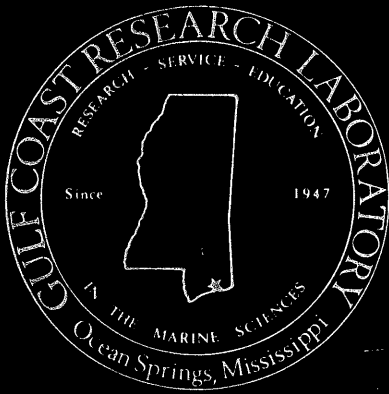


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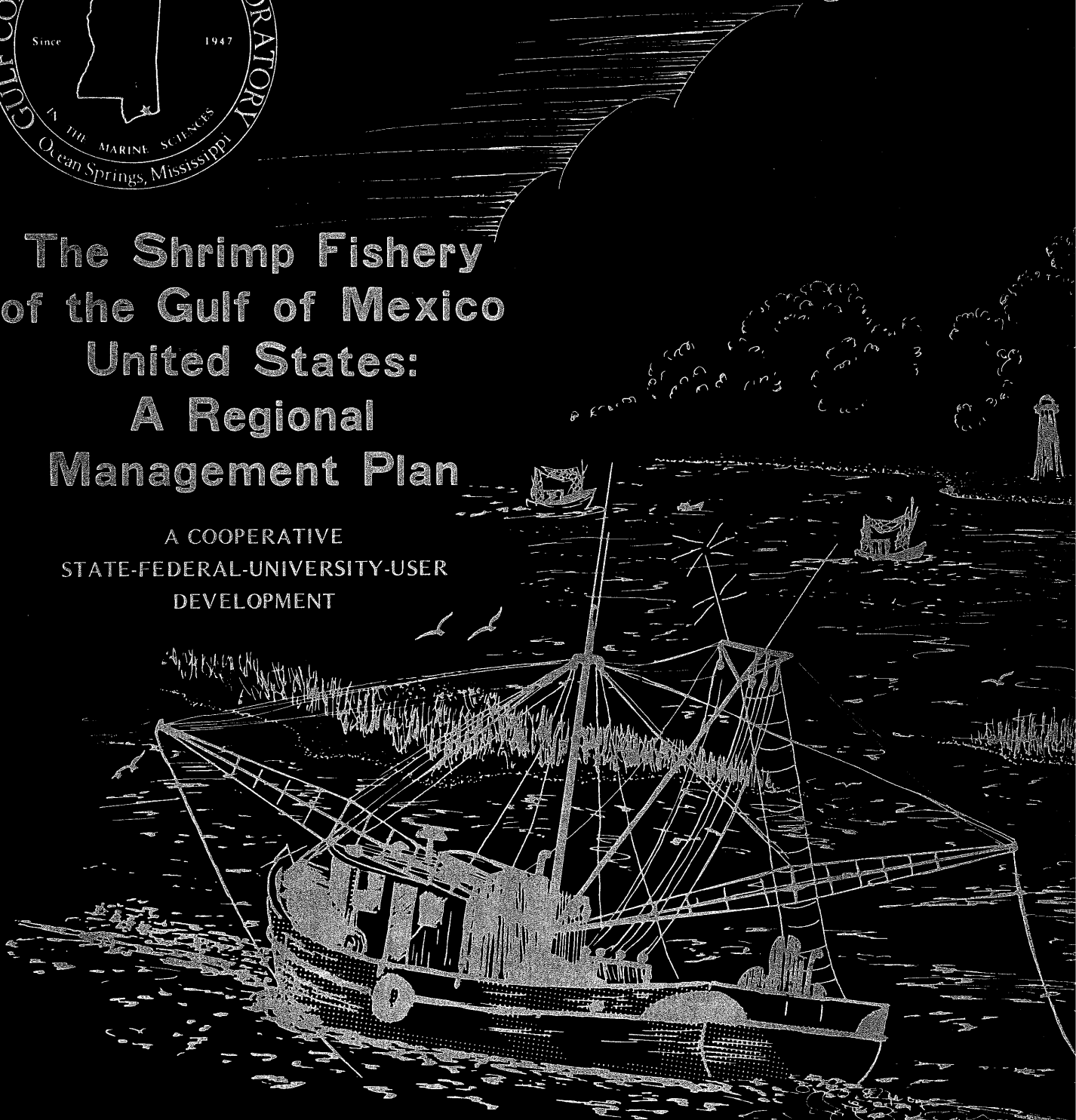


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**The Shrimp Fishery
of the Gulf of Mexico
United States:
A Regional
Management Plan**

A COOPERATIVE
STATE-FEDERAL-UNIVERSITY-USER
DEVELOPMENT

**GULF COAST RESEARCH LABORATORY
Ocean Springs, Mississippi**



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**THE SHRIMP FISHERY OF THE GULF OF MEXICO
UNITED STATES: A REGIONAL MANAGEMENT PLAN**

edited by

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Gulf Coast Research Laboratory**

and

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Ocean Springs, Mississippi 39564**

AUGUST 1977

Preface

The Gulf Shrimp Management Plan Task Force was established when the Gulf State-Federal Fisheries Management Board approved a project proposal for development of a Gulf Shrimp Management Plan. Representatives of each of the five Gulf States' management agencies, the National Marine Fisheries Service, and individuals from several universities made invaluable contributions of time and expertise to development of the plan. The Technical Support Specialist of the Gulf of Mexico Fisheries Management Council also actively participated in the plan formulation. During the plan preparation, liaison was maintained with the shrimp industry constituency of the entire Gulf area.

The Task Force and staff were comprised of the following members and alternates:

Claude J. Boudreaux, Louisiana Department of Wildlife and Fisheries
Charles Caillouet, National Marine Fisheries Service
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Charles White, Louisiana Department of Wildlife and Fisheries

In developing the contents of this plan and in writing the document, each member of the Task Force contributed in the area of his expertise and in discussions that resulted in changes of draft material. Thus, any assignment of authorship must include all members of the Task Force and the planning staff.

Gulf States Marine Fisheries Commission made arrangements for all Task Force workshops and, under contract with National Marine Fisheries Service, funded travel for state agency representatives.

Plan development relied heavily on three documents. "The Shrimp Fishery of the South Atlantic United States: A Regional Management Plan (Eldridge and Goldstein, Editors, 1975) and "The Shrimp Fishery of the Southeastern United States: A Management Planning Profile" (Calder, Eldridge and Joseph, Editors, 1974) provided models for development of the Gulf Shrimp Management Plan. Special thanks to the editors and authors who contributed to development of the South Atlantic Shrimp Plan.

Information was also freely used from the Shrimp Resource Assessment (SRA) Program (Technical Coordinating Committee, Gulf States Marine Fisheries Commission, June 1976). Our indebtedness to the many people who contributed to development of that draft paper is hereby acknowledged.

Additional direct workshop and review participation by the shrimp fishery community were accomplished by four special workshop sessions held at locations selected by State and fishery organization representatives for the convenience of shrimp fishermen and other industry constituents in each of the five States. In general, it was evident that most problems are common to all of the Gulf States. The tentative lists developed by the Task Force, with few exceptions, were the same as those developed from direct industry input.

Emerging problems as well as long established ones were incorporated in the plan. For example, bottom obstructions on fishing grounds had not been considered by the task force until direct industry input was received (see Chapter 3, 3.2 and Chapter 7, Table 24, task O-5). Nor had the Task Force previously included the problems inherent in the need for diversification of effort because the shrimp fleet has been expanded due to the movement of many domestic vessels from foreign fishing grounds to U.S. Gulf waters (see Chapter 3, 3.2 and Chapter 7, Table 24, task E-6). These and other problems identified by the fishery community have been incorporated into the plan. We are especially grateful to those fishermen, processors, organization officials and others who took the time to participate in workshops and to review early drafts of this document.

Dr. Ted Ford, chairman of the Technical Coordinating Committee, Gulf States Marine Fisheries Commission, attended Task Force and industry workshop sessions and offered valuable suggestions and advice.

Bill Turner, National Marine Fisheries Service Regional Office, not only served as a member of the Task Force, but provided continuing liaison with National Marine Fisheries Service at all levels.

The assistance of Buck Byrd, with his continuing interest in Regional Management under the State-Federal management concept, is gratefully acknowledged.

Special commendation and our thanks to Terry McBee and Richard Waller who, as members of the Task Force planning staff, bore the brunt of the multi-faceted task of completing this document.

Some others, but undoubtedly not all, who have our thanks are Joe Colson, former Director, Gulf States Marine Fisheries Commission; Harmon Shields, Florida Department of Natural Resources; Wayne and Hugh Swingle, Alabama Department of Natural Resources; Richard Leard, Mississippi Marine Conservation Commission; Burton Angelle and Dr. Lyle St. Amant, Louisiana Department of Wildlife and Fisheries; Clayton Garrison and Tom Moore, Texas Parks and Wildlife Commission; Charles H. Lyles, Director, Gulf States Marine Fisheries Commission; and Bill Stevenson, Director, Southeast Region, National Marine Fisheries Service.

Development of this plan provided for recommendation of specific strategic procedures. Identification of alternate regulatory needs, their evaluation and implementation are functions of the management entity selected by appropriate authorities to implement this plan.

This study was supported by a contract agreement from U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service issued to the Mississippi Marine Conservation Commission (MMCC) for execution by Gulf Coast Research Laboratory with professional planning from University of Southern Mississippi.

J. Y. Christmas, Principal Investigator
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David J. Etzold, Chief Planner
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Chapter 1. Summary

The Gulf of Mexico shrimp fishery is the most valuable fishery in the United States. It is one of the most complex fisheries: over 90,000 commercial and recreational fishermen use approximately 60,000 boats and vessels to harvest seven species (brown, pink and white account for more than 98 percent by weight). The total catch for 1976 was 210,078,000 lb (heads-on), with a dockside value of \$275,187,000.

Large numbers of recreational fishermen participate in the inshore harvest and many more depend on the bait shrimp fishery to satisfy their needs for bait. Fishing effort ranges from the individual fisherman throwing a cast net from a dock or seawall to large trawlers (with sophisticated equipment) that are capable of participating in distant-water fisheries. Much of the bait and recreational landings are not recorded in landings data and considerable quantities of small shrimp are caught and discarded at sea. Consequently, catch and effort data are far from complete.

The annual landings (in weight) per unit of effort of the three major species have been declining. This seems to be more a reflection of socio-economic conditions in the fishery than of an obvious biological effect on the shrimp populations (Gulf of Mexico Shrimp Resource Assessment Program, draft 1976). Regulation of the fishery has been confined to territorial waters under jurisdiction of the several Gulf States. Since 1960 valuable data have been collected by State and Federal agencies which provide for improved management of penaeid shrimp fisheries within state waters. State regulations, however, often partially based on socio-economic factors without a sound data base for decision making, vary considerably from state to state.

The Gulf States Marine Fisheries Commission's Technical Coordinating Committee (TCC) has primarily been responsible for identifying shrimp research and management needs for the Gulf area, and coordinating cooperative shrimp research and management efforts of the Federal and State governments.

Cooperative efforts begun in 1971 have provided a draft document, "Gulf of Mexico Shrimp Resource Assessment (SRA) Program," as a proposal for implementing the required research.

The TCC, meeting on March 30-31, 1976 as a subcommittee of the whole for shrimp, recommended that a regional management plan for Gulf shrimp be developed by the State fisheries agencies in cooperation with the

National Marine Fisheries Service and the shrimp industry.

A proposal for the development of such a plan, prepared by Gulf Coast Research Laboratory and the University of Southern Mississippi for the Mississippi Marine Conservation Commission was approved by the TCC Shrimp Subcommittee, TCC and the Gulf State-Federal Fisheries Management Board in early May 1976. The National Marine Fisheries Service issued Contract No. 03-6-042-35127 dated June 1, 1976 for the development of this regional fisheries management plan for Gulf shrimp.

Chapter 2 presents a description of shrimp resources and their associated fisheries. The resource is discussed with respect to species composition, life histories (including reproductive cycle, age and growth characteristics and population dynamics), food habits, geographic distribution and habitat.

Chapter 3 describes the present management system—basically one in which state natural resource agencies and industry manage shrimp in their waters fairly independently of other State or Federal agencies. Problems of the present management system, especially with respect to needed research and on-going programs are identified and categorized as: biologic, economic, social, environmental, administrative and other.

Chapter 4 lists the goal and objectives of the Regional Plan.

Chapter 5 describes the proposed Regional Plan and includes a conceptual model for a proposed system that will provide for determining management alternatives, management decisions, action, implementation, measuring, monitoring and evaluating results of management actions and updating the data base as required. Options of alternative management structures are discussed, as well as development of a method for overall plan implementation and periodic re-evaluation.

Chapter 6 presents recommendations that will provide for plan implementation. Recommendations are ranked in order of priority (high, medium and low) with a short description of potential benefits for each. Some 37 recommendations are presented.

Chapter 7 is a Management Action Program Summary presented in chart form and shows time horizons, estimated funds needed, potential funding sources and suggested responsibilities for activities that will be undertaken to implement the plan.

A discussion of planning methodology and chronology is appended along with state laws and regulations, references cited and a glossary of terms.

Chapter 2. Description of the Resource and Fishery

The shrimp fishery in the Gulf of Mexico is based almost entirely on three shallow-water species of the family Penaeidae: the brown shrimp (*Penaeus aztecus* Ives), the white shrimp (*Penaeus setiferus* Linnaeus) and the pink shrimp (*Penaeus duorarum* Burkenroad). Of minor importance to the Gulf shrimp fishery at the present time are seabobs (*Xiphopenaeus kroyeri* Heller), rock shrimp (*Sicyonia brevirostris* Stimpson), *Trachypenaeus constrictus* Stimpson, *Trachypenaeus similis* Smith and royal red shrimp (*Hymenopenaeus robustus* Smith).

