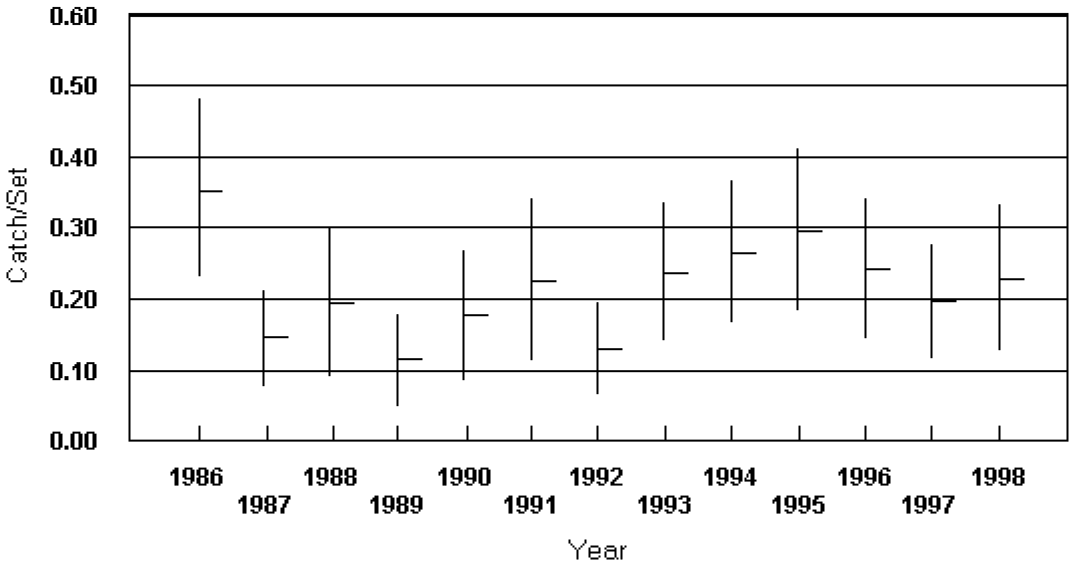
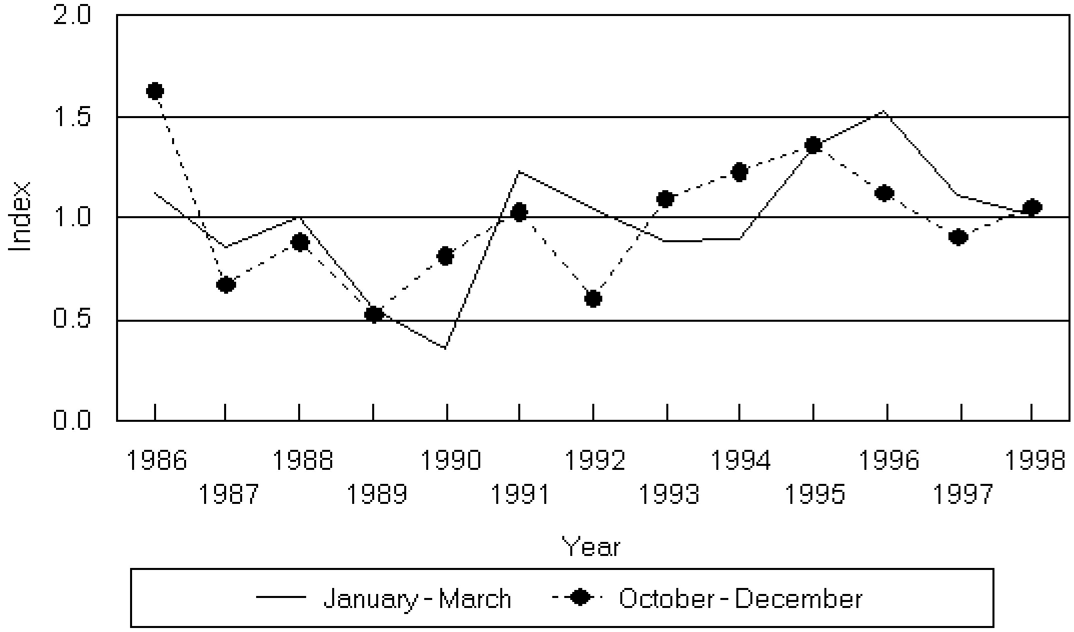


Figure 5.8C - Standardized CPUE of Southern Flounder in Trammel Nets
Marine Fisheries Division, Monitoring Program



14.3.3 Assessment of the Eastern Gulf Stocks - A Stock Assessment of Southern Flounder and Gulf Flounder, prepared by Michael D. Murphy, Robert G. Muller, and Ben McLaughlin, Florida Marine Research Institute

Executive Summary

Nearly all the flounder landings in Florida consist of three species: gulf flounder *Paralichthys albigutta*, southern flounder *P. lethostigma*, and summer flounder *P. dentatus.* Summer flounder were not directly included in this assessment except within data that could not be separated to the species level, e.g. commercial landings in the flounder category. Their center of abundance is within the Middle Atlantic Bight of the U.S.,and they are only a minor component of the flounder landings in northeast Florida.

Gulf flounder ranges along the entire Florida coast while southern flounder is absent between the Loxahatchee River on the Atlantic coast and the Caloosahatchee River on the Gulf coast. Their distributions appear to be related to substrate type with gulf flounder dominant on sand bottoms and southern flounder more restricted to soft substrates, such as mud, clay, or silt. Gulf flounder is also less tolerant of low salinities, rarely found in less than 20‰; southern flounder appear to prefer salinities of less than 20‰ while in estuaries. Both flounders move offshore during the late fall in response to dropping water temperatures. Spawning occurs offshore in 20-60 m (66-197 feet) during the late fall-winter. Both feed on copepods as larvae, other crustaceans and amphipods as juveniles, and fish as adults. Female southern flounder mature at age-3 or 4; female gulf flounder mature at age-2. Southern flounder get larger and older than gulf flounder. Female southern flounder reach 700 mm (27.5 inches) total length and seven years; female gulf flounder reach about 450 mm (18 inches) and three years. Males of both flounders do not get as large or as old as females.

Landings of flounder in Florida are about equally split between the recreational and commercial fisheries. In 1993, statewide landings were 1,008,000 pounds with about two-thirds occurring on the Atlantic coast. Flounder landings are greatest during the fall and are made most often using shrimp trawls, hook and line, or gill nets. Modal lengths of flounders landed range from 250 to 350 mm (10-14 inches) depending on the species landed and gear used. Penaeid shrimps or black mullet dominate the commercial landings made in conjunction with flounder, except in south Florida where Spanish mackerel and pompano are a large component of the landings made with flounders. Only in northwest and northeast Florida do flounder rank in the top three species landed, by weight, during commercial trips that reported flounder landings. Most commercial trips landing flounder land fewer than 50 pounds per trip. The by-catch of small juvenile flounders appears to be significant in the shrimp fishery in the St. Johns River. Elsewhere in the state, flounders were a relative small portion of the discarded bycatch. About 85% of the anglers targeting flounder catch less than two flounder per trip on either the Atlantic or Gulf coasts.

Flounder landings did not show an overall trend between 1980 and 1993. Within this time frame, Atlantic coast landings were lowest in 1987 and increased through 1992. Gulf coast landings were high in 1986-1988 but have recently returned to levels only slightly less than those made in the early 1980s. Recent fishing effort has declined in the commercial fishery since reaching a peak number of trips in 1991. The number of trips taken by anglers has increased on the Atlantic coast but decreased on the Gulf. The CPUE in the commercial fishery has declined on both coasts. Catch-per-angler-hour has remained steady except for a decline in CPAH for southern flounder on the Atlantic coast. Changes in CPUE have generally offset changes in effort so that overall harvest has fluctuated but without a long-term trend.

The available information is not adequate for a traditional assessment of the status of flounder in Florida. However, a rough characterization of the population dynamics of gulf flounder suggests that it is unlikely that gulf flounder are being fished at a maximum level of yield per recruit. Little can be determined about the spawning stock biomass of gulf flounder but the production of juveniles showed a peak in 1992 in the Tampa Bay. In theory, southern flounder and summer flounder should be more susceptible to growth and recruitment overfishing than gulf flounder. This can be inferred from their longer life spans (lower natural mortality), slower relative growth rates, and older ages at maturity.

Biological Characteristics

Data Sources. General reviews of the biology of southern flounder *Paralichthys lethostigma* by Reagan and Wingo (1985) and Gilbert (1986) are used throughout this section. Specific published (Stokes 1977, Music and Pafford 1984, Wenner et al. 1990) and unpublished reports (Smith et al. unpublished manuscript) are also used. Little data are available on the biological characteristics of southern flounder from Florida.

Notes on the general biology of the gulf flounder *Paralichthys albigutta* are included in the review by Gilbert (1986) who relied heavily on Stokes (1977) and Nall (1979). Little data on the biological characteristics of gulf flounder are available from Florida. As of August 1994, 76 gulf flounders sampled mostly in the Panhandle were available for analyses (FMRI unpublished data).

Morphometrics. Least-square regressions of southern flounder log-transformed weight and length data collected in South Carolina (Smith et al. unpublished manuscript), Georgia (Music and Pafford 1984), Northwest Florida (Nall 1979), and Texas (Harrington et al. 1979) are:

for males,
SC:$\log_{10}$(Wt,g) = 3.17$\log_{10}$(TL,mm)-5.38; n=675, 110-476 mm, r^2 = 0.98
GA:$\log_{10}$(Wt,g) = 2.98$\log_{10}$(TL,mm)-4.89; n=12, range ?, r^2 = 0.95
for females,
SC:$\log_{10}$(Wt,g) = 3.15$\log_{10}$(TL,mm)-5.33; n=926, 106-703 mm, r^2 = 0.99
GA:$\log_{10}$(Wt,g) = 2.97$\log_{10}$(TL,mm)-4.84; n=105, range ?, r^2 = 0.92
and for all fish collected,
SC:$\log_{10}$(Wt,g) = 3.14$\log_{10}$(TL,mm)-5.31; n=1753, 53-710, r^2 = 0.99
GA:$\log_{10}$(Wt,g) = 3.09$\log_{10}$(TL,mm)-5.16; n=233, 125-700, r^2 = 0.98
FL:$\log_{10}$(Wt,g) = 3.10$\log_{10}$(SL,mm)-4.92; n=175, 130-490, r^2 = ?
TX:$\log_{10}$(Wt,g) = 3.13$\log_{10}$(TL,mm)-5.26.

Insufficient statistical documentation is available to evaluate the significance of differences in weight-length relations between sexes or among areas.

Predictive equations between standard length and total length, in millimeters, are also available from these studies for South Carolina, Florida, and Texas:

SC: TL = 1.19 + 8.45 SL
FL: SL = 5.34 + 0.82 TL
TX: TL = 1.17 + 8.96 SL

The length-weight relation for gulf flounder determined from 34 unsexed individuals collected in northwest Florida and southern Alabama (Nall 1979) was:

$$\log_{10}(\text{Weight,g}) = 2.81 \log_{10}(\text{SL,mm}) - 4.23.$$

The length-weight relation (standard errors of parameters in parentheses) for gulf flounder sampled mostly from Choctawhatchee Bay (FMRI unpublished data) was:
$\log_{10}$(Wt,g) = 2.9969 $\log_{10}$(TL,mm) - 4.90622, n = 73, r^2 = 0.965
(0.067953) (0.030943).

These samples were almost exclusively from females with only seven males represented in the data base. Inspection of the data did not suggest any differences in length-weight relation between the sexes (Figure 1).

The linear regression of standard length on total length, in millimeters, for specimens collected in Nall's (1979) study was:
SL = -4.82 + 0.833 TL; n=34, r^2=0.99.

Predictive regressions for length-length conversions estimated from unpublished FMRI data for gulf flounder are:
TL = 21.64 + 1.127 SL; n=76, r^2=0.978 SL = 12.01 + 0.867 TL; n=76, r^2=0.978.

Stock Distribution

Southern flounder occurs from Albemarle Sound, North Carolina south to the Loxahatchee River on the lower east coast of Florida. It is absent from there south and around the tip of peninsular Florida but occurs in the Caloosahatchee River estuary, on the southwest coast of Florida and from there around the Gulf of Mexico to northern Mexico (Gilbert 1986). Southern flounder are common out to 47 m depths (Nall 1979). Springer and Woodburn (1960) did not collect southern flounder during an intensive study of the Tampa Bay area. Likewise, FMRI fishery-independent monitoring of juvenile fish populations have not collected southern flounder from Charlotte Harbor or Tampa Bay since sampling began in 1989. The wide break in their distribution at the southern tip of Florida suggests there is a reasonable possibility of distinct subpopulations of southern flounder in Florida.

The gulf flounder ranges from Cape Lookout, North Carolina, to the Laguna Madre, Texas, usually in waters less than 92 m deep but occasionally in waters as deep as 128 m (Ginsburg 1952, Hildebrand 1954, Simmons, 1957, Guntherz 1967). It has been recorded from the extreme western Bahamas (Bolke and Chaplin 1968), and its center of abundance is in the eastern Gulf of Mexico along the coast of Florida (Topp and Hoff 1972). West of the Mississippi River delta it occurs in very low numbers (Matlock 1982, Miller 1965, Gunter 1945, Hildebrand 1954).

Three flounders are responsible for the bulk of the flounder landings in Florida: southern flounder, gulf flounder, and summer flounder *Paralichthys dentatus*. These species show distinct differences in relative abundance along Florida's coastline. Gulf flounder is the most common flounder landed along the Gulf coast. Southern flounder is landed primarily west of Apalachee Bay but with less frequency than that of the gulf flounder. Gulf flounder is the only species that occurs in southeast Florida. From Cape Canaveral north, summer flounder apparently dominate the commercial landings, followed by southern flounder then gulf flounder (Topp and Hoff 1972). However, during extensive sampling of inshore waters from Volusia County south to Brevard County (FMRI unpublished data), no summer flounder juveniles have been captured. These samples indicate that gulf flounder is the most abundant, large paralichthid flounder in shallow waters of east-central Florida. It appears likely that juvenile summer flounder do not occur in inshore areas sampled by the FMRI juvenile monitoring program. Southern flounder is less abundant in this area and apparently occur in deeper waters than does gulf flounder (FMRI unpublished data).

Habitat Requirements and Distribution Patterns

In culture, southern flounder yolk-sac larvae begin to metamorphose into post larvae at 40-46 days after attaining lengths of 8-11 mm. Metamorphosis is complete by about 50 days (Arnold et al. 1977). There is no information on the habitat requirements of larval southern flounder. The pelagic larval stage apparently occur over the continental shelf where spawning is reported to occur (Benson 1982). Early stage postlarvae grow most rapidly at high salinities (about 30‰) and are not very tolerant of lower salinities (Gilbert 1986).

Post-larval and early juveniles southern flounder move into estuaries during the winter (Wenner et al. 1990). Williams and Deubler (1968) reported that juveniles are found in Atlantic estuaries when temperatures are as low as 2°-4°C. Juveniles begin to immigrate into Texas bays when water temperatures are as low as 13.8°C. Peak immigration occurs when water temperatures average about 16°C (Gilbert 1986). Southern flounder become euryhaline at an advanced post-larval or early juvenile stage, at which time they can survive abrupt changes in salinity and thrive 5‰-15‰ (Deubler 1960, Stickney and White 1973). Postlarval southern flounder held in aquaria actively withdrew from areas with oxygen concentrations less than 3.7 ml/L (Deubler and Posner 1963).

Juvenile and adult southern flounder prefer soft substrates of rich organic muds, clay, or silt (Gilbert 1986). This substrate preference may explain why southern flounder is the dominant, large paralichthid flounder in the muddier western Gulf of Mexico and why southern flounder is not distributed on the sandier southern Florida shelf (Lynch 1954).

Adult southern flounder have been found over a wide temperature and salinity range. Perret et al. (1971) reported collecting southern flounder in Louisiana in waters 5.0°-34.9°C, although adults appear to emigrate from estuaries when water temperatures drop rapidly during early winter (Stokes 1977). Adult southern flounder often ascend rivers and appear to prefer waters less than 20‰ while within estuaries (Gilbert 1986). Hickman (1968) found that adults showed seasonal changes in their osmoregulatory abilities that corresponded to migrations into and out of estuaries.

The inshore-offshore patterns of movement of southern flounder are related to spawning activities. Tagging studies in Texas suggest only limited movement of southern flounder within and between Texas bays (Stokes 1977). In contrast, Music and Pafford (1984) found that southern flounder in Georgia moved (on average) over 50 km from where they had been tagged. The greatest movement appeared to occur during the fall and was directed toward the south, possibly indicating movement to higher salinity areas and warmer waters for the winter. There is no information on the habitat requirements of larval gulf flounder.

Juvenile gulf flounder occur over a wide range of salinities and temperatures, 13.7‰-33.7‰ and 11.2° - 32.5 °C (Springer and Woodburn 1960) but are rarely collected from waters with salinities less than 20‰. In Texas, gulf flounder are apparently limited to waters less than 45‰, but a few specimens have been reported taken at 60‰ (Simmons 1957). In Atlantic estuaries, juvenile gulf flounder are found at water temperatures as low as 2°-4°C (Williams and Deubler 1968). Juvenile gulf flounder immigrate into Texas estuaries from the Gulf of Mexico at water temperatures as low as 13.8°C, but peak ingress occurred between 16.0° and 16.2°C (Stokes 1977).

Analyses of the distribution of collections of adult gulf flounder made in the Gulf of Mexico indicates a strong preference for hard, sandy bottoms in waters with salinities of 20‰ or greater (Gunter 1945, Ginsburg 1952, Reid 1954, Springer and Woodburn 1960, Williams and Deubler 1968, Topp and Hoff

1972, Stokes 1977, Nall 1979). Adult gulf flounder have been found in temperatures ranging from 8.3°C (Reid 1954) to 32.5°C (Springer and Woodburn 1960). Gulf flounder left Aransas Bay, Texas, when mean water temperature dropped from 23.0°C in October to 14.1°C in December. Maximum emigration often coincided with the passage of cold fronts, when sudden drops in temperature occurred (Stokes 1977).

The distribution of adult gulf flounder does not appear to be related to the distribution of aquatic vegetation, but juveniles utilize vegetation. Stokes (1977) found juvenile gulf flounder to be most abundant in areas of the estuary where dense patches of shoal grass (*Diplanthera wrightii*) were present (30% to 60% of area). Reid (1954) also reported juvenile gulf flounder to be more abundant on shallow grass flats around Cedar Key. Springer and Woodburn (1960) suggested that specimens collected in grass flats are actually taken from sandy areas within and adjacent to the grass flats.

Food Habits

Food habits of larval southern flounder have been implied from their acceptance of copepods, *Artemia* nauplii, and rotifers in culture aquaria (Deubler 1958, Peters and Angelovic 1971, Lasswell et al. 1977). Houde and Taniguchi (1979) suggested that copepod nauplii dominate the food of many larval fishes, including those of the flounder genus *Pleuronectes.*

Juvenile southern flounder eat a variety of invertebrates but become piscivorous when they reach about 200 mm TL (Gilbert 1986). Mysids and paleomonid shrimps are apparently the most abundant food items taken by juveniles (Stokes 1977, Powell and Schwartz 1979, Wenner et al. 1990). Fishes eaten by larger juveniles or adults were mummichog (*Fundulus heteroclitus*), spot (*Leiostomus xanthurus*), striped mullet (*Mugil cephalus*), fat sleepers (*Dormitator maculatus*), menhaden (*Brevoortia*), and anchovies (*Anchoa* spp) (White 1962, Stokes 1977, Wenner et al. 1990).

