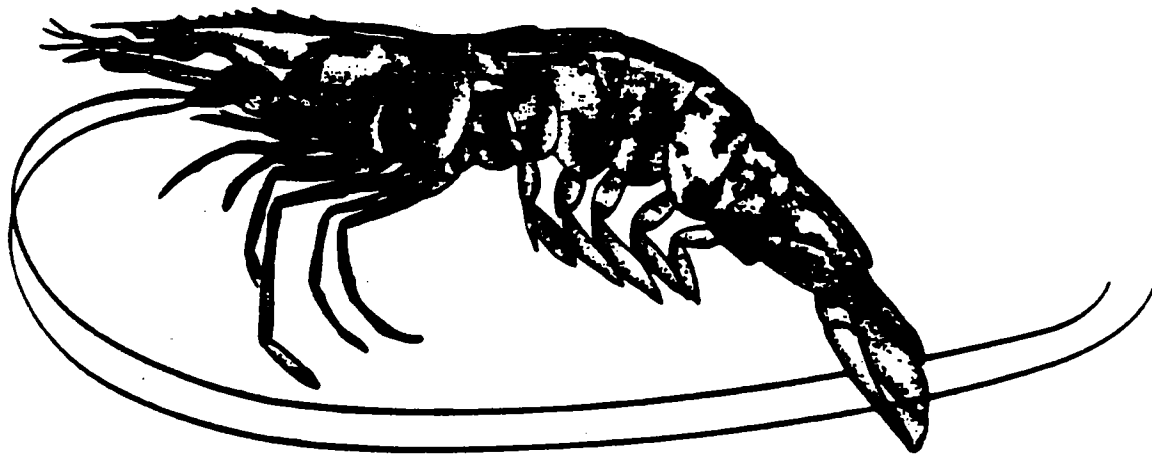


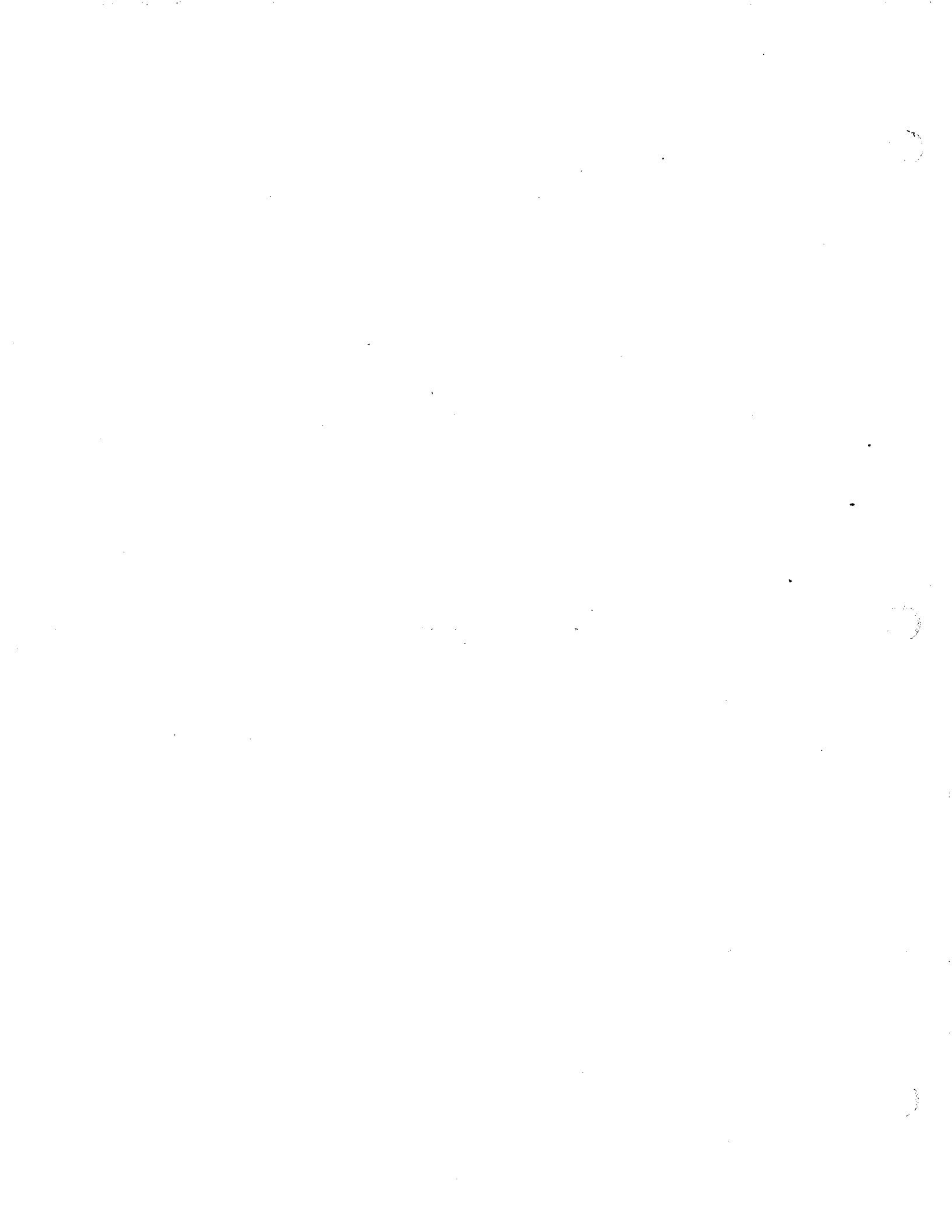
**FISHERY MANAGEMENT PLAN
FOR THE
SHRIMP FISHERY
OF THE
GULF OF MEXICO,
UNITED STATES WATERS**

(INCLUDES AMENDMENTS 1 AND 2)



REVISED NOVEMBER 1981

**GULF OF MEXICO FISHERY MANAGEMENT COUNCIL
TAMPA, FLORIDA**



DRAFT UPDATE
OF
FISHERY MANAGEMENT PLAN
FOR
SHRIMP
GULF OF MEXICO

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2.0 INTRODUCTION

The Magnuson Fishery Conservation and Management Act (Public Law 94-265) provides for exclusive United States management authority over the fishery resources within a fishery conservation zone extending from the seaward boundary to the United States territorial sea (three nautical miles for the Gulf of Mexico states of Louisiana, Mississippi, and Alabama and nine nautical miles for Texas and the west and northwest coasts of Florida) to a point 200 miles from shore. Responsibility for developing a shrimp fishery management plan for the Gulf of Mexico is vested in the Gulf of Mexico Fishery Management Council; and implementation and enforcement of any regulations pertinent to the management of fisheries within the fishery conservation zone are the responsibility of the Secretary of Commerce and Secretary of the Department wherein the U.S. Coast Guard is located.

Successful implementation of the plan will require unity of purpose between federal regulations and those of the five Gulf states (Florida, Alabama, Mississippi, Louisiana, and Texas). Authority for implementing state regulations is vested in the Florida Department of Natural Resources, the Alabama Department of Conservation and Natural Resources, the Mississippi Marine Conservation Commission, the Louisiana Wildlife and Fisheries Commission, and the Texas Parks and Wildlife Commission.

The fishery addressed is composed of six species, occurring in the area of jurisdiction of the Gulf of Mexico Fishery Management Council as well as in the territorial seas adjacent thereto and the associated bays, inlets, wetlands, and upland areas as appropriate. Species include brown shrimp (*Penaeus aztecus* Ives), white shrimp (*Penaeus setiferus* Linnaeus), pink shrimp (*Penaeus duorarum* Burkenroad), and royal red shrimp (*Hymenopenaeus robustus* Smith¹), plus seabobs (*Xiphopenaeus kroyeri* Heller) and rock shrimp (*Sicyonia brevirostris* Stimpson), which are incidental bycatch. The management unit is to be equal to the fishery throughout its range; however, federal implementation will occur only in the fishery conservation zone.

Biological aspects of the shrimp species have been reviewed, and the maximum probable catch is estimated at: (see Sec. 4.7.1.1)

Brown shrimp	--	132 million pounds (tails) per year
White shrimp	--	64 million pounds (tails) per year
Pink shrimp	--	20 million pounds (tails) per year
Royal red shrimp	--	0.392 million pounds (tails) per year

Each year's take of brown, white, and pink shrimp will be heavily influenced by water salinity and temperature during critical periods of estuarine shrimp growth. Maximum sustainable yield (MSY) estimates for the seabobs and rock shrimp cannot be made with any authority because they are caught incidentally by fishermen trawling for the other species.

Seabobs and rock shrimp are caught incidental to the three main species of penaeid shrimp. MSY estimates are weakened because of lack of data.

None of the stocks appear to be biologically overfished.

Major concern for future stocks is related to concern for adequate habitat, particularly for the estuarine-dependent brown, white, and pink shrimp, which account for most of the annual shrimp harvest.

¹ The genus *Hymenopenaeus* is the same as *Pleoticus* according to Isabel Farfante.

The effects of shrimping on sea turtles and incidentally caught finfish are considered in the plan.

The fishery is the most valuable and probably the most diverse in the nation. Harvesters include (1) a large commercial fleet fishing the inshore, nearshore Gulf, and open Gulf waters, (2) an undetermined (but large) number of recreational shrimpers mainly fishing the inshore and nearshore Gulf waters, and (3) a substantial number of bait shrimpers mainly fishing the inshore waters. Processed products include frozen, canned, fresh, and breaded shrimp as well as a host of specialty items. Present management regimes differ in the fishery over the allowable size of shrimp at first harvest as size is related to whom can harvest and process the shrimp.

Unfortunately, socioeconomic data are insufficient for this complex fishery to evaluate fully the relative needs of various user groups for shrimp of different sizes. Care has therefore been taken in making recommendations to reduce the waste of current culling practices so that one user group will not be favored over another. No recommendations are made on limiting fishing effort because the resource is not biologically overfished. There is insufficient socioeconomic data to suggest methods or reasons, consistent with MFCMA, to limit entry at this time.

During a period of public review of the Draft Fishery Management Plan and Environmental Impact Statement, 21 public hearings were held and written comments were received by mail. Public comments and responses are contained in the Final Environmental Impact Statement.

The plan is to be reviewed annually so that management measures can be evaluated for their fairness and effectiveness and so that other methods of optimizing yield can be assessed.

Problems in the Fishery (See Section 8.3)

The Council has identified the following problems associated with the fishery and the present management regime and has prepared the plan objectives to address and alleviate them. In a free access fishery, a management regime to maximize protein yield and economic return to the fisherman is of importance.