Landing statistics on the three major species from 1956 to 1974 are shown in Table 1. Brown shrimp account for the bulk of landings in the Gulf of Mexico. Most of the brown shrimp landed in the Gulf are taken in Texas and Louisiana. Catches are highest during late spring and early summer and begin to decline in August. White shrimp predominate in the north central Gulf with a majority of the catch landed in Louisiana. Young-of-the-year shrimp are taken almost entirely during summer and autumn while the spring white shrimp fishery consists of overwintered adults. Most pink shrimp are taken along the west coast of Florida.

2.1 LIFE HISTORY

Reproductive Cycle. The generalized reproductive cycle for brown, white and pink shrimp can be divided into Gulf (offshore) and estuarine (inshore) segments. Spawning and larval development generally occur offshore. Post-larvae migrate into inshore areas where they grow and mature. As adults, the shrimp move back offshore to spawn.

Renfro (1964) and Cook and Lindner (1970) reported brown shrimp reached sexual maturity at approximately 140 mm**. Broad (1965) indicated white shrimp reach sexual maturity at 140 mm while Burkenroad (1934) suggested females of this species reach maturity at about 165 mm and males at about 119 mm. Eldred et al. (1961) reported pink shrimp females became mature at lengths of 85 mm and males at 74 mm. Observations of rock shrimp

show females may reach sexual maturity as small as 13 mm carapace length (CL) (Cobb et al., 1973). However, the majority of the population does not reach maturity before 24 mm CL (89 mm). Anderson and Lindner (1971) indicated males and females of royal red shrimp mature at total lengths of about 125 mm and 155 mm, respectively.

Eggs of these species are all demersal. Eggs of white, brown and pink shrimp have diameters of 0.28 mm, 0.26 mm and 0.31 to 0.33 mm, respectively (Pearson, 1939; Dobkin, 1961; Cook and Lindner, 1970; and Lindner and Cook, 1970). Cook and Murphy (1965) indicated rock shrimp eggs measured approximately 0.23 mm. *Trachypenaeus* eggs are considerably more buoyant than those of *Penaeus* species due to a larger perivitelline space (Pearson, 1939).

Cook and Lindner (1970) indicated the duration of spawning periods and times of spawning peaks for brown shrimp were dependent upon water depths. Spawning takes place at depths greater than 14 m (8 fm), however, activity varies with depth. At 46 m (25 fm) (where the greatest percentage of ripe females are found), 64 m (35 fm), 82 m (45 fm) and 110 m (60 fm) spawning is continuous for brown shrimp, with peaks in October through December and March to May; at 27 m (15 fm) spawning occurs from spring to early winter with a peak in September (Cook and Lindner, 1970). Temple and Fischer (1967) concluded that peak spawning in the northwest Gulf of Mexico was from September to November based upon the seasonal occurrence of larvae. Along the northwest coast of Florida, brown shrimp spawn in late winter and postlarvae are recruited to estuarine nursery areas from late winter through spring. A secondary spawn has been suggested for early fall (Joyce and Eldred, 1966).

White shrimp spawn in the shallow Gulf of Mexico during spring through fall. Lindner and Anderson (1956) found that, on the basis of gonadal development of females, most spawning in Louisiana occurs at depths of 8 to 31 m (4.5 to 17 fm). They thought that spawning may continue from late March or early April until November. Renfro and Brusher (1964) indicated that spawning begins in mid-April or early May at a depth of 14 m (7.5 fm), but may begin in March at 27 m (15 fm)

*Essentially this description reports, without evaluation, that body of literature considered relevant by the Task Force.

**All lengths are expressed as total length unless otherwise stated.

TABLE 1.
Landing statistics for brown, white and pink shrimp (heads-on) in the Gulf of Mexico
in thousands of pounds and percentage of the catch from 1956 to 1974.

Year	Florida (West Coast)						Alabama						Mississippi					
	Brown Shrimp Lbs. (10 ³)	%	White Shrimp Lbs. (10 ³)	%	Pink Shrimp Lbs. (10 ³)	%	Brown Shrimp Lbs. (10 ³)	%	White Shrimp Lbs. (10 ³)	%	Pink Shrimp Lbs. (10 ³)	%	Brown Shrimp Lbs. (10 ³)	%	White Shrimp Lbs. (10 ³)	%	Pink Shrimp Lbs. (10 ³)	%
1956	557.0	02	617.4	02	28,013.4	96	3,067.8	67	1,249.9	27	261.9	06	6,095.4	70	2,355.6	27	200.4	02
1957	707.1	03	881.2	04	23,155.8	93	2,993.8	83	410.4	11	188.3	05	5,673.8	81	957.1	14	354.3	05
1958	1,024.0	04	1,573.4	06	24,539.4	90	2,261.5	72	829.2	26	68.9	02	2,973.0	65	1,512.6	33	103.8	02
1959	953.3	05	755.2	04	17,352.7	90	3,795.4	80	974.3	20	2.2	*	5,457.8	73	1,894.2	25	168.9	02
1960	688.2	03	1,325.6	05	24,305.1	92	3,355.3	79	856.2	20	52.7	01	4,997.4	76	1,519.5	23	49.2	01
1961	308.0	01	639.3	03	20,397.2	95	1,718.4	82	236.0	11	144.0	07	2,291.6	87	218.1	08	113.8	04
1962	579.7	03	468.1	02	18,999.7	94	1,825.2	78	490.7	21	33.5	01	2,760.2	72	1,047.7	27	20.7	01
1963	499.2	02	777.4	04	20,580.5	94	3,515.4	72	1,308.8	27	53.0	01	3,775.9	64	1,972.8	33	160.9	03
1964	498.3	02	1,336.8	05	23,140.5	92	2,847.1	63	1,624.2	36	81.1	02	2,874.7	71	1,127.6	28	32.1	01
1965	1,048.7	04	1,037.6	04	21,452.7	91	4,823.0	80	1,150.7	19	54.0	01	4,151.1	81	978.1	19	22.4	*
1966	1,094.0	06	555.0	03	16,332.5	90	5,825.8	88	776.6	12	20.4	*	3,888.5	82	804.0	17	38.4	01
1967	1,433.4	10	530.1	04	12,637.9	86	7,684.4	85	1,101.5	12	236.6	03	5,258.3	88	593.0	10	153.5	03
1968	1,686.9	10	847.2	05	14,465.6	85	8,388.1	87	939.9	10	281.5	03	5,780.7	91	378.8	06	187.1	03
1969	799.6	06	1,181.0	08	12,265.9	85	6,673.9	71	2,511.4	27	206.3	02	4,021.3	72	1,224.5	22	340.3	06
1970	856.8	05	1,218.9	07	14,527.7	87	6,710.0	71	2,536.0	27	201.5	02	4,795.7	80	1,127.8	19	87.4	01
1971	1,141.4	08	1,017.8	07	11,361.0	84	8,294.8	79	2,075.5	20	96.5	01	4,961.9	84	816.2	14	147.9	02
1972	1,027.0	07	637.5	04	12,155.4	85	9,398.0	86	1,338.4	12	223.1	02	4,243.3	87	460.9	09	149.6	03
1973	339.3	02	487.3	03	14,860.0	91	5,328.0	71	1,460.9	19	605.3	08	1,683.5	75	416.3	18	145.5	06
1974	697.0	04	711.2	04	14,865.8	84	5,944.0	68	1,935.9	22	594.2	07	2,676.9	81	343.2	10	241.3	07
Mean	838.9		873.6		18,179.4		4,971.0		1,253.0		179.2		4,124.3		1,039.4		143.0	
Year	Louisiana						Texas						Totals					
	Brown Shrimp Lbs. (10 ³)	%	White Shrimp Lbs. (10 ³)	%	Pink Shrimp Lbs. (10 ³)	%	Brown Shrimp Lbs. (10 ³)	%	White Shrimp Lbs. (10 ³)	%	Pink Shrimp Lbs. (10 ³)	%	Brown Shrimp Lbs. (10 ³)	%	White Shrimp Lbs. (10 ³)	%	Pink Shrimp Lbs. (10 ³)	%
1956	12,123.2	40	17,131.6	57	0.8	*	33,139.7	90	3,135.7	08	496.3	01	55,023.1	50	24,490.2	22	28,972.8	26
1957	11,120.1	62	6,581.7	37	0.1	*	43,136.2	94	2,298.5	05	138.9	*	63,631.0	64	11,128.9	11	23,837.4	24
1958	8,324.2	35	14,454.8	61	9.9	*	36,669.9	82	7,369.8	17	294.4	*	51,252.6	50	25,739.8	25	25,016.4	24
1959	16,143.5	48	15,172.2	45	1.5	*	43,438.5	86	5,779.3	11	938.0	02	69,788.5	61	24,575.2	21	18,463.3	16
1960	18,933.3	52	16,365.3	45	9.8	*	37,922.3	78	8,314.9	17	2,094.6	04	65,896.5	54	28,381.5	23	26,511.4	22
1961	10,501.3	57	6,492.1	35	11.4	*	24,333.9	70	6,862.8	20	3,416.3	10	39,153.2	49	14,448.3	18	24,082.7	30
1962	11,773.2	42	14,136.5	51	6.5	*	24,478.7	69	7,021.8	20	3,025.1	09	41,417.0	46	23,164.8	26	22,085.5	25
1963	16,884.2	33	34,119.1	66	7.7	*	31,305.9	71	8,908.7	20	3,380.3	08	55,980.6	44	47,086.8	37	24,182.4	19
1964	10,011.4	26	27,800.3	73	—	—	25,929.8	62	12,089.1	29	3,553.4	09	42,161.3	37	43,978.0	39	26,807.1	24
1965	18,052.4	45	21,192.1	53	7.5	*	34,335.7	71	9,240.0	19	4,635.9	10	62,410.9	51	33,598.5	27	26,172.5	21
1966	19,210.9	49	19,929.7	50	8.2	*	33,949.7	78	7,851.8	18	1,972.4	05	63,968.9	57	29,917.1	26	18,371.9	16
1967	30,977.1	65	16,315.8	34	24.5	*	55,550.4	87	6,418.6	10	2,220.8	03	100,903.6	71	24,959.0	18	15,273.3	11
1968	25,985.1	61	16,279.9	38	8.5	*	37,040.6	71	12,472.1	24	2,697.5	05	78,881.4	62	30,917.9	24	17,640.2	14
1969	24,199.0	46	27,883.4	53	14.2	*	30,103.7	68	11,959.9	27	2,347.3	05	65,797.5	52	44,760.2	35	15,174.0	12
1970	26,975.6	47	28,698.3	50	29.7	*	41,596.2	75	12,381.2	22	1,428.7	03	80,934.3	56	45,962.4	32	16,275.0	11
1971	29,367.8	50	29,004.8	49	63.2	*	44,099.0	81	9,150.0	17	1,094.1	02	87,864.9	61	42,064.3	29	12,762.7	09
1972	27,090.4	51	24,091.6	46	105.9	*	48,295.5	79	11,388.8	19	1,411.8	02	90,054.2	63	37,917.2	26	14,045.8	10
1973	18,073.6	48	16,846.0	45	45.8	*	33,493.0	65	14,944.9	29	2,341.2	05	58,917.4	51	34,155.4	30	17,997.8	16
1974	17,551.8	46	16,876.3	45	20.2	*	35,551.4	72	11,506.0	23	1,426.4	03	62,421.1	53	31,372.6	27	17,147.9	15
Mean	18,594.6		19,440.6		19.8		36,547.9		8,899.7		2,048.1		65,076.7		31,506.2		20,569.5	

* less than 1%

— no reported catch

Source: *Fishery Statistics of the United States*, NMFS

in the northern Gulf. Temple and Fischer (1967) believed that spawning of white shrimp occurred in shallow water—14 m (8 fm)—off Galveston from April through August. Bryan and Cody (1975) sampled shrimp in water depths of 7, 11, 15 and 22 m (4, 6, 8 and 12 fm) near major passes in Texas to determine spawning habits based upon gonadal development of female shrimp. They found that most spawning occurred between April and August

(principally in June), with evidence of spawning as early as February and as late as October. The principal spawning depth was 11 m (6 fm). Their findings agreed with Lindner and Anderson (1956) that advent of spawning coincided with rising temperatures. Most spawning occurred at temperatures of 21.0 to 29.7 C. Burkenroad (1934) indicated that a female white shrimp produces an average of about 500,000 eggs. Anderson et al. (1949)

stated that a female could be expected to lay between 500,000 and 1,000,000 eggs at a single spawning. The ovary of a 172-mm female contained about 860,000 eggs.

Pink shrimp are by far the most important commercial shrimp species off Florida. Centers of production occur in the Tortugas-Sanibel area, the central west coast (Tampa Bay area) and the panhandle (Apalachicola) area. In the southern section spawning occurs year-round, but peak reproduction occurs in early spring. Tampa and Apalachicola Bays provide nursery areas and overwintering areas for shrimp in other centers of production. Spawning occurs during summer and juveniles overwinter in the bays and enter the adult population offshore in spring. Pink shrimp fecundity has been estimated at 440,000 to 534,000 depending upon size of the individual (Martosubroto, 1974).

Very little research has been conducted on the reproductive cycle of the other species covered in this plan. Gravid females of seabobs were collected by Renfro and Cook (1963) during the warm months between April and October near the Galveston jetties on the Texas coast. In an unpublished study in Louisiana, gravid females were collected along the southwestern coastline on several occasions during July and August (Conrad Juneau, pers. comm.). However, no subsequent postlarval specimens were taken.

According to Bryan and Cody (1975) and Cobb et al. (1973) spawning of the rock shrimp occurs all year but is most prevalent from fall through spring. On the east coast of Florida, spawning occurs for three months during the winter and early spring. Bottom temperature increases during the fall initiate gonadal maturation. There is evidence of spawning coinciding with a full moon. Individuals spawn several times during one season but rarely survive to spawn a second season.