Reid (1954) reported that gulf flounder under 45 mm TL fed primarily on amphipods and other small crustaceans. At larger, sizes they fed primarily on fish (Reid 1954, Springer and Woodburn 1960, Topp and Hoff 1972, Stokes 1977, Powell and Schwartz 1979). This shift in diet was also noted by Stokes (1977) for fish from Aransas Bay. Genera or species of fishes that have been found in the diet of gulf flounder include anchovies (*Anchoa* spp.), mullet (*Mugil* spp.), menhaden (*Brevoortia* spp.), Atlantic croaker (*Micropogonias undulatus*), and pinfish (*Lagodon rhomboides*) (Reid 1954, Darnell 1958, Springer and Woodburn 1960, Fox and White 1969, Topp and Hoff 1972, Stokes 1977, Overstreet and Heard 1982).

Predators

There is no information on the predators of the various life history stages of southern or gulf flounders.

Reproductive Life History

Southern flounder spawn from September through April with peak activity during the period November-January (Gunter 1945). Spawning apparently occurs at depths of 20-60 m (Benson 1982), although winter records of trawl catches indicate southern flounder occur out to about 140 m depths in the South Atlantic Bight area (Wenner et al. 1990). Stokes (1977) and Shepard (1986) also cite offshore spawning for southern flounder in the Gulf of Mexico.

The only available estimates of fecundity for southern flounder are from captive spawns which averaged 40,000 eggs for 1-3 kg fish (Arnold et al. 1977). It is unknown if southern flounder are fractional spawners and, if so, how frequently they spawn.

No estimates have been made of the relationship of fecundity to length, weight, or age of southern flounder.

Male southern flounder apparently reach maturity at 225-315 mm total length when between ages-2 and 3, while females mature between 330 and 360 mm when between three and four years old (Wenner et al. 1990). These ages agree with other observations of size and age at maturity (Stokes 1977, Manooch and Raver 1984, Powell 1974), except for those reported by Nall (1979). Nall (1979) reported that maturity was first reached at four years and that all fish were not mature until age-6. Topp and Hoff (1972) suggested that females mature at much smaller sizes in Florida, about 145 mm SL.

Adult gulf flounder spend most of the year in bays and estuaries, emigrating into deeper offshore waters to spawn during fall and winter. Movement appears to be triggered by drops in water temperature associated with cold fronts. Stokes (1977) reported ripe adults leaving Aransas Bay, Texas, from mid October through December. Spawning evidently occurs offshore, and specimens with ripe gonads have been collected at depths of 20-40 m in the eastern Gulf of Mexico between November and February (Topp and Hoff 1972). Gulf flounder first become mature at age 2

(Stokes 1977). No fecundity data are available for the gulf flounder.

Larval gulf flounder appear in the eastern Gulf of Mexico from December to early March (Topp and Hoff 1972). Juveniles are first seen in the bays and estuaries beginning in January throughout their range, with peak ingress usually occurring in early February (Reid 1954, Springer and Woodburn 1960, Tagatz and Dudley 1961, Stokes 1977).

Growth Patterns

There is no information available on the growth of larval and early juvenile southern flounder.

The growth of juvenile and adult southern flounder has been investigated using validated annuli enumerated from whole otoliths (Wenner et al. 1990). Young-of-the-year southern flounder appear to consist of a group of fast growing, early spawned individuals and a group of more slowly growing, late spawned individuals. During their second year of life male growth becomes much slower than female growth (Stokes 1977, Music and Pafford 1984, Wenner et al. 1990). While few males attain ages of greater than three years, females continue to grow and may attain seven years of age and 700 mm TL in the South Atlantic Bight area. Younger maximum ages and smaller maximum sizes have been reported for the Gulf of Mexico (580 mm, age 5 in western Florida, Palko 1984; 606 mm, age 4 in Texas, Stokes 1977). Von Bertalanffy growth models (with asymptotic standard errors in parentheses) for South Carolina southern flounder were:
for males,

$$\text{mm TL} = \underset{(80.0)}{518}\,(1-\exp(\underset{(0.074)}{-0.246}(\text{Age} + \underset{(0.210)}{1.066}))),\quad n = 442$$

and for females,

$$\text{mm TL} = \underset{(51.4)}{759}\,(1-\exp(\underset{(0.029)}{-0.235}(\text{Age} + \underset{(0.072).}{0.570}))),\quad n = 511$$

Age and growth data for southern flounder collected in the northern Gulf of Mexico (Nall 1979) did not show the asymptotic growth found by other studies and appeared unrealistic (Wenner et al. 1990). Although its accuracy is questionable, the maximum age reported for southern flounder in the northeastern Gulf is nine years (Nall 1979). In general it appears that southern flounder from the South Atlantic Bight area are smaller through age-2, but tend to live longer and attain a larger maximum size than their Gulf of Mexico conspecifics (Wenner et al.1990).

The only published age and growth study on the gulf flounder was conducted by Stokes (1977), who concluded, based on a total of 123 specimens, that female and male gulf flounder live only three and two years, respectively. Males grew more slowly than females and never exceeded 290 mm total length (Stokes 1977). Stokes (1977) also believed that older gulf flounder might reside outside of his sampling area in deeper Gulf waters.

Preliminary age determination of 67 gulf flounder sampled in Florida found most fish to be one or two years old (Figure 2). Only four fish were older than age-2, two females at age-3 and two males, one at age-3 and one at age-4. Gulf flounder ranged from about 250-410 mm total length at age 1, 305-440 mm at age-2, and 325-450 mm at age-3. The single male at age-4 was 455 mm long. These sizes at age are similar to those found for Texas gulf flounder (Stokes 1977), except for the relatively large sizes of some males found in northwest Florida. Few males were sampled from Florida, possibly because their typical maximum size falls below the sizes efficiently retained by the commercial gear used to capture most of the fish sampled.

Fishery Characteristics

Data Sources. Prior to 1986, commercial landings data were collected by the NMFS from monthly dealer reports. Historical commercial landings for flounders had to be adjusted because of inflated landings by a West coast dealer for the period prior to June 1984. We adjusted the landings from that dealer using a multiple regression model that used year, month, the landings of other dealers within the same county, and a dummy variable for period (Muller and Murphy 1994). Gulf coast landings had to be adjusted approximately 30% lower to account for over-reporting by a dealer before 1985.

The Department of Environmental Protection's Marine Fisheries Information System, more commonly known as the Trip Ticket System, began in November 1984 and became the sole source of Florida's commercial fisheries statistics in 1986. Under this system, the landings of all species from each commercial fishing trip are recorded together with information on license number, gear, time fished, fishing area, and date. Since NMFS landings for 1985 are the official landings, we treated tickets from 1985 as a sample that could provide commercial CPUE values for 1985. The landings summaries used edited batches 145-262 and 295-304 and unedited batches 263-294 and 305-326. Trip ticket data through 1991 are complete and edited. Part of the trip ticket data for 1992 and 1993 are unedited, but these data are considered complete. Detailed analyses of trip tickets such as composition of catches, numbers of saltwater products licenses, and trip-poundage categories were based on 1992 and 1993 data. Additional information on the species composition and length, weight, and ages of fish landed in the commercial fishery was collected in 1992, 1993, and 1994 through the Florida Marine Institute's Biostatistical Sampling Program.

The NMFS Marine Recreational Fisheries Statistical Survey (MRFSS) collects information from approximately 27,000 fishing trips each year and estimates participation rates from approximately 40,000 random calls to households in Florida. MRFSS produces estimates of the number of fish caught, kept, and released as well as trips by coast, two-month period, fishing mode, and area. Landings estimates from the initial year of the survey, 1979, were excluded from the summaries in accordance with NMFS procedures.

The NMFS is revising their estimation protocols and will provide FDEP with new estimates when the numbers become available. New estimates are available only for 1991 through 1993. Therefore to maintain consistency in the estimates, the recreational information in this report used NMFS's original estimates and "old" 1991 through 1993 estimates.

Commercial Harvest

The landings from commercial trips that reported flounder are dominated by penaeid shrimps, black mullet, and Spanish mackerel. Penaeid shrimps or black mullet dominate the landings made in conjunction with flounder along the Gulf coast south to Monroe County. In south Florida, Spanish mackerel and pompano were caught in abundance with flounder. North of Palm Beach County, penaeid shrimps again dominate the commercial landings co-occuring with flounder, along with black mullet and whitings. Most commercial trips landing flounder land fewer than 50 pounds per trip (Table 2). With the dominant species indicated, it is clear that most flounder landed in the state are captured using trawls or gill nets while fishermen target penaeid shrimps with trawls or black mullet, Spanish mackerel, or pompano with gill nets.

Statewide commercial landings for flounder decreased significantly (t-test of $\beta = 0$, $t = 3.58$, $df = 14$, $P < 0.01$) during 1978-1993. Annual statewide landings averaged about 570,000 pounds before dropping to less than 400,000 pounds in 1986 (Figure 3). Commercial landings have gradually increased since then reaching 450,00-550,000 pounds in 1991 and 1992. Statewide flounder landings in 1993 were 285,000 pounds, the lowest level recorded since at least 1978.

Coast-wise commercial landings of flounders showed significant declines on both the Atlantic ($t = 2.49$, $P < 0.05$) and Gulf ($t = 3.74$, $P < 0.01$) coasts. Atlantic coast landings averaged just over 320,000 pounds a year during 1978-1985. Since 1986, landings have averaged 256,000 pounds with only 158,000 pounds reported landed in 1993. Commercial effort on the Atlantic coast increased steadily since record keeping began in 1986 until 1991. The number of successful trips increased from 5,900 in 1987 to 9,800 in 1991. The number of trips has declined since and was about 5,900 trips in 1993 (Figure 4). The trend in the annual Gulf coast landings reflects the statewide landings trend, a decline between the periods 1978-1985 and 1986-1993. Landings declined from an average of 245,000 pounds during the late 1970s-early 1980s to 177,000 pounds during the late 1980s-early 1990s. The 1993 Gulf landings of 127,000 pounds were the lowest since at least 1978. Commercial effort for flounder on the Gulf coast increased steadily beginning in 1986 and reached a peak in 1991 at 19,500 trips (Figure 4). The number of trips has declined since then and was about 11,700 trips in 1993.

A slight majority of the total commercial landings of flounders in Florida comes from the Atlantic coast. Between 51% and 68% of the total landings during 1978-1993 came from the Atlantic coast where nearly 70% of the landings were made in two counties, Duval and Volusia (Figure 5). Most of the remaining landings are evenly split between Nassau, St. Johns, and Brevard counties. On the Gulf coast, most of the landings have historically come from the panhandle region, especially Franklin and Okaloosa counties. Recent landings are distributed (relatively) even among Escambia, Bay, Franklin, Dixie, Pinellas, and Lee counties.

The distribution of commercial flounder trips mirrors the distribution of landings on the Atlantic coast. Most successful commercial trips were taken in Duval and Volusia counties in 1992 and 1993 (Figure 5). On the Gulf coast, the number of commercial trips was greatest in Lee County in 1992 and 1993 whereas landings were distributed evenly among several counties. It follows that catch per trip for flounders was lower in Lee County than in Escambia, Bay, Dixie, or Pinellas counties.

Commercial landings of flounder are generally highest during the fall (Figure 6). In northwest Florida, 54% of the annual landings are made in October, November, and December. Likewise, 45% of the landings in the Southeast, 40% of the landings in the Northwest, and about 30% of the landings in the Southwest are made during these months.

Flounder landings were reported by 2,587 saltwater products license holders in 1993. This was down from 3,257 license holders reporting flounder landings in 1992 (Table 4). Most of the license holders reported annual landings of less than 100 pounds.

The modal total length of flounders sampled from commercial landings during 1992-1994 was generally 350 mm on the Atlantic coast and between 300 and 350 mm on the Gulf coast (Figure 7). Except for two gulf flounders, the entire sample from the Atlantic coast was made up of southern flounder. Only gulf flounder were sampled and measured on the Gulf coast. This flounder does not get as large as southern or summer flounder. No summer flounder were sampled from the commercial catch by the TIPS program.

Flounders are caught commercially using trawl, gill net, gig, hook-and-line, and trammel nets. Too few flounder were sampled from each of these gears to characterize the sizes of the different species of flounder caught by these gears on each coast (Figure 7). No flounder landed by trawl were sampled for lengths. On the Atlantic coast, gill and trammel nets caught similar-sized flounders (Figure 7). However, in general there appears to be little difference in length frequencies of flounder caught by gill net, spear, or hook and line on the Gulf coast (Figure 15.19).

Recreational Harvest

Estimates of the number of gulf and southern flounder landed by recreational fishermen varied without trend (t-test of $\beta = 0$, Atlantic, $t = 0.42$, $df = 13$, $P > 0.50$; Gulf, $t = 0.80$, $df = 13$, $P > 0.4$) on either coast of Florida during the period 1980-1993. Estimates of landings varied widely ranging from 40,000-357,000 fish (average = 193,000 fish) on the Atlantic coast and 87,000-523,000 fish (average = 266,000 fish) on the Gulf coast (Table 5, Figure 8). Landings estimates for the Atlantic coast recreational fishery were at the highest levels observed since the mid 1980s during 1992-1993. An average of 291,000 fish (552,900 pounds) were landed each year during 1992 and 1993.

The recreational fishing effort on the Atlantic coast fluctuated widely around a mean of 202,200 trips during 1980-1989. Since then trips have increased steadily; in 1993, 432,100 trips were made (Table 5, Figure 4). Gulf coast recreational landings varied around an average of about 225,000 fish (250,000 pounds) each year since 1980 except for a period of high landings during 1986-1988 when about 415,000 fish (605,000 pounds) were landed each year. West coast recreational effort has fluctuated but appeared to be consistently higher during the mid 1980s than during recent years. The most recent effort levels (1992-1993) averaged 180,000 trips (Figure 4).

While flounders are targeted by sport fishermen using various methods (hook and line, still fishing, drift fishing, casting from shore) one of the more popular methods for catching these fish is by "gigging" at night in shallow water, using a long-handled, three pronged spear and a torch or flashlight (DeSylva 1965). Sport fishing usually begins in spring (when fish return from deeper waters offshore) and continues into fall. Based on the numbers of fish intercepted during the MRFSS, over 99% of the flounder on the Atlantic coast and 87% of the flounder sampled from the West coast were captured using hook-and-line gear. Spears apparently represent a frequently used gear; 12% of the flounder sampled on the Gulf coast were reported captured by spear.

Several species of flounders were identified in the recreational catch landed between 1980 and 1993. The three most abundant on the Atlantic coast were gulf flounder, southern flounder, and summer flounder. Length samples for each of these species had modal lengths between 250 and 350 mm total length. On the Atlantic coast, gulf flounder had a modal length of 250 mm while southern and summer flounder had a modal length of 350 mm (Figure 9). On the Gulf coast, gulf flounder and southern flounder had modal lengths of 300 mm total length.

In general, recreational landings of flounders appears to be greatest during the late summer through fall. Landings of southern flounder on the Atlantic coast appear to peak in the summer then possibly again during the late fall (Figure 10). Southern flounder landings on the Gulf coast seem to be greatest during the fall. Most landings of gulf flounder on the Gulf coast occur during the second half of the year.

Bycatch

Flounder are commonly captured as bycatch in the shrimp trawl fishery. In general, flounder command a high enough price that those caught by the shrimp fishery are landed and sold. Larger southern flounder were retained by commercial shrimp fishermen operating in Pensacola Bay (Coleman et al. 1993).

Coleman et al. (1993) investigated the by-catch of both the inshore food-shrimp fishery and the bait-shrimp fishery. Southern flounder was a minor bycatch species in Pensacola Bay and gulf flounder occurred infrequently in the catches from Choctawhatchee Bay south to Biscayne Bay. Southern flounder was abundant in the bycatch of the shrimp fishery within the St. Johns River, ranking just behind the drums and trouts in abundance. Berkeley et al. (1985) also found that gulf flounder occurred as a relatively small bycatch in Biscayne Bay's bait-shrimp fishery.

Combined Harvest

The statewide 1993 total landings of flounders were 1,080,000 pounds, 672,000 pounds landed on the Atlantic coast and 336,000 pounds landed on the Gulf coast. Atlantic coast landings were lowest in 1987 and have increased in recent years (Figure 11). Total landings on the Gulf coast were high in 1986-1988 and have since returned to their prior levels. There was no significant trend in either coast-wise or statewide total landings of flounders in Florida between 1980 and 1993 ((t-test of $\beta = 0$; Atlantic, $t = 0.43$, $df = 12$, $P > 0.50$; Gulf, $t = 0.86$, $df = 12$, $P > 0.4$; State, $t = 0.30$, $df = 12$, $P > 0.50$). The commercial to recreational split of landings averaged about 1:1 on the Atlantic coast and 1:1.4 on the Gulf coast during 1980-1993.

Assessment

Trends in abundance. Median catch-per-angler-hour (CPAH) for southern flounder has varied without trend between 1979 and 1993 on the Atlantic coast (t-test of $\beta = 0$, $t = 1.38$, $df = 13$, $P > 0.20$) but apparently declined on the Gulf coast ($t = 3.16$, $df = 13$, $P < 0.01$). Since 1989, the median CPAH has been zero for all years except 1992 on the Atlantic coast and 1991 on the Gulf (Figure 12).

Median catch-per-angler-hour for gulf flounder has been zero since 1979 on the Atlantic coast. On the Gulf coast, CPAH has varied without trend ($t = 0.61$, $df = 13$, $P > 0.50$) between 1979 and 1993. Median CPAH for gulf flounder was over 0.2 fish for much of the 1980s but has recently returned to levels similar to rates estimated for the late 1970s-early 1980s (Figure 12).

The mean catch per trip for commercial fishermen declined significantly on both coasts (t-test of $\beta = 0$; Atlantic, $t = 3.83$, $df = 7$, $P < 0.01$; Gulf, $t = 4.82$, $df = 7$, $P < 0.01$) during 1985-1993. On the Atlantic coast, peak catch per trip was 57 pounds in 1985 (Figure 13). On the Gulf coast peak catch per trip was 18 pounds in 1986. This declined to about 27 pounds per trip on the Atlantic coast and to about 10 pounds per trip on the Gulf coast in 1993 (Figure 13).

Mortality Estimates

Data are not available for estimation of mortality rates for any of the economically important flounders in Florida.

Recruitment

The only paralichthid flounder captured regularly by the Fisheries-Independent Monitoring Program operating in Tampa Bay, Charlotte Harbor, Indian River Lagoon, or Choctawhatchee Bay is the gulf flounder. Since this flounder has a fall/winter spawning period the spring monitoring programs were analyzed for trends in total catch. Total catch in Tampa Bay increased dramatically in 1992 suggesting recruitment of a large year-class to the bay (Figure 4). In Charlotte Harbor peak total catches occurred in 1990 and 1992. While a relatively large number of gulf flounder are captured in the Choctawhatchee Bay monitoring program, routine sampling began there only in 1993. Too few gulf flounders were captured in the Indian River Lagoon system for a complete analyses.

Equilibrium Yield and Spawning Potential Per Recruit

Available information is inadequate for assessment of the biological condition of the flounders in Florida. Catch and effort data are available for the flounder complex; however, these data cannot be validly used to calculate surplus production of this complex. All species within this group will not respond to fishing in the same way because their life history traits are different. Southern flounder and summer flounder get older and larger than gulf flounder and probably have a lower rate of natural mortality.

Traditional species-specific assessments based on yield- or spawning-stock-biomass-per-recruit analyses are not possible without age composition data. With that said, it is possible to estimate the effects of regulations using a stochastic procedure developed by Restrepo and Fox (1988). This analysis uses informed guesses about the values of ratios for particularly important population parameters (Beverton and Holt 1957) to compute the median changes in yield-per-recruit that would be expected given changes in exploitation ratio (E) or in recruitment-size ratio (C). Changes in exploitation ratio imply changes in fishing mortality and changes in recruitment-size ratio imply changes in size limits.