- 1) Conflict among user groups as to area and size at which shrimp are to be harvested.
- 2) Discard of shrimp through the wasteful practice of culling.
- 3) The continuing decline in the quality and quantity of estuarine and associated inland habitats.
- 4) Lack of comprehensive, coordinated and easily ascertainable management authorities over shrimp resources throughout their ranges.
- 5) Conflicts with other fisheries such as the stone crab fishery in southern Florida, the groundfish fishery of the north central Gulf, and the Gulf's reef fish fishery.
- 6) Incidental capture of sea turtles.
- 7) Loss of gear and trawling grounds due to man-made underwater obstructions.
- 8) Partial lack of basic data needed for management.

2.1 Goal and Objectives

GOAL:

To manage the shrimp fishery of the United States waters of the Gulf of Mexico in order to attain the greatest overall benefit to the nation with particular reference to food production and recreational opportunities on the basis of the maximum sustainable yield as modified by relevant economic, social or ecological factors.

OBJECTIVES:

1. Optimize the yield from shrimp recruited to the fishery.
2. Encourage habitat protection measures to prevent undue loss of shrimp habitat.
3. Coordinate the development of shrimp management measures by the GMFMC with shrimp management programs of the several states, where feasible.
4. Promote consistency with the Endangered Species Act and the Marine Mammal Protection Act.
5. Minimize the incidental capture of finfish by shrimpers, when appropriate.
6. Minimize conflicts between shrimp and stone crab fishermen.
7. Minimize adverse effects of underwater obstructions to shrimp trawling.
8. Provide for a statistical reporting system.

2.2 Management Measures Considered and Adopted (See Sec. 8.5.1.1)

In order to obtain the above objectives, the Council has adopted the following management measures:

- Measure 1: Establish a cooperative permanent closure with the State of Florida and the U.S. Department of Commerce of the area delineated in Table 8.3-1 to protect small pink shrimp until they have generally reached a size range larger than 69 tails to the pound.
- Measure 2: Establish a cooperative closure of the territorial sea of Texas and the adjacent U.S. FCZ with the State of Texas and the U.S. Department of Commerce during the time when a substantial portion of the brown shrimp in these waters weigh less than a count of 65 tails to the pound (39 heads-on shrimp to the pound).
- Measure 3: Recommend that all Gulf states consider establishing shrimp management sanctuaries in important segments of nursery grounds under their sole jurisdiction.
- Measure 4: The Gulf of Mexico Fishery Management Council has established an internal committee to review and assess the status of Gulf fishery habitats, with particular attention to those factors which might further stimulate "the downward trends in quality and quantity of fish habitats." (Atlantic States Marine Fisheries Commission, et al., 1977.)
- Measure 5: The Gulf states are encouraged to adopt flexible management procedures which would provide regulation by administrative agencies of the shrimp resources in inland waters and territorial seas.

Measure 6: The Gulf states are encouraged to adopt reciprocal internal management decisions flexible enough to allow joint management of shrimp with other states and with the Department of Commerce.

Measure 7: Develop and implement an educational program to inform shrimpers of the current status of sea turtle populations and of proper methods of resuscitation and return to sea of incidentally captured sea turtles.

Measure 8: Encourage research on and development of shrimping gear in order to reduce the incidental catch without decreasing the overall efficiency of shrimping or excessively increasing the cost of gear.

Measure 9: Consistent with the Stone Crab Management Plan, establish a seasonal closure of a portion of the Dry Tortugas shrimp grounds in order to avoid gear conflicts with stone crab fishermen.

Measure 10: The Gulf of Mexico Fishery Management Council will attempt to reduce, where feasible, the loss of offshore trawlable bottom by establishing within GMFMC, a committee to monitor and review construction of offshore reefs, with attention to the needs of the reef fish and shrimp user groups.

Measure 11: All statistical reporting requirements will be mandatory.

2.3 Operational Definitions of Terms Used

Acceptable Biological Catch (ABC) is a seasonally determined catch that may differ from MSY for biological reasons. It may be lower or higher than MSY in some years for species with fluctuating recruitment. It may be set lower than MSY in order to rebuild overfished stocks.

Annual Crop is a species which is harvested essentially as a 0-year class (less than one year of age).

Boats are crafts that displace less than five gross tons.

Catch Per Unit of Effort (CPUE) is the total number or weight of fish harvested by a defined unit of fishing effort.

Commercial Shrimpers are shrimpers who sell any portion of their catch.

Culling is the practice of discarding those shrimp caught which are smaller than a size the fisherman wishes to retain.

Determination for Total Allowable Level of Foreign Fishing (TALFF). The foreign allowable catch is determined by deducting the expected domestic annual harvest from the optimum yield.

Detritus is considered as decaying plant material and its associated community of microscopic plants and animals.

Domestic Annual Fishing Capacity (DAFC) is the total potential physical fishing capacity of the fleet, modified by logistic factors. The components of the concept are:

- a. An inventory of total potential physical capacity, defined in terms of appropriate vessel and gear characteristics (that is, size, horsepower, hold capacity, gear design, etc.).

- b. Logistic factors determining total annual fishing capacity, (that is, variations in vessel and gear performance, trip length between fishing locations and landing points, weather constraints, etc.).

Domestic Annual Processing Capacity (DAPC) is the amount that can be processed if supplies are available.

Equilibrium Yield (EY) is the annual or seasonal harvest that maintains the resource at approximately the same level of abundance (apart from the effects of environmental variation) in succeeding seasons or years.

Estuarine Dependent Species are those organisms that must complete a portion of their life cycle within an estuary.

Expected Domestic Annual Harvest (EDAH) is the total expected catch of the U.S. shrimp fleet.

Fishery Conservation Zone (FCZ) is the area of federal jurisdiction, beginning at the outer limit of the states' territorial seas and extending 200 miles from shore.

Fishing Effort is the total fishing gear in use for a specified period of time.

Fishing Mortality includes all deaths to the exploited populations associated with the harvesting practices.

Growth Overfishing is a level of effort which prevents the exploited population from providing its maximum yield but does not impair the reproductive capacity of the stock.

Incidental Catch refers to the catch of species other than the target species (bycatch).

Inland Waters (Inside waters) are areas of state jurisdiction and include all bays and lagoons inland from the baseline from which the territorial sea is measured.

Maximum Economic Efficiency (MEE) is that level of fishing effort at which the value to society of the last unit of shrimp produced is equal to the cost to society of producing that unit.

Maximum Economic Yield (MEY) is the level of harvest from the common property resource that maximizes the stream of generated net incomes over time.

Maximum Sustainable Yield (MSY) is an average over a reasonable length of time of the largest catch which can be taken continuously from a stock, under current environmental conditions.

Natural Mortality includes deaths from all causes except capture by man.

Omnivore is an animal which eats whatever dead or alive animal or plant material is available.

Optimum Yield (OY) with respect to the yield from a fishery, means the amount of fish:

- (a) which will provide the greatest overall benefit to the nation, with particular reference to food production and recreational opportunities; and
- (b) which is prescribed as such on the basis of the maximum sustainable yield from such fishing, as modified by any relevant economic, social, or ecological factor.

Recreational Shrimpers are shrimpers who do not sell their catch.

Recruitment Overfishing is used to denote that level of fishing effort which reduces the spawning stock size to the point where there is a reduction in the amount of young recruited to the fishery.

Spawner-Recruit Relationship is the quantifiable relationship between the number of reproducing adults and the resulting number of young recruited to the fishery.

Stock is a group of fish manageable as a unit.

Target Species are the species at which the fishery is directed.

Territorial Sea is the area of state jurisdiction extending from the baseline to three nautical miles seaward for Alabama, Mississippi, and Louisiana, and to nine nautical miles for Texas and the Florida west and northwest coasts.

Total Allowable Level of Foreign Fishing (TALFF) is any surplus in the optimum yield above the expected domestic annual harvest.

Unit Fishing Effort is a measure of harvesting pressure which has been adjusted to account for differences in the ability of boats and vessels of different types to harvest the resource.

Vessels are crafts with displacement greater than or equal to five gross tons.

Year-class is the fish spawned in a given year.

Yield is the amount of a species harvested by man.

3.0 DESCRIPTION OF FISHERY

3.1 Area and Stocks Involved

The fishery being addressed is comprised of the species listed below and occurs in the area of jurisdiction of the Gulf of Mexico Fishery Management Council as well as in the area of jurisdiction of the various Gulf states including their territorial seas, associated bays, inlets, wetlands, and upland areas as appropriate.

Consideration of this large area is necessary because of the migratory natures of the exploited species and fishermen, the critical role of estuaries in the life cycles of the dominant shrimp species, and the impacts upland alterations may have on the quality of shrimp habitat.

Shrimp species within the fishery are:

Brown shrimp (Penaeus aztecus Ives)
White shrimp (Penaeus setiferus Linnaeus)
Pink shrimp (Penaeus duorarum Burkenroad)
Royal red shrimp (Hymenopenaeus robustus Smith)
Seabobs (Xiphopenaeus kroyeri Heller) INCIDENTAL BYCATCH
Rock shrimp (Sicyonia brevirostris Stimpson) INCIDENTAL BYCATCH

In addition to these shrimp species, shrimpers also catch sea turtles and other shellfish and finfish. The sea turtle catch is of concern to the development of this plan because all the sea turtles which occur in the Gulf are listed as either endangered or threatened under the U.S. Endangered Species Act which prohibits capture of endangered species. Though primary responsibility for protection of these sea turtle species lies with the National Marine Fisheries Service and the U.S. Fish and Wildlife Service, the plan contains appropriate suggestions to minimize the impact on sea turtle populations. The incidental catch of other shellfish and finfish is also of concern because much of this catch is discarded at sea. Since much of the discarded catch is dead or dies as a result of being caught, this operation largely represents a direct conversion of national resources into food for scavengers. Many of these resources can be used by other national interests. Primary responsibility for managing these resources lies with the GMFMC, NMFS, and the Gulf states. Management plans are currently being prepared by GMFMC for two major bycatch groups--groundfish and reef fish--in which appropriate measures are suggested to reduce this bycatch. In addition, the groundfish management plan contains a thorough treatment of current efforts to develop markets for these discarded species.

Brown shrimp range along the north Atlantic and Gulf of Mexico coasts from Martha's Vineyard, Massachusetts, to the northwestern coast of Yucatan. The range is not continuous but is marked by an apparent absence of brown shrimp along Florida's west coast between the Sanibel and the Apalachicola shrimping grounds (Perez Farfante, 1969). In the U.S. Gulf of Mexico, catches are high along the Texas, Louisiana, and Mississippi coasts.