Studies by Subrahmanyam (1969) off the Mississippi coast indicate year-round spawning of *Trachypena* sp., triggered, as with many penaeids, by sudden changes in bottom temperature. Brusher et al. (1972) working off the Texas and Louisiana coasts found spawning of *T. similis*, as indicated by the presence of "ripe" females, appeared to be more intense in April and August. No ripe *T. constrictus* were noted. Subrahmanyam (1969) noted spawning of *T. similis* began in April and lasted through November with indications of late spring and fall peaks. In Tampa Bay, occurrence of larval and postlarval *T. constrictus* showed that spawning began in February, reached a peak in August and September and diminished in November (Eldred et al., 1965). Off the northeast coast of Florida, Joyce (1965) noted the peak percentage of impregnated *T. constrictus* occurred in April and May with the first appearance of recruits in the nursery area in mid-June and more in October and November, the result of a possible second spawning. Data across the Gulf

for both species indicate spawning begins near shore in early spring and moves to deeper water during the warmer months with a fall peak again near shore.

Little is known of the biology of the royal red shrimp, particularly its reproduction and early life history (Roe, 1969). Anderson and Lindner (1971) stated spawning probably is not extensive before December and is essentially completed by June, although some spawning continues throughout the year. The occurrence of small specimens reported by Burkenroad (1936) in March corresponds to this estimate of the peak spawning season.

Age and Growth Characteristics. Rates of growth in shrimp are highly variable and depend upon such factors as season, water temperature and size and sex of individuals (Perez-Farfante, 1969; Costello and Allen, 1970). The growth rate of brown shrimp is closely correlated with associated hydrological conditions in Louisiana (Barrett and Gillespie, 1973; Gaidry and White, 1973; White 1975). Retarded growth can be expected if spring water temperatures remain below 20 C (St. Amant et al., 1966). Increased growth occurs with temperatures above 20 C, when accompanied by adequate salinity levels (10 to 15 ppt). Under average conditions, growth of brown shrimp in Louisiana inshore waters has been reported by Broom (1968) to be approximately 1.0 mm per day from late March to June. This takes into consideration periods of early inward migration when water temperatures are generally cooler and the growth rate may be retarded. During the latter part of this period, when water temperatures are warmer, growth rates may exceed 2.0 mm per day. Under normal conditions the growth rate during peak brown shrimp recruitment (mid-April to mid-May) is expected to reach 1.5 mm per day (Ford and St. Amant, 1971). Ringo (1965) calculated that in Galveston Bay young brown shrimp grew an average of 0.1 mm per day from March to early April and as temperatures rose the growth rate increased to an average of 1.7 mm per day. A maximum rate of 3.3 mm per day was reached during late May. Swingle (1971) and Loesch (1965) reported spring growth rates of 26.0 to 33.6 mm and 30 to 35 mm per month, respectively, in Alabama with a spring maximum of 50 mm (Loesch, 1965). From November through April an average of 13 to 18 mm per month was recorded.

Young white shrimp grow very rapidly in estuaries, about 1.2 mm per day (Williams, 1955; Gunter, 1956) with mature white shrimp growing at a slower rate (Lindner and Anderson, 1956). Observations of growth in captivity have shown a rate of 2.0 mm per day (Johnson and Fielding, 1956). In Louisiana coastal waters, white shrimp experience two periods of growth (1) during the period when recently recruited larvae enter the estuaries during summer (May and June) and (2) when overwintering whites reenter the estuaries during spring (April and May). Growth of the early spring population is

nearly identical to growth for the fall population. Some growth is evident in overwintering white shrimp populations in near offshore waters, probably averaging less than 0.5 mm per day for November through February. In Mobile Bay, Loesch (1965) found that white shrimp increase from 12 to 27 mm per month in winter, 18 to 31 mm in summer and the "very young" may grow as much as 65 mm per month in summer. Kutkuhn (1962) estimated that the rate of weight increase is relatively low in small shrimp, reaches a maximum in the middle of the size range and then decreases progressively with further increase in size.

There are various estimates of growth rate in juvenile and subadult pink shrimp. Eldred et al. (1961) estimated a growth rate of 20 mm per month for small shrimp up to 65 mm and about 10 mm per month thereafter. Kutkuhn (1966) established growth rates of 3.4 mm per week in 80- to 140-mm shrimp, slightly higher than Eldred's estimates. Other estimates for young pink shrimp range from 0.25 to 1.7 mm per day, while adults and subadults ranged from 0 to 20 mm per month (Costello and Allen, 1970).

Little data on growth of the other species are available. Growth of rock shrimp is rapid in juveniles, averaging 0.25 to 0.38 mm per day, and slows to 1.5 to 1.9 mm per month in adults. The most rapid growth observed was 0.64 mm per day from June to July (Kennedy et al., in press). No definite data on *Trachypenaeus* sp. are available although Joyce (1965) estimated that *T. constrictus* grew at a rate of 6 mm per month from October through February.

Estimates of growth parameters related to Von Bertalanffy equations for the three commercially important penaeid species are shown in Table 2. These estimates assume a constant mortality rate over a range of sizes. Since the mortality rate of shrimp may decrease with increasing size, it is important in establishing proper yield strategies that mortality rates for all relevant sizes be determined (Calder et al., 1974). Weekly instantaneous mortality rates for the three commercially important shrimp species are shown in Table 3. In order to maximize yield from the fishery, a high instantaneous mortality rate would indicate harvesting should begin as soon as shrimp reached acceptable size while lower rates would indicate fishing should be postponed until shrimp are considerably larger.

Length-weight and length-length relationships for the three commercially important *Penaeus* species are shown in Table 4. Length-weight relationships for the other species are not well documented. Kennedy et al. (in press) working off the west Florida coast collected data that indicated morphometric relationships for rock shrimp. These morphometric relationships are as follows:

Carapace length vs weight

	Geometric Mean Equations
Female: <23 mm CL	$W = 3.398 \times 10^{-4} CL^{3.364}$
>23 mm CL	$W = 1.818 CL - 20.475$
Male: <23 mm CL	$W = 4.104 \times 10^{-3.303}$
>23 mm CL	$W = 1.886 CL - 30.922$
Combined: <23 mm CL	$W = 3.557 \times 10^{-3.352}$
>23 mm CL	$W = 1.817 CL - 29.951$

Carapace length vs total length

Female: <20 mm CL	$TL = 3.786 CL + 0.118$
>20 mm CL	$TL = 2.881 CL + 18.498$
Male: <20 mm CL	$TL = 3.803 CL + 0.249$
>20 mm CL	$TL = 3.448 CL + 7.523$
Combined: <20 mm CL	$TL = 3.813 CL - 0.106$
>20 mm CL	$TL = 3.058 CL + 15.170$

Klima (1969) calculated length-weight relationships of royal red shrimp for two areas in the Gulf of Mexico:

Dry Tortugas

$$\text{Female: } Y = -5.67188 + 3.22x$$

$$\text{Male: } Y = -4.79226 + 2.82x$$

$$\text{Combined: } Y = -5.10459 + 2.96x$$

Mississippi River Delta

$$\text{Female: } Y = -5.36404 + 3.06x$$

$$\text{Male: } Y = -4.87595 + 2.83x$$

$$\text{Combined: } Y = -5.23262 + 3.00x$$

Population Dynamics. Some information is available on population dynamics of the commercially important penaeid shrimp on the nursery grounds. For shrimp populations outside the nursery grounds, information needed to determine optimum size for harvest is inadequate (i.e., growth rate, mortality, movement in the shrimp stock and costs and earnings data from the fisheries). Most population dynamics models do not appear to adequately describe many commonly observed changes in the commercially exploited shrimp species. This is particularly true for commercially exploited crustaceans because:

- (1) crustaceans are extremely difficult to age; (2) adequate catch and effort data are lacking for many crustacean fisheries; (3) crustaceans are apparently vulnerable to a variety of exogenous factors, including droughts, pesticides and sudden climate changes; (4) most crustaceans not only have several life stages, but also molt more or less continuously throughout life, thereby being regularly exposed to greater physiological stresses and higher rates of predation than other organisms such as fishes; and (5) clearly defined relationships between parents and progeny are often apparently lacking (Calder et al., 1974).

Effort data are available for commercially exploited shrimp in the Gulf of Mexico through *Gulf Coast Shrimp Data*. This publication lists the number of trips and days fished in each area of capture and at each trawling depth. Although useful, the data are extrapolated from a random sample and no distinction is made as to vessel size.

Environmental Tolerances. Various data have been

TABLE 2.
Estimates of growth parameters^a for three commercially important shrimp species

Species/Sex	K ₁	L _∞ (mm)	K _c	C _∞ (mm)	W _∞ (g)	b	t ₀ Weeks	t _p Weeks	Total Length Range (mm)	Carapace Length Range (mm)	Weight Range (mm)	Source
Brown												
Combined	0.073	177.7					0.0 ^d	12	115.0-135.0			McCoy (1968)
Male			0.317	30.0			-5.98			23.5-29.5		McCoy (1972)
Female			0.171	36.6			-7.20			25.0-34.5		McCoy (1972)
White												
Male	0.064	170.0										Lindner & Anderson (1956)
Female	0.047	190.0										Lindner & Anderson (1956)
Combined	0.12				87.0	3.0	-0.57					Klima (1964)
Combined	0.09											Klima & Benigno (1965)
Combined	0.09	214.0										
	0.06	224.0					0.2					Klima (1974)
Pink												
Male			0.016	46.38								Iverson & Jones (1961)
Female			0.022	46.05								Iverson & Jones (1961)
Combined	0.068	185.0			57.8							Lindner (1965)
Combined ^b	0.071				42.0	3.14	0.68	15	88.8-130.4		5.9-19.5	Kutkuhn (1966)
Combined ^c	0.085				35.6	3.14	3.20	15	75.3-157.5		3.5-35.2	Kutkuhn (1966)
Male	0.046	168.0			42.3	3.134	-5.68	11	95.3-148.0			Berry (1967)
Female	0.055	199.0			73.3	3.115	0.06	11	95.7-170.0			Berry (1967)
Male			0.217	27.0			-9.82			23.5-26.5		McCoy (1972)
Female			0.188	34.5			-6.93			25.0-32.5		McCoy (1972)

^aParameters apply to Von Bertalanffy equations describing growth: (1) in total length, $l_t = 1_{\infty}(1 - e^{-k_1(t-t_0)})$ (2) in carapace length, $c_t = c_{\infty}(1 - e^{-k_c(t-t_0)})$, and (3) in weight $W_t = W_{\infty}(1 - e^{-kw(t-t_0)})^b$, in which 1_{∞} , C_{∞} , and W_{∞} are asymptotic sizes of the average individual in terms of total length, carapace length, and total weight, respectively. K_1 and K_c are coefficients proportional to rates of catabolism based on total length and carapace length, respectively. t_0 is a hypothetical age at which length is zero. t_p is age at recruitment based on a recruitment size of 70 shrimp per pound (= g). b is the exponent in the relationship between weight, w , and total length, l ; viz., $w=al^b$.

^bValues represent the Tortugas fishery off south Florida.

^cValues represent the Sanibel fishery off southwest Florida.

^dAuthors assumed $t_0 = 0$.

TABLE 3.
Weekly instantaneous mortality rates, F, M and Z, for three commercially important shrimp species (sexes combined)

Shrimp Species	Fishing Mortality F	Natural Mortality M	Total Mortality Z	Source
Brown	0.06	0.21	0.27	Klima (1963)
	0.020-0.315 ^e	-	-	Neal (1967)
	-	-	0.993-1.243	McCoy (1968)
	0.206	0.364	0.571	McCoy (1972)
White	-	-	0.46	Klima (1963)
	0.06-0.19	0.08	0.14-0.27	Klima and Benigno (1965)
	0.104-0.131 ^d	0.041-0.121 ^d	0.164-0.226 ^d	Klima (1974)
Pink	0.09 ^a	0.27 ^a	-	Iverson (1962)
	0.96	0.55	0.76 ^b -1.51	Kutkuhn (1966)
	0.160-0.227	0.024-0.061	0.22-0.27	Berry (1967)
	0.03-0.07	0.08-0.11	0.11-0.18	Costello and Allen (1968)
	0.09	0.02	0.11	Berry (1969)
	0.337	0.280	0.612	McCoy (1972)
	-	-	0.317 ^c -0.350 ^c	McCoy (1972)

^aCorrected values.

^bObtained during the partially exploited phase of the mark-recapture experiment.

^cZ = 0.317 and Z = 0.350 were fall and spring values, respectively.

^dValues were reported by the author as questionable.

^eCalculated from reported maximum exploitation rates.

TABLE 4.
Length-weight and length-length relationships¹ for the three commercially important shrimp species.

Species/Sex	Total Length to Total Weight				Carapace Length to Total Weight				Carapace Length to Total Length				Source
	$W = a l^b$		Size Range (mm)	No. measured	$W = a' c^b$		Size Range (mm)	No. measured	$l = a'' c^b$		Size Range (mm)	No. measured	
	a	b			a'	b			a''	b			
Brown													
Combined	12.3×10^{-6}	3.02^3	65-165 ²	2104									McCoy (1968)
Male	11.61×10^{-6}	2.911	45-204	1396									Fontaine and Neal (1971)
Female	9.53×10^{-6}	2.966	55-240	2016									Fontaine and Neal (1971)
Combined	10.52×10^{-6}	2.938	45-240	3412									Fontaine and Neal (1971)
Male					0.000819	2.94	10-42 ²	259	4				McCoy (1972)
Female					0.00113	2.84	10-42 ²	243	4				McCoy (1972)
White													
Combined	7.69×10^{-6}	2.976	55-160	100									Perret (1966)
Male	2.02×10^{-6}	3.261	70-200	970									Fontaine and Neal (1971)
Female	2.32×10^{-6}	3.234	70-214	1120									Fontaine and Neal (1971)
Combined	2.16×10^{-6}	3.247	70-214	2090									Fontaine and Neal (1971)
Pink													
Male	4.49×10^{-6}	3.13	35-175 ²	729	0.001	3.04	8-40 ²	729	5.27	0.96	35-175	729	Kutkuhn (1966)
Female	5.06×10^{-6}	3.12	35-215 ²	888	0.002	2.79	8-55 ²	888	6.14	0.90	35-215	888	Kutkuhn (1966)
Combined	9.79×10^{-6}	2.98^3	65-165 ²	2641									McCoy (1968)
Male	10.02×10^{-6}	2.967	70-175	1173									Fontaine and Neal (1971)
Female	5.93×10^{-6}	3.92	60-214	2125									Fontaine and Neal (1971)
Combined	7.71×10^{-6}	3.029	60-214	3298									Fontaine and Neal (1971)
Combined					0.0062	3.03443	6-22 ²						Tabb, et al. (1962a)
Male					0.00148	2.77	10-42 ²	297	4				McCoy (1972)
Female					0.00209	2.66	10-42 ²	503	4				McCoy (1972)

¹ Additional data on length-weight relationship was published by Anderson and Lindner (1958), pink, and by Iversen and Idyll (1960), white.