We applied this approach to construct a preliminary simulation of the effect of fishing on gulf flounder. With data available from FMRI sampling of gulf flounder in Florida, the following ratios for important parameters were determined: 1) the ratio of M/K (instantaneous natural mortality to Brody growth coefficient) ranges from 1.0-1.5; 2) the ratio of the size at recruitment to the maximum size, C (length at entry to fishery to asymptotic length) ranges from 0.6 to 0.7; and 3) the exploitation ratio, E (instantaneous fishing mortality to instantaneous total mortality coefficient), ranges from 0.25 to 0.50. The M/K ratio combines a range of guesses of the value of M, 0.5-0.75, with an estimate of K from the FMRI dataset, 0.51. The C ratio combines an approximate size at recruitment of 275-325 mm with an estimate of asymptotic length, 465 mm. The estimate of E was the most difficult to arrive at objectively. In this case, it was simply assumed that fishing mortality ranged from one-third the estimate on natural mortality to one and one-half times the estimate of natural mortality. Therefore, E ranged from 0.25 to 0.60.

Results from the simulation indicate that reducing the size at first entry from the present 11 inch minimum size or increasing fishing mortality cause a positive change in the median yield per recruit of gulf flounder (Figure 15). These observations make intuitive sense considering the short life span (high natural mortality) and rapid growth (to a relatively small asymptotic size) of gulf flounder. However, it should be noted that the results from yield-per-recruit analyses do not account for the potential reduction in recruitment that could be associated with a reduced spawning stock biomass caused by an increase in fishing mortality. Therefore, lacking the necessary data to conduct an assessment of the spawning potential ratio of gulf flounder, the yield-per-recruit analysis should be viewed with caution.

The effect of changing fishing mortality or age at entry for gulf flounder will also effect other species of flounder. Fishermen do not generally distinguish among the flounder species that they catch. Based on their longer life spans, slower relative growth, and larger sizes at maturity, southern and summer flounder should be more sensitive to fishing than gulf flounder. Therefore, it would be more biologically sound to manage the flounder fishery based on these species, the most sensitive to fishing pressure, than on gulf flounder.

Present and Possible Future Condition of the Stock

Unknown.

Management

History of Management. There is a minimum size limit of 11" total length for all species of flounder or "fluke" caught in Florida. The Atlantic States Marine Fisheries Commission (1982) recommended implementation of a 14" minimum size limit for summer flounder. This was recommended to increase yield per recruit and allow more females the opportunity to spawn. Maturity data used to formulate these recommendations come from fish collected from Delaware Bay. It is likely that size at maturity is smaller in Florida since many fishes show smaller sizes at maturity in the more southern reaches of their ranges.

A bag-limit analysis was included as part of the aggregate bag limit (memo from R. Muller to V.Vail, August 29, 1994) and that same information (memo Tables 12 and 13) is included here as Tables 6 and 7. An analysis of the number of flounder retained by anglers targeting flounder showed that nearly half the anglers in the state either did not catch a flounder when targeting them. On the Atlantic coast, about 75% of flounder landed by anglers are caught by anglers landing three or fewer flounder per trip; 95% of the landings are from anglers landing 12 or fewer flounder per trip (Table 6). On the Gulf coast, about 75% of flounder landed by anglers are caught by anglers landing six or fewer flounder per trip; 95% of the landings are from anglers landing 30 or fewer flounder per trip (Table 6). Only small bag limits create substantial reductions in the harvest of flounders. For example, a six-fish bag limit gives an average reduction of only 3% on the Atlantic coast and 10% on the Gulf.

Research Needs

The following items are not listed by priority. FMRI has an informal program looking at age-and-growth of Gulf flounder inshore. Needed areas of research include:

1. Identification of species composition of flounders in the recreational and commercial catch throughout Florida.
2. Determination of southern and summer flounder mixing rates with more northern populations along the Atlantic coast.
3. Age composition of the commercial and recreational catches of summer, southern, and gulf flounders.
4. Life history and population dynamics of these flounders in Florida waters, including size and age at maturity, growth, spawning seasonality,

fecundity, and mortality.

5. Determination of the factors effecting the distribution of different flounder species and their life history stages in Florida waters, including water characteristics, vegetation, prey densities, and bottom type.

In addition, areas in need of monitoring are:

1. Size, age, and species composition of catches.
2. Levels of recruitment of the various flounders.

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TABLE 1. FLORIDA MARINE RESEARCH INSTITUTE 11:11 FRIDAY, SEPTEMBER 30, 1994 1
MARINE FISHERIES INFORMATION SYSTEM

LANDINGS OF TOP 10 SPECIES ON FLOUNDER TRIPS 1992-1993

EDITED BATCHES 2-309
UNEDITED BATCHES 263-294,310-326

REGION ESCAMBIA-FRANKLIN

		YEAR			
		92		93	
		TRIPS	POUNDS	TRIPS	POUNDS
RANK	SPECIES				
1	Mullet, Black	684	234,173	874	287,516
2	Shrimp, Brown (whole)	625	252,242	395	165,443
3	Flounders	2,100	66,623	2,145	73,461
4	Shrimp, White (whole)	115	56,281	55	15,738
5	Mullet, Silver	39	26,133	17	8,988
6	Crabs, Blue (lbs,hard)	277	12,427	170	14,580
7	Seatrout, Sand	268	17,258	132	9,244
8	Shrimp, Pink (whole)	108	21,979	24	2,538
9	Mackerel, Spanish	182	14,154	140	9,503
10	Snapper, Red	37	19,099	51	4,510
	Other 108 categories		189,769		139,366
REGION			910,138		730,887

TABLE 1 (Con't). FLORIDA MARINE RESEARCH INSTITUTE 11:11 FRIDAY, SEPTEMBER 30, 1994 2
MARINE FISHERIES INFORMATION SYSTEM

LANDINGS OF TOP 10 SPECIES ON FLOUNDER TRIPS 1992-1993

EDITED BATCHES 2-309
UNEDITED BATCHES 263-294,310-326

REGION WAKULLA-HERNANDO

		YEAR			
		92		93	
		TRIPS	POUNDS	TRIPS	POUNDS
RANK	SPECIES				
1	Mullet, Black	2,401	808,348	1,734	564,177
2	Shrimp, Brown (whole)	371	137,714	117	65,145
3	Shrimp, Pink (whole)	158	48,681	493	145,775
4	Sea Bass (common)	299	51,159	395	86,151
5	Grunts	123	20,235	287	100,918
6	Crabs, Blue (lbs,hard)	152	44,308	231	69,602
7	Spot	780	46,236	387	11,330
8	Seatrout, Spotted	414	30,679	749	20,131
9	Flounders	2,975	28,772	2,353	20,287
10	Jack, Crevalle	302	21,428	199	21,376
	Other 141 categories		191,186		183,428
REGION			1,428,746		1,288,320

TABLE 1 (Con't)

FLORIDA MARINE RESEARCH INSTITUTE
MARINE FISHERIES INFORMATION SYSTEM

11:11 FRIDAY, SEPTEMBER 30, 1994 3

LANDINGS OF TOP 10 SPECIES ON FLOUNDER TRIPS 1992-1993

EDITED BATCHES 2-309
UNEDITED BATCHES 263-294,310-326

REGION PASCO-COLLIER

		YEAR			
		92		93	
RANK	SPECIES	TRIPS	POUNDS	TRIPS	POUNDS
1	Mullet, Black	8,081	2,198,773	6,651	1,813,593
2	Shrimp, Pink (whole)	221	168,228	127	204,901
3	Jack, Crevalle	2,875	166,534	2,086	151,856
4	Sheepshead	4,681	140,934	5,067	134,583
5	Seatrout, Spotted	4,822	106,742	3,491	57,791
6	Mojarra	1,906	87,926	1,463	59,605
7	Mackerel, Spanish	1,088	72,310	711	43,800
8	Misc. food fish	3,558	82,154	1,663	24,900
9	Pompano	1,448	49,846	1,231	53,702
10	Flounders	8,269	54,398	6,074	44,721
	Other 163 categories		444,670		441,416
REGION			3,572,515		3,030,868

TABLE 1 (Con't)

FLORIDA MARINE RESEARCH INSTITUTE
MARINE FISHERIES INFORMATION SYSTEM

11:11 FRIDAY, SEPTEMBER 30, 1994 4

LANDINGS OF TOP 10 SPECIES ON FLOUNDER TRIPS 1992-1993

EDITED BATCHES 2-309
UNEDITED BATCHES 263-294,310-326

REGION MONROE-DADE

		YEAR			
		92		93	
RANK	SPECIES	TRIPS	POUNDS	TRIPS	POUNDS
1	Mackerel, Spanish	159	93,258	9	2,893
2	Pompano	162	16,074	8	447
3	Bluefish	159	14,192	7	956
4	Bait fish (pounds)	38	10,668	3	957
5	Jack, Mixed	84	9,192	1	2
6	Shark	33	4,529	2	179
7	Grouper, Red	6	98	3	3,840
8	Lobsters, Spanish (tails)	1	3,520	.	.
9	Seatrout, Spotted	136	2,763	4	49
10	Snapper, Yellowtail	7	1,119	10	1,290
	Other 65 categories		10,967		5,666
REGION			166,380		16,279

TABLE 1 (Con't). FLORIDA MARINE RESEARCH INSTITUTE 11:11 FRIDAY, SEPTEMBER 30, 1994 5
MARINE FISHERIES INFORMATION SYSTEM

LANDINGS OF TOP 10 SPECIES ON FLOUNDER TRIPS 1992-1993

EDITED BATCHES 2-309
UNEDITED BATCHES 263-294,310-326

REGION BROWARD-PALM BEACH

		YEAR			
		92		93	
		TRIPS	POUNDS	TRIPS	POUNDS
RANK	SPECIES				
1	Mullet, Black	2	333	'41	9,342
2	Mackerel, Spanish	16	704	43	6,794
3	Bluefish	13	529	64	5,857
4	Pompano	23	1,525	61	2,775
5	Mojarra	8	720	45	2,935
6	Sheepshead	16	1,039	87	2,122
7	Jack, Crevalle	5	373	22	2,010
8	Misc. food fish	19	672	77	1,628
9	Catfish	.	.	22	1,524
10	Menhaden (Pogies)	.	.	11	1,427
	Other 49 categories		1,292		10,419
REGION			7,187		46,833

TABLE 1 (Con't). FLORIDA MARINE RESEARCH INSTITUTE 11:11 FRIDAY, SEPTEMBER 30, 1994 6
MARINE FISHERIES INFORMATION SYSTEM

LANDINGS OF TOP 10 SPECIES ON FLOUNDER TRIPS 1992-1993

EDITED BATCHES 2-309
UNEDITED BATCHES 263-294,310-326

REGION MARTIN-BREVARD

		YEAR			
		92		93	
		TRIPS	POUNDS	TRIPS	POUNDS
RANK	SPECIES				
1	Mullet, Black	1,015	79,961	801	100,108
2	Shrimp, White (whole)	139	70,212	98	94,554
3	Sheepshead	1,558	80,390	1,154	64,509
4	Whiting	356	33,181	314	55,779
5	Mojarra	1,023	47,532	755	35,281
6	Mackerel, Spanish	427	44,011	292	37,500
7	Shark	92	56,164	68	24,738
8	Flounders	2,427	30,957	1,927	26,407
9	Pompano	625	31,392	442	19,824
10	Bluefish	768	30,326	495	15,215
	Other 103 categories		230,560		218,343
REGION			734,686		692,258

TABLE 1. (Con't). FLORIDA MARINE RESEARCH INSTITUTE 11:11 FRIDAY, SEPTEMBER 30, 1994 7
MARINE FISHERIES INFORMATION SYSTEM

LANDINGS OF TOP 10 SPECIES ON FLOUNDER TRIPS 1992-1993

EDITED BATCHES 2-309
UNEDITED BATCHES 263-294,310-326

REGION VOLUSIA-NASSAU

		YEAR			
		92		93	
		TRIPS	POUNDS	TRIPS	POUNDS
RANK	SPECIES				
1	Shrimp, White (whole)	3,019	1,786,231	1,834	1,041,301
2	Whiting	2,386	358,363	1,654	209,135
3	Shrimp, Brown (whole)	339	130,679	683	327,337
4	Flounders	5,640	222,762	5,361	200,548
5	Mullet, Black	558	97,542	568	98,230
6	Seatrout, Gray	958	44,371	752	45,097
7	Spot	611	33,737	559	45,084
8	Shrimp, Rock (whole)	23	36,327	16	23,128
9	Jack, Mixed	82	22,494	68	17,039
10	Menhaden (Pogies)	69	19,176	59	19,425
	Other 113 categories		200,995		207,359
REGION			2,952,677		2,233,683

TABLE 1 (Con't). FLORIDA MARINE RESEARCH INSTITUTE 11:11 FRIDAY, SEPTEMBER 30, 1994 8
MARINE FISHERIES INFORMATION SYSTEM

LANDINGS OF TOP 10 SPECIES ON FLOUNDER TRIPS 1992-1993

EDITED BATCHES 2-309
UNEDITED BATCHES 263-294,310-326

REGION INLAND/OUT OF STATE

		YEAR			
		92		93	
		TRIPS	POUNDS	TRIPS	POUNDS
RANK	SPECIES				
1	Shrimp, Brown (whole)	5	7,745	1	9,935
2	Mullet, Black	13	5,202	27	10,720
3	Shrimp, Pink (whole)	2	6,571	1	1,995
4	Flounder, gulf	6	439	37	2,203
5	Snapper, Red	.	.	1	1,802
6	Lobsters, Spanish (whole)	2	1,774	.	.
7	Flounders	15	448	45	1,165
8	Sheepshead	2	31	41	1,468
9	Grunts	.	.	3	1,344
10	Spot	9	564	2	45
	Other 35 categories		576		2,835
REGION			23,350		33,512

FLORIDA MARINE RESEARCH INSTITUTE
MARINE FISHERIES INFORMATION SYSTEM

FLOUNDER LANDINGS BY SPECIES AND TRIP CATEGORY 1992-1993

PROGRAM: FLDRA EDITED BATCHES 2-309
UNEDITED BATCHES 263-294,310-326

SPECIES MIXED

		YEAR					
		92			93		
		TRIPS	POUNDS	TIME AWAY FROM DOCK MEAN	TRIPS	POUNDS	TIME AWAY FROM DOCK MEAN
REGION	TRIP CATEGORY						
ESCAMBIA-FRANKLIN	1-49	1,754	22,553	1.7	1,748	21,348	1.5
	50-99	201	13,521	1.5	225	15,449	1.3
	100-249	108	15,808	1.6	139	20,183	1.7
	250-499	34	11,274	2.3	23	6,630	3.3
	500-999	1	658	4.0	7	4,309	2.1
	1000-2499	2	2,809	1.0	2	2,541	1.0
	2500-4999	.	.	.	1	3,001	12.0
	TOTAL	2,100	66,623	1.7	2,145	73,461	1.5
WAKULLA-HERNANDO	TRIP CATEGORY						
	1-49	2,874	18,735	1.2	2,294	13,022	1.2
	50-99	72	5,094	1.2	39	2,515	1.1
	100-249	26	3,770	1.2	19	2,790	1.4
	250-499	3	1,173	1.7	.	.	.
	1000-2499	.	.	.	1	1,960	1.0
	TOTAL	2,975	28,772	1.2	2,353	20,287	1.2
PASCO-COLLIER	TRIP CATEGORY						
	1-49	8,071	29,834	1.1	5,930	20,766	1.2
	50-99	101	7,074	3.4	87	5,827	3.0
	100-249	87	12,851	2.9	33	4,801	5.2
	250-499	7	2,251	9.0	12	4,059	6.2
	500-999	2	1,126	1.0	11	7,116	6.8
	1000-2499	1	1,262	3.0	1	2,152	8.0
	TOTAL	8,269	54,398	1.2	6,074	44,721	1.2
MONROE-DADE	TRIP CATEGORY						
	1-49	135	505	1.3	20	140	1.2
	50-99	2	133	1.0	2	136	2.0

(CONTINUED)

TABLE 2. FLORIDA MARINE RESEARCH INSTITUTE 12:36 MONDAY, OCTOBER 3, 1994 2
MARINE FISHERIES INFORMATION SYSTEM

FLOUNDER LANDINGS BY SPECIES AND TRIP CATEGORY 1992-1993

PROGRAM: FLDRA EDITED BATCHES 2-309
UNEDITED BATCHES 263-294,310-326

SPECIES MIXED

		YEAR					
		92			93		
		TRIPS	POUNDS	TIME AWAY FROM DOCK MEAN	TRIPS	POUNDS	TIME AWAY FROM DOCK MEAN
REGION	TRIP CATEGORY						
MONROE-DADE	100-249	.	.	.	1	160	10.0
	TOTAL	137	638	1.2	23	436	1.7
BROWARD-PALM BEACH	TRIP CATEGORY						
	1-49	17	80	1.0	132	558	1.1
	50-99	.	.	.	2	141	1.0
	100-249	.	.	.	1	156	1.0
	250-499	.	.	.	1	315	4.0
	TOTAL	17	80	1.0	136	1,170	1.1
MARTIN-BREVARD	TRIP CATEGORY						
	1-49	2,292	18,582	1.1	1,808	14,941	1.2
	50-99	106	7,477	1.8	89	6,183	2.0
	100-249	26	3,761	2.4	26	3,805	2.8
	250-499	2	605	3.5	4	1,478	3.0
	500-999	1	532	10.0	.	.	.
	TOTAL	2,427	30,957	1.2	1,927	26,407	1.2
VOLUSIA-NASSAU	TRIP CATEGORY						
	1-49	4,386	75,763	1.4	4,287	75,029	1.4
	50-99	845	57,651	1.8	721	49,246	1.8
	100-249	337	48,289	2.6	289	42,425	2.9
	250-499	51	17,087	3.5	49	15,820	4.0
	500-999	13	8,986	4.5	8	5,225	4.5
	1000-2499	7	10,551	2.7	5	6,767	1.2
	2500-4999	1	4,435	5.0	2	6,036	1.0
	TOTAL	5,640	222,762	1.6	5,361	200,548	1.5
INLAND/OUT OF STATE	TRIP CATEGORY						
	1-49	12	117	1.0	37	444	1.6

(CONTINUED)

FLOUNDER LANDINGS BY SPECIES AND TRIP CATEGORY 1992-1993

PROGRAM: FLDRA EDITED BATCHES 2-309
UNEDITED BATCHES 263-294,310-326

SPECIES GULF

		YEAR					
		92			93		
		TRIPS	POUNDS	TIME AWAY FROM DOCK MEAN	TRIPS	POUNDS	TIME AWAY FROM DOCK MEAN
REGION	TRIP CATEGORY						
ESCAMBIA-FRANKLIN	1-49	204	2,388	1.4	179	1,790	1.6
	50-99	21	1,464	1.5	15	1,142	4.4
	100-249	17	2,457	3.2	9	1,461	4.7
	250-499	8	2,860	4.5	2	519	4.0
	500-999	3	2,456	19.3	1	576	1.0
	1000-2499	1	1,427	20.0	.	.	.
	TOTAL	254	13,052	1.9	206	5,488	2.0
WAKULLA-HERNANDO	TRIP CATEGORY						
	1-49	636	3,451	1.3	747	3,550	1.3
	50-99	3	219	1.3	2	152	1.0
	100-249	4	774	1.0	1	167	2.0
	250-499	5	1,867	1.0	.	.	.
	500-999	1	564	1.0	.	.	.
	TOTAL	649	6,875	1.3	750	3,869	1.3
PASCO-COLLIER	TRIP CATEGORY						
	1-49	1,995	9,470	1.1	1,888	6,564	1.1
	50-99	38	2,580	2.0	53	3,804	1.8
	100-249	11	1,571	1.0	26	3,762	2.4
	250-499	1	413	1.0	1	305	7.0
	500-999	1	710	6.0	.	.	.
	TOTAL	2,046	14,744	1.2	1,968	14,435	1.1
MONROE-DADE	TRIP CATEGORY						
	1-49	56	163	1.1	3	3	1.3
	TOTAL	56	163	1.1	3	3	1.3
BROWARD-PALM BEACH	TRIP CATEGORY						
	1-49	15	86	1.0	6	21	1.0