Mark-recapture experiments indicate a mixing of brown shrimp populations along the north central and northwestern Gulf coast. A southward drift of brown shrimp off the Texas coast towards Mexico has been proposed (Gunter, 1962). There is some speculation that the Mississippi River may act as a barrier to east-west migration.

Brown shrimp are caught out to at least 50 fathoms, though most come from less than 30 fathoms. The season begins in May, peaks in June and July, and gradually declines to an April low.

White shrimp range along the Atlantic coast from Fire Island, New York, to Saint Lucie Inlet, Florida, and along the Gulf coast from the mouth of the Ochlockonee River, Florida, to Campeche. In the Gulf there are two centers of abundance: one along the Louisiana coast and one in the Campeche area (Perez Farfante, 1969).

There appears to be a general mixing of white shrimp west of the Mississippi River to at least the northeast coast of Mexico, with an observed northward migration along the Mexico-Texas shore to at least Aransas Pass, Texas, during the spring (Lindner and Anderson, 1956). A reciprocal southward movement in the fall and winter has been proposed (Gunter, 1962). It has been suggested that again the Mississippi River may act as a barrier in east-west migration (Lindner and Anderson, 1956; Perez Farfante, 1969).

White shrimp are a comparatively shallow-water shrimp, with most of the catch coming from less than 15 fathoms. Annual catch has two peaks: the major one in late summer-early fall, with an October high; the minor one is the "Easter fishery" on over-wintered shrimp which peaks in May. Largest U.S. catches occur west of the Mississippi River to the Freeport, Texas, area, though catch is considerable along the entire north central and western Gulf.

Pink shrimp range along the Atlantic from lower Chesapeake Bay south to around the Florida Keys and up and around the Gulf coast to Isla Mujeres, Mexico. They are also found in the Bermuda Islands and the northern coast of Yucatan. Major concentrations are off southwest Florida and in the south-eastern part of Golfo de Campeche (Perez Farfante, 1969).

The two major pink shrimp grounds in the United States are the Tortugas and Sanibel grounds in southwestern Florida. There is little movement of shrimp between these grounds, and they are derived from largely different estuarine areas (Castello and Allen, 1965).

Pink shrimp catch comes mainly from less than 25 fathoms, with a peak catch at 11 to 15 fathoms. Because of continuous recruitment in southeastern Florida, the catch exhibits a broad peak October through May. U.S. catch is mainly restricted to Florida and is greatest in southwestern Florida.

Royal red shrimp are deepwater shrimp occurring as far north as Cape Hatteras, North Carolina, to as far south as the coast of the Guianas, and primarily in depths of 140 to 300 fathoms. Concentrations of royal red are known to exist in three geographical areas: (1) east of St. Augustine, Florida, in the western Atlantic; (2) south-southeast of the Dry Tortugas in the Florida Straits; and (3) southeast of the Mississippi River Delta in the Gulf of Mexico (Roe, 1969).

Seabobs are caught most often in shallow waters at six to seven fathoms or less and almost never in estuaries (Renfro and Cook, 1963). U.S. catch is highest along the Louisiana coast in October through December.

Rock shrimp occur along the Atlantic coast from Virginia to the Florida Keys and up along the Gulf coast to Cabo Catoche, Mexico (Cobb, et al., 1973; Hildebrand, 1954). Major concentrations occur at Cabo Catoche, Mexico, and in the Cape Canaveral, Florida, area (Christmas and Etzold, 1977). Major Gulf catch (1971-1975) comes from the Panhandle area of Florida at depths of 10 to 22 fathoms (Christmas and Etzold, 1977).

3.2 History of Exploitation

3.2.1 Domestic Fishery

3.2.1.1 Description of User Groups

The shrimp fishery of the Gulf can be divided into four general categories of users -- harvesters (directly involved in the taking of shrimp), processors, marketers, and consumers.

The actual taking of shrimp is done by recreational fishermen, commercial belt shrimpers, and commercial (food) shrimpers. The commercial shrimp user category includes employees as well as owners of vessels and may be divided into smaller boat operations, which are restricted to inland bay and shallow offshore activities, and the offshore vessels, which range from the territorial seas out to the limits of the FCZ and into foreign waters.

The structure of the shrimp fishery includes a large number of harvesters, the boatyard and gear industry, and the suppliers of ice and fuel (essential inputs for shrimping operations).

Processors include the shrimper as a first level processor, if he heads the shrimp. Fish houses may perform one or all processing activities such as heading, peeling, grading, packing in ice, and freezing, cooking, or drying. The non-shrimper processors handle the shrimp between the fish house and the purchaser. The three basic types of processors are: (1) producers of "green" (fresh) or frozen shrimp; in 1974 they accounted for 86.25 million pounds valued at \$152.6 million, or 59 percent of the total value of shrimp produced in the Gulf that year; (2) "breeders," who in 1974 produced 52.66 million pounds of breaded shrimp (including imports) valued at \$75.7 million, or 29 percent of the total value of shrimp processed in the Gulf region (Florida and Texas accounted for 91 percent of the breaded shrimp); (3) canners, who generally use small- to medium-sized shrimp; such canning plants are located primarily in south Louisiana and Mississippi, with the greatest concentration found in the Orleans area. They accounted for \$13.1 million worth of canned shrimp represented by 1.9 million standard cases, or seven percent of the total value of all shrimp processed in the Gulf region. In addition, there is a wide array of specialty items such as dried shrimp, gumbo, etc.

Restaurants are also an important processing entity. It is estimated that more shrimp are consumed in restaurants than used in homes. The role of restaurants as processors ranges from minimal, limited to the actual cooking process, to the handling of shrimp in raw and unpeeled form.

Marketing of shrimp involves every stage of the industry; there also are groups which engage solely in marketing, with their processing function limited to possible repackaging. Transportation of shrimp is usually handled by trucks operated by the wholesale marketing entities.

Consumers are given a choice of several different ways to purchase shrimp, ranging from heads-on to stove-ready status.

3.2.1.2 General Description of Fishery Effort

Prior to the introduction of the otter trawl in 1917, most shrimp were commercially harvested in shallow inshore areas with haul seines. White shrimp were the main shrimp caught and marketed until the early 1950s. Quantities of seabobs and brown shrimp were used for dried products. During these years, fishing efforts were concentrated in areas where white shrimp were abundant. From 1917 to the late 1940s, most shrimp were caught from vessels rigged with single otter trawls which operated within about six miles of shore. However, vessels occasionally went out about ten miles and, in some instances off Louisiana, out fifty miles. Wing or butterfly nets were also used in Louisiana passes. By the early 1950s, increased markets for brown and pink shrimp and the discovery of new fishing grounds initiated a period of rapid expansion of the shrimp industry. As a result, some vessels began to move farther offshore because of the increasing difficulty of making profitable catches on traditional fishing grounds. By the early 1960s, U.S. shrimp vessels were fishing off the coasts of Mexico

and South America. A major change in gear methodology took place in the late 1950's with the introduction of double-rig trawling. Two small trawls were pulled instead of a single large net, resulting in a substantial increase in catch efficiency and a reduction of handling problems. Double-rig trawls were used by most vessels fishing for pink and brown shrimp. More recently the twin-trawl has become popular in the offshore Gulf shrimp fleet because of its efficiency (Figure 3.2-11). With this arrangement four small trawls are towed instead of two from a single vessel. The inshore shrimp fishery is primarily confined to the territorial waters of each of the Gulf states. There are numerous small boats rigged with single otter trawls which harvest shrimp commercially from the bays and marshes. Some of the boats may fish in the Gulf during favorable weather conditions, especially for white shrimp.

Fishing efforts for royal red shrimp occur intermittently when shrimping along the coast is poor. Royal red shrimp are harvested from vessels using a single trawl. The deep-water habitat of the species necessitates the use of heavier winches and cables than are used to catch shallow-water shrimp species and, in general, the use of larger vessels.

The live-bait shrimp fishery is generally limited to bays and the shallow inshore waters of the Gulf. Bait shrimp catches on the Florida west coast consist primarily of pink shrimp, which are harvested in shallow grass beds from boats equipped with single or double side-frame trawls. The bait shrimp fishery in the remaining Gulf states is usually dependent upon white and brown shrimp, which are harvested with boats rigged with a single otter trawl. Mortality of the live shrimp is minimized by trawling for short durations during the cooler early morning hours and then rapidly sorting the catch. The limited capacity of live-holding facilities aboard the boat and the perishability of live shrimp probably restrict bait shrimping operations to areas near the dealer where the catch is sold. The dealer in turn, however, may transport live shrimp considerable distances, i.e., 200 or more miles.

Recreational shrimping efforts are generally concentrated in shallow inshore waters, though few individuals may occasionally venture into the territorial sea during favorable weather conditions. It is unlikely, however, that any recreational shrimpers operate in the fishery conservation zone. The boats used in the recreational shrimp fishery are usually outboard or inboard pleasure craft rigged to tow a single otter trawl ranging from about 16 to 40 feet in width. Although most of the recreational catch is harvested with otter trawls, other gear such as cast nets, wing nets, channel nets, and dip nets may account for a substantial amount of the harvest in localized areas.

The actual amount of fishing effort applied in the shrimp fishery and a more descriptive analysis of the gear employed are discussed in detail in several other sections of the management plan. For example, see Sections 3.2.1.4, 3.5.2.1, 3.5.2.4, 3.5.3.2, 4.7 and 5.0. Fishing effort in the shrimp fishery from a physical standpoint increases through more vessels entering the fishery and through more technologically efficient harvesting techniques. More units of effort due these two factors occur due to industry responses to high profit levels and returns on investment. Because of the open access characteristic of the shrimp fishery and some periods of rapidly rising product prices, fishing effort sometimes reaches levels beyond that which yields satisfactory economic returns during certain time periods. The reasons for this occurrence in a fishery and its relation to periodically poor financial years in the shrimp fishery are discussed in detail in Sections 3.5.2.3 and 5.1.2.

3.2.1.3 Catch Trends

Trends in the shrimp fishery discussed here are based on two data sets. The first is the reported commercial catch by species (U.S. Department of Commerce, 1959-1975). The second is the reported commercial landings by state (U.S. Department of Commerce, 1880-1975). These two data sets are not identical. The catch is the amount of shrimp caught in a specific inshore or offshore area. Landings are the total catch, whose origin may not be known, delivered at a port and sold commercially.