² Size range was estimated from published graph.

³ Reported value of b is not significantly different at 95% confidence level from theoretical value, i.e., b = 3.

⁴ McCoy (1972) gives linear equations for conversion of carapace length to total length.

Pink Male $L = 12.37 + 3.81C$
 Female $L = 21.90 + 3.40C$

Brown Male $L = 3.50 + 4.16C$
 Female $L = 10.50 + 3.83C$

collected on the exogenous factors affecting shrimp resources. Considerable effort has been directed toward determining the range of environmental tolerances for penaeid shrimp species. Numerous investigations have developed criteria by which a dependable degree of predictability can be expected in relating production or population changes to certain environmental factors.

Ford and St. Amant (1971) indicated a strong relationship exists between Mississippi River discharge and brown shrimp production in the Barataria Bay area. Higher levels of production were correlated to lower river stages, and higher salinities.

Loesch (1965) working in Mobile Bay, Alabama, found greater abundance of brown shrimp in salinity ranges above 10 ppt with white shrimp more abundant at the lower salinity levels.

In Mississippi, Gunter et al. (1964) discussed the relationship of salinity to penaeid populations and compared salinity regimes to species preferences. They concluded that the three major shrimp species of the Gulf coast may be ranked in order of "preference" to salinity in the younger stages as low, intermediate and high; these were respectively, the white, brown and pink shrimp. They found indications that salinity was a limiting factor to the distribution and abundance of shallow-water penaeid shrimp.

Gunter and Edwards (1969) stated that white shrimp production is positively correlated with rainfall in Texas, with a significant lag effect. No such relationship was evident for brown shrimp.

Barrett and Gillespie (1973), however, did find that brown shrimp production in Louisiana waters was related to rainfall and the resulting salinity. These differences are apparently due to characteristically differing estuarine types.

In Texas waters, young brown shrimp were found in greatest abundance within the salinity range of 10 to 30 ppt, with considerably higher concentrations at salinities above 20 ppt than at salinities below 10 ppt. However, white shrimp do quite well at salinity levels below 10 ppt.

Williams (1955) pointed out that in North Carolina, young white shrimp are most abundant in areas of lowest salinity and that in general they are more abundant in lower salinity waters than are the brown or pink shrimps.

Joyce (1965) reported that white shrimp in Florida composed by far the largest percentage of shrimp in localities of lower salinities and that no white shrimp were caught in high-salinity waters.

Temperature becomes a limiting factor in survival and growth of young penaeid shrimp. Spawning appears to be greatly influenced by temperature; a sudden change may initiate or terminate ovulation (Perez-Farfante, 1969).

Temple and Fischer (1967) found that along the Texas

coast white shrimp larvae were present from May through September and that a close correlation appears to exist between temperature and abundance of larvae.

Laboratory experiments by Zein-Eldin and Griffith (1966) indicate that temperature affected the growth and molting of postlarvae.

Studies by Zein-Eldin and Aldrich (1965) indicated that postlarvae were able to grow in a wide range of salinity, but that growth was arrested at low temperatures. Postlarvae survived but did not grow at 11 C and 15 ppt, and growth rates accelerated with increases in temperature.

St. Amant et al. (1962) placed considerable importance on water temperature of 20 C, indicating that rapid growth of juveniles occurs suddenly after water temperature exceeds 20 C. Gaidry and White (1973) also correlated brown shrimp production in Barataria Bay with the warming of bay waters to 20 C.

Estimates are that the maximum tolerable temperature for postlarvae is only slightly above 35 C. The lowest temperature that can be tolerated is not known, but Gunter and Hildebrand (1951) reported a mass narcosis of the young at 4.4 C and below. Additional environmental factors that affect growth, survival and production were discussed by Barrett and Gillespie (1973), including the relationship between Mississippi River discharge and brown shrimp production. Other factors felt to be related to penaeid shrimp population dynamics were: fertility of the estuarine system, availability of food, population distribution, food content, protection, light intensity, tide and rainfall.

There are circumstances when population dynamics are severely altered by catastrophic environmental factors. Gunter and Hildebrand (1951) reported on the devastating effects on marine organisms resulting from a cold front in 1951. White (1975) discussed the effects of the Mississippi River flood of 1973 and showed a significant decrease in brown shrimp landings that year as a result.

Environmental factors are fairly predictable; even catastrophic occurrences such as floods, hurricanes and severe cold fronts can be predicted. Although the effects may be considered devastating at the time of occurrence, the natural system usually is capable of returning to a normal condition with little residual effects shortly after the catastrophe.

Alteration of Habitat. Comparatively little is known of the impact of man-made factors or changes in the estuarine habitat and their subsequent effects on penaeid shrimp.

In recent years, expanding populations, cheap water transportation, a growing agricultural industry and unprecedented recreational demands have turned to these highly productive coastal regions for their needs. Sizeable estuarine areas have been destroyed or altered to a point of low productivity. Future demands if not properly

regulated will further threaten remaining coastal areas.

It has been estimated that 10.06 million ha (26.6 million ac) of estuarine areas currently remain in the United States; approximately 29%—3.16 million ha (7.9 million ac)—are considered prime habitat for the propagation of fish and wildlife resources (U.S. House of Representatives, 1967). A major portion of the prime habitat borders the northern Gulf of Mexico. It is this precise area that presently is faced with change, perpetuated by man's continued progress.

Factors changing the Gulf coast are many, including flood and hurricane protection facilities, port and navigation facilities, dredging operations for pipelines, access canals, drainage projects, housing, industrial and recreational demands and the ever increasing agricultural needs of the growing world population.

The total effect of this continued deterioration of the estuarine zone, and the related effects on production, are difficult to access. In terms of habitat loss some figures are available. Chapman (1968) reported that 80,000 ha (200,000 ac) of shallow coastal bays had been dredged and filled in the southeastern and Gulf states during the previous 20 years.

In Louisiana, Gagliano et al. (1970) indicated, "a net average land loss of 16.5 square miles annually during the last 30 years along the coast." In further studies, Gagliano (1973) stated, "it is doubtful that the Louisiana coastal zone can survive another 30 years of attrition through canal dredging at the present rate." He claimed that mineral extraction industries alone were responsible for 65% of the total dredging in Louisiana. Drainage canals accounted for 21% and navigation canals for 11% of the dredging activity.

Taylor and Saloman (1968) noted that filling of 1,400 ha (3,500 ac) of Boca Ciega Bay, Florida for housing development destroyed an annual standing crop of 1,113 metric tons of sea grass and about 1,812 metric tons of associated infauna in terms of annual production. The total loss of biological resources was far greater. Minimum estimates were 25,841 metric tons of sea grasses, 73 metric tons of fishery products and 1,091 metric tons of infauna, exclusive of meiofauna. Various authors (Taylor and Saloman, 1968; Christmas et al., 1976; and Gosselink et al., 1974) have provided estimates of the dollar value of marsh and grass bed habitats. Results vary widely. Economically satisfactory estimates are apparently not available.

Recent evaluations of the effect of housing developments in Texas estuarine areas (Trent et al., 1972) showed that "the deepening of about 1,120 km of federal navigation channels has altered 5,265 ha of bay bottom and destroyed 2,830 ha of brackish marsh and the dredge spoil has filled 2,025 ha of shallow bay and covered 9,315 ha of brackish marsh."

Although certain correlations between habitat alteration and subsequent effect on penaeid shrimp populations may be difficult to accurately assess, effects have been measured in certain situations. In cases where landing statistics are available prior to and following a major alteration of an estuarine system, or in specific biological studies, the effects on annual production and fauna are retrievable. Although landing statistics measure only commercial implications, the overall impact may be better comprehended. One example is the reduction in the overall marine community and commercial shrimp landings that occurred in Sabine Lake, Louisiana-Texas as a result of the Toledo Bend and Sam Rayburn projects (White and Perret, 1973). These projects resulted in an alteration of normal river flow and subsequent salinity regimes. Other marine fisheries losses occurred with the completion of the Mermentau Basin project in Louisiana in 1963 (Gunter and Shell, 1958). In this particular instance more than 40,000 ha (100,000 ac) of marine habitat were converted to a freshwater impoundment for agricultural irrigation, totally eliminating marine fisheries production.

Another cause for concern is estuarine alterations that have occurred along the northern Gulf coast in the last few decades. Deep-water navigation channels connecting major coastal cities with offshore shipping lanes have altered current patterns and salinity regimes in much of the adjacent estuarine systems. These alterations have apparently changed much of the coast system from a transitional marsh type to a more saline marsh. The apparent effect on penaeid shrimp was a shift from a primarily white shrimp fishery toward higher brown shrimp production along the central northern Gulf. Although this transition may be regarded as a shift rather than an actual production loss, other serious implications are involved. A primary concern is the rapid breakdown of the fragile marsh vegetation. With increased salinity and tidal action, breakdown of the less salinity-tolerant vegetative zone far exceeds replacement by more tolerant species. Consequently, open tidal flats persist in the affected area where formerly dense vegetative communities persisted. The long range implication of these alterations on the shrimp resource poses serious concern.

Other factors affecting the dynamics of shrimp along the Gulf coast are pesticides. Conte and Parker (1971) in studies on the effect of aerially applied Malathion on brown and white shrimp near west Galveston Bay, Texas, found that shrimp at treated stations (85.7 g/ha) exhibited mortalities ranging from 14 to 80% as a result of these operations. The use of Malathion in mosquito control programs has progressed to the point that, presently much of the Gulf coast employs some form of mosquito control utilizing this substance. Other pesticides used along the drainage systems of the Gulf pose significant threats to the future of the estuarine areas. Increasing

industrial and agricultural discharges into waterways present serious problems now and in the future. Studies are needed to adequately appraise the effect of these substances on penaeid as well as all marine populations.

Heavy metals continue to exceed EPA criteria in most monitoring programs (Department of the Army, 1976). Although much physical data are available, the effects of these substances on penaeid populations has not been fully evaluated. It is imperative that some understanding of the effects of these substances on the marine community be developed so that proper regulations may be implemented.

The effect of fishing pressure upon the population dynamics of shrimp populations should also be considered. Little is known about the number or size of shrimp stocks in the Gulf of Mexico, however, major concentrations have been delineated. The highest concentrations of brown shrimp are found off the Texas coast while the majority of white shrimp are taken around the Mississippi Delta in Louisiana. Primary stocks of pink shrimp are restricted to the Sanibel and Tortugas grounds off southwest Florida and the Obregon and Campeche grounds of the Yucatan Peninsula (Kutkuhn, 1962). The largest segment of the United States seabob fishery is generally confined to that portion of the shoreline along the Louisiana coast between the mouth of the Mississippi River and the Texas coastline. Based upon stock concentration reports, rock shrimp populations along the Gulf coast can be separated into three stocks, centered around Apalachicola Bay, Florida, Louisiana and Contoy, Mexico. No separate centers of population are suggested for *Trachypenaeus* spp., and only two areas in the Gulf support commercial quantities of royal red shrimp. These grounds are located south-southwest of the Dry Tortugas in the Florida Straits and southeast of the Mississippi River Delta (Bullis, 1956; Bullis and Cummins, 1962; Roe, 1969; Anderson and Lindner, 1971).

The availability of shrimp stocks to the shrimp fishery has, for the most part, remained rather constant from year to year, except in years of environmental extremes. Shrimp fishing in the Gulf of Mexico is not as restricted as it is along the southeast Atlantic coast. Although many smaller boats fish in bays and sounds only, much of the fleet follows the shrimp into deeper waters or moves westward into Louisiana and Texas waters. Mid-winter weather conditions tend to restrict the activities of many boats and this is usually the only reason the fishery is slack.

Abundance of shrimp for any given year apparently depends primarily upon environmental conditions affecting the survival of postlarvae and juveniles. There is little evidence to suggest a relationship between the abundance of shrimp from year to year; therefore, penaeid shrimp in the Gulf of Mexico are generally considered to be an

annual crop (one year class produces the next). After disastrous years in the shrimp fishery there is often a quick recovery.