(CONTINUED)

FLOUNDER LANDINGS BY SPECIES AND TRIP CATEGORY 1992-1993

PROGRAM: FLDRA EDITED BATCHES 2-309
UNEDITED BATCHES 263-294,310-326

SPECIES MIXED

		YEAR					
		92			93		
		TRIPS	POUNDS	TIME AWAY FROM DOCK MEAN	TRIPS	POUNDS	TIME AWAY FROM DOCK MEAN
REGION	TRIP CATEGORY						
INLAND/OUT OF STATE	50-99	1	70	1.0	6	465	1.0
	100-249	2	261	1.0	2	256	4.0
	TOTAL	15	448	1.0	45	1,165	1.6
STATEWIDE		21,580	404,678	1.3	18,064	368,195	1.3

FLOUNDER LANDINGS BY SPECIES AND TRIP CATEGORY 1992-1993

PROGRAM: FLDRA EDITED BATCHES 2-309
UNEDITED BATCHES 263-294,310-326

SPECIES SOUTHERN

		YEAR								
		92			93			94		
		TRIPS	POUNDS	TIME AWAY FROM DOCK MEAN	TRIPS	POUNDS	TIME AWAY FROM DOCK MEAN	TRIPS	POUNDS	TIME AWAY FROM DOCK MEAN
REGION	TRIP CATEGORY									
ESCAMBIA-FRANKLIN	1-49	30	143	1.2	40	219	1.9	.	.	.
	TOTAL	30	143	1.2	40	219	1.9	.	.	.
WAKULLA-HERNANDO	TRIP CATEGORY									
	1-49	2	18	1.0	.	.	.	.	.	.
	TOTAL	2	18	1.0	.	.	.	.	.	.
PASCO-COLLIER	TRIP CATEGORY									
	1-49	2	6	1.0	257	969	1.0	.	.	.
	50-99	.	.	.	5	332	1.0	.	.	.
	100-249	.	.	.	1	214	1.0	.	.	.
	TOTAL	2	6	1.0	263	1,515	1.0	.	.	.
BROWARD-PALM BEACH	TRIP CATEGORY									
	1-49	.	.	.	4	29	1.0	.	.	.
	TOTAL	.	.	.	4	29	1.0	.	.	.
MARTIN-BREVARD	TRIP CATEGORY									
	1-49	9	45	1.3	7	137	2.4	.	.	.
	50-99	1	70	1.0	.	.	.	.	.	.
	100-249	1	100	1.0	.	.	.	.	.	.
	TOTAL	11	215	1.3	7	137	2.4	.	.	.
VOLUSIA-NASSAU	TRIP CATEGORY									
	1-49	272	4,895	1.7	227	3,925	1.7	1	22	2.0
	50-99	56	3,763	2.7	36	2,451	2.6	.	.	.
	100-249	23	3,266	3.8	7	1,131	4.9	.	.	.
	250-499	3	825	3.0	.	.	.	.	.	.
	TOTAL	354	12,749	2.0	270	7,507	1.9	1	22	2.0
STATEWIDE		399	13,131	1.9	584	9,407	1.5	1	22	2.0

TABLE 2. FLORIDA MARINE RESEARCH INSTITUTE 12:36 MONDAY, OCTOBER 3, 1994 5
MARINE FISHERIES INFORMATION SYSTEM

FLOUNDER LANDINGS BY SPECIES AND TRIP CATEGORY 1992-1993

PROGRAM: FLDRA EDITED BATCHES 2-309
UNEDITED BATCHES 263-294,310-326

SPECIES GULF

		YEAR					
		92			93		
		TRIPS	POUNDS	TIME AWAY FROM DOCK MEAN	TRIPS	POUNDS	TIME AWAY FROM DOCK MEAN
REGION	TOTAL						
BROWARD-PALM BEACH		15	86	1.0	6	21	1.0
MARTIN-BREVARD	TRIP CATEGORY						
	1-49	17	117	1.1	3	12	1.0
	50-99	.	.	.	2	170	1.0
	250-499	1	255	1.0	.	.	.
	TOTAL	18	372	1.1	5	182	1.0
VOLUSIA-NASSAU	TRIP CATEGORY						
	1-49	1	12	1.0	7	148	1.0
	TOTAL	1	12	1.0	7	148	1.0
INLAND/OUT OF STATE	TRIP CATEGORY						
	1-49	3	65	3.7	15	301	1.0
	50-99	.	.	.	14	928	1.0
	100-249	3	374	9.3	8	974	1.1
	TOTAL	6	439	6.5	37	2,203	1.0
STATEWIDE		3,045	35,743	1.2	2,982	26,349	1.2

FLOUNDER LANDINGS BY SPECIES AND TRIP CATEGORY 1992-1993

PROGRAM: FLORA EDITED BATCHES 2-309
UNEDITED BATCHES 263-294,310-326

SPECIES SUMMER

		YEAR					
		92			93		
				TIME AWAY FROM DOCK			TIME AWAY FROM DOCK
		TRIPS	POUNDS	MEAN	TRIPS	POUNDS	MEAN
REGION	TRIP CATEGORY						
ESCAMBIA-FRANKLIN	1-49	.	.	.	6	53	1.2
	TOTAL	.	.	.	6	53	1.2
WAKULLA-HERNANDO	TRIP CATEGORY						
	1-49	6	15	2.0	8	49	2.6
	50-99	.	.	.	1	68	1.0
	100-249	.	.	.	2	321	2.5
	TOTAL	6	15	2.0	11	438	2.5
PASCO-COLLIER	TRIP CATEGORY						
	1-49	.	.	.	5	34	1.0
	TOTAL	.	.	.	5	34	1.0
BROWARD-PALM BEACH	TRIP CATEGORY						
	1-49	.	.	.	2	4	1.0
	TOTAL	.	.	.	2	4	1.0
MARTIN-BREVARD	TRIP CATEGORY						
	1-49	8	94	1.3	1	1	1.0
	TOTAL	8	94	1.3	1	1	1.0
VOLUSIA-NASSAU	TRIP CATEGORY						
	1-49	28	689	1.1	11	246	1.3
	50-99	.	.	.	6	369	1.0
	100-249	1	118	3.0	2	293	2.5
	TOTAL	29	807	1.2	19	908	1.3
INLAND/OUT OF STATE	TRIP CATEGORY						
	1-49	.	.	.	1	4	1.0
	TOTAL	.	.	.	1	4	1.0
STATEWIDE		43	916	1.3	45	1,442	1.5

FLOUNDER LANDINGS BY REGION AND GEAR

PROGRAM: FLORG SAS EDITED BATCHES 2 -309
UNEDITED BATCHES 263-294,310-326

SPECIES MIXED

		YEAR			
		92		93	
		TRIPS	LBS	TRIPS	LBS
REGION	GEAR USED				
ESCAMBIA-FRANKLIN	UNKNOWN	438	15,992	185	8,163
	TRAWL	499	6,304	400	4,929
	GILL NET	627	12,750	823	15,942
	TRAMMEL	15	1,012	1	19
	GIG/SPEAR	351	21,884	459	27,374
	OTHER	170	8,681	277	17,034
	REGION	2,100	66,623	2,145	73,461
WAKULLA-HERNANDO	GEAR USED				
	UNKNOWN	447	8,056	40	804
	TRAWL	128	1,784	98	1,259
	GILL NET	1,348	8,559	992	5,322
	TRAMMEL	688	4,779	544	3,636
	GIG/SPEAR	16	1,578	32	1,069
	OTHER	348	4,016	647	8,197
	REGION	2,975	28,772	2,353	20,287
PASCO-COLLIER	GEAR USED				
	UNKNOWN	900	10,383	231	2,625
	TRAWL	332	10,999	340	15,070
	GILL NET	6,353	24,560	4,925	17,222
	TRAMMEL	355	1,197	294	820
	GIG/SPEAR	54	4,199	17	644
	OTHER	275	3,060	267	8,340
	REGION	8,269	54,398	6,074	44,721
MONROE-DADE	GEAR USED				
	UNKNOWN	44	105	1	160
	GILL NET	66	158	5	12
	TRAMMEL	7	13	.	.
	OTHER	20	362	17	264
	REGION	137	638	23	436

(CONTINUED)

TABLE 3. FLORIDA MARINE RESEARCH INSTITUTE 10:23 FRIDAY, SEPTEMBER 30, 1994 2

FLOUNDER LANDINGS BY REGION AND GEAR

PROGRAM: FLORG SAS EDITED BATCHES 2 -309
UNEDITED BATCHES 263-294,310-326

SPECIES MIXED

		YEAR			
		92		93	
		TRIPS	LBS	TRIPS	LBS
REGION	GEAR USED				
BROWARD-PALM BEACH	UNKNOWN	1	4	7	17
	GILL NET	5	10	85	279
	TRAMMEL	7	58	15	62
	GIG/SPEAR	.	.	1	315
	OTHER	4	8	28	497
	REGION	17	80	136	1,170
MARTIN-BREVARD	GEAR USED				
	UNKNOWN	338	5,987	54	1,180
	TRAWL	145	6,386	230	10,308
	GILL NET	1,313	12,457	1,014	8,480
	TRAMMEL	460	2,427	374	2,477
	GIG/SPEAR	8	480	10	186
	OTHER	163	3,220	245	3,776
	REGION	2,427	30,957	1,927	26,407
VOLUSIA-NASSAU	GEAR USED				
	UNKNOWN	810	30,330	215	8,154
	TRAWL	2,719	109,643	2,084	62,172
	GILL NET	832	28,322	869	28,140
	TRAMMEL	84	4,645	43	4,188
	GIG/SPEAR	845	38,853	1,615	73,043
	OTHER	350	10,969	535	24,851
	REGION	5,640	222,762	5,361	200,548
INLAND/OUT OF STATE	GEAR USED				
	UNKNOWN	9	408	10	512
	GILL NET	5	22	8	30
	TRAMMEL	.	.	3	10
	GIG/SPEAR	1	18	2	47
	OTHER	.	.	22	566
	REGION	15	448	45	1,165

(CONTINUED)

TABLE 3. FLORIDA MARINE RESEARCH INSTITUTE 10:23 FRIDAY, SEPTEMBER 30, 1994 4

FLOUNDER LANDINGS BY REGION AND GEAR

PROGRAM: FLORG SAS EDITED BATCHES 2 -309
UNEDITED BATCHES 263-294,310-326

SPECIES GULF

		YEAR			
		92		93	
		TRIPS	LBS	TRIPS	LBS
REGION	GEAR USED				
ESCAMBIA-FRANKLIN	UNKNOWN	22	1,065	32	313
	TRAWL	88	6,361	61	1,602
	GILL NET	65	714	46	1,190
	TRAMMEL	16	939	4	509
	GIG/SPEAR	30	1,576	5	151
	OTHER	33	2,397	58	1,723
	REGION	254	13,052	206	5,488
WAKULLA-HERNANDO	GEAR USED				
	UNKNOWN	124	497	30	142
	TRAWL	288	1,818	489	2,663
	GILL NET	195	3,784	128	406
	TRAMMEL	19	690	56	359
	GIG/SPEAR	.	.	1	167
	OTHER	23	86	46	132
	REGION	649	6,875	750	3,869
PASCO-COLLIER	GEAR USED				
	UNKNOWN	40	599	26	1,150
	TRAWL	114	3,519	50	2,373
	GILL NET	1,651	7,644	1,761	5,749
	TRAMMEL	64	192	23	45
	GIG/SPEAR	27	1,697	58	4,120
	OTHER	150	1,093	50	998
	REGION	2,046	14,744	1,968	14,435
MONROE-DADE	GEAR USED				
	UNKNOWN	38	104	.	.
	GILL NET	18	59	2	2
	OTHER	.	.	1	1
	REGION	56	163	3	3

(CONTINUED)

TABLE 3. FLORIDA MARINE RESEARCH INSTITUTE 10:23 FRIDAY, SEPTEMBER 30, 1994 3

FLOUNDER LANDINGS BY REGION AND GEAR

PROGRAM: FLORG SAS EDITED BATCHES 2 -309
UNEDITED BATCHES 263-294,310-326

SPECIES MIXED

	YEAR			
	92		93	
	TRIPS	LBS	TRIPS	LBS
STATEWIDE	21,580	404,678	18,064	368,195

TABLE 3. FLORIDA MARINE RESEARCH INSTITUTE 10:23 FRIDAY, SEPTEMBER 30, 1994

FLOUNDER LANDINGS BY REGION AND GEAR

PROGRAM: FLDRG SAS EDITED BATCHES 2 -309
UNEDITED BATCHES 263-294,310-326

SPECIES SOUTHERN

		YEAR			
		92		93	
		TRIPS	LBS	TRIPS	LBS
REGION	GEAR USED				
ESCAMBIA-FRANKLIN	UNKNOWN	3	6	2	16
	TRAWL	8	24	10	58
	GILL NET	16	47	26	125
	GIG/SPEAR	2	56	.	.
	OTHER	1	10	2	20
	REGION	30	143	40	219
WAKULLA-HERNANDO	GEAR USED				
	GILL NET	2	18	.	.
	REGION	2	18	.	.
PASCO-COLLIER	GEAR USED				
	UNKNOWN	.	.	1	94
	TRAWL	.	.	42	653
	GILL NET	1	4	211	737
	TRAMMEL	1	2	1	1
	OTHER	.	.	8	30
	REGION	2	6	263	1,515
BROWARD-PALM BEACH	GEAR USED				
	GILL NET	.	.	2	3
	OTHER	.	.	2	26
	REGION	.	.	4	29
MARTIN-BREVARD	GEAR USED				
	UNKNOWN	1	5	.	.
	TRAWL	.	.	5	128
	GILL NET	1	1	.	.
	OTHER	9	209	2	9
	REGION	11	215	7	137
VOLUSIA-NASSAU	GEAR USED				
	UNKNOWN	14	530	3	51
	TRAWL	157	7,069	105	3,613

(CONTINUED)

TABLE 3. FLORIDA MARINE RESEARCH INSTITUTE 10:23 FRIDAY, SEPTEMBER 30, 1994 5

FLOUNDER LANDINGS BY REGION AND GEAR

PROGRAM: FLDRG SAS EDITED BATCHES 2 -309
UNEDITED BATCHES 263-294,310-326

SPECIES GULF

		YEAR			
		92		93	
		TRIPS	LBS	TRIPS	LBS
REGION	GEAR USED				
BROWARD-PALM BEACH	UNKNOWN	1	8	.	.
	GILL NET	6	33	3	5
	TRAMMEL	5	30	1	9
	OTHER	3	15	2	7
	REGION	15	86	6	21
MARTIN-BREVARD	GEAR USED				
	UNKNOWN	1	5	.	.
	GILL NET	14	361	2	170
	OTHER	3	6	3	12
	REGION	18	372	5	182
VOLUSIA-NASSAU	GEAR USED				
	GILL NET	1	12	.	.
	OTHER	.	.	7	148
	REGION	1	12	7	148
INLAND/OUT OF STATE	GEAR USED				
	UNKNOWN	2	250	1	19
	TRAWL	3	158	.	.
	GILL NET	.	.	7	24
	GIG/SPEAR	1	31	29	2,160
	REGION	6	439	37	2,203
STATEWIDE		3,045	35,743	2,982	26,349

TABLE 3. FLORIDA MARINE RESEARCH INSTITUTE 10:23 FRIDAY, SEPTEMBER 30, 1994

FLOUNDER LANDINGS BY REGION AND GEAR

PROGRAM: FLDRG SAS EDITED BATCHES 2 -309
UNEDITED BATCHES 263-294,310-326

SPECIES SUMMER

		YEAR			
		92		93	
		TRIPS	LBS	TRIPS	LBS
REGION	GEAR USED				
ESCAMBIA-FRANKLIN	GILL NET	.	.	2	5
	OTHER	.	.	4	48
	REGION	.	.	6	53
WAKULLA-HERNANDO	GEAR USED				
	UNKNOWN	1	2	.	.
	GILL NET	5	13	8	234
	OTHER	.	.	3	204
	REGION	6	15	11	438
PASCO-COLLIER	GEAR USED				
	TRAWL	.	.	1	11
	GILL NET	.	.	4	23
	REGION	.	.	5	34
BROWARD-PALM BEACH	GEAR USED				
	GILL NET	.	.	1	3
	TRAMMEL	.	.	1	1
	REGION	.	.	2	4
MARTIN-BREVARD	GEAR USED				
	TRAWL	1	12	.	.
	GILL NET	5	34	1	1
	OTHER	2	48	.	.
	REGION	8	94	1	1
VOLUSIA-NASSAU	GEAR USED				
	UNKNOWN	2	42	.	.
	TRAWL	3	183	.	.
	GILL NET	2	41	4	161
	GIG/SPEAR	17	440	10	413
	OTHER	5	101	5	334
	REGION	29	807	19	908

(CONTINUED)

TABLE 3. FLORIDA MARINE RESEARCH INSTITUTE 10:23 FRIDAY, SEPTEMBER 30, 1994 7

FLOUNDER LANDINGS BY REGION AND GEAR

PROGRAM: FLDRG SAS EDITED BATCHES 2 -309
UNEDITED BATCHES 263-294,310-326

SPECIES SOUTHERN

		YEAR			
		92		93	
		TRIPS	LBS	TRIPS	LBS
REGION	GEAR USED				
VOLUSIA-NASSAU	GILL NET	53	1,612	7	516
	GIG/SPEAR	117	3,068	98	2,561
	OTHER	13	470	57	766
	REGION	354	12,749	270	7,507
STATEWIDE		399	13,131	584	9,407

TABLE 3. FLORIDA MARINE RESEARCH INSTITUTE 10:23 FRIDAY, SEPTEMBER 30, 1994 9

FLOUNDER LANDINGS BY REGION AND GEAR

PROGRAM: FLDRG SAS EDITED BATCHES 2 -309
UNEDITED BATCHES 263-294,310-326

SPECIES SUMMER

		YEAR			
		92		93	
		TRIPS	LBS	TRIPS	LBS
REGION	GEAR USED				
INLAND/OUT OF STATE	GILL NET	.	.	1	4
	REGION	.	.	1	4
STATEWIDE		43	916	45	1,442

TABLE 4.

FLORIDA MARINE RESEARCH INSTITUTE
MARINE FISHERIES INFORMATION SYSTEM

FLOUNDER LANDINGS BY LICENSE CATEGORY 1991-1993

PROGRAM: FLDRB EDITED BATCHES 145-309
UNEDITED BATCHES 263-294,310-326

SPECIES MIXED

		YEAR					
		92			93		
		NUM SPL	TRIPS	FLOUNDER POUNDS	NUM SPL	TRIPS	FLOUNDER POUNDS
REGION	ANNUAL LANDINGS CATEGORY						
ESCAMBIA-FRANKLIN	1-99	335	896	8,239	349	921	7,686
	100-249	58	445	9,470	54	454	8,791
	250-499	27	196	9,491	21	182	7,189
	500-999	18	246	13,714	19	218	13,306
	1000-2499	11	253	15,866	14	296	22,147
	2500-4999	1	32	3,425	5	74	14,342
	5000-9999	1	32	6,418	.	.	.
	TOTAL	451	2,100	66,623	462	2,145	73,461
WAKULLA-HERNANDO	ANNUAL LANDINGS CATEGORY						
	1-99	289	1,291	5,239	301	1,506	6,923
	100-249	39	747	6,340	31	459	5,227
	250-499	19	485	6,482	12	292	4,281
	500-999	9	319	6,773	3	95	1,896
	1000-2499	3	133	3,938	1	1	1,960
	TOTAL	359	2,975	28,772	348	2,353	20,287
PASCO-COLLIER	ANNUAL LANDINGS CATEGORY						
	1-99	742	4,181	13,103	603	3,400	10,629
	100-249	89	2,254	13,156	69	1,996	10,307
	250-499	35	1,448	11,670	19	426	6,690
	500-999	10	285	6,300	8	201	5,784
	1000-2499	2	15	2,447	4	37	8,219
	2500-4999	2	86	7,722	1	14	3,092
	TOTAL	880	8,269	54,398	704	6,074	44,721
MONROE-DADE	ANNUAL LANDINGS CATEGORY						
	1-99	52	137	638	21	22	276
	100-249	.	.	.	1	1	160

(CONTINUED)

TABLE 4.