3.2.1.3.1 Commercial Catch Trends by Species

Annual Catch Patterns

The average annual reported commercial catch of shrimp (\pm one standard deviation) by species in the U.S. Gulf area:

Brown shrimp ¹	66.5	\pm 16.6	million pounds (tails)
White shrimp ¹	36.9	\pm 7.2	million pounds (tails)
Pink shrimp ¹	13.0	\pm 1.8	million pounds (tails)
Royal Red shrimp *	.83	\pm .091	million pounds (tails)
Seebob shrimp **	1.4	\pm 1.6	million pounds (tails)
Rock shrimp ***	.331	\pm .358	million pounds (tails)

¹ 1963-1977

* 1959-1975

** 1959-1975

*** 1971-1976

The most recent information, 1977, indicates that brown, white and pink shrimp account for 97 percent of the total catch. This reflects essentially no change from the average total catch of 98 percent for the 1959-1975 period.

Shrimpers, processors, consumers, and resource managers recognize the historical annual variation in annual catches of the dominant species (brown, white, pink). The vulnerability of shrimp during the critical estuarine growth phase to environmental perturbations is the basic cause of catch variation (Section 4.1). Griffin and others (1976) calculated a yield function for shrimp using the level of discharge from the Mississippi. Discharge was useful because of its impact on salinity and temperature while the shrimp are in the nursery ground. Two recent incidences of environmentally induced problems with shrimp production resulted in the Small Business Administration (SBA) declaring areas of Louisiana and Texas to have suffered economic disasters. Tropical storms in coastal areas of Texas during 1979 caused heavy rains which SBA found to adversely affect the shrimp catch. Heavy spring rainfalls in Louisiana during 1980 were judged by SBA to have severely impaired brown shrimp catch. Both of these natural events caused unacceptable variation, in the eyes of SBA, in earning potential of small businesses. The variation in catch of the three minor species is more related to the market conditions and the supply of other shrimp than to variation in their abundance. This is particularly evident for seebob shrimp. Primarily a fall-early winter fishery off Louisiana, catch has fallen only once between 1969-1975 compared to the white shrimp fishery decline in catch during five of those years (Fig. 3.2-1 and Fig. 3.2-2).

Catch for a given year appears to be independent of the preceding year's catch. The absence of any defined spawner-recruit relationship suggests that the shrimp catch can fluctuate widely from year to year. The critical determinant is estuarine environmental conditions which vary annually, often times radically. No apparent or significant linear trends in annual catches of brown, white, or pink shrimp (Fig. 3.2-1 and Table 4.7-1) have yet been determined.

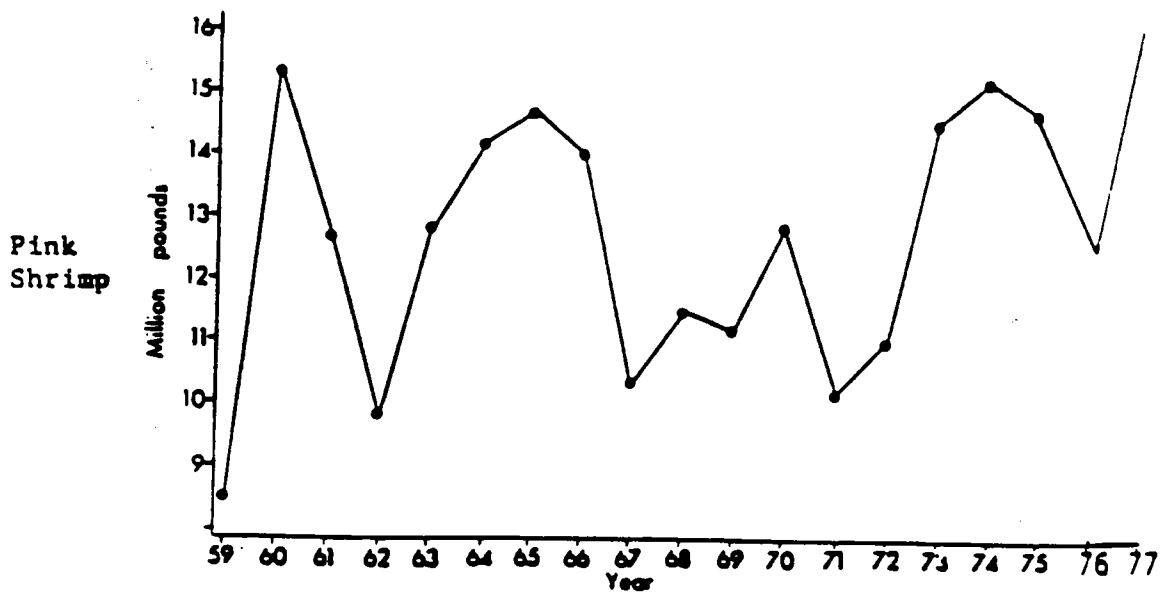
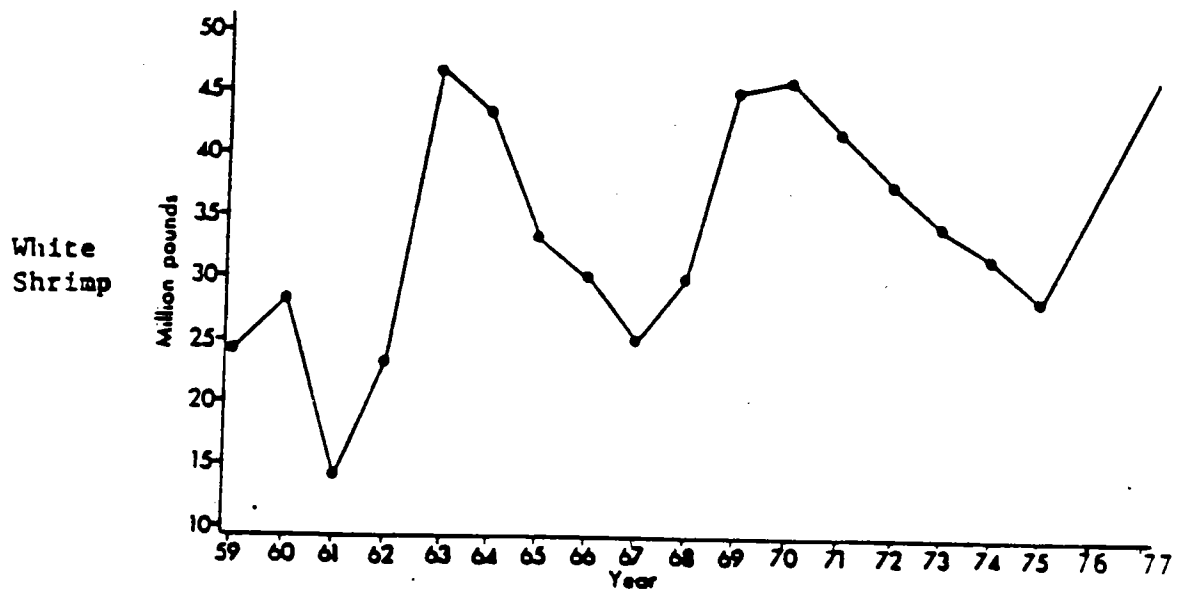
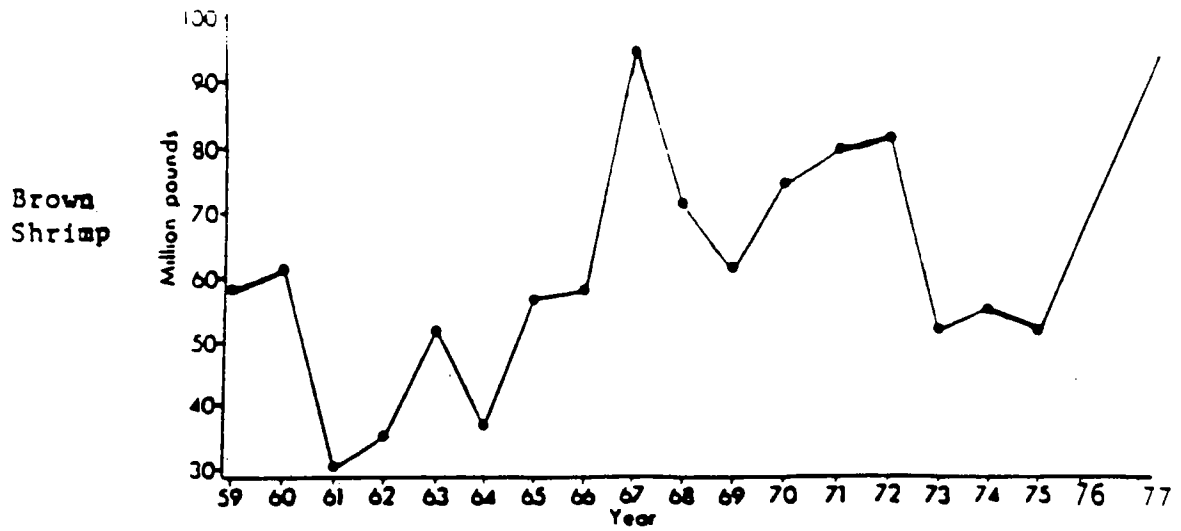


Figure 3.2-1. Annual reported commercial catch of brown, white, and pink shrimp from the US Gulf of Mexico (US Dept. Com., Gulf Coast Shrimp Data, 1959-1977). Weight is in pounds of tails.