Annual landings of brown, white and pink shrimp are shown in Table 1 with landings data for each state and percentage of the total landings produced by each species. The maximum, minimum and range of landings (1956 to 1974) by state and species are as follows:

	Browns	Whites	Pinks
	Florida		
Max	1,686.9*	1,573.4	28,013.4
Min	308.0	468.1	11,361.0
Range	1,378.9	1,105.3	16,652.4
	Alabama		
Max	9,398.0	2,536.0	605.3
Min	1,718.4	236.0	2.2
Range	7,679.6	2,300.0	603.1
	Mississippi		
Max	6,095.4	2,355.6	354.3
Min	1,683.5	218.1	20.7
Range	4,411.9	2,137.5	333.6
	Louisiana		
Max	30,977.1	34,119.1	105.9
Min	8,324.2	6,492.1	0.1
Range	22,652.9	27,627.0	105.8
	Texas		
Max	55,550.4	14,944.9	4,635.9
Min	24,333.9	2,298.5	138.9
Range	31,216.5	12,646.4	4,497.0
	U.S. Gulf Coast		
Max	100,903.6	47,068.8	28,972.8
Min	39,153.2	11,128.9	12,762.7
Range	61,750.4	35,957.9	16,210.1

*landings in thousands of pounds

Utilizing the range to illustrate variability, the larger ranges for brown and white shrimp occur in Louisiana and Texas, where the majority of these shrimp are taken. These variations are several times larger than those from Florida, Alabama and Mississippi. Variation in pink shrimp landings are the result of variations in the Florida catch, which is over 80% of the total Gulf catch. Maximum and minimum landings generally do not occur in the same year for all states and there are large variations between states in some years; thus, these variations appear to be the result of environmental factors.

Rock shrimp production has a very short history but wide annual changes are evident. Gulf wide summary statistics for 1971 and 1972 show 880 lb and 397,048 lb, respectively, were reported. Florida landings for 1973 were 1,164,959 lb, and 1,915,311 lb in 1975. It is not clear whether price and demand have been major factors in the variability of these landings since the market was developed.

Since 1961 annual landings of seabob in Louisiana

have varied from a low of 181,868 lb in 1967 to a high of 3,978,835 lb in 1975. No information is available on total effort or catch per unit of effort during this time. There was a steady increase in total landings from 1972 through 1975. During 1973, which was considered a flood year in Louisiana, catches of brown and white shrimp during the spring, summer and fall were extremely low. This factor, coupled with the high value per pound of seabobs (\$0.61) probably caused extra effort within the industry toward exploitation of seabob stocks. Again in 1974, high landings were reported with apparently no effect to the stock.

Catch statistics for royal red shrimp are available from 1962 through 1975. Total catches for this period are as follows:

1962 - 5,233 lb	1969 - 271,292 lb
1963 - 6,245 lb	1970 - 40,917 lb
1964 - 4,591 lb	1971 - 64,081 lb
1965 - 17,045 lb	1972 - 36,645 lb
1966 - 23,475 lb	1973 - 230,794 lb
1967 - 36,256 lb	1974 - 226,871 lb
1968 - 72,866 lb	1975 - 122,607 lb

Because this species is only found on the continental slope and requires larger vessels with more expensive trawling systems, the variability in landings appears to fluctuate with effort. The larger vessels which are capable of exploiting royal red shrimp appear to harvest brown, pink or white shrimp during years when these species are abundant. During years when the inshore species are not abundant, more effort may go into fishing for royal red shrimp.

The dynamics of shrimp resources, shrimp fisheries and shrimp environments of the Gulf of Mexico continue to receive considerable attention but our knowledge in this regard is still insufficient for optimum management. However, it is clear that the yield of shrimp fluctuates annually, that it is limited and that our capability of economically over-exploiting these resources has already been demonstrated. In addition, continued alteration of shrimp habitat (e.g. mineral exploitation, bulkheading, dredging and filling, channelization and similar activities) and pollution of the estuarine and marine environments have the potential of reducing these shrimp resources through attrition of productive estuarine nursery grounds and offshore spawning grounds.

In order to fully evaluate the effectiveness of programs and understand the dynamics of shrimp populations, comprehensive research programs must be initiated to obtain necessary data. Once adequate information has been assimilated into a management system, simulation models can be developed which would offer managers a wide array of management strategies and could utilize techniques commonly used in fisheries population dynamics.

Food Habits. Penaeid larvae subsist on yolk until the Protozoa I stage, when active feeding begins (Lindner and Cook, 1970; Cook and Lindner, 1970; Costello and Allen, 1970). During the postlarval and juvenile stages, abundance of food is essential for rapid growth (Williams, 1955). Feeding occurs largely at night, although in turbid waters daytime feeding may occur (Eldred et al., 1961; Costello and Allen, 1970).

Juvenile and adult shrimp are reported to be omnivorous by Weymouth et al. (1933), Darnell (1958) and Broad (1965). Brown, white and young pink shrimp have been described as omnivores (Perez-Fartante, 1969; Odum, 1971). From observations on specimens held in aquaria, Lindner and Cook (1970) considered shrimp to be selective and particulate feeders

Pearson (1939), Williams (1955 and 1959) and Marshall and Orr (1960) reported that the early larval stages feed on plankton and suspended detrital material. Intermediate stages apparently combine detrital feeding with scavenging on the bottom sediment. As the adult stage is approached, predation is combined with detrital feeding. The primary difference in feeding in young and adult shrimp is the nature of the food material selected. Jones (1973) reported fine particles, both organic and inorganic, provided a significant food base for young penaeid shrimp in Louisiana. Fecal pellets were an important food item for juveniles in both the non-selective and selective feeding size ranges. Brown shrimp above 65 mm were active predators and fed intensively on polychaetes, amphipods, nematodes and chironomid larvae concentrated in the detrital mat.

Stomach analyses, based mainly on content of the foregut, indicate shrimp are able to ingest a wide variety of food items. Williams (1955) examined the gut contents of penaeids taken off the coast of North Carolina. Material in the foregut was described as finely triturated and difficult to identify. Most abundant materials in order of decreasing frequency were as follows: unrecognizable debris, chitin fragments, setae and jaws from annelids, plant fragments and sand. Other material identified included: foraminiferans, gastropod and lamellibranch shells, squid suckers, small fish, fish scales and muscle fibers. Flint (1956) stated that the major items in the intestine of larger shrimp included particles of bryozoans, sponges, corals, sand covered with algae, filaments of blue-green algae and roots and stems of vascular plants.

In studies on pink shrimp in Florida, Eldred et al. (1961) and Odum (1971) reported plant material found in the stomach included particles of algae, diatoms, dinoflagellates, detritus and leaves of vascular aquatic plants. Animal parts included polychaetes, nematodes, caridean shrimp, mysids, copepods, isopods, amphipods, molluscs, foraminiferans, caridean eggs and fish scales.

As omnivores, the younger juvenile penaeids have a full complement of digestive enzymes which enable them to utilize a broad spectrum of nutrient sources in the estuary (Jones, 1973). Condrey et al. (1972) found that assimilation efficiency in juvenile white and brown shrimp was high (80–85%) for a variety of plant and animal material. Jones (1973) found the high assimilation efficiency reported in the literature for commercial penaeids may greatly exceed the actual assimilation efficiency in the field where lower food concentrations become a critical factor.

Geographic Distribution Throughout Life Cycle. In the following account, much of the general information on the commercially important *Penaeus* spp. is summarized from Perez-Farfante (1969).

Brown shrimp range from Martha's Vineyard south to the Florida Keys and north on the west coast of Florida to the northwest Sanibel grounds. Apparently they are absent north of these grounds to the vicinity of Apalachicola Bay, where they appear again, ranging along the northern and western coasts of the Gulf of Mexico and the northwestern coast of Yucatan (Figure 1). Brown shrimp attain their maximum offshore density along the coast of Texas but are also relatively abundant along the Louisiana and Mississippi coasts and off the northeast coast of Mexico south to Veracruz; a dense concentration exists in Campeche in the area west of Carmen.

Highest offshore densities of brown shrimp are found at depths between 27 and 55 m (15 and 30 fm) but they are commercially abundant to 110 m (60 fm). Along the Texas coast about 90% of the brown shrimp catch is made at depths between 11 and 82 m (6 and 45 fm). Around 60% of the catch comes from depths within 37 m (20 fm) and 30% from between 37 to 82 m (20

to 45 fm). The largest shrimp (21 to 25 tail count and greater) are taken beyond the depth of 37 m (20 fm). Greatest catches are from May or June through November or December.

White shrimp range along the Atlantic coast from Fire Island, N.Y. to St. Lucie Inlet in east Florida. They are absent around the southernmost portion of the Florida peninsula. White shrimp appear again at the mouth of the Ochlockonee River and continue uninterrupted around the Gulf of Mexico to the Golfo de Campeche (Figure 2). Within the Gulf of Mexico, centers of abundance are located in Louisiana and in northeast Tabasco, including the adjacent waters of Campeche.

The fishery for white shrimp extends to a depth of just beyond 37 m (20 fm). Kutkuhn (1966) stated that adult white shrimp are rarely found at depths greater than 35 m (19 fm), well within that part of the littoral zone measurably influenced by land drainage. Osborn et al. (1969) reported that even in the offshore fishery, almost 90% of the landings were from waters less than 18 m (10 fm) deep. White shrimp, which remain longer and grow larger in inside waters than brown shrimp, are the mainstay of the Texas commercial bay fishery.

The range of pink shrimp extends from lower Chesapeake Bay to the Florida Keys and the Gulf of Mexico. In the Gulf it ranges from the Tortugas Islands along the coast, through the coastal waters of Mexico to Cago Catoche and south to Isla Mujeres (Figure 3). The most dense populations are off southwestern Florida and in the southeastern portion of Golfo de Campeche. The greatest concentrations are in depths between 11 and 37 m (6 and 20 fm) but in some localities they are abundant at depths of as much as 64 m (35 fm).

The range of seabobs is thought to be from Cape

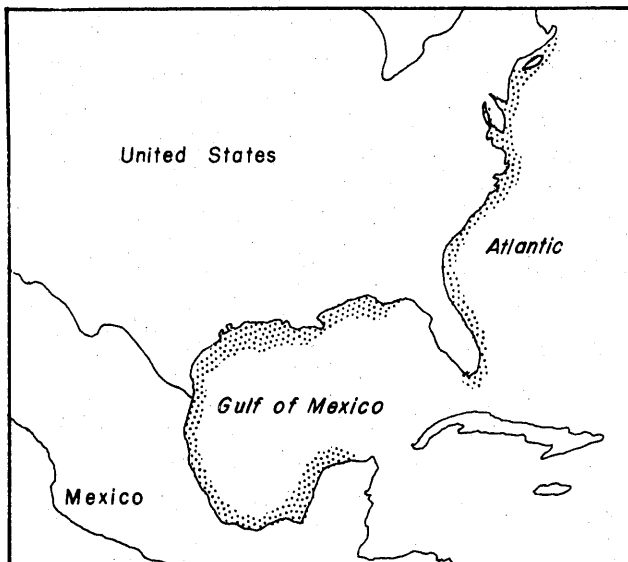


Figure 1. Geographic range of the brown shrimp.

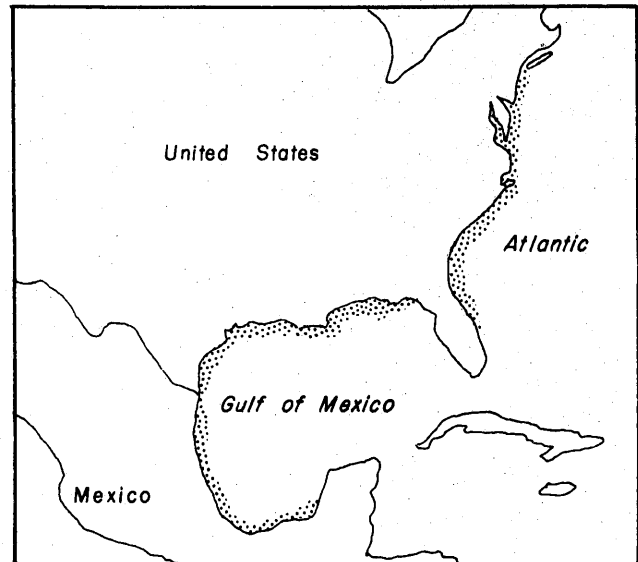


Figure 2. Geographic range of the white shrimp.

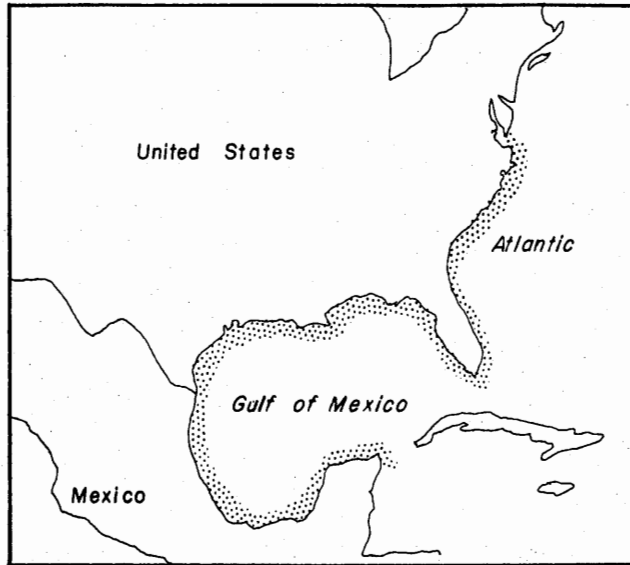


Figure 3. Geographic range of the pink shrimp.

Hatteras, North Carolina through the Gulf of Mexico and Caribbean Sea to Santos, São Paulo, Brazil (Williams, 1965). Anderson (1970) reported that seabobs once occurred in relatively large numbers off the coast of Georgia in shallow waters and in the mouths of river systems but are no longer as abundant along the Georgia coast as in the 1930's. Anderson (1970) also reported seabobs occurring along the South Carolina coast in small numbers.

Seabobs generally occur along the U.S. coastline within a narrow zone near the shoreline (Kutkuhn, 1966). Renfro and Cook (1963) reported the seabob to be a littoral species found most often at depths of 11 to 13 m (6 to 7 fm) or less, and almost never in protected bays and estuaries inside the barrier islands. In Louisiana, seabobs are normally harvested in an area along the coastline within 4 m (2 fm) and very rarely venture into estuaries. During January and February, 1975 in a scientific survey off the coast of French Guiana and Surinam by Dragovich et al. (1975), seabobs were reported in small numbers at the 46 m (25 fm) curve.