FLORIDA MARINE RESEARCH INSTITUTE
MARINE FISHERIES INFORMATION SYSTEM

FLOUNDER LANDINGS BY LICENSE CATEGORY 1991-1993

PROGRAM: FLDRB EDITED BATCHES 145-309
UNEDITED BATCHES 263-294,310-326

SPECIES MIXED

		YEAR					
		92			93		
		NUM SPL	TRIPS	FLOUNDER POUNDS	NUM SPL	TRIPS	FLOUNDER POUNDS
REGION	TOTAL						
MONROE-DADE		52	137	638	22	23	436
BROWARD-PALM BEACH	ANNUAL LANDINGS CATEGORY						
	1-99	10	17	80	46	131	585
	100-249	.	.	.	2	4	270
	250-499	.	.	.	1	1	315
	TOTAL	10	17	80	49	136	1,170
MARTIN-BREVARD	ANNUAL LANDINGS CATEGORY						
	1-99	343	1,165	7,510	297	945	6,290
	100-249	51	559	7,859	48	536	7,672
	250-499	12	207	4,369	19	231	6,262
	500-999	12	383	8,214	3	151	1,799
	1000-2499	2	113	3,005	1	39	1,357
	2500-4999	.	.	.	1	25	3,027
	TOTAL	420	2,427	30,957	369	1,927	26,407
VOLUSIA-NASSAU	ANNUAL LANDINGS CATEGORY						
	1-99	239	566	7,764	302	826	9,511
	100-249	102	680	17,188	80	596	13,268
	250-499	45	583	15,540	47	566	16,176
	500-999	43	747	29,987	33	717	23,531
	1000-2499	50	1,696	81,142	51	1,766	78,660
	2500-4999	17	1,251	53,518	13	584	41,036
	5000-9999	3	117	17,623	3	306	18,366
	TOTAL	499	5,640	222,762	529	5,361	200,548
INLAND/OUT OF STATE	ANNUAL LANDINGS CATEGORY						
	1-99	2	7	52	22	37	444
	100-249	.	.	.	1	2	134

(CONTINUED)

TABLE 4.

FLORIDA MARINE RESEARCH INSTITUTE
MARINE FISHERIES INFORMATION SYSTEM

FLOUNDER LANDINGS BY LICENSE CATEGORY 1991-1993

PROGRAM: FLDRB EDITED BATCHES 145-309
UNEDITED BATCHES 263-294,310-326

SPECIES MIXED

		YEAR					
		92			93		
		NUM SPL	TRIPS	FLOUNDER POUNDS	NUM SPL	TRIPS	FLOUNDER POUNDS
REGION	ANNUAL LANDINGS CATEGORY						
INLAND/OUT OF STATE	250-499	1	8	396	.	.	.
	500-999	.	.	.	1	6	587
	TOTAL	3	15	448	24	45	1,165
STATEWIDE		2,674	21,580	404,678	2,507	18,064	368,195

TABLE 4.

FLORIDA MARINE RESEARCH INSTITUTE
MARINE FISHERIES INFORMATION SYSTEM

FLOUNDER LANDINGS BY LICENSE CATEGORY 1991-1993

PROGRAM: FLDRB EDITED BATCHES 145-309
UNEDITED BATCHES 263-294,310-326

SPECIES GULF

		YEAR					
		92			93		
		NUM SPL	TRIPS	FLOUNDER POUNDS	NUM SPL	TRIPS	FLOUNDER POUNDS
REGION	ANNUAL LANDINGS CATEGORY						
ESCAMBIA-FRANKLIN	1-99	51	128	1,118	65	135	1,588
	100-249	12	37	1,910	6	42	923
	250-499	7	57	2,488	6	22	1,752
	500-999	2	18	1,700	2	7	1,225
	1000-2499	1	5	1,009	.	.	.
	2500-4999	1	9	4,827	.	.	.
	TOTAL	74	254	13,052	79	206	5,488
WAKULLA-HERNANDO	ANNUAL LANDINGS CATEGORY						
	1-99	99	331	1,588	73	268	946
	100-249	7	159	1,057	7	154	1,206
	250-499	2	35	576	5	328	1,717
	500-999	3	106	1,924	.	.	.
	1000-2499	1	18	1,730	.	.	.
	TOTAL	112	649	6,875	85	750	3,869
PASCO-COLLIER	ANNUAL LANDINGS CATEGORY						
	1-99	213	1,009	3,662	217	1,409	3,542
	100-249	20	655	3,174	15	380	2,569
	250-499	3	152	1,052	4	44	1,285
	500-999	4	171	3,117	1	51	507
	1000-2499	3	59	3,739	2	37	3,493
	2500-4999	.	.	.	1	47	3,039
	TOTAL	243	2,046	14,744	240	1,968	14,435
MONROE-DADE	ANNUAL LANDINGS CATEGORY						
	1-99	19	56	163	3	3	3
	TOTAL	19	56	163	3	3	3

(CONTINUED)

MARINE FISHERIES INFORMATION SYSTEM

FLOUNDER LANDINGS BY LICENSE CATEGORY 1991-1993

PROGRAM: FLDR8 EDITED BATCHES 145-309
UNEDITED BATCHES 263-294,310-326

SPECIES GULF

		YEAR					
		92			93		
		NUM SPL	TRIPS	FLOUNDER POUNDS	NUM SPL	TRIPS	FLOUNDER POUNDS
REGION	ANNUAL LANDINGS CATEGORY						
BROWARD-PALM BEACH	1-99	7	15	86	5	6	21
	TOTAL	7	15	86	5	6	21
MARTIN-BREVARD	ANNUAL LANDINGS CATEGORY						
	1-99	12	16	107	5	5	182
	250-499	1	2	265	.	.	.
	TOTAL	13	18	372	5	5	182
VOLUSIA-NASSAU	ANNUAL LANDINGS CATEGORY						
	1-99	1	1	12	5	7	148
	TOTAL	1	1	12	5	7	148
INLAND/OUT OF STATE	ANNUAL LANDINGS CATEGORY						
	1-99	3	3	65	4	9	75
	100-249	3	3	374	.	.	.
	1000-2499	.	.	.	1	28	2,128
	TOTAL	6	6	439	5	37	2,203
STATEWIDE		475	3,045	35,743	427	2,982	26,349

MARINE FISHERIES INFORMATION SYSTEM

FLOUNDER LANDINGS BY LICENSE CATEGORY 1991-1993

PROGRAM: FLDR8 EDITED BATCHES 145-309
UNEDITED BATCHES 263-294,310-326

SPECIES SOUTHERN

		YEAR					
		92			93		
		NUM SPL	TRIPS	FLOUNDER POUNDS	NUM SPL	TRIPS	FLOUNDER POUNDS
REGION	ANNUAL LANDINGS CATEGORY						
ESCAMBIA-FRANKLIN	1-99	10	30	143	13	40	219
	TOTAL	10	30	143	13	40	219
WAKULLA-HERNANDO	ANNUAL LANDINGS CATEGORY						
	1-99	2	2	18	.	.	.
	TOTAL	2	2	18	.	.	.
PASCO-COLLIER	ANNUAL LANDINGS CATEGORY						
	1-99	2	2	6	28	208	679
	100-249	.	.	.	3	37	468
	250-499	.	.	.	1	18	368
	TOTAL	2	2	6	32	263	1,515
BROWARD-PALM BEACH	ANNUAL LANDINGS CATEGORY						
	1-99	.	.	.	3	4	29
	TOTAL	.	.	.	3	4	29
MARTIN-BREVARD	ANNUAL LANDINGS CATEGORY						
	1-99	6	10	115	5	7	137
	100-249	1	1	100	.	.	.
	TOTAL	7	11	215	5	7	137
VOLUSIA-NASSAU	ANNUAL LANDINGS CATEGORY						
	1-99	39	78	1,450	40	59	1,258
	100-249	14	48	2,201	6	23	742
	250-499	7	80	2,325	8	111	2,771
	500-999	5	91	3,069	4	77	2,736
	1000-2499	3	57	3,704	.	.	.
	TOTAL	68	354	12,749	56	270	7,507
STATEWIDE		89	399	13,131	109	584	9,407

TABLE 4.

FLORIDA MARINE RESEARCH INSTITUTE
MARINE FISHERIES INFORMATION SYSTEM

FLOUNDER LANDINGS BY LICENSE CATEGORY 1991-1993

PROGRAM: FLDRB EDITED BATCHES 145-309
UNEDITED BATCHES 263-294,310-326

SPECIES SUMMER

		YEAR					
		92			93		
		NUM SPL	TRIPS	FLOUNDER POUNDS	NUM SPL	TRIPS	FLOUNDER POUNDS
REGION	ANNUAL LANDINGS CATEGORY						
ESCAMBIA-FRANKLIN	1-99	.	.	.	5	6	53
	TOTAL	.	.	.	5	6	53
WAKULLA-HERNANDO	ANNUAL LANDINGS CATEGORY						
	1-99	3	6	15	5	7	14
	100-249	.	.	.	2	4	424
	TOTAL	3	6	15	7	11	438
PASCO-COLLIER	ANNUAL LANDINGS CATEGORY						
	1-99	.	.	.	5	5	34
	TOTAL	.	.	.	5	5	34
BROWARD-PALM BEACH	ANNUAL LANDINGS CATEGORY						
	1-99	.	.	.	2	2	4
	TOTAL	.	.	.	2	2	4
MARTIN-BREVARD	ANNUAL LANDINGS CATEGORY						
	1-99	6	8	94	1	1	1
	TOTAL	6	8	94	1	1	1
VOLUSIA-NASSAU	ANNUAL LANDINGS CATEGORY						
	1-99	9	16	366	8	8	161
	100-249	1	3	183	3	5	474
	250-499	1	10	258	1	6	273
	TOTAL	11	29	807	12	19	908
INLAND/OUT OF STATE	ANNUAL LANDINGS CATEGORY						
	1-99	.	.	.	1	1	4
	TOTAL	.	.	.	1	1	4
STATEWIDE		20	43	916	33	45	1,442

TABLE 5.

DEPARTMENT OF ENVIRONMENTAL PROTECTION
FLORIDA MARINE RESEARCH INSTITUTE, St. Petersburg
LANDINGS SUMMARY

STATE : Florida
SPECIES : Paralichthys albigutta and lethostigma Gulf and Southern Flounders
YEARS : 1980 - 1993

COAST : ATLANTIC

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Number Intercepts	39	21	102	146	172	126	76	53	100	148	112	166	336	534
Number Total	387,000	139,000	573,000	318,000	428,000	593,000	441,000	351,000	344,000	426,000	414,000	386,000		
Number Florida	246,000	97,000	486,000	46,000	314,000	325,000	141,000	84,000	153,000	285,241	182,132	192,812	360,119	371,395
Number Type A	352,000	115,000	180,000	279,000	370,000	389,000	335,000	178,000	304,000	332,000	294,000	269,000		
Number Type A + B1	352,000	115,000	421,000	279,000	402,000	493,000	377,000	223,000	315,000	355,000	337,000	319,000		
Weight Type A	277,000	54,000	101,000	193,000	173,000	210,000	176,000	109,000	209,000	227,000	170,000	228,000		
Est Fla EC Type A + B1	223,752	80,252	357,079	40,358	294,925	270,194	120,537	53,368	140,102	231,828	156,610	148,421	302,248	279,236
Fla EC Total Fish/Trip	1.564	1.190	1.461	0.822	0.836	0.984	0.750	0.849	1.030	0.973	0.795	0.699	1.071	0.860
Est Fla EC Trips	157,279	81,480	332,698	55,967	335,453	330,242	188,000	98,933	148,544	293,164	229,200	275,921	336,111	432,060
Fla EC Fish Kept/Trip	1.436	1.190	1.225	0.719	0.868	0.889	0.671	0.755	0.920	0.750	0.696	0.546	0.914	0.672
Ratio Kept : Total	0.91	n.a.	0.73	0.88	0.94	0.83	0.85	0.64	0.92	0.61	0.86	0.77	0.84	0.75
Fla EC Total Fish/Angler	1.189	1.129	1.291	0.751	0.807	0.838	0.635	0.610	0.929	0.806	0.693	0.587	0.763	0.680
Est Fla EC Anglers	208,953	85,949	376,449	61,240	368,920	388,029	222,093	137,691	164,664	353,763	262,927	328,275	471,888	545,999
Fla EC Total Fish/(Ang Hr)	0.525	0.275	0.338	0.242	0.262	0.272	0.194	0.153	0.283	0.196	0.191	0.175	0.209	0.178
Est Fla EC Total Hours	468,228	352,558	1,436,744	190,294	1,198,182	1,195,790	728,661	547,340	539,696	1,453,541	952,300	1,103,058	1,726,515	2,084,161
Fla EC Fish Kept/(Ang-Hr)	0.478	0.275	0.285	0.217	0.246	0.248	0.176	0.142	0.237	0.151	0.162	0.126	0.171	0.129
Mean Weight So Atl Lb	1.734	1.034	1.236	1.524	1.030	1.189	1.157	1.349	1.515	1.506	1.274	1.867		
Mean Weight Fla EC Lb	2.079	1.349	1.354	1.618	1.019	1.142	1.102	1.192	1.496	1.540	1.500	2.088	1.956	1.843
Number EC fish Weighed	42	17	77	92	132	105	51	37	74	60	51	68	156	234
Est Rec Landings Lb	465,091	108,236	483,556	65,280	300,470	308,616	132,868	63,598	209,522	356,899	234,915	309,888	591,167	514,576
Commercial Landings Lb.	302,645	276,909	379,636	274,587	311,549	389,158	215,449	225,093	288,380	283,134	282,113	308,995	268,136	237,064
Total Landings EC Lb	767,736	385,145	863,192	339,867	612,019	697,774	348,317	288,691	497,902	640,033	517,028	618,683	859,303	751,640
Ratio (Rec/Comm)	1.54	0.39	1.27	0.24	0.96	0.79	0.62	0.28	0.73	1.26	0.83	1.00	2.20	2.17
Percent Commercial	39.4%	71.9%	44.0%	80.8%	50.9%	55.8%	61.9%	78.0%	57.9%	44.2%	54.6%	49.9%	31.2%	31.5%
Commercial Trips							6,207	5,851	7,028	7,991	8,775	9,810	8,521	7,746
Pounds/Trip						57.4	34.7	38.5	41.0	35.4	32.1	31.5	31.5	30.6

Revised September 30, 1994

TABLE 5.

DEPARTMENT OF ENVIRONMENTAL PROTECTION
FLORIDA MARINE RESEARCH INSTITUTE, St. Petersburg
LANDINGS SUMMARY

STATE : Florida
SPECIES : Paralichthys albigutta and lethostigma Gulf and Southern Flounders
YEARS : 1980 - 1993

COAST : GULF

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Number Intercepts	116	61	88	52	58	60	117	127	240	152	122	115	195	227
Number Total	1,636,000	1,025,000	1,855,000	2,300,000	1,287,000	2,482,000	3,070,000	910,000	1,423,000	828,000	1,491,000	1,007,000		
Number Florida	491,000	135,000	250,000	270,000	841,000	298,000	658,000	552,000	509,000	274,593	262,614	342,484	213,845	220,158
Number Type A	1,320,000	489,000	1,103,000	948,000	456,000	1,360,000	621,000	561,000	781,000	455,000	664,000	744,000		
Number Type A + B1	1,431,000	664,000	1,171,000	2,108,000	649,000	),628,000	2,442,000	673,000	869,000	518,000	767,000	840,000		
Weight Type A	575,000	273,000	630,000	502,000	192,000	974,000	364,000	329,000	517,000	281,000	330,000	440,000		
Est Fla WC Type A + B1	429,475	87,454	157,817	247,461	424,094	197,053	523,399	408,237	310,637	180,844	179,079	240,013	157,342	178,441
Fla WC Total Fish/Trip	1.207	1.197	1.477	1.250	3.586	1.333	2.402	2.228	1.688	1.324	1.169	1.470	1.159	1.251
Est Fla WC Trips	406,829	112,808	169,231	216,000	234,510	223,500	273,972	247,717	301,630	207,413	220,958	233,051	184,512	175,971
Fla WC Fish Kept/Trip	0.974	0.738	1.091	1.000	0.862	1.017	2.000	1.906	1.163	0.814	0.811	1.043	0.892	1.031
Ratio Kept : Total	0.87	0.65	0.63	0.92	0.50	0.66	0.80	0.74	0.61	0.66	0.68	0.70	0.74	0.81
Fla WC Total Fish/Angler	1.032	1.088	1.305	1.132	3.448	1.084	1.934	1.690	1.315	1.004	1.036	1.172	0.900	1.059
Est Fla WC Anglers	475,776	124,083	191,499	238,505	243,890	274,936	340,144	326,532	387,128	273,454	253,539	292,287	237,538	207,829
Fla WC Total Fish/(Ang Hr)	0.415	0.424	0.397	0.353	1.019	0.448	0.740	0.677	0.472	0.348	0.346	0.304	0.248	0.356
Est Fla WC Total Hours	1,182,875	318,137	629,022	765,501	825,655	664,664	888,766	815,904	1,077,780	789,279	758,390	1,124,915	861,549	618,563
Fla WC Fish Kept/(Ang Hr)	0.327	0.266	0.297	0.250	0.260	0.378	0.614	0.575	0.296	0.171	0.222	0.212	0.193	0.294
Mean Weight Gulf Lb	0.960	1.230	1.258	0.525	0.928	1.578	1.291	1.292	1.458	1.361	1.095	1.303		
Mean Weight Fla WC Lb	0.919	1.310	1.218	0.999	0.888	1.221	1.313	1.489	1.682	1.280	1.073	1.311	1.283	1.170
Number WC fish Weighed	83	34	86	45	35	54	66	153	148	82	60	94	129	124
Est Rec Landings Lb	394,687	114,547	192,158	247,312	378,638	240,542	687,066	607,661	522,735	231,428	192,134	314,657	201,933	208,758
Commercial Landings Lb	355,621	313,196	395,734	322,497	224,632	184,844	174,163	180,270	152,889	168,632	193,160	237,081	185,445	165,650
Adjusted Commercial	288,339	226,220	302,010	226,011	205,563									
Total Landings WC Lb	750,308	427,743	587,892	569,809	601,270	425,386	861,229	787,931	675,624	400,058	385,294	551,738	387,378	374,408
Adjusted Total	683,026	340,767	494,168	473,323	582,201									
Ratio (Rec/Comm)	1.37	0.51	0.64	1.09	1.83	1.30	3.94	3.37	3.42	1.37	0.99	1.33	1.09	1.26
Percent Commercial	42.2%	66.4%	61.1%	47.7%	35.3%	43.5%	20.2%	22.9%	22.6%	42.2%	50.1%	43.0%	47.9%	44.2%
Commercial Trips							9,661	12,183	11,570	13,668	14,498	19,548	16,525	13,870
Pounds/Trip						15.3	18.0	14.8	13.2	12.3	13.3	12.1	11.2	11.9

Recreational data from Marine Recreational Fisheries Statistical Surveys
Commercial Landings Data (all flounders)
1980-85 NMFS SEFC Miami
Through Trip Ticket 145-309 (edited), 263-294 (unedited, and 310-326 (unedited)

Revised September 30, 1994

TABLE 6.