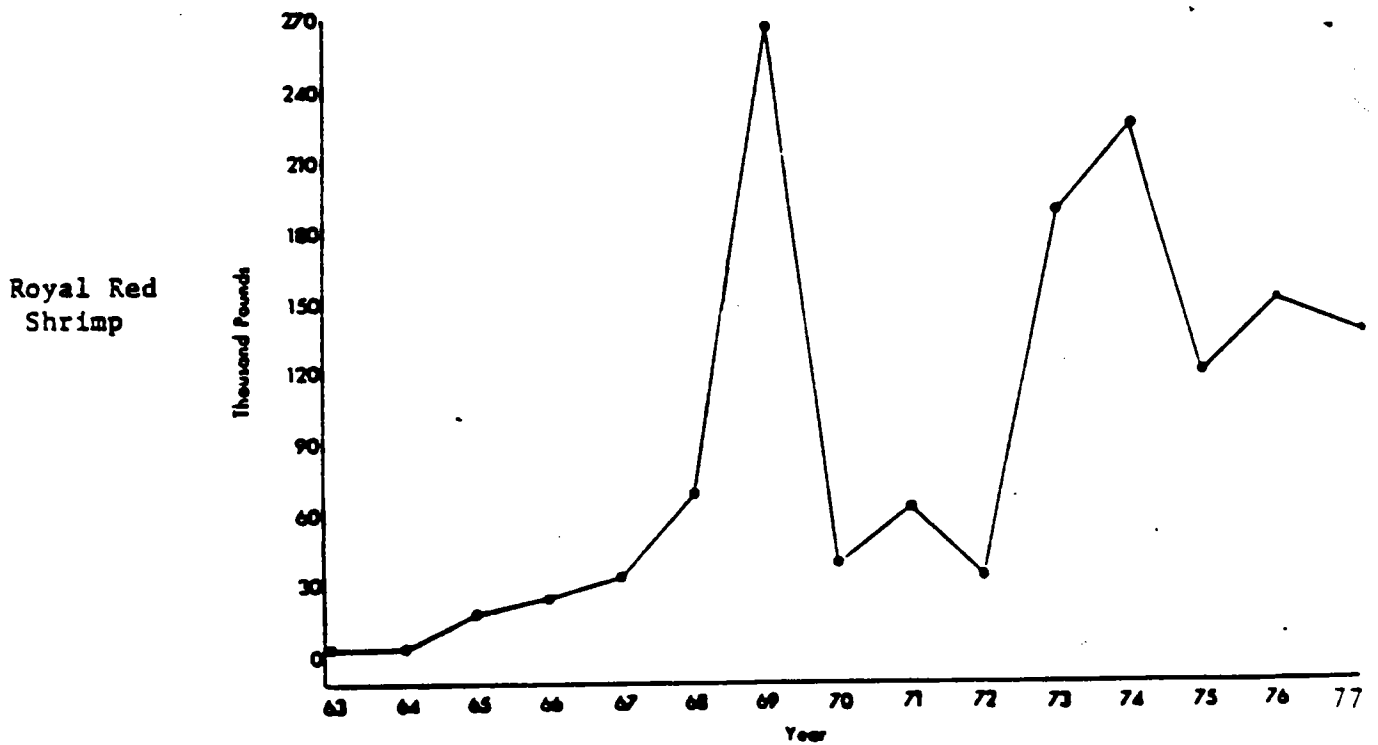
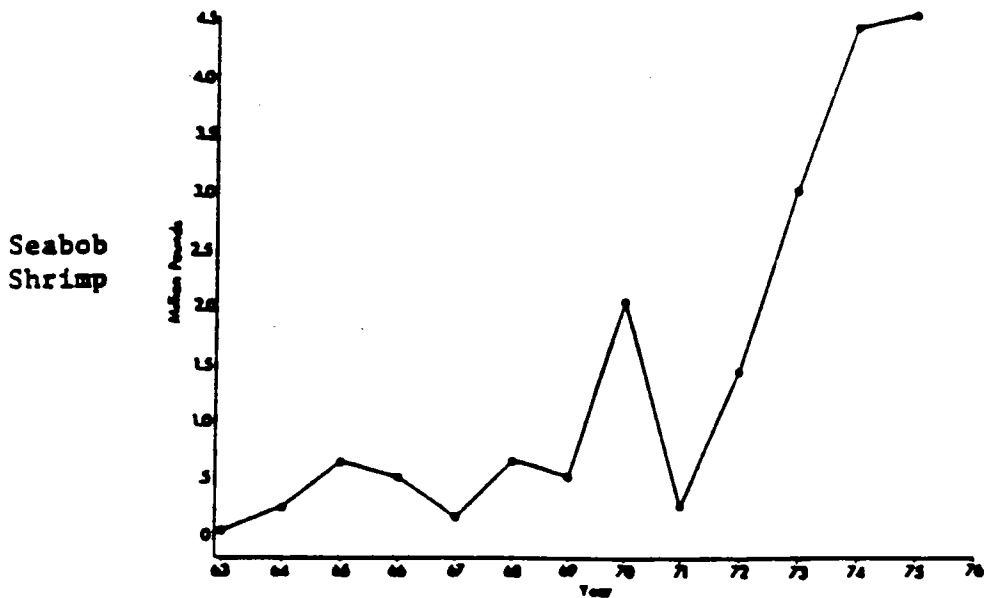


Figure 3.2-2. Annual reported commercial catch of seabob (1963-1975) and royal red shrimp (1963-1977) from the U.S. Gulf of Mexico (U.S. Dept. Com., Gulf Coast Shrimp Data, 1963-1975). Weight is in pounds of tails.

Annual catch of minor species has increased with time (Table 4.7-3). As effort increased to harvest major species, the catch of minor species increased (Table 4.7-1). Annual catch of royal red shrimp ranged between 4,600 and 270,000 pounds of tails with an average increase of 14,000 \pm 5,000 pounds of tails per year (1963-1976).

The acceptability of seabob shrimp in Louisiana by the canning industry was in part responsible for the catch increase over the 1963-1975 period (Fig. 3.2-2). The seabob catch results in part from incidental catch during white shrimping activities (Table 4.7-5), though a targeted fishery develops when price is high and other shrimp are in short supply (P. Juneau, personal communication, 1978).

The reported catch of rock shrimp is relatively recent, with the first report occurring in 1971. Catch for the 1971-76 period is listed in Table 4.7-3. Rock shrimp are mostly caught incidentally with other species, especially pink shrimp (Table 4.7-9), however, a small directed fishery does exist.

Area Distribution of the Catch

The reported commercial catch of shrimp is classified by NMFS into 21 areas along the U.S. Gulf coast (Fig. 3.2-3).

The average annual commercial catch by area is compared for brown, white, and pink shrimp in Fig. 3.2-4 and for royal red, seabob, and rock shrimp in Fig. 3.2-5.

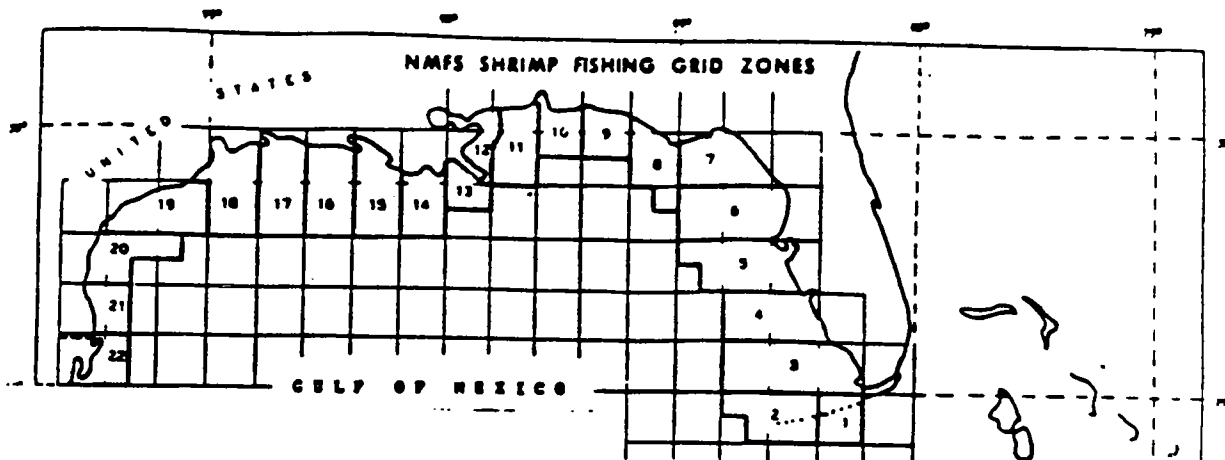
Brown and white shrimp exhibit a similar broad peak in catch from the Apalachee to Brownsville areas. Pink shrimp catch is substantial in the Key West to Apalachee Bay areas. There is little overlap of dominant pink areas with brown or white shrimp.

Brown shrimp catch normally exceeds two million pounds of tails annually in each of the NMFS grid areas in the Biloxi to Brownsville areas. The Freeport area normally has the largest catch, averaging 12 million pounds of tails annually. White shrimp catch normally exceeds four million pounds of tails annually in the Barataria, Terrebonne, and Atchafalaya areas. Catches from the Rockefeller through Freeport areas are also normally high, averaging about 2.5 million pounds of tails annually. Pink shrimp harvest is concentrated in the Dry Tortugas areas with an annual catch of nine million pounds of tails.

There are two main areas for the royal red shrimp catch. One is off the Dry Tortugas areas; the other is off the mouth of the Mississippi River and is reported for the Biloxi and Barataria areas. Catch is highest from January through June and in September and occurs at depths of 100 to 300 fathoms. Seabob catch is normally highest in waters associated with the Louisiana coast, peak catch normally occurring in the Atchafalaya area at 0.5 million pounds annually. Rock shrimp catch (1971 to 1975) is mainly limited to waters associated with Florida. Annual catch is highest in the Panama City and Apalachee areas.

Month, Depth, and Size Patterns in Catch of Brown, White and Pink Shrimp

Brown and white shrimp exhibit distinct annual cycles in their abundance and size at different depths in the shrimping grounds of the U.S. Gulf. Although pink shrimp have an expected size-depth relationship (Section 4.1), their seasonal and size patterns in reported commercial catch are not as dramatic as those of brown and white shrimp; pink shrimp have a more or less continual recruitment in the Dry Tortugas area and Florida has practiced area closures to protect undersized pink shrimp. Pink shrimp catch (Fig. 3.2-8) exhibits a peak from October through May at 11 to 15 fathoms. Seasonal patterns in size or depth of catch are not pronounced because of the fairly continual recruitment of pink shrimp in the Dry Tortugas area and closure of the Tortugas shrimp bed by Florida to protect undersized shrimp.



Area code index to prominent city, bay, or federal game reserve associated with the area:

1. Key West
2. Dry Tortugas
3. Everglades
4. Naples
5. Tampa
6. Tarpon Springs
7. Apalachee
8. Panama City
9. Fort Walton
10. Mobile
11. Biloxi
12. Chandeleur
13. Barataria
14. Terrebonne
15. Atchafalaya
16. Rockerfeller
17. Calcasieu
18. Galveston
19. Freeport
20. Corpus Christi
21. Brownsville

Figure 3.2-3. National Marine Fishery Service Shrimp Fishery Grid Zones in the US Gulf of Mexico (US Department of Commerce, Gulf Coast Shrimp Data, 1959-1975).