Rock shrimp have been reported from Virginia southward to the Florida Keys, in the Bahamas, in Cuba and along the entire Gulf of Mexico coast to Cabo Catoche, Mexico (Cobb et al., 1973; Hildebrand, 1954). Major concentrations have been successfully fished at Cabo Catoche, Mexico and the Cape Canaveral area of east central Florida. Elsewhere in the Gulf, Brusher et al. (1972) and Bryan and Cody (1975) reported possible commercial quantities of rock shrimp in offshore areas, 27 to 67 m (15 to 35 fm), between Freeport, Texas and Vermilion Bay, Louisiana. A commercial population also exists along the eastern panhandle area of Florida (Ingle, 1956). Although not fished consistently, these areas

occasionally yield large hauls of rock shrimp at depths from 18 to 40 m (10 to 22 fm) (*Gulf Coast Shrimp Data, 1959 to 1975*).

Although *T. similis* is frequently encountered west of 88° 10' (Burkenroad, 1939), Hildebrand (1955) found *T. constrictus* the more prevalent of the two species on the Campeche shrimp grounds. In the Tortugas area, Eldred (1959) reported *T. similis* second in abundance to pink shrimp. Along the west coast of Florida, *T. similis* has been reported only from Tampa Bay (Saloman, 1964) with *T. constrictus* more common (Eldred et al., 1961). In Texas, Louisiana and Mississippi waters, *T. similis* is the dominant species (Brusher et al., 1972; Christmas et al., 1976). Off Texas and Louisiana, *T. similis* was most abundant at 27 m (15 fm) stations and rare at depths beyond 82 m (45 fm). *Trachypenaeus constrictus* was more common in shallower waters, 14 to 27 m (8 to 15 fm) (Brusher et al., 1972). Burkenroad (1939) gave the bathymetric range of these two species as 20 to 37 m (11 to 20 fm) for *T. similis* and 5 to 55 m (3 to 30 fm) for *T. constrictus*.

Royal red shrimp occur on the upper continental slope as far north as Cape Hatteras, North Carolina and as far south as the coast of the Guianas, but, are abundant in only a few areas (Bullis and Cummins, 1962; Roe, 1969). Within the Gulf of Mexico, two of these areas contain concentrations of royal red shrimp that exceed the minima for full-scale shallow-water shrimping operations. These areas are located south to southwest of the Dry Tortugas and off the Mississippi delta from southeast of the Mississippi passes to off Mobile, Alabama (Bullis, 1956; Bullis and Cummins, 1962).

The general bathymetric range for this species is from 348 to 494 m (190 to 270 fm) with a minimum and maximum depth of 275 to 915 m (150 to 500 fm) (Springer and Bullis, 1952 and 1954; Bullis and Rathjen, 1959; Bullis, 1956; Bullis and Cummins, 1962). The depth distribution appears to be related to temperature. Royal red shrimp are commonly found through a temperature range of 5 to 15 C, however, catch rates exceeding 25 lb per hour have been confined to a range of 9 to 12 C (Bullis and Cummins, 1962); and Roe (1969) reported the bathymetric distribution to be related to the location of the 9 to 10 C range. Larvae and postlarvae of these penaeid shrimp are normally planktonic in offshore waters. Transport of these stages has generally been attributed to water currents (Perez-Farfante, 1969).

Postlarval brown shrimp enter Texas bays from the Gulf of Mexico throughout the year, with peaks occurring between February and May and between July and October. The spring peak is dominant. King (1971) found peak influx of young began as early as mid-January. Catch rates increased through February, reached a peak in late March and declined after the first part of April.

Christmas et al. (1966) collected postlarval brown shrimp in Mississippi as early as February. Copeland and Truitt (1966) found two peaks of postlarval shrimp at the Aransas Pass inlet with brown shrimp postlarvae comprising the spring peak. In Louisiana, White and Boudreaux (1977) found peak larval movement in March and April; however, movement into the estuaries usually begins in January. In Alabama, brown shrimp postlarvae begin entering bays as early as January during some years but it is usually February or March before they are abundant. March is the peak month of the migration (Swingle, 1971) which lasts until November (Loesch, 1965).

Postlarvae may overwinter in Gulf waters, possibly burrowing during cold weather, and enter bays in spring when temperatures increase. Temple (1968) found that growth of shrimp was retarded in the Gulf in winter and that postlarvae increased in number in the shallow Gulf in fall and winter before they entered the estuary. Although Fischer (1967) found postlarvae throughout the water column in 5 m (3 fm) off Galveston at 10 C, several investigators have found that peak influx does not begin until waters are considerably warmer. King (1971) found that peak migration out through Cedar Bayou, Texas occurred at 14 to 18 C. The lowest temperature at which Compton (1965a) found postlarvae in major bay and Gulf passes was 14 C. In laboratory experiments, Aldrich et al. (1968) found that most postlarvae burrowed into the substrate at 12 to 16.5 C and re-emerged at 18 to 21.5 C.

Juvenile brown shrimp are abundant all along the Texas coast from spring to fall with massive migrations to the Gulf beginning in late May or early June. In addition to the major spring peak in abundance, minor fall and winter peaks are not uncommon in warm climates. Generally, the largest numbers are collected at salinities of 10 to 20 ppt (Gunter et al., 1964). Flooding and low water temperatures during critical spring periods may have disastrous effects upon brown shrimp year classes. The most successful year classes have occurred when salinities and temperatures were relatively high in spring.

King (1971) found that peak migration of brown shrimp through Cedar Bayou, Texas occurred from mid-May to mid-June at average sizes of 82 to 91 mm. Trent (1967) found that peak migration from Galveston Bay was in May and June and that size of migrating shrimp increased from an average of 58 mm in May to 106 mm in August. Copeland (1965) stated that brown shrimp migrated out through Aransas Pass in summer at a total length of 70 to 80 mm. Joyce (1965) indicated this species migrates offshore at an average size of 100 to 105 mm. In Louisiana, brown shrimp were reported by Gaidry and White (1973) to experience two movements,

the first taking place in the upper estuarine system where larger shrimp, 60 to 70 mm, move south to the lower bay system. Then migration offshore normally begins in May and consists of shrimp 90 to 110 mm long.

White shrimp postlarvae reach estuaries when 6 to 7 mm long. Migration from the Gulf usually begins in May with two peaks occurring from summer to fall (Baxter and Renfro, 1967). Postlarvae are generally scarce from November through April when water temperatures are low. King (1971) found that postlarvae migrated in through Cedar Bayou, a natural pass in Texas, in July 1968 and in mid-May 1969. This migration continued through summer and fall both years (and through winter in 1968). None were taken in March and April 1969 or mid-February through March 1970. Copeland and Truitt (1966) found that most postlarvae entered the Aransas Pass inlet from June through September.

Gaidry and White (1973) presented the basic parameters of white shrimp population movements in Louisiana estuaries. Postlarvae enter the estuaries in greatest abundance from June through September. Peak abundance of juvenile shrimp in the shallow marshes typically occurs 1 to 2 months after maximum postlarval catches. Juveniles less than 50 mm long are present in the nursery areas from July through September, and in some years as early as June. Throughout the summer and fall most white shrimp on the nursery grounds are between 50 and 100 mm. During August and September, some larger (100 to 150 mm) white shrimp are found on the nursery grounds but these constitute a minor portion of the population.

White shrimp occur in Texas bays in all seasons but are most abundant in summer and fall. In mild weather they may overwinter in bays or the shallow Gulf and contribute to commercial catches the following spring and summer. Johnson (1975a) found that white shrimp from the previous year class populated the shallow Gulf around the mouth of the San Bernard River and reentered estuaries in March at sizes of 90 to 120 mm. In Louisiana, Lindner and Anderson (1956) in March detected shoreward movement of small shrimp which had been forced offshore by cold weather in January. These late recruited white shrimp, forced offshore at a small size by rapidly falling water temperatures, re-entered the inland estuaries with warming temperatures and remained inland until reaching a size of 145 to 160 mm.

Juvenile white shrimp penetrate rivers and tributaries farther than brown or pink shrimp and are usually found in lower salinities. Joyce (1965) found them as far as 210 km (131 mi) inland in the St. Johns River system in Florida. In Texas, Johnson (1975b) and Breuer (Texas Parks and Wildlife Department, personal communication) found that white shrimp penetrate the Brazos and Rio Grande Rivers to at least 40 km (25 mi). Gunter et al.

(1964) reported the low salinity of Louisiana nursery grounds may be optimal for juvenile white shrimp.

White shrimp usually begin migrations from estuaries to the Gulf in summer and fall when they are 100 to 120 mm long, although smaller shrimp migrate during winter (Compton and Bradley, 1964; Compton, 1965b). Moffett (1972), Moffett and McEachron (1973 and 1974) and Johnson (1975b) sampled shrimp on bay fishing grounds in summer and fall to determine the percentage of shrimp greater than 39 count. Percentages were high from mid-August through September and October and low in late fall when cold spells flush small shrimp from secondary bays to the fishing grounds.

Extensive sampling from southwest Florida suggests pink shrimp postlarvae enter inshore waters throughout the year but that peaks of abundance vary annually.

In Florida Bay a large peak of abundance was reported from April to June by Tabb et al. (1962b) and from July through October by Jones et al. (1964). A secondary peak has been demonstrated in the fall or during the winter. In Tampa Bay a very large peak was recorded in July by Eldred et al. (1965). In Mississippi pink shrimp postlarvae were taken from May through December, but only a few were collected before July (Christmas et al., 1966). Copeland and Truitt (1966) observed a maximum peak of postlarvae in August and September in Aransas Pass inlet.

Costello and Allen (1966) estimated that pink shrimp remain in the estuaries of southwest Florida for a period lasting from about 2 to 6 months. Several studies have been conducted to follow the pink shrimp migrations as they leave the estuaries. Tabb et al. (1962b) observed that many shrimp move into Florida Bay at about 82 to 90 mm and practically all move in before attaining a total length of 105 mm. The relative abundance of shrimp moving into Florida Bay fluctuates seasonally. Numbers are greatest in late summer and early fall with a peak in September (Idyll et al., 1966). A second peak occurs from January to April. Eldred et al. (1961), working in Tampa Bay, found that shrimp began their seaward movement at 85 mm in April and continued through July. Mass migration to offshore waters did not seem to occur during the fall and winter. Copeland (1965) reported most shrimp leave through Aransas Pass inlet at sizes of 70 to 90 mm from April through October.

Distributions of the young of the less abundant penaeid species are not as well documented. In Louisiana and off the Texas coast, seabobs generally complete their life cycles within a narrow zone near the shoreline. In Louisiana seabobs are generally found in fairly large numbers during the winter from mid-November to the end of February at which time they are usually harvested. They reappear near the shoreline in about July or August during which time gravid females are captured in large

numbers. Studies in Galveston Bay by Renfro and Cook (1963) found that gravid females were prominent near the jetties from April through October.

Very little is known about the distribution of post-larval rock shrimp. The larvae are planktonic in continental shelf waters and start a benthic life at sizes of about 4 to 11 mm.

Off the Mississippi coast, *Trachypenaeus* spp. were the most abundant penaeid larvae at 10-, 18- and 36-m (5-, 10- and 20-fm) stations with a marked decline in number at 54- to 90-m (30- to 49-fm) stations. Concentration of all stages was greatest at 18 m (10 fm) in summer and 36 m (20 fm) in other seasons (Subrahmanyam, 1969). No correlation was found between vertical distribution and stage, i.e., protozoa at the bottom, mysis in mid-water, etc., nor were diurnal stratifications apparent. However, there is some evidence that adults of both species are nocturnal (Bryan and Cody, 1975; Joyce, 1965).

The early life history of royal red shrimp is unknown. Anderson and Lindner (1971) reported that juveniles under 50 mm have not been taken.

In addition to the inshore and offshore migrations by various developmental stages of brown shrimp, migration of adults along the Gulf coast has also been reported. Klima and Beningo (1965) found that small brown shrimp moved parallel to the coastline and seaward. Ninety-five percent of recaptures from shrimp marked and released at depths of 18 to 22 m (10 to 12 fm) off Port Aransas were caught inside 27 m (15 fm) and within 48 km (30 mi) of the release site. Klima (1964) reported that shrimp released in 38 to 44 m (21 to 24 fm) off Pass Cavallo were recaptured within the 29 to 55 m (16 to 30 fm) contours and within 32 km (20 mi) of the release site. He also reported that young brown shrimp marked in or near Galveston Bay were recruited to the fished populations all along the Texas coast. Compton and Bradley (1962) found that juvenile brown shrimp marked and released in Aransas Bay moved primarily toward the Gulf during summer. Movement of shrimp in the Gulf was southward and within a depth of 42 m (23 fm). Brown shrimp marked in the Laguna Madre moved south and east in the direction of Gulf passes in summer (Pullen, 1963). Shrimp moved northward in the Gulf after leaving the bay. Gunter (1962) believed that, based on commercial catches, brown and white shrimp moved southward during winter.

Lindner and Anderson (1956) studied white shrimp migration patterns in the Gulf of Mexico and found that offshore movements appear to be random feeding movements. Movements may be 160 km (100 mi) or more. They also found inshore-offshore movements associated with temperature changes and spawning. During fall, winter and spring, they found very few shrimp less than

130 mm in depths greater than 9 m (5 fm) except when unusual cold spells drove smaller shrimp to the deeper waters. Small shrimp returned toward shore when temperatures increased. In May and June, shrimp made spawning movements toward deeper water. Shrimp along the major portion of the Gulf exhibited little coastwise movement. Although their evidence was not conclusive, Lindner and Anderson (1956) suggested that white shrimp may move south from the lower Texas coast to Mexico in fall and winter, and back toward Texas in spring.