FLORIDA MARINE RESEARCH INSTITUTE
FISHERIES STATISTICS SECTION
BAG LIMIT ANALYSIS

09/30/1994
10:06:54
PAGE : 1

SPECIES : FLOUNDERS SPP. MRFSS DATA : 1979-1993
COAST : East
DATA SOURCE : NMFS Marine Recreational Fisheries Statistical Survey

********** BASED ON FISH KEPT ***********

Number of Fish Kept per Angler	Number of Years	Number of Trips	Number of Anglers	Average Number of Anglers per Trip	Cumulative Percentage of Anglers	Number of Fish		Cumulative Percentages of Fish	
						Caught	Retained	Caught	Retained
0	15	1329	1549	1.17	55.20	434	36	17.01	1.77
1	15	653	842	1.29	85.21	775	755	47.37	38.81
2	15	223	272	1.22	94.90	571	526	69.75	64.62
3	14	38	46	1.21	96.54	144	132	75.39	71.10
4	5	42	50	1.19	98.33	207	193	83.50	80.57
5	8	10	12	1.20	98.75	62	60	85.93	83.51
6	3	11	12	1.09	99.18	86	72	89.30	87.05
7	2	2	3	1.50	99.29	23	21	90.20	88.08
8	5	7	10	1.43	99.64	82	80	93.42	92.00
10	2	2	3	1.50	99.75	29	29	94.55	93.42
12	2	3	3	1.00	99.86	39	36	96.08	95.19
14	2	2	2	1.00	99.93	30	28	97.26	96.57
30	1	1	1	1.00	99.96	30	30	98.43	98.04
40	1	1	1	1.00	100.00	40	40	100.00	100.00
Totals		2324	2806			2552	2038		

TABLE 6.

FLORIDA MARINE RESEARCH INSTITUTE
FISHERIES STATISTICS SECTION
BAG LIMIT ANALYSIS

09/30/1994
10:06:54
PAGE : 2

SPECIES : FLOUNDERS SPP. MRFSS DATA : 1979-1993
COAST : West
DATA SOURCE : NMFS Marine Recreational Fisheries Statistical Survey

********** BASED ON FISH KEPT ***********

Number of Fish Kept per Angler	Number of Years	Number of Trips	Number of Anglers	Average Number of Anglers per Trip	Cumulative Percentage of Anglers	Number of Fish		Cumulative Percentages of Fish	
						Caught	Retained	Caught	Retained
0	15	979	1399	1.43	49.36	1297	134	31.12	4.87
1	15	728	953	1.31	82.99	894	811	52.57	34.35
2	15	243	284	1.17	93.01	564	546	66.10	54.20
3	15	34	50	1.47	94.78	175	143	70.30	59.40
4	15	55	60	1.09	96.89	261	239	76.56	68.08
5	6	8	17	2.13	97.49	82	80	78.53	70.99
6	10	23	24	1.04	98.34	168	144	82.56	76.23
7	5	6	8	1.33	98.62	60	57	84.00	78.30
8	6	13	13	1.00	99.08	154	104	87.69	82.08
10	1	3	3	1.00	99.19	30	30	88.41	83.17
11	1	1	2	2.00	99.26	22	22	88.94	83.97
12	2	7	10	1.43	99.61	140	120	92.30	88.33
14	1	1	2	2.00	99.68	27	27	92.95	89.31
20	1	1	1	1.00	99.72	20	20	93.43	90.04
26	1	2	2	1.00	99.79	52	52	94.67	91.93
28	1	1	1	1.00	99.82	28	28	95.35	92.95
30	1	1	1	1.00	99.86	30	30	96.07	94.04
32	1	1	2	2.00	99.93	64	64	97.60	96.36
40	1	1	1	1.00	99.96	40	40	98.56	97.82
60	1	1	1	1.00	100.00	60	60	100.00	100.00
Totals		2109	2834			4168	2751		

TABLE 6.

FLORIDA MARINE RESEARCH INSTITUTE
FISHERIES STATISTICS SECTION
BAG LIMIT ANALYSIS

09/30/1994
10:06:54
PAGE : 3

SPECIES : FLOUNDERS SPP. MRFSS DATA : 1979-1993
COAST : Statewide
DATA SOURCE : NMFS Marine Recreational Fisheries Statistical Survey

********** BASED ON FISH KEPT ***********

Number of Fish Kept per Angler	Number of Years	Number of Trips	Number of Anglers	Average Number of Anglers per Trip	Cumulative Percentage of Anglers	Number of Fish		Cumulative Percentages of Fish	
						Caught	Retained	Caught	Retained
0	15	2308	2948	1.28	52.27	1731	170	25.76	3.55
1	15	1381	1795	1.30	84.10	1669	1566	50.60	36.25
2	15	466	556	1.19	93.95	1135	1072	67.49	58.63
3	15	72	96	1.33	95.66	319	275	72.23	64.38
4	15	97	110	1.13	97.61	468	432	79.20	73.40
5	12	18	29	1.61	98.12	144	140	81.34	76.32
6	11	34	36	1.06	98.76	254	216	85.12	80.83
7	7	8	11	1.38	98.95	83	78	86.35	82.46
8	10	20	23	1.15	99.36	236	184	89.87	86.30
10	3	5	6	1.20	99.47	59	59	90.74	87.53
11	1	1	2	2.00	99.50	22	22	91.07	87.99
12	4	10	13	1.30	99.73	179	156	93.74	91.25
14	3	3	4	1.33	99.80	57	55	94.58	92.40
20	1	1	1	1.00	99.82	20	20	94.88	92.82
26	1	2	2	1.00	99.86	52	52	95.65	93.90
28	1	1	1	1.00	99.88	28	28	96.07	94.49
30	2	2	2	1.00	99.91	60	60	96.96	95.74
32	1	1	2	2.00	99.95	64	64	97.92	97.08
40	2	2	2	1.00	99.98	80	80	99.11	98.75
60	1	1	1	1.00	100.00	60	60	100.00	100.00
		------	------			------	------		
Totals		4433	5640			6720	4789		

TABLE 7. *FLORIDA MARINE RESEARCH INSTITUTE* August 28, 1994

St. Petersburg, Florida

FLOUNDERS PARALICHTHYS SPP.

DATA: MRFSS 1979-1993

Estimated percent reduction in harvest for different bag limits based upon 200 iterations of 500 interviews.

East Coast

1979-93 Number of interview 2,324

	BAG LIMITS									
	2	4	6	8	10	12	14	16	18	20
Average	21	10	6	4	3	2.	2	2	2	1
Std Dev	5.3	4.9	4.4	4.0	3.6	3.3	3.0	2.7	2.4	2.2
Max	39	27	20	18	16	14	13	11	10	9
Min	10	1	0	0	0	0	0	0	0	0

1990-199 Number of interview 1,173

Average	22	7	3	1	1	0	0	0	0	0
Std Dev	4.2	2.9	1.9	1.3	0.9	0.5	0.0	0.0	0.0	0.0
Max	32	16	9	6	4	2	0	0	0	0
Min	11	0	0	0	0	0	0	0	0	0

West Coast

1979-93 Number of interview 2,109

	BAG LIMITS									
	2	4	6	8	10	12	14	16	18	20
Average	31	18	13	10	8	6	5	5	4	4
Std Dev	5.9	6.1	5.9	5.5	5.1	4.8	4.5	4.1	3.8	3.5
Max	49	40	35	31	28	26	24	21	19	17
Min	14	4	0	0	0	0	0	0	0	0

1990-199 Number of interview 905

Average	25	15	10	7	6	5	5	4	4	3
Std Dev	6.6	6.3	5.7	5.3	4.9	4.6	4.1	3.8	3.4	3.0
Max	40	29	25	23	21	20	18	17	15	14
Min	9	2	0	0	0	0	0	0	0	0

FIGURE 1. Weight (grams) and total length (mm) data for 67 gulf flounder sampled in Florida during 1992-1994; M=male, F=female, U=unsexed.

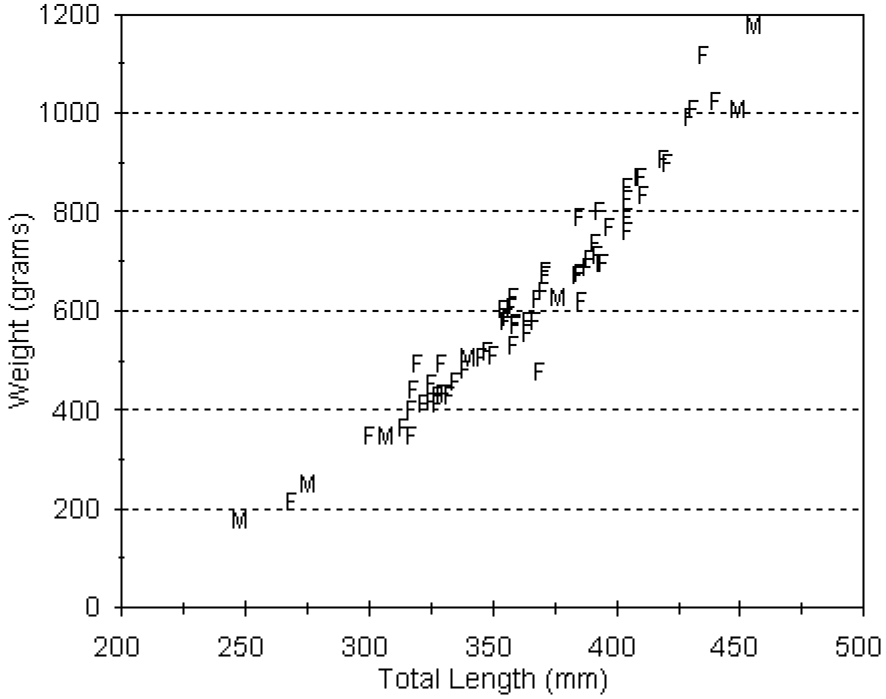


FIGURE 2. Preliminary age (years) and total length (mm) data for 67 gulf flounder sampled in Florida during 1992-1994; M=male, F=female, U=unsexed.

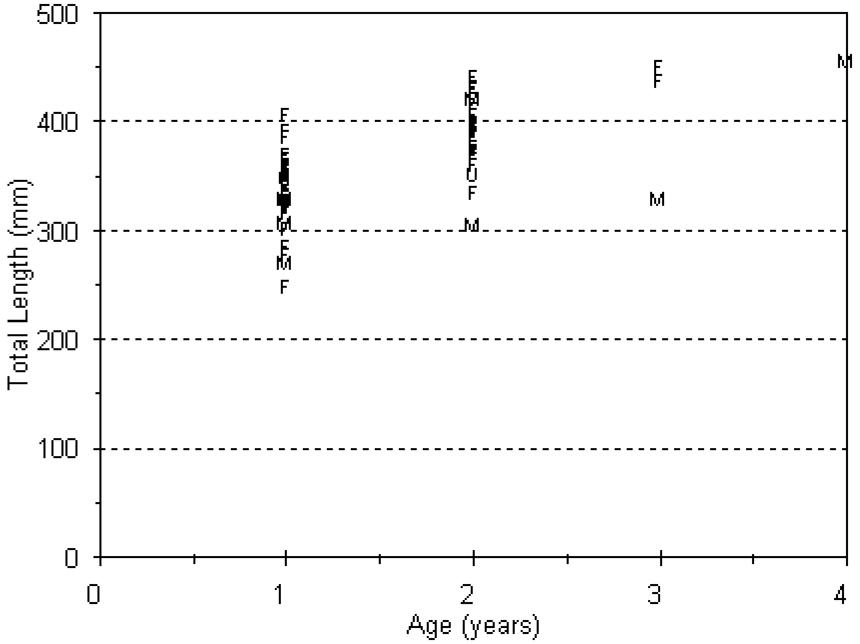
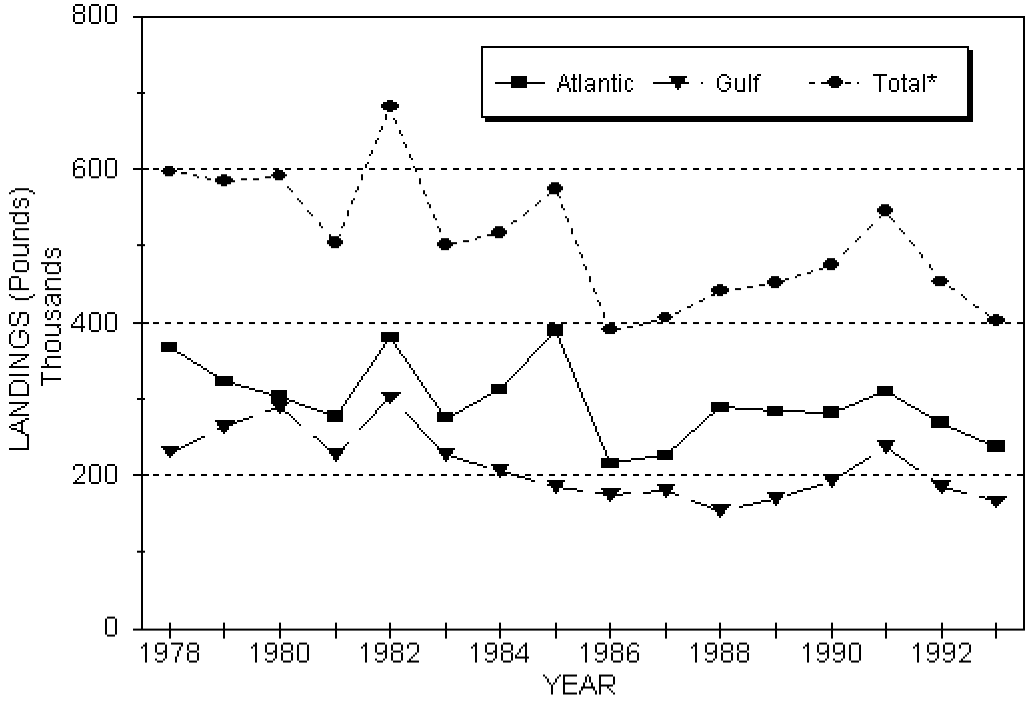


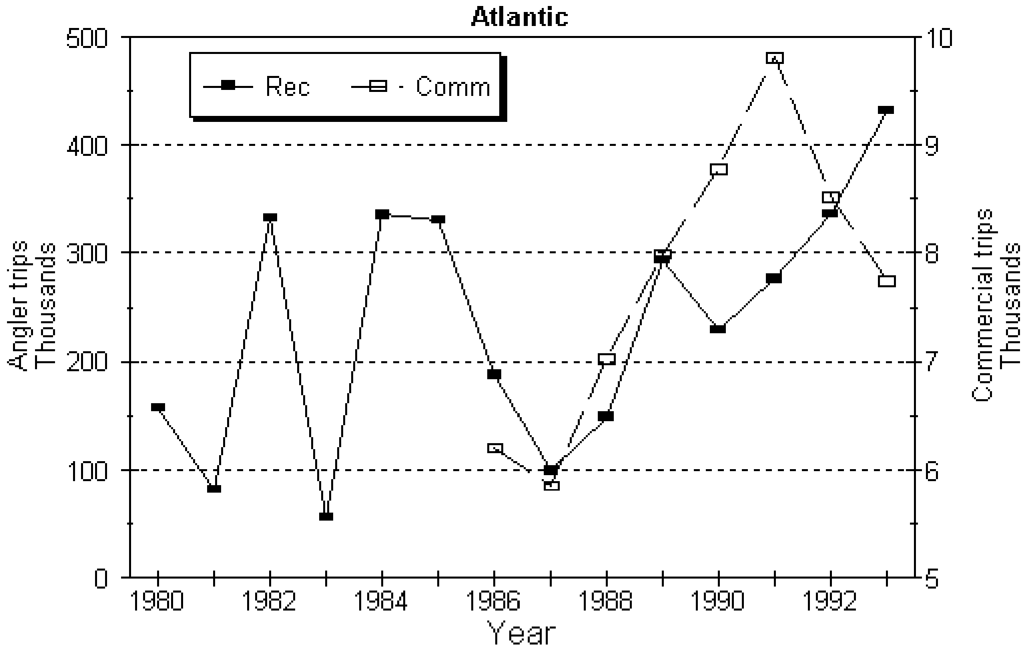
FIGURE 3. Annual commercial landings (pounds) of flounder made in Florida along the Atlantic and Gulf coasts and statewide, 1978-1993.



Year	Atlantic	Gulf	Total*
1978	366,450	230,479	596,929
1979	322,493	262,993	585,486
1980	302,645	288,339	590,984
1981	276,909	226,220	503,129
1982	379,636	302,010	681,646
1983	274,587	226,011	500,598
1984	311,549	205,563	517,112
1985	389,158	184,844	574,002
1986	215,449	174,163	389,612
1987	225,093	180,270	405,363
1988	288,380	152,889	441,269
1989	283,134	168,632	451,766
1990	282,113	193,160	475,273
1991	308,995	237,081	546,076
1992	268,136	185,445	453,581
1993	237,064	165,650	402,714

*out-of-state landings not included

FIGURE 4. The number of trips taken by anglers or commercial fishermen for flounder on the Atlantic and Gulf coasts of Florida during 1980-1993.



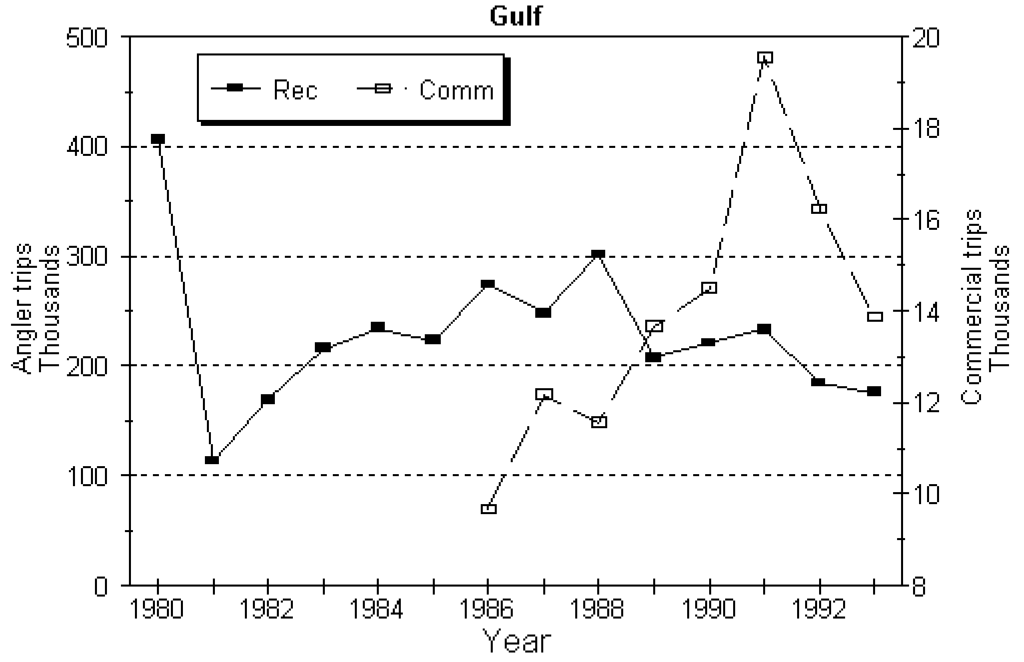


FIGURE 5. The geographic distribution of commercial landings (pounds) and commercial trips landing flounder in Gulf and Atlantic counties of Florida.