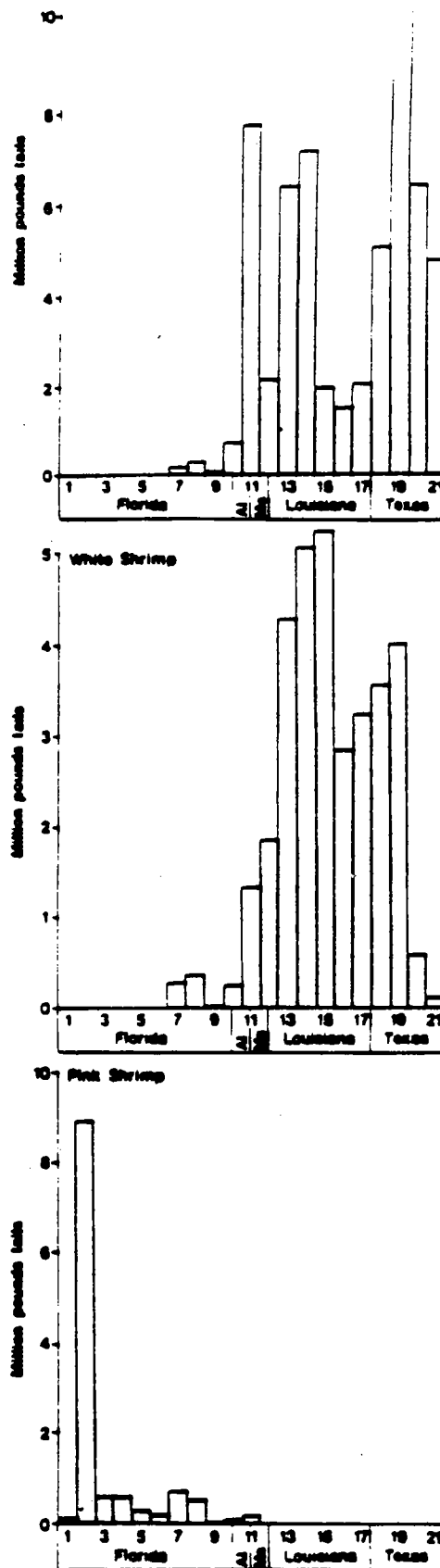


Figure 3.2-4. Average reported commercial catch of brown, white, and pink shrimp along the US Gulf Coast (US Dept. Com., Gulf Coast Shrimp Data, 1959-1975). Catch is represented as averages reported for the 21 NMFS statistical reporting zones along the US Gulf Coast (Fig. 3.2-3).

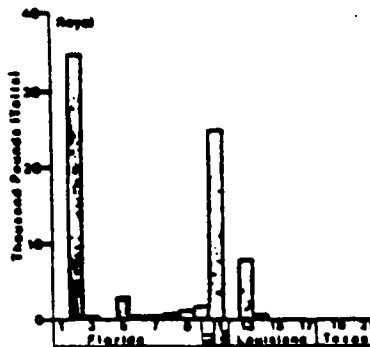
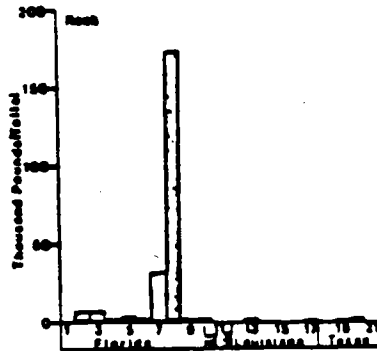
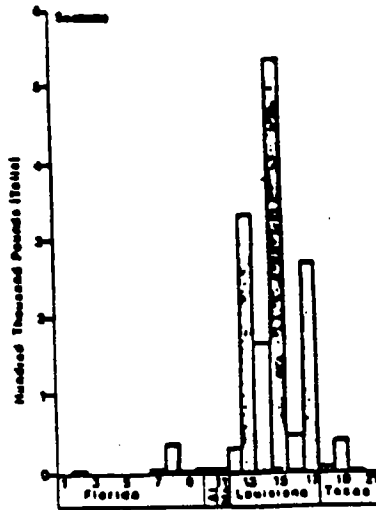


Figure 3.2-5. Average reported commercial catch of seabed (1963-1975), rock (1971-1975), and royal red shrimp (1963-1975) along the US Gulf Coast (US Dept. Com., Gulf Coast Shrimp Data, 1963-1975). Averages are for the 21 NOAA statistical reporting zones (Fig. 3.2-3).

As shown in Fig. 3.2-6, the fishery on 0-year class brown shrimp normally starts in inland waters in May on shrimp of a count greater than 67 tails to the pound. The inshore catch peaks in June at an average catch of 6.6 million pounds of tails. Although it consists mainly of smaller size shrimp, this inshore catch is popular among recreational and small boat commercial shrimpers whose gear does not normally allow them to fish the open waters of the Gulf.

The offshore fishery for brown shrimp peaks in July and August at depths of 11 to 20 fathoms. The dominant size class in the reported commercial catch is 31 to 40 tails to the pound. The actual average size shrimp caught may be much smaller since a considerable number of undersized shrimp are discarded off the Texas coast (Baxter, 1973; Sections 4.7 and 8.3) and the primary brown shrimp catch during this time also occurs off the Texas coast.

The September brown shrimp catch is dominated by 26 to 30 tails-to-the-pound shrimp at 16 to 20 fathoms. The catch becomes further restricted to deeper waters and larger shrimp in October to December. The January to April pattern is relatively constant, with greatest catch in open Gulf waters of 21 to 40 fathoms and of shrimp of a count less than 21 tails to the pound.

The size-depth-month patterns in white shrimp catch are not as simple as those of brown shrimp, but they do reflect the annual nature of the white shrimp's life cycle. The fishery on the 0-year class white shrimp, spawned in the spring and summer, essentially begins in August and September (Fig. 3.2-7). The white shrimp catch in internal waters contains much larger size shrimp than does the brown shrimp catch. This size difference reflects the rapid growth rate of white shrimp and their tendency to leave the estuaries at a larger size than brown shrimp. Catch remains comparatively high from August to November, though it is essentially limited to water shoreward of 11 fathoms. The comparative increase in shrimp catch in the 68 tails and over count group in October through December reflects a decline in the growth rate of white shrimp as well as a migration of shrimp to deeper waters. Both of these phenomena are associated with cold fronts advancing during these months and the accompanying decline in temperature.

Catch declines from December through February. The decline reflects, in part, adverse weather conditions for shrimping but also the dwindling supplies and comparatively small size of white shrimp during this period.

In March through June with the spring warming of the estuaries and shallow Gulf, the overwintered white shrimp are believed to exhibit an increase in their growth rates. This increase is reflected in the commercial catch: peak size classes of white shrimp shift from those greater than 67 tails to the pound to 31 to 40 tails to the pound in March, to shrimp 15 to 20 tails to the pound in June and July. The May and June inshore catch of white shrimp reflects the reentry of overwintering white shrimp into the estuaries for a period of pre-spawning growth.

Catch by Size, State, and Species for Brown, White and Pink Shrimp

Different harvesting strategies have developed among the several Gulf states. These differences largely relate to the evolution of the dominant fisheries at different times (Section 3.2.1.2). The Louisiana-Mississippi fishery developed comparatively early on inshore and nearshore Gulf concentrations of white, brown, and seabob shrimp. The brown shrimp fishery in Texas and the pink shrimp fishery in Florida developed in the 1950s on offshore concentrations of shrimp in comparatively deep water. In large part local management still reflects the needs of the historical fisheries in these areas for shrimp of certain sizes or of their gear restrictions limiting the depth of harvest.

Tables 3.2-1 and 3.2-2 compare estimates of the average commercial (1963 to 1976) catch of brown, white, and pink shrimp in the various reported size categories in terms of pounds and estimated number (see Table 3.2-2 for method in which number of shrimp were estimated).