Bryan and Cody (1975) found an inshore-offshore movement. Catches at 22 m (12 fm), while always low, were greatest in the spring, fall and winter months and were virtually zero during the summer. Catches at 15 m (8 fm) were lower than at 22 m (12 fm) in April 1973, then increased in the next few months, while the catches at 22 m (12 fm) were decreasing. The same thing occurred in February 1974, indicating an inshore movement by the shrimp. Spring catches in a depth of 7 m (4 fm) during both years yielded more but smaller shrimp, suggesting movement of overwintering shrimp from the bays to the Gulf and at the same time an inshore movement of shrimp from the Gulf.

Klima (1964) marked 4,205 white shrimp in two areas off the western Louisiana coast in September 1962. More than 88% of the recoveries between September and December were taken within 48 km (30 mi) of the release areas, and the greatest distance travelled was about 128 km (80 mi).

Recent tagging studies (W. S. Perret, pers. comm.) in Louisiana indicate a westward drift of migrating penaeids along the coast. Fishing effort off Louisiana for brown shrimp during early summer and white shrimp during fall also indicate a westward movement of brown and white shrimp.

Studies along the Louisiana coast on the seabob showed that populations move primarily north and south between the shoreline and near offshore (C. L. Juneau, pers. comm.). Migrations to the beach from offshore usually occur immediately following the passage of a cold front. Another migration of a lesser magnitude usually occurs in July and August when gravid females move closer to shore. No known tagging and recapture studies have been conducted to determine east-west migration patterns.

No coastal migrations for the other species have been described.

Habitat. Brown shrimp range from shore out to depths of at least 110 m (60 fm), being most abundant at depths of 27 to 55 m (15 to 30 fm). Adults show a definite preference for mud and silt bottoms and are found to a lesser extent upon mud, shell and sand substrates. Juveniles show a preference for muddy-sand, sandy-mud or peat bottoms and are especially abundant in areas

covered with vegetation and plant debris.

Bottom substrate preference of adult white shrimp is similar to brown shrimp, although juvenile whites prefer a softer substrate (Perez-Farfante, 1969). This preference for silt and mud bottoms together with a preference for lower salinities accounts for the greatest concentration of white shrimp along the Louisiana coast and their scarcity off the Florida coasts.

The preference of pink shrimp for sand, shell-sand and coral-mud bottoms and for moderate to high salinities largely limits their abundance throughout their range. This species has been reported from the Laguna Madre in salinities as high as 69 ppt; it is seldom taken below 5 ppt, and shows a preference for salinities of 20 ppt and higher. Juveniles are especially abundant in submerged vegetation.

Virtually no information is available on substrate preferences of seabobs. Neiva (1967) reported that seabobs landed in Santos from the coastline of São Paulo, Brazil are taken in areas where the bottom is composed of mud or mud mixed with sand. In Louisiana, since most of the catches occur in close proximity to large river mouths (Mississippi River and Atchafalaya River), it could be assumed that bottom types are also mud, silt or silt mixed with sand. If so, the marginally attractive bottom composition and texture may be enhanced by abundant nutrients.

Rock shrimp occur from shallow offshore waters to depths of 311 m (170 fm) but are most abundant from 27 to 73 m (14 to 40 fm). They show a preference for hard and biogenic sands with shell fragments. They are not dependent upon estuaries and are rare in inshore waters. Rock shrimp prefer high stable salinities of offshore waters with moderate temperatures.

Both species of *Trachypenaeus* range throughout the Gulf of Mexico. *Trachypenaeus constrictus* is an offshore species found primarily on sand or mud and shell bottoms in high-salinity waters. It is rarely taken in estuarine or inshore waters. *Trachypenaeus similis* is found shoreward of 82 m (45 fm) and apparently is found mostly over mud bottoms. This species enters estuarine waters to some extent but does not appear to be estuarine dependent.

Royal red shrimp occur on sand, silty-sand, terrigenous and calcareous sediments and show no apparent preference for a particular sediment type (Roe, 1969). They are widely distributed on the continental slope wherever soft bottoms occur within the 5 to 15 C temperature range. They occur in higher densities on some grounds than on others and this variation can be related, in part, to the amount of environmental disturbances on the shrimping grounds. Roe (1969) reported the Mississippi Delta grounds had the lowest densities of royal red shrimp among the commercial grounds studied. He concluded

active sedimentation and deposition in this area produce mud slides, erosion and other substrate disturbances which interfere with the permanent establishment of densities comparable to those of other areas.

2.2 DESCRIPTION OF INDUSTRY: HARVESTING SECTOR

Shrimp were first caught around the Atlantic and Gulf of Mexico with dipnets, seines and leafy weirs such as are still used in the Rio Soto la Marina, Mexico. Prior to the start of the use of the otter trawl by the shrimp industry between 1912 and 1915 at Beaufort, N.C., almost the entire catch of shrimp was taken by haul seines. Between 1912 and 1917, use of the otter trawl spread rapidly throughout the South Atlantic and Gulf states. By 1931 less than 1% of the shrimp catch was made by haul seines.

The shrimp fishermen were usually natives of European maritime countries or recent descendants from peoples of such countries. People of Italian, Greek, Slavic, Portuguese and French extraction made up the majority of the early shrimpermen, with the predominant nationality varying from state to state.

For a great many years Gulf coast trawling craft were generally small boats. The fishing grounds consisted of those areas that could be reached within a reasonable length of time by the trawler and an ice boat from the major shrimp ports. There were many areas along the Gulf coastline with little or no shrimping due to the inaccessibility of these areas to the small trawlers (Johnson and Lindner, 1934).

Otter trawling for shrimp is one of the few fishing methods originating in the United States. Early trawlers were typically open skiffs 4.5 to 7.5 m (15 to 25 ft) long, powered by gasoline engines. During the early 1920's, these boats were decked over and a pilot house added. The major advancement of the 1930's was the introduction of the diesel engine.

For the entire Gulf of Mexico, white shrimp production reached its peak in 1945 and in that year accounted for at least 95% of the total production. With the exception of some production of dried shrimp, some bait shrimp and some incidental catches, landings consisted mainly of white shrimp.

Brown shrimp were first taken in quantity off the Texas coast in 1947. Market resistance to the more extensively pigmented brown shrimp was overcome. The strong demand for shrimp increased production and thus encouraged the expansion of the shrimp fleet (Springer, 1951).

Coincident with the need for larger vessels to operate greater distances offshore, horsepower was increased along with making innovations in design and construction. The first all steel shrimp trawlers appeared during the 1940's in conjunction with the first freezer trawlers.

Current trends in the Gulf shrimp fleet are toward large trawlers made of aluminum, steel or fiberglass having extended range and the capability to function with a variety of fishing gear without structural changes. Other innovations included more powerful engines, more attractive and air conditioned crew's quarters with modern sanitary facilities, modern hydraulic equipment and ships generators and ever-increasing advancements in electronic gear capable of plotting the vessel's exact location on offshore shrimping grounds (Captiva, 1966).

Even though many Gulf trawlers are still made of wood with the pilot house off the hold forward, the trend is to larger offshore "Florida type" vessels 22.9 to 24.4 m (75 to 80 ft) or more in length and double rigged to pull two nets simultaneously. Double-rig fishing became popular in the early and midfifties and has been estimated to increase the catch by 15 to 30% as well as reducing fuel costs and repair time (Klima and Ford, 1970). Many owners of smaller wooden Gulf shrimp boats have increased their fishing efficiency without a great amount of capital by converting their single rig trawlers to double rigs and working their boats in nearby offshore waters when the weather is suitable.

Vessels used in the inshore shrimping fleet generally do not exceed 12.2 to 15.2 m (40 to 50 ft) long and are made primarily of wood. There are several types of smaller boats with a variety of design and rigging. Many of these are used by weekend shrimpermen who use their catch for home consumption. Some of these boats are equipped with a gasoline-powered winch with rope towlines rigged for towing a single trawl from the stern. The use of fast commercial skiff-type vessels, usually operated by one man in inshore waters, in particular the large "mosquito" fleet operating in the Louisiana marshes and bays, has become quite extensive. These boats are able to operate in shallow water and tow trawls up to 12.2 m (40 ft) in length. They are able to get to and from the shrimping grounds rapidly and usually satisfy their requirements in half a day. This circumvents the need for large ice-carrying spaces.

The advent and acceptance of diesel motor power has done more to expand the shrimp fishery than any other piece of equipment. All offshore vessels in the Gulf States use diesel power with reduction gears and power takeoffs to operate trawl winches throughout a system of sprockets, chains and shafts. The main engine installation is usually convenient, and routine maintenance is accomplished by the captain and crew members.

Fishing Methods. There are three basic designs employed in the otter trawl; flat, two-seam semi-balloon and four-seam semi-balloon. The otter trawl consists of: (1) a heavy mesh bag in which the shrimp are gathered in the tail or cod end; (2) wings on each side of the bag for funneling the shrimp into it; and (3) trawl doors or otter

boards at the end of each wing for holding the mouth of the net open. A lead line extends from door to door on the bottom of the trawl while a cork line is similarly attached at the top of the net. With flat nets the mouths are rectangular with the lead and cork lines being close to the same length (Figure 4). With the semi-balloon nets, the float line forms a pronounced arch. This type of net prevents white shrimp from escaping when they jump off the bottom. The semi-balloon trawls also have a much wider throat which prevents "choke-off" so that the catch does not build up in the body.

A chain, somewhat shorter than the lead line, is attached between the trawl doors resulting in a tickler which tows just ahead of the net. This chain is used to frighten shrimp off the bottom. The lead lines of larger nets are weighted with a 1/4 to 3/8-inch loop chain attached at about 0.3 m (1 ft) intervals with a 14- to 16-inch drop. Many larger nets are also equipped with rollers on the lead line. This keeps the lead line from digging into the mud.

The most common mesh sizes in nets range from 1 1/2- to 2-inch stretch mesh, with a 3 1/2- to 4-inch stretch mesh chafing gear tied around the bag for protection.

Marinovich and Whiteleather (1968) stated that the two-seam semi-balloon trawl (Figure 5) was introduced in the Gulf in 1947. In 1950 there was a further modification which created the four-seam semi-balloon trawl (Figure 6) with a shorter jib and with wings on either side between the top and bottom bellies rather than two bellies being joined directly together as in the two-seam form.

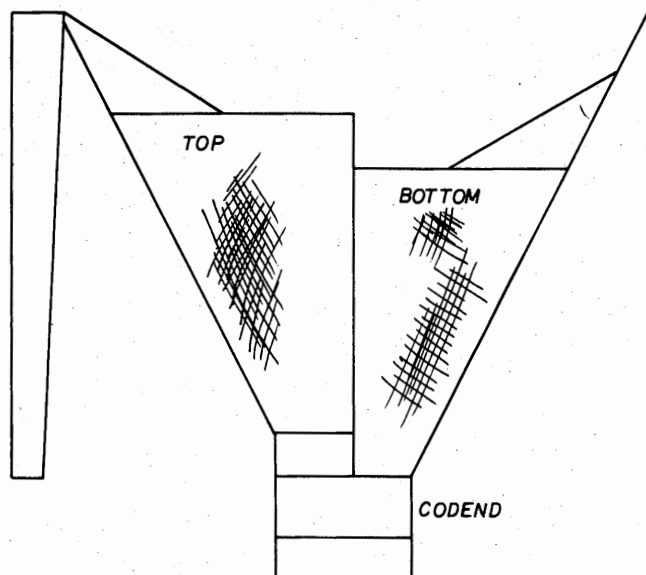


Figure 4. Gulf flat net.

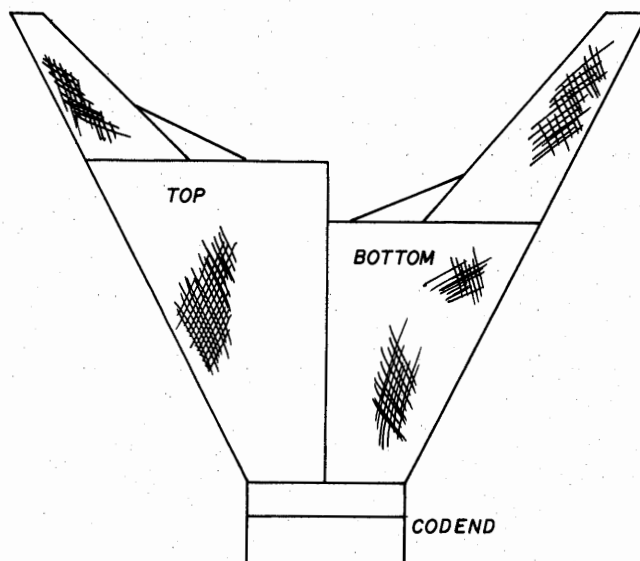


Figure 5. Two-seam semi-balloon trawl.

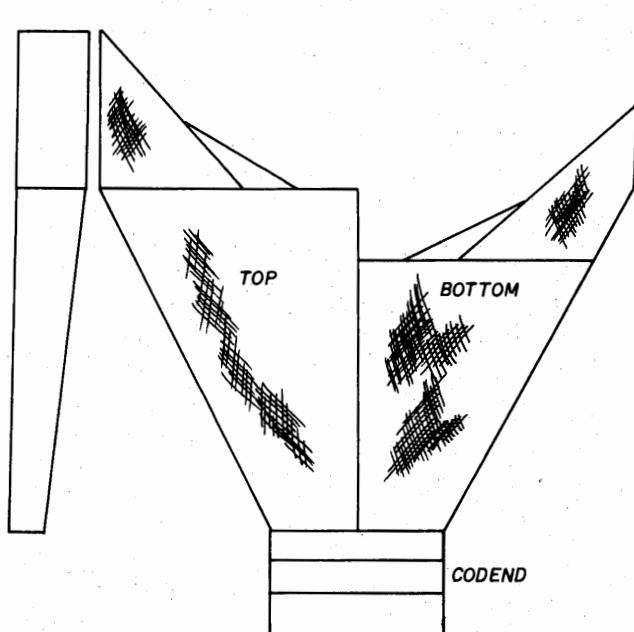


Figure 6. Gulf four-seam semi-balloon trawl.