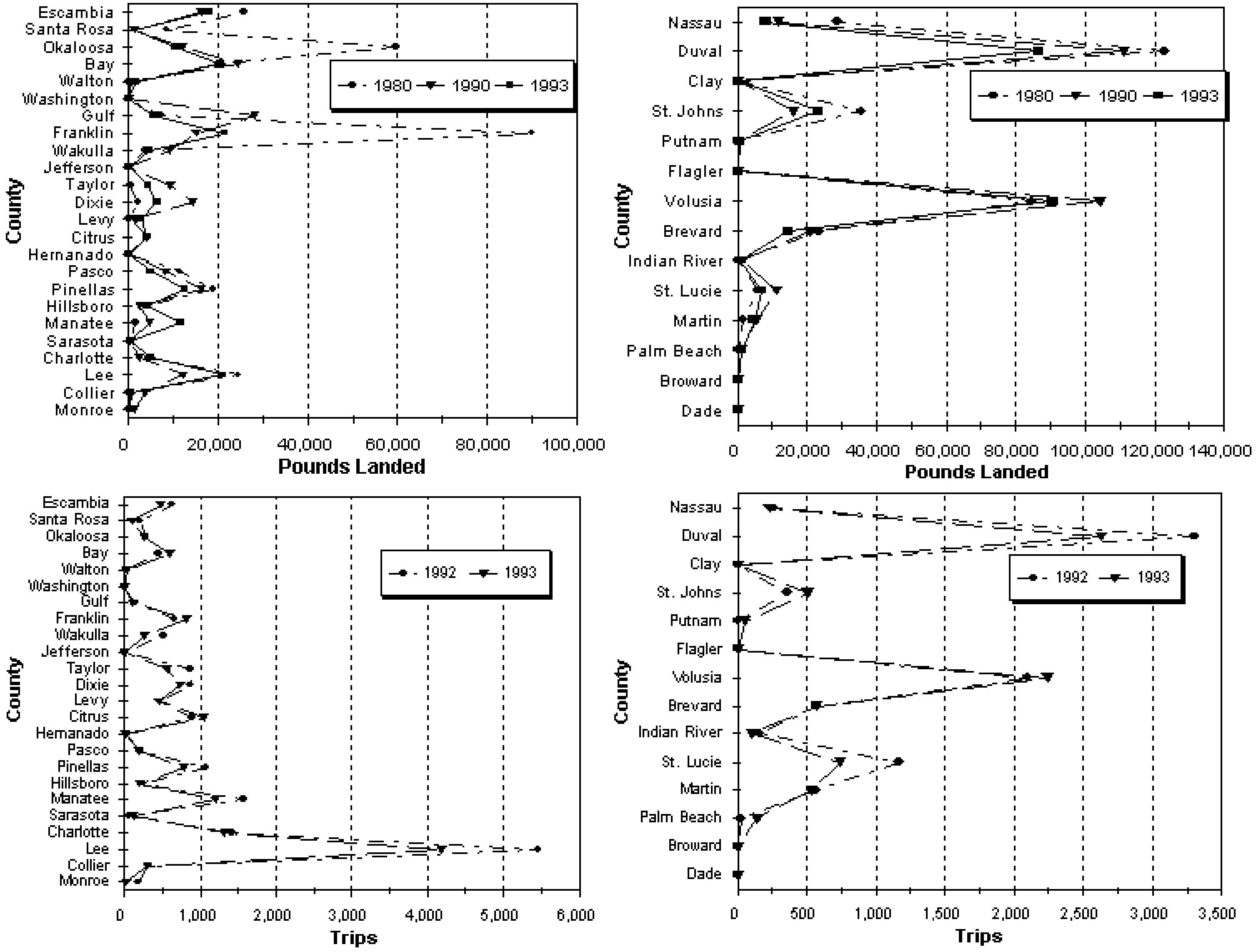


FIGURE 6. Monthly commercial landings of flounders during 1980, 1990, and 1993 in Northwest, Southwest, and Northwest Regions of Florida.

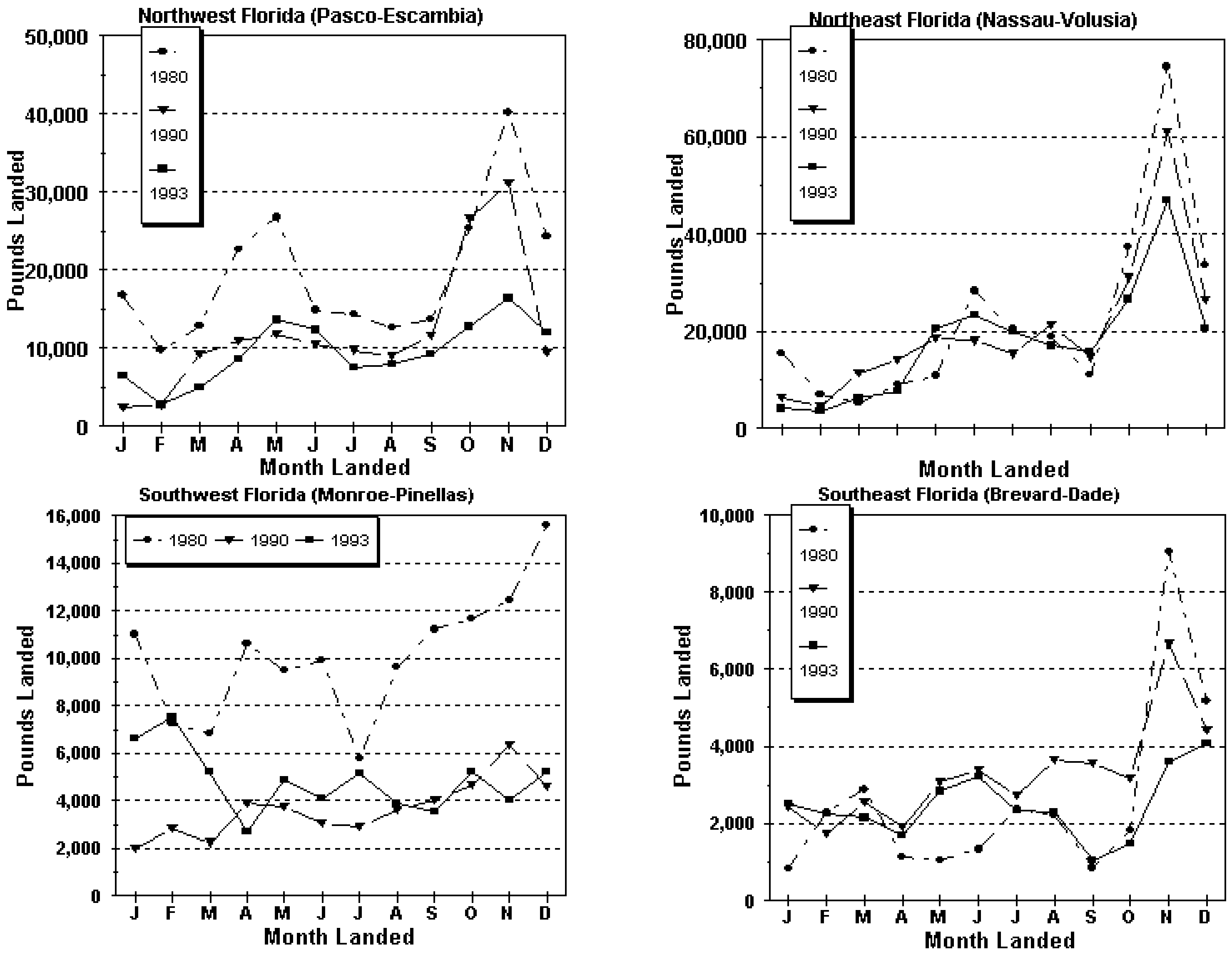


Figure 7. Total lengths of flounders sampled from the commercial landings on the Atlantic and Gulf coasts.

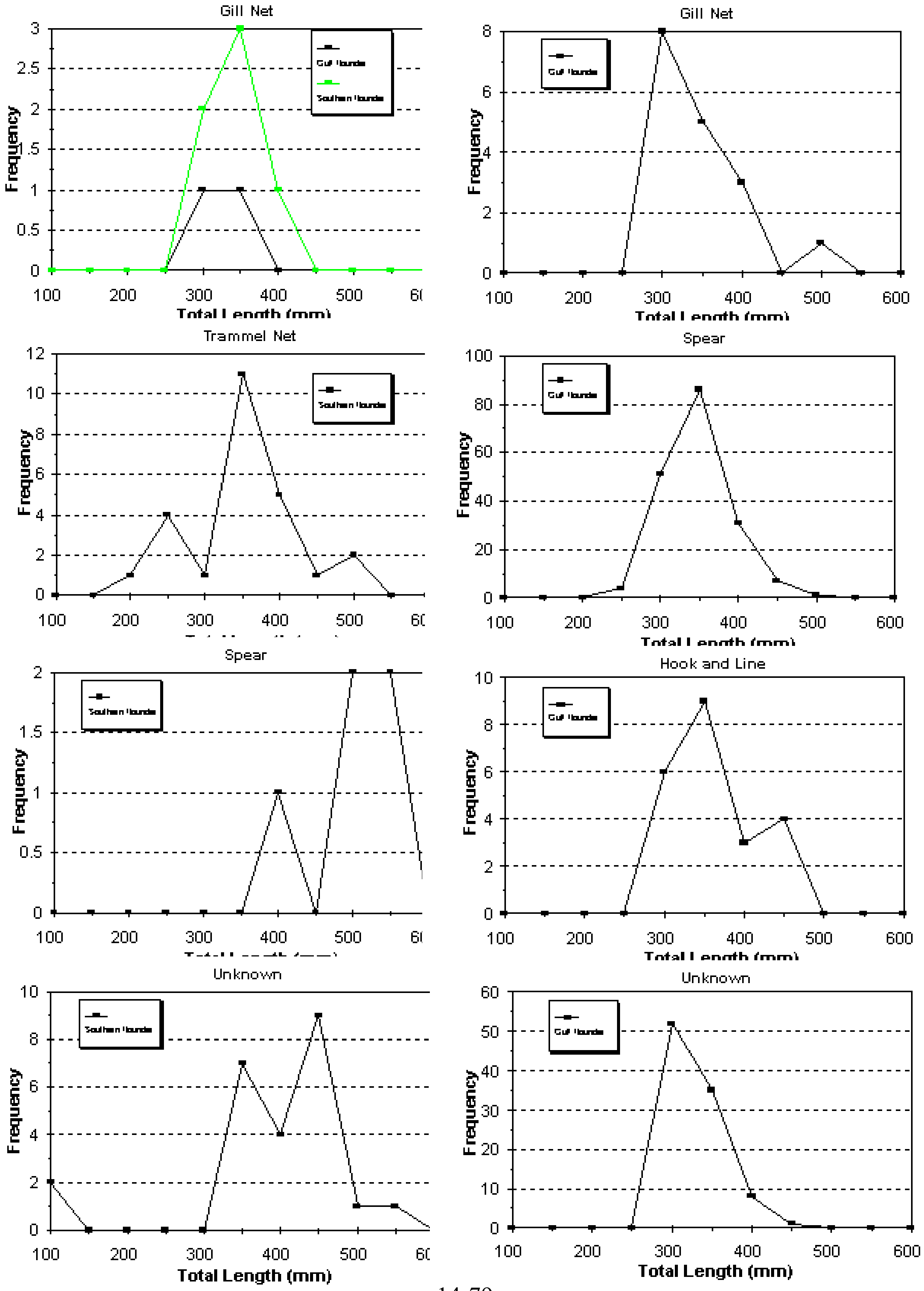
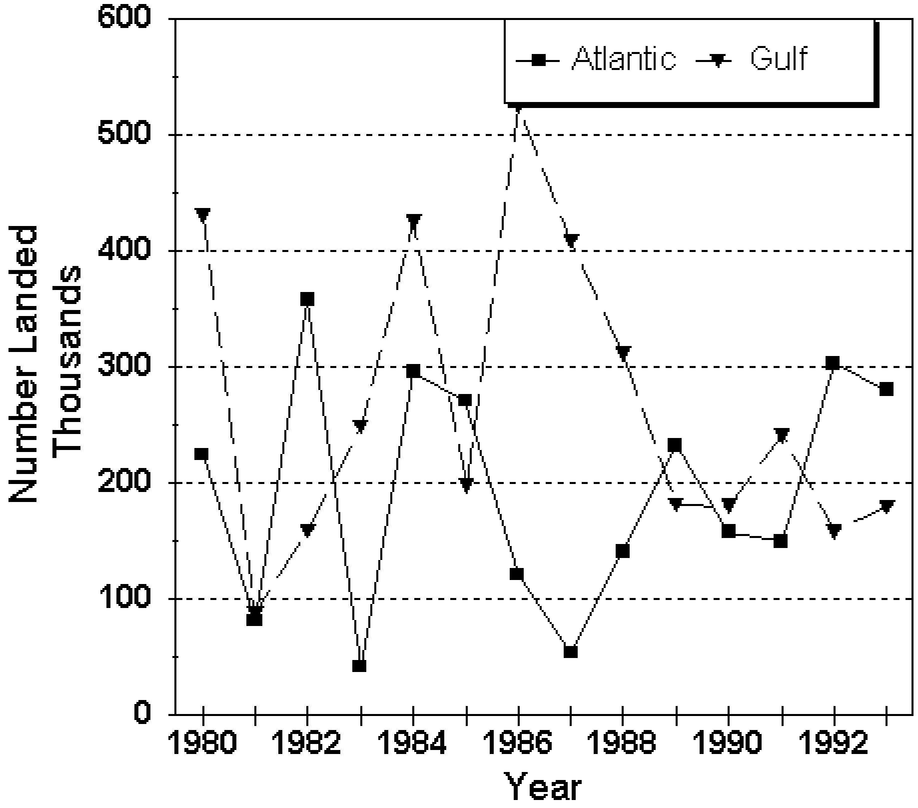


FIGURE 8. Estimated number of gulf and southern flounder landed by anglers fishing along the Atlantic and Gulf coasts of Florida during 1980-1993.



	Atlantic	Gulf
1980	223,752	429,475
1981	80,252	87,454
1982	357,079	157,817
1983	40,358	247,461
1984	294,925	424,094
1985	270,194	197,053
1986	120,537	523,399
1987	53,368	408,237
1988	140,102	310,837
1989	231,828	180,844
1990	156,610	179,079
1991	148,421	240,013
1992	302,248	157,342
1993	279,236	178,441

FIGURE 9. Lengths of flounders sampled from anglers fishing on the Atlantic and Gulf coasts of Florida between 1979 and 1993.

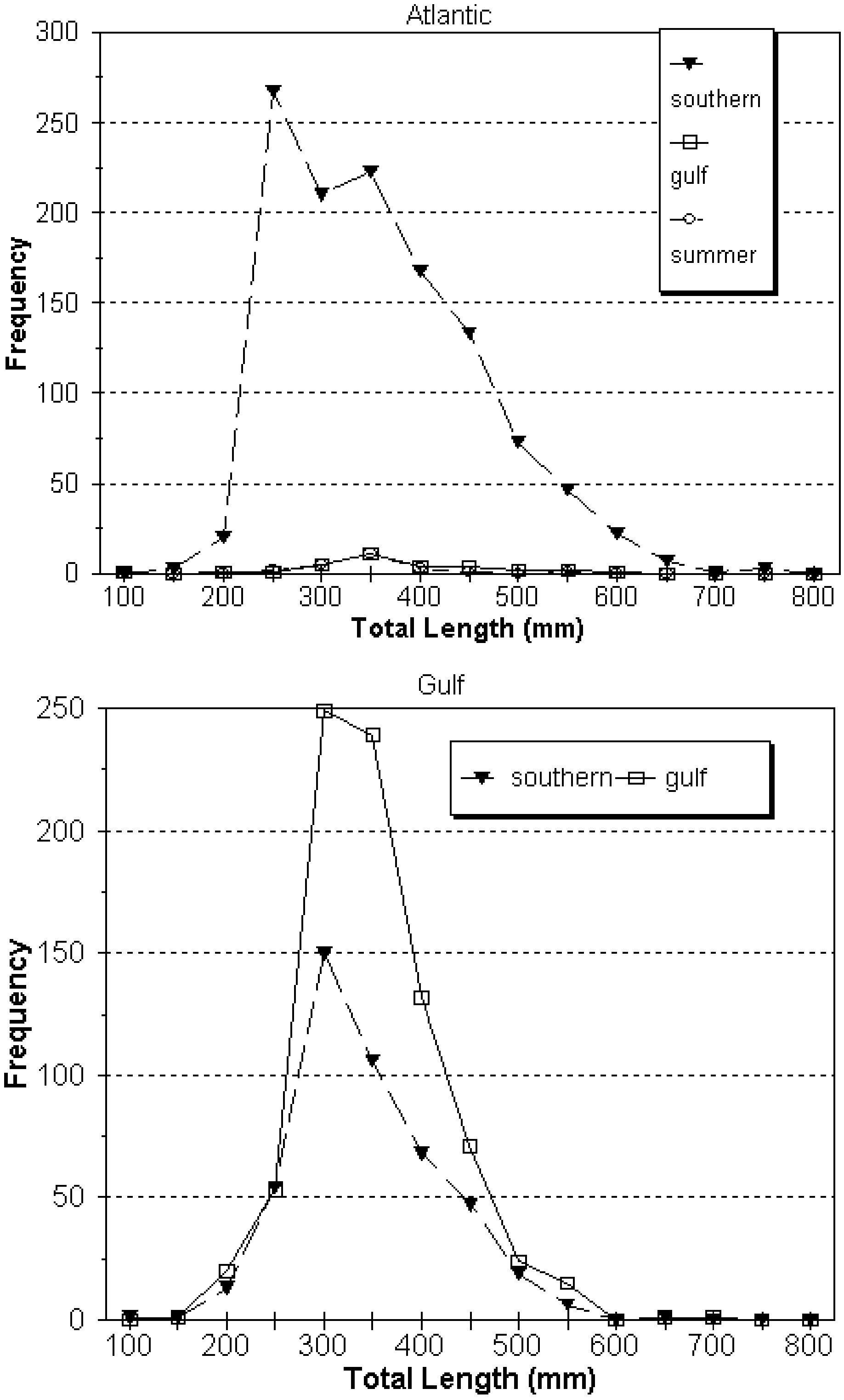
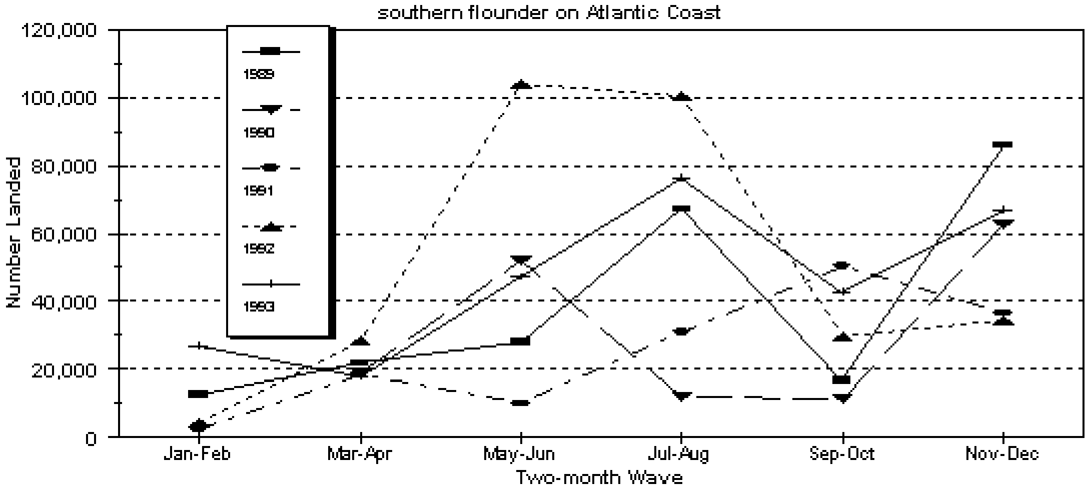
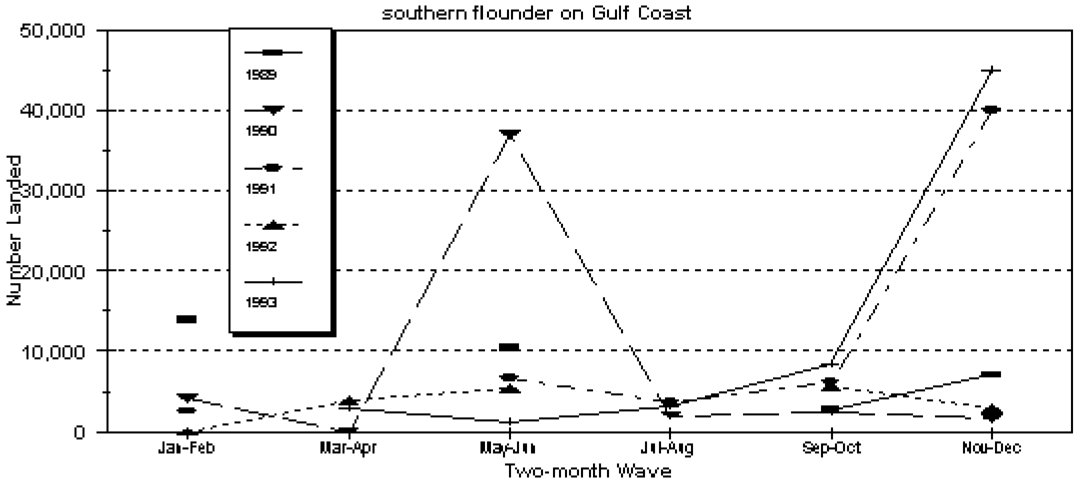