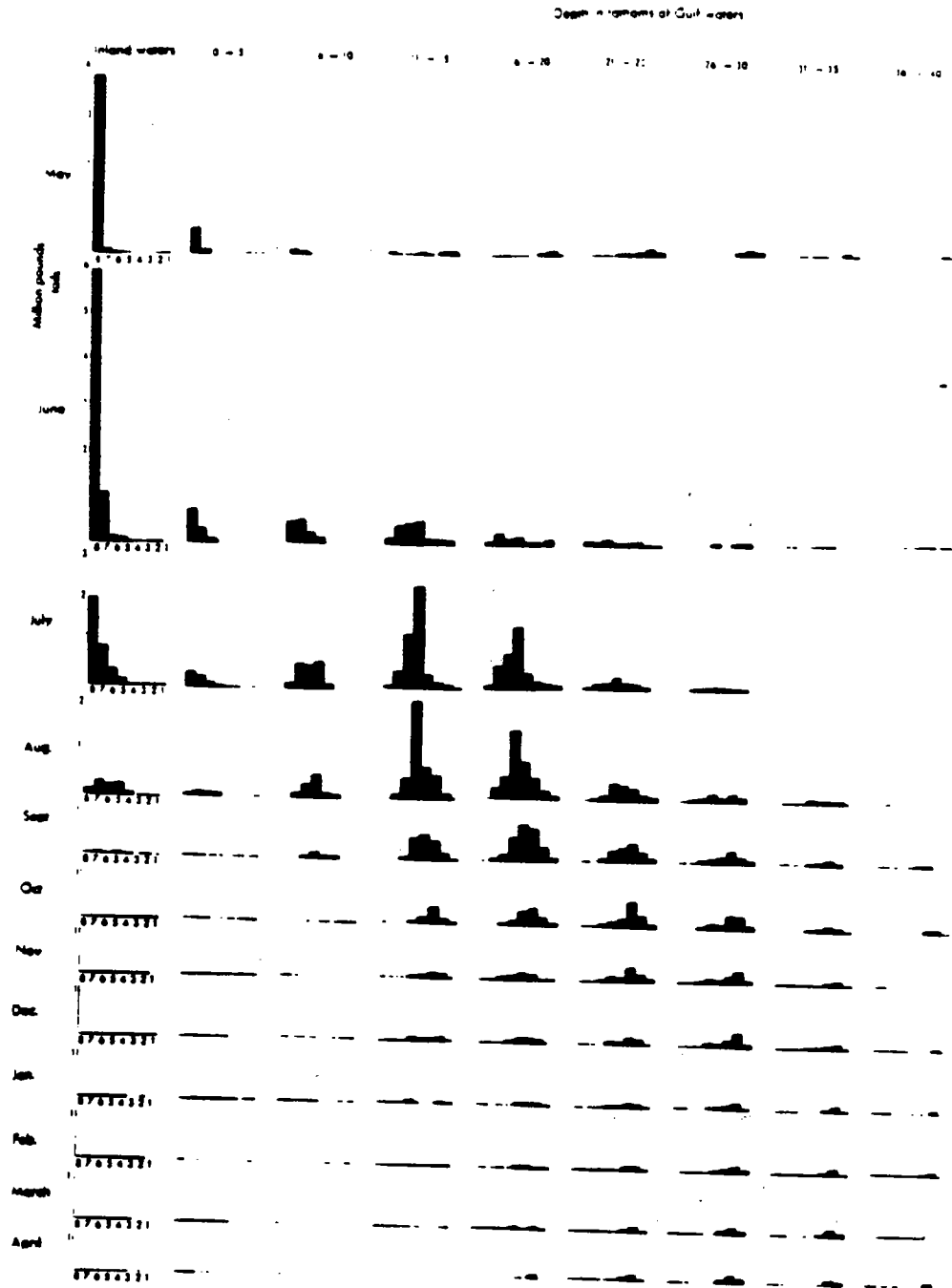


Figure 3.2-6. Brown shrimp average catch in the US Gulf by size, class, depth, month (US Dept. Com., Gulf Coast Shrimp Data, 1959-75). Code to size of shrimp: 1 = under 15 tails per pound; 2 = 15-20 tails per pound; 3 = 21-25 tails per pound; 4 = 26-30 tails per pound; 5 = 31-40 tails per pound; 6 = 41-50 tails per pound; 7 = 51-67 tails per pound; 8 = 68 and over tails per pound.

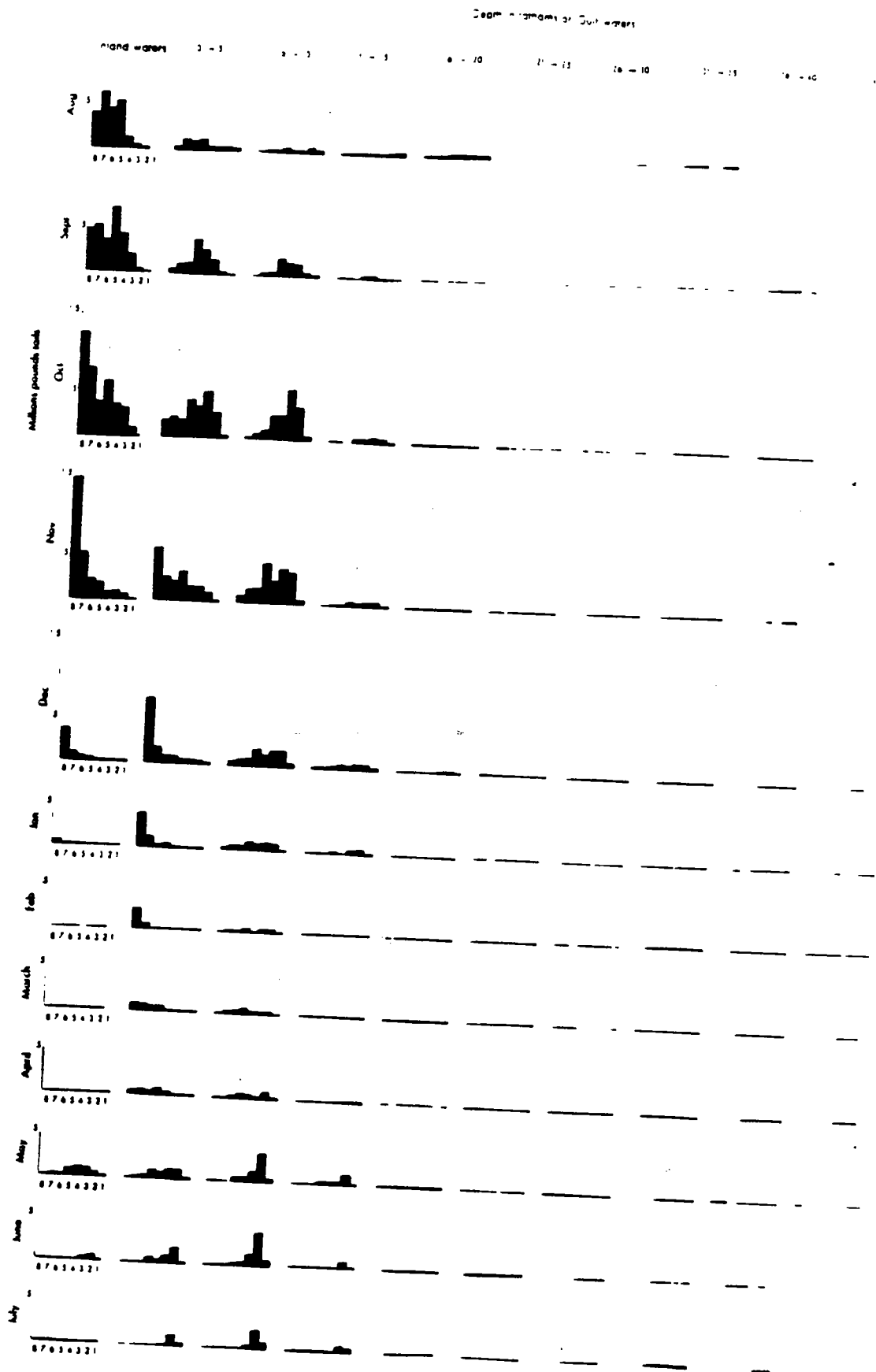


Figure 3.2-7. White shrimp average catch in the US Gulf by size, class, depth, month (US Dept. Com., Gulf Coast Shrimp Data, 1959-1975). Code to size of shrimp: 1 = under 15 tails per pound; 2 = 15-20 tails per pound; 3 = 21-25 tails per pound; 4 = 26-30 tails per pound; 5 = 31-40 tails per pound.

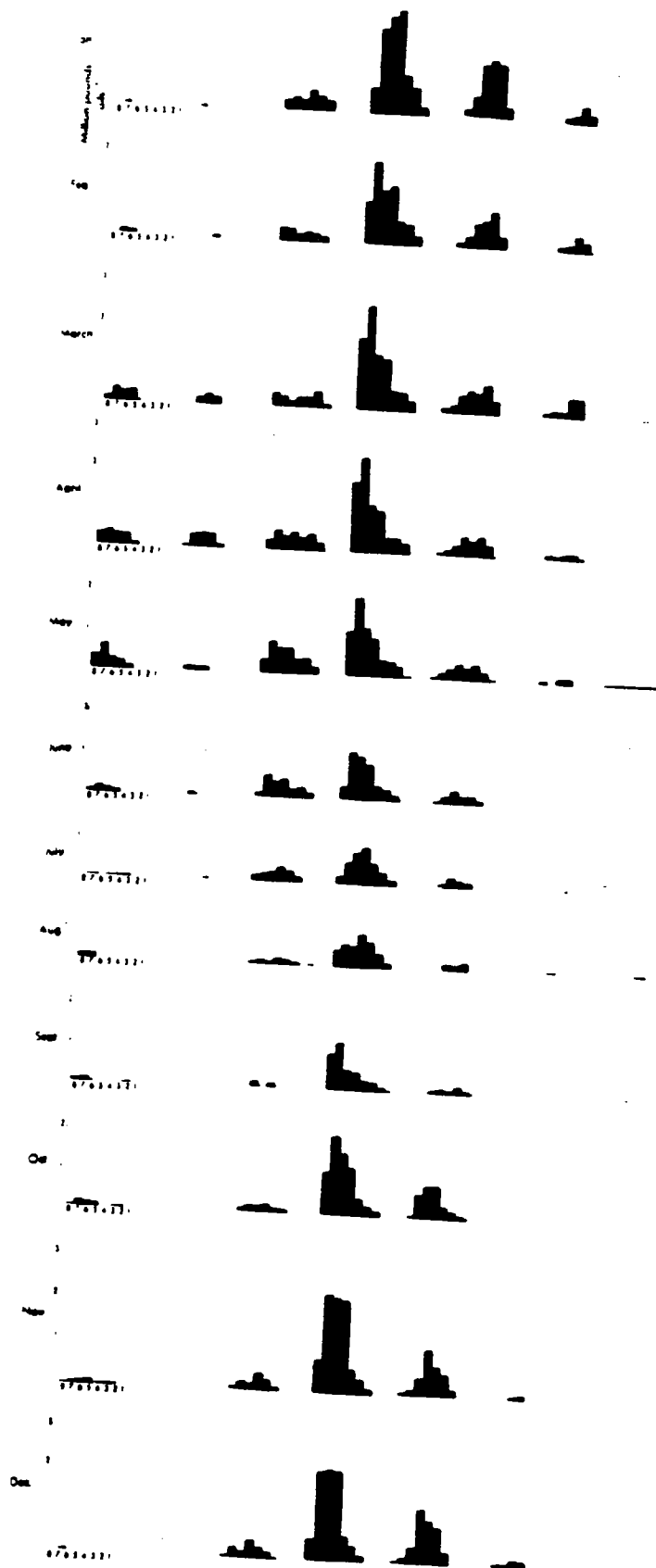


Figure 3.2-8. Pink shrimp average catch in the US Gulf by size class, depth, month (US Dept. Com., Gulf Coast Shrimp Data, 1959-1975). Code to size of shrimp: 1 = under 15 tails per pound; 2 = 15-20 tails per pound; 3 = 21-25 tails per pound; 4 = 26-30 tails per pound; 5 = 31-40 tails per pound; 6 = 41-50 tails per pound; 7 = 51-67 tails per pound; 8 = 68 and over tails per pound.

Catch from the states of Mississippi and Alabama were combined due to similarities in the minimum size of harvest and overlapping areas in the reported catch statistics.

The brown shrimp catch off the Texas coast accounts for 46 percent of the total poundage and 25 percent of the number of brown shrimp caught commercially in the U.S. Gulf of Mexico. The catch associated with Louisiana accounts for 40 percent of the poundage but 64 percent of the number of commercially caught brown shrimp. The apparent discrepancy lies in the fact that Louisiana is estimated to harvest a tremendous number of shrimp in the smallest commercial size category, some 54 percent of average total catch of brown shrimp in the Gulf. Much of these shrimp are utilized in the Louisiana canning industry. Conversely, the reported catch of brown shrimp off Texas, peaks at a larger size, 31 to 40 tails to the pound of shrimp. There are no shrimp canneries in Texas and much of this product is utilized by the fresh-frozen industry. The introduction of several peeling machines has recently allowed utilization of smaller shrimp, however. The Mississippi-Alabama and Florida catches of brown shrimp exhibit a peak catch at 51 to 67 tails to the pound size category.