This was a substantial advance over the two-seam trawl as the net shaped better in the water during towing, thereby creating less resistance through better mesh openings. Balloon trawls do not become misshapen under towing strains as easily as do the flat nets that require frequent rehang and rerigging to maintain maximum performance.

A forward design recently placed in use and currently popular for shallow-water fishing in the Gulf of Mexico is

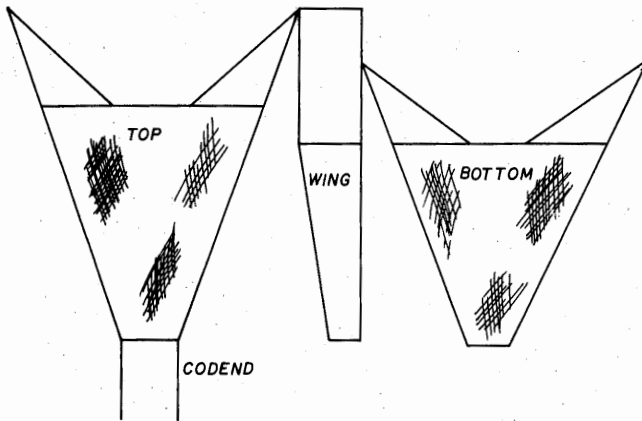


Figure 7. Star net.

the star net (Figure 7). This trawl has a much wider angle on both bottom and top bellies and wide angle corner jibs to give the net a further spreading form. This, in return, reduces the force required by the doors in spreading the net and easier opening meshes reduce the friction of the trawl webbing in the water. This gear has proven itself in shallow water; however, in depths of over 18 m (10 fm) it is not as effective.

The try net is another type of otter trawl which is used in conjunction with the larger trawls. This trawl is small—usually 3.7 to 4.6 m (12 to 15 ft)—and used to test an area for shrimp concentration. This trawl is also towed during regular trawling operations and lifted every 10 to 15 minutes to assess the amount of shrimp and trash being caught. The amount of time the large trawls are left set depends on the amount of trash fish and shrimp being caught. Trawling times usually range from 1 to 3 hours but can go as high as 5 or 6 hours.

Some smaller trawls are still made of cotton twine or a combination of cotton and synthetics. The majority of shrimp trawls manufactured today are of synthetic twine. Synthetic twines are smoother and smaller per unit of tensile strength and add a factor of longer life to the webbing because of their resistance to rot and abrasion.

About 20 years ago, double-rigged trawlers became dominant in the offshore shrimp fishery. In place of the usual 24.4 to 30.5 m (80 to 100 ft) single trawl, the trawler now tows two 12.2- to 15.2-m (40- to 50-ft) trawls. Two trawls produce more shrimp per unit of effort than a single trawl, and gear losses from wrecks and hangs are lower as only one trawl is usually involved. The two trawls are pulled simultaneously off port and starboard booms. The try net is handled from a davit on the side of the boat or close in on one of the booms. One of the two trawls is usually pulled about 45.7 m (150 ft) behind the other to prevent fouling. The dragging warp ratio commonly used is 9.1 m (30 ft) or 11.0 m (36 ft) of line to each 1.8 m (6 ft) of water. Experimental work with a redesigned double-rig trawl

is presently being conducted. Instead of the usual single net pulled on both sides of a vessel, two smaller nets are pulled, rigged to a single cable with a bridle consisting of three pieces—one to the outside wings of each net and the other to a metal sled which is attached to the inside wings of the two trawls. A similar configuration is towed from the other side of the boat.

The trawl doors used by the U.S. shrimp fleet are much lighter than those used in other fisheries and can be purchased completely rigged. The door bridle chains are set to give an outward and slightly downward thrust. When they are purchased the chains are cut with a few extra lengths and can be set to individual preferences.

The number of floats placed on the cork line of the trawl varies with the type of trawl and fishing conditions. In areas where a lot of trash fish are caught, and brown shrimp, which burrow in the mud, are being fished, fewer corks are used. White shrimp tend to escape the trawl by jumping off the bottom and therefore, additional floats are added to increase the height of the net. Generally fewer corks are used on sandy bottoms than on muddy bottoms.

Pink shrimp and brown shrimp burrow in the bottom during daylight and come out at night to forage for food. Commercial fishing, therefore, is generally restricted to night trawling when these shrimp are available. Higman (1965) in an attempt to more efficiently utilize time spent on the fishing grounds, established that a pulsed direct current produced definitive behavior patterns in shrimp and Kessler (1965) used capacitor discharge pulses to determine the threshold electrical voltage needed to produce this involuntary hopping response. Pease and Seidel (1967) determined that the average time for shrimp to reach a height of 3 inches from the bottom was 2.0 seconds, and the width of the electrical field in front of the trawl should be 2.4 m (8 ft) by using the 2-second interval and a trawl dragging speed of 2.5 knots. The optimum electrical characteristics were found to be 3.0 volts at 4 to 5 pulses per second.

From this basic research the electric trawl was developed. It is a basic otter trawl equipped with an electrode array creating an electrical field in front for the foot rope (Figure 8). Alternating current from the ship's generator is converted to a DC capacitor discharge pulse by the underwater pulse generator attached to either port or starboard trawl door. The output of the pulse generator is supplied to the electrode array, producing the involuntary jumping response in the burrowed shrimp.

Any durable, noninsulated, flexible, copper alloy cable about 3/8 inch in diameter can be used for the electrode array material. Pease and Seidel (1967) had satisfactory use with six strands—three strands of insulated stainless steel wire for strength and three strands of

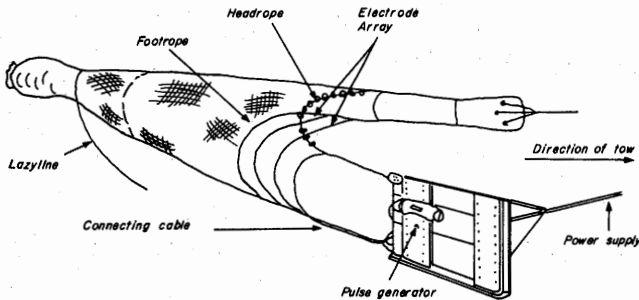


Figure 8. Schematic drawing of electro-shrimp trawl.

noninsulated copper wire for current carriers. They concluded that the daytime catch was increased from 96 to 109% over that of a non-electric trawl on mud bottoms and increased up to 50% over harder, sandy bottoms.

The separator trawl presently being designed by the gear research unit at the National Marine Fisheries Service, Pascagoula Lab, is a modification of the basic four-seam otter trawl. Personnel in this research unit stated that no separator trawls are presently being used commercially in the Gulf and that the project is about 70% completed.

The purpose of this trawl is to eliminate all of the by-catch (vertebrates and undesirable invertebrates) and retain 90% of the shrimp. To date this trawl is able to separate 60 to 65% of the undesirable species while losing only about 10% of the shrimp. No diagram or figures of this net are presently available.

The roller frame, beam or side frame trawl has been exclusively designed for bait shrimping in shallow-water grass beds and mud bottoms. It is the key to the large scale catching of live bait shrimp along the western coast of Florida (Woodburn et al., 1957). The rectangular frame is constructed of galvanized iron pipe. The lower portion serves as the attachment for the mouth of the trawl net and the upper part serves as attachment points for ropes used to pull and raise or lower the net. A roller made of wooden or metal slats is attached to the bottom of the frame and rides over the beds of grass as the boat moves along the shrimping grounds. The mouth of the net is usually 1.8 m (6 ft) wide and 0.6 to 0.7 m (2 to 2.5 ft) high with a stretched mesh of 0.75 to 1 inch. The tail of the net may be from 2.7 to 5.5 m (9 to 18 ft) long and tapers to the cod end which is closed. Bait shrimp boats operate in depths from 2 to 29 m (1 to 16 fm) and generally fish two nets, one from each side of the boat. The trawls are usually pulled from 10 to 15 minutes. During this period the contents of the preceding haul are rapidly sorted. This necessitates a two-man operation since each trawl requires the speed and attention of one man in handling and sorting contents efficiently.

Several other types of nets have been utilized by the shrimping industry. Prior to the otter trawl, the haul

seine was the most popular gear used in the commercial shrimp fishery. Appearing in the late 1800's, the haul seine was a huge net up to several hundred meters long and 6.1 m (20 ft) deep and requiring a sizeable crew to set and use it. The mesh size ranged from 1/2- to 1 1/2-inch bar. This net varies in length and depth, with a lead line running along the bottom and a cork line along the top. Many of the seines had bags or pockets into which the shrimp were herded. The haul seine was used primarily as a beach seine and gave the fishermen a means to catch white shrimp and seabobs migrating along the beach during the spring and fall.

Today, although still licensed in some states, the haul seine is rarely used. Most haul seines in use today are under 30.5 m (100 ft) long and are used by sportsmen and institutions for scientific collection.

Cast nets are used by sportsmen and to a lesser extent by live bait fishermen fishing along the edges of bayous and tidal creeks where small shrimp congregate. These nets are circular, usually having a spread of 1.8 to 37 m (6 to 12 ft), with a lead line running around the outside edge. A cord line extends through a ring in the center of the net, and then radiates numerous smaller cords fastened at regular intervals to the lead line. These cast nets are usually constructed of nylon webbing with a 1/4- to 3/4-inch mesh. Some nets are made from monofilament. The net is thrown so that it will fall in a circular pattern on the water and then sink to the bottom. After the net has settled, the cord line is pulled in, drawing the smaller lines into the center forming a bag to hold the shrimp.

Channel nets are fished in areas that have large tidal flow and are used to catch migrating shrimp. Channel nets must not be set in areas that would create a hazard to navigation; they seem to be especially successful with the passage of northern frontal systems. In Louisiana they are licensed the same as butterfly nets and cannot exceed 6.7 m (22 ft) in width. These nets are essentially shrimp trawls anchored in such a manner as to block narrow cuts and bayous. Instead of otter boards to hold the net open, poles and anchors are used to seam the net. The net is fished by emptying the cod end into a skiff or in a sorting box on the shore next to the net.

Butterfly nets are hung on rectangular frames and attached to the sides of a boat. Similar to trawls, these nets vary in size and are used in areas where there is a strong tidal flow. The boat anchors itself heading against the current and lowers the nets at right angles from the sides of the boat, letting the current sweep into the mouth of the net. The cod end or tail of the net is lifted, without removing the frame, through the use of a lazy line and the catch emptied on the boat and then replaced.

Push nets are used in shallow-water areas over grassy and muddy bottom. The catch is usually emptied into the

bow of a skiff the fisherman drags behind him and sorted by someone in the boat. These nets are used in areas of Florida and Texas. They consist of rectangular frames varying from 0.9 to 3.1 m (3 to 10 ft) wide and 0.6 to 1.2 m (2 to 4 ft) high. A bag of small mesh nylon webbing is hung to the frame.

Recreational Fishing for Shrimp. Recreational shrimping along the Gulf coast has become popular in recent years. Most of this shrimping is done with small trawls from 4.9 to 6.1 m (16 to 20 ft); however, seines, cast nets and push nets are also utilized. The extent of commercial utilization of the catch resulting from these efforts is not known.

At present, no information is available on sport shrimping along the west coast of Florida. Recreational shrimping does occur in very accessible unrestricted shoreline areas when shrimp are plentiful, for example, in Tampa Bay during the fall pink shrimp season. It also occurs and is possibly quite prevalent during the fall season for white shrimp along the northwest coast of Florida.

Swingle et al. (1976) reported the Alabama recreational catch during 1972, 1973 and 1974 was 277,051, 204,577 and 290,541 lbs, respectively. A total of 5,727 sport trawls was owned in the two coastal counties in 1972. Alabama law allows the use of 4.9 m (16 ft) or smaller trawls with no license at any time of the year. Quantities allowed are 5 lb per person not to exceed 15 lb per boat during the closed commercial season and 25 lb per person during the open season. Some sport shrimpers buy commercial licenses so they can catch all they want during the open season. During the open commercial season, shrimp must be legal count* (68/lb) but during the closed commercial season they do not.

Current estimates of recreational or subsistence shrimping in Mississippi place the number of this type of shrimper at approximately 1,900. Mississippi law has no provision for recreational trawling, thus these fishermen are under the same limitations and licensing requirements as commercial fishermen. Recreational shrimpers outnumber their commercial counterparts approximately 3 to 1 (T. M. Weaver, pers. comm.). Information obtained for the past three years indicates this ratio is slowly increasing. In 1974, the shrimp taken by recreational and subsistence fishermen in Mississippi amounted* to 166,667 lb (heads-on). This figure increased to 176,353 lb in 1975 and to 182,112 lb in 1976. The number of shrimpers engaged in this activity increased approximately 15%.

Recreational shrimping in Louisiana has increased significantly since 1950. Present estimates, extrapolated from U.S. Fish and Wildlife Service River Basin Division

studies in the early 1950's, place the number of recreational shrimpers in Louisiana at 45,000. The otter trawl continues as the primary gear used for recreational shrimping; some cast-netting does occur, though small in comparison.

In Louisiana, sport trawling with a net of 4.9 m (16 ft) or less does not require licensing. Sport trawlers without licenses are allowed up to 100 lb (heads-on, any size) per vessel per day. Louisiana has also established a license category for sport trawlers. Under this license, sport trawlers may use a trawl in excess of 4.9 m (16 ft) but less than 15.2 m (50 ft) in width for recreational purposes. The trawler is not restricted to catch and may keep, for personal use, as much as he so desires; however, he is prohibited from selling his catch.

Another factor in sport shrimping in Louisiana is the significant participation of actual sport shrimpers who purchase commercial licenses, taking advantage of non-limited access and relatively low prices. This group, generally fully employed in other endeavors, may constitute up to 50% of the licensed commercial shrimpers in Louisiana, especially in certain areas of the state. Normally this group, whose catch may be significant, often sells a portion of its catch either for profit or to defray