FIGURE 10. Estimated number of flounders landed (Type A + B1) during each two-month wave along the Atlantic and Gulf coast of Florida during the period 1989-1993


southern flounder on Atlantic Coast


southern flounder on Gulf Coast

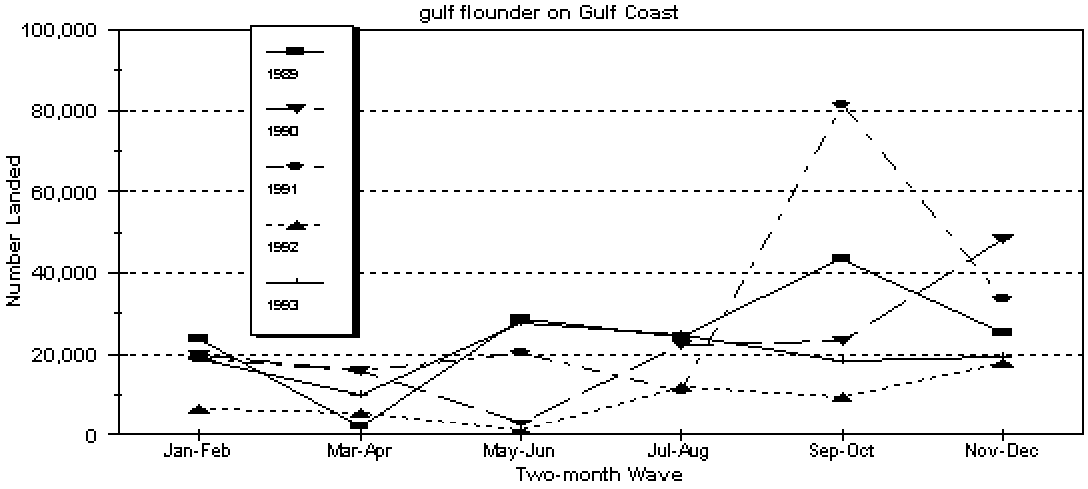
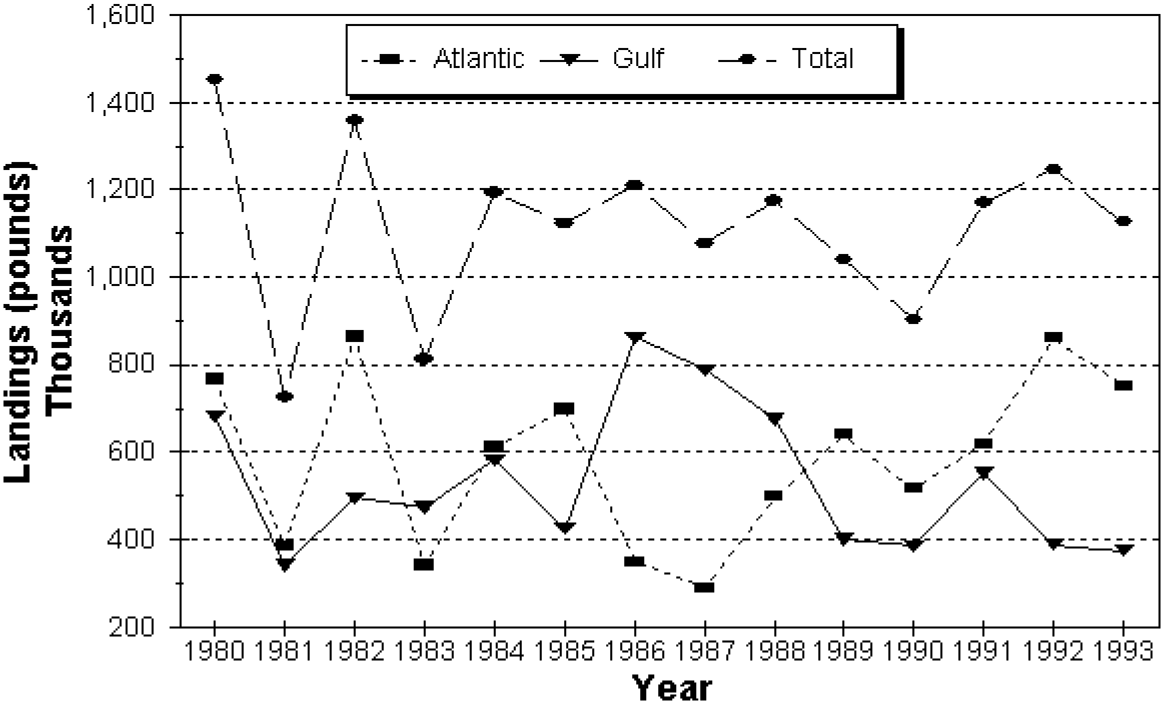

gulf flounder on Gulf Coast

FIGURE 11. Total harvest (pounds) of flounder on Florida's Atlantic coast, Gulf coast and statewide during the period 1980-1993. Only gulf and southern flounder are included in the recreational landings.



	Atlantic	Gulf	Statewide
1980	767,736	683,026	1,450,762
1981	385,145	340,767	725,911
1982	863,192	494,168	1,357,359
1983	339,867	473,323	813,190
1984	612,019	582,201	1,194,220
1985	697,774	425,386	1,123,160
1986	348,317	861,229	1,209,547
1987	288,691	787,931	1,076,622
1988	497,902	675,624	1,173,526
1989	640,033	400,058	1,040,091
1990	517,028	385,294	902,322
1991	618,883	551,738	1,170,621
1992	859,303	387,378	1,246,681
1993	751,640	374,408	1,126,048

FIGURE 12. Median and quartiles for the annual distribution of observed catch-per-angler hour for flounder anglers along the Atlantic and Gulf coasts of Florida during 1979-1993.

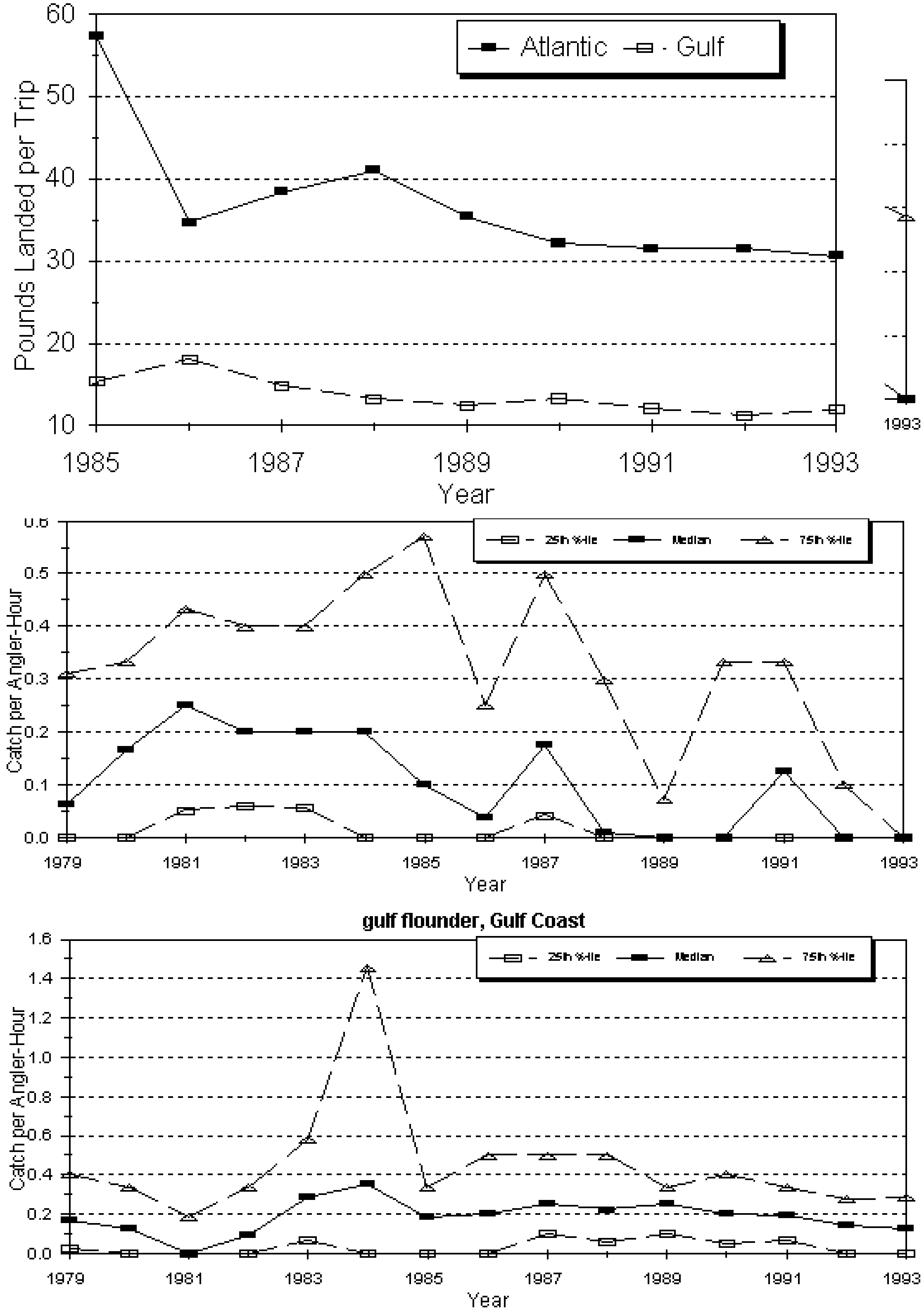


FIGURE 13. Mean catch-per-trip for commercial fishing trips that contained flounder and were made along the Atlantic and Gulf coasts of Florida during 1985-1993.

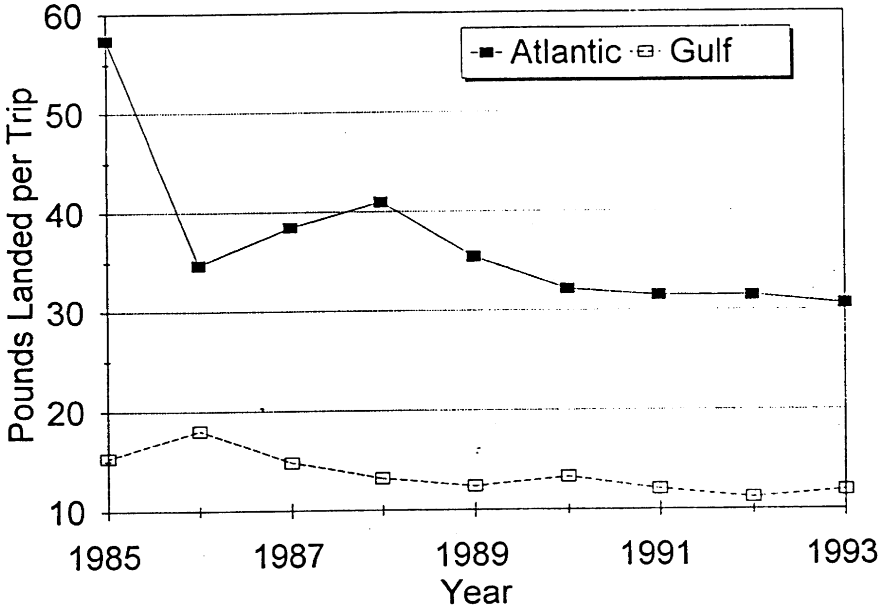


FIGURE 14. The total number of gulf flounder collected during fisheries-independent monitoring of juvenile fish populations in Tampa Bay and Charlotte Harbor, 1989-1993.

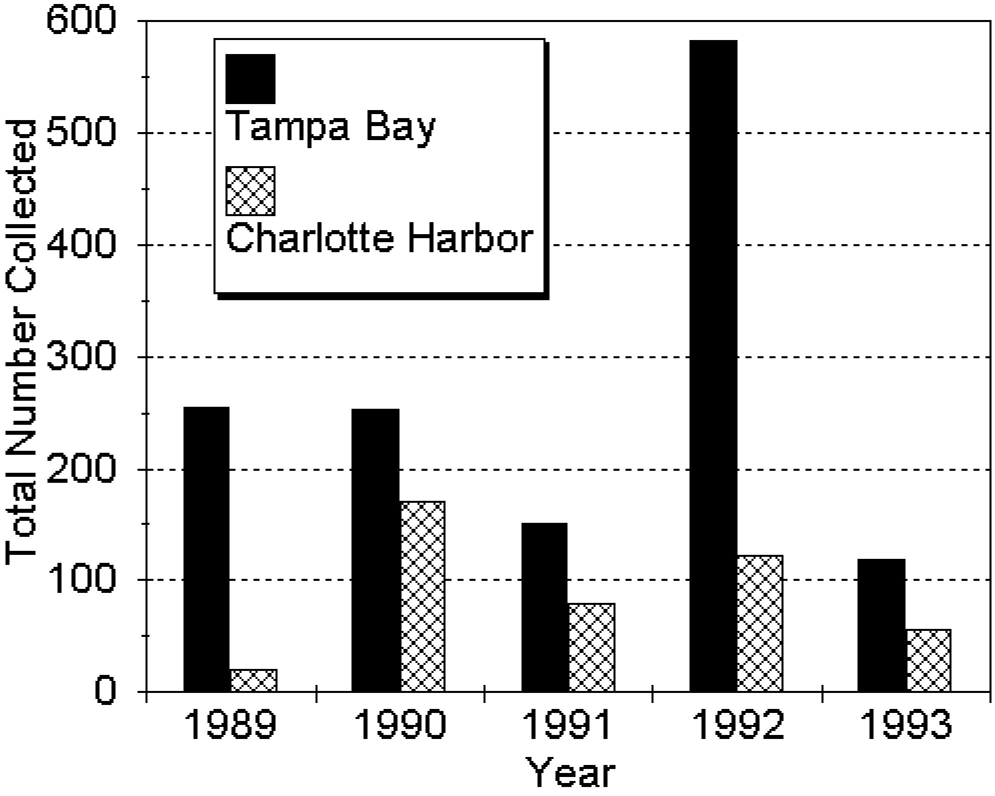
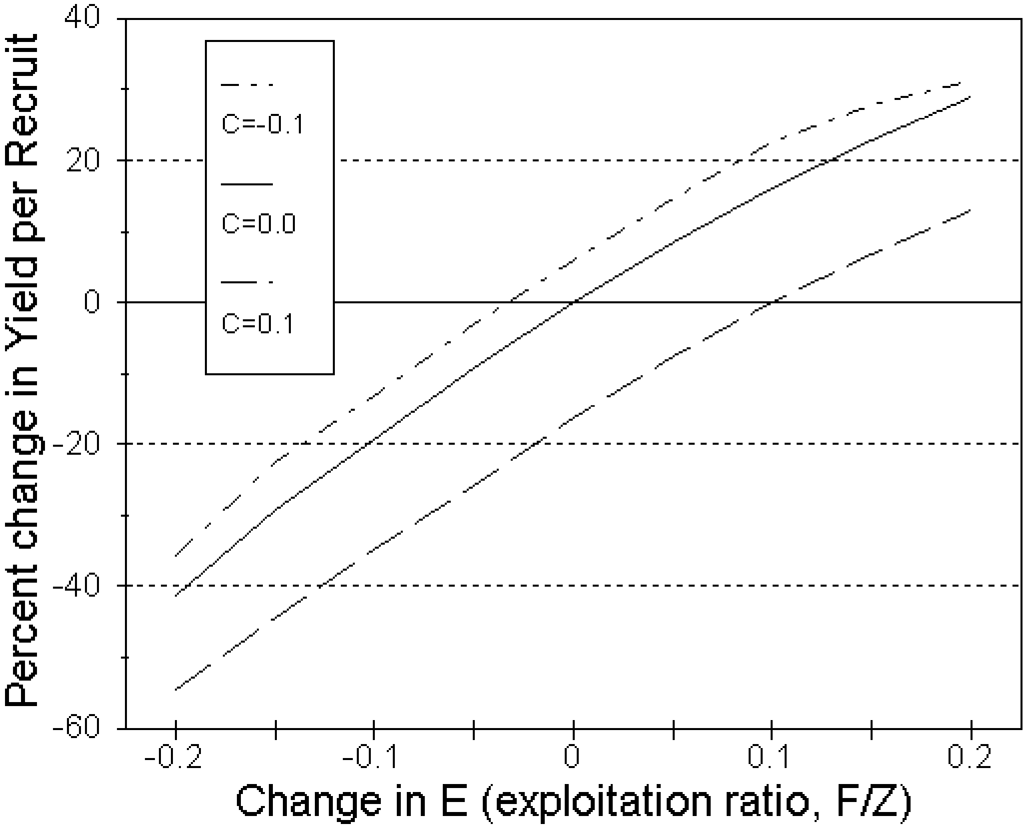


FIGURE 15. Estimates of the median change in yield per recruit for gulf flounder in Florida associated with changes in exploitation ratio of -20% to +20% and changes in relative size at recruitment of -10%, 0%, and +10%.



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Cover art for the flounder fishery management plan was graciously provided by Clemente Guzman, III, who has been drawing since the third grade. Guzman drew his way through the Edgewood District Schools in San Antonio, and every summer his family of 11 went to Minnesota to work in the fields.

Guzman won a scholarship to the Mankato Technical Institute in Mankato, Minnesota, where he earned an Associates Degree in commercial art. He is a two-time overall winner of the Tejano Conjunto Musical Festival Poster contest in San Antonio, and has won an Izaak Walton League award and several Addys. His work is found in both business and private collections.

He is currently a graphic artist for the Texas Parks and Wildlife Department and lives in Lockhart with his wife, Gabriela, and their son, C.J.