Louisiana has by far the largest catch of white shrimp, accounting for some 82 percent by number and 77 percent by weight of the average reported catch. As with brown shrimp, the peak in catch occurs in the smallest commercial size group, though there is a comparatively better mix of larger size shrimp than with brown shrimp. The Texas white shrimp catch peaks at a size similar to the brown shrimp catch, or 31 to 40 tails to the pound. Though the Florida white shrimp catch peaks at the same size class as its brown shrimp catch, the Mississippi-Alabama catch of white shrimp peaks at a larger size, 15 to 20 tails to the pound in terms of weight, and 31 to 40 tails to the pound in terms of number.

Florida accounts for 98 percent of the pounds and numbers of pink shrimp caught in the reported commercial fishery of the U.S. Gulf of Mexico. Pounds and numbers both peak at a size of 51 to 67 tails to the pound.

Although the previously mentioned difference in harvesting strategies has resulted in larger shrimp being harvested in Texas vis-a-vis Louisiana-Mississippi, there has been a trend toward landing more small shrimp. Callowet, et al. (1979) report that for brown and white shrimp in both Louisiana and Texas there was a significant trend toward increased proportions of small shrimp in the 1959 to 1976 catches. Louisiana catches contain greater proportions of small shrimp than Texas catches. It is important to note that the proportion of Louisiana inshore catch in the 68 count and smaller category increased markedly during 1963 to 1976 with the major change occurring between 1973 to 1976 (Sass, 1979). Sass reports the major change to be in the size composition of the white shrimp catch.

3.2.1.3.2 Landing Trends by State

The historical pattern of landings among states during 1880-1975 is evident in Figure 3.2-9. Landings data differ from the catch data used in the preceding section. Landings are reported in heads-on units and are attributed to the state where off-loaded regardless of catch location. Due to the lengthy historical period portrayed, the data may not have been collected consistently; however, the data are suitable for reflecting long run trends and accurately depict in recent time the frequent fluctuation in landings.

Before about 1920, Louisiana and Mississippi were the dominant shrimp producing states in the Gulf. Between 1920 and 1948 the fisheries off Texas and Alabama began to rival that of Mississippi. At the same time, Louisiana's landings far exceeded any of the other states. During these early years the fishery was mainly an inshore and shallow water fishery predominantly of white shrimp, with minor catches of seabob and brown shrimp used mainly as dried shrimp. After World War II, the fishery began to expand. Sudden increases of landings in Texas and Florida were due to the discovery of concentrations of offshore populations of brown and pink shrimp, respectively, and the successful development

Table 3.2-1. Average weight of catch of brown, white, and pink shrimp by size and state¹ in thousand pounds of tails (US Dept. Comm., 1963-1975).

Shrimp	State	Size (Tails per Pound)										Total
		70 & over	31-37	21-30	11-20	12-20	21-25	12-20	Under 12			
Brown	FLA	37	84	50	64	18	4	2				259
	ALA-MISS	1724	2223	1288	1313	786	674	467	73			8744
	LA	13598	2612	1675	2636	1254	1550	1974	378			25771
	TX	1222	2707	3708	8224	4224	2124	2288	482			29383
	CALF	16682	2286	6361	12939	6484	2462	3949	1876			64159
White	FLA	189	154	81	104	64	34	22	1			649
	ALA-MISS	74	133	184	268	278	365	379	31			1604
	LA	2228	3646	2187	2212	2212	2648	2593	516			26794
	TX	512	387	628	1212	722	722	822	122			3188
	CALF	8882	4328	2922	5356	3288	3812	3672	683			32237
Pink	FLA	1135	3199	2164	2786	1611	1245	367	27			12514
	ALA-MISS	16	79	61	46	33	16	5	1			247
	LA	1	3	3	3	1	1	1	1			12
	TX	---	---	---	---	---	---	---	---			6
	CALF	1132	2281	2228	2838	1436	1263	553	28			12779
Species Combined	25836	15887	11331	21133	11189	12537	18175	1787			109175	

¹ Florida - statistical area 1-9. ALA-MISS - statistical area 10-11. Louisiana - statistical area 12-17. Texas - statistical area 18-21. See Fig. 3.2-3 for location of statistical areas.

Table 3.2-2. Estimated average number¹ of brown, white, and pink shrimp by size and state² in thousands of shrimp (US Dept. of Comm., 1963-1975).

Shrimp	State	Size (Tails per Pound)							Total	
		68 & over	51-67	41-50	31-40	26-30	21-25	15-20		Under 15
Brown	FLA	2536	4954	2253	2270	513	99	31	---	12456
	ALA-MISS	151742	131134	50618	53699	21942	15513	8174	912	461734
	LA	2109355	154116	73920	93597	35159	35640	34554	6496	2622837
	TX	89252	22522	152594	307264	123920	120292	61364	6043	1000976
	CULF	2433582	425153	209385	459330	181536	171645	104123	13451	4078203
White	FLA	12848	9089	3669	3709	1782	789	384	8	32278
	ALA-MISS	6361	7034	7461	9236	6168	7939	6636	389	51984
	LA	620918	213132	99228	134204	61933	60721	45371	6446	1264753
	TX	32298	34624	22282	43020	21638	18240	11886	1690	108689
	CULF	675405	266689	132941	190189	91501	87489	64277	8533	1517204
Pink	FLA	77200	188731	98487	98920	39497	28445	9570	343	541393
	ALA-MISS	1392	4658	2765	1628	640	371	90	11	11555
	LA	241	197	122	122	31	14	7	---	734
	TX	1	18	23	115	29	19	18	1	224
	CULF	78334	193604	101397	100785	40197	29049	9685	335	553906
Species Combined	CULF	3187821	885446	523723	750284	313232	288383	178085	22339	6149313

¹The number of shrimp caught in each size category was estimated in the following manner:

If size equals	Then number equals
shrimp	Pounds times
Under 15	12.5
15-20	17.5
21-25	23
26-30	28
31-40	35.5
41-50	45.5
51-67	59
68 and over in Fla or Tx	68
68 and over brown or pink shrimp Miss-Ala	88
68 and over brown or pink shrimp in La	161
68 and over white shrimp in La or Miss-Ala	86

²Florida - statistical area 1-9, ALA-MISS - statistical area 10-11, Louisiana - statistical area 12-17, Texas - statistical area 18-21. See Fig. 3.2-3 for location of statistical area.

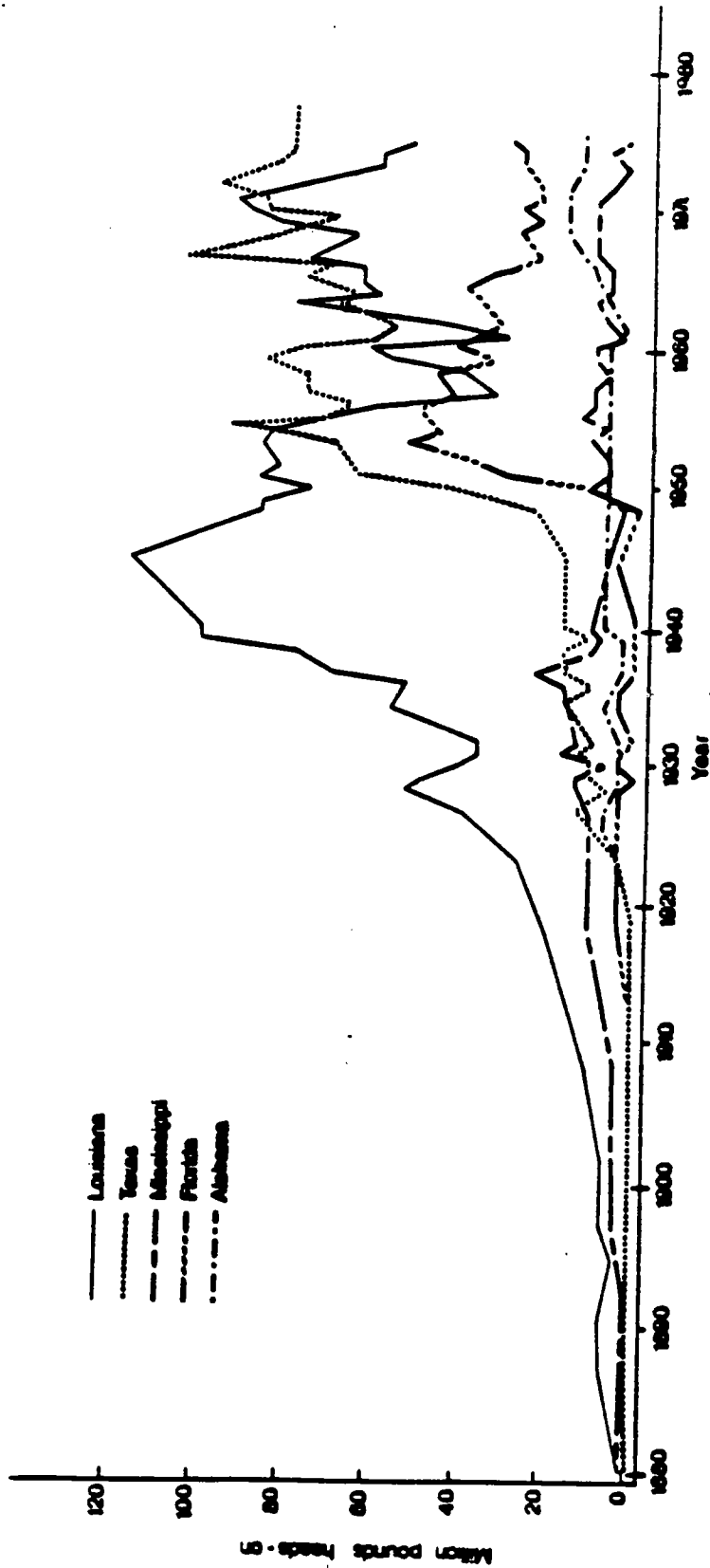


Figure 3.2-9. Annual reported commercial landings of shrimp (heads-on) by Gulf state (US Dept. Com., 1880-1975). Note that landings data are for heads-on shrimp off-loaded within a state regardless of where they were caught. This graph is not directly comparable with catch data used in this report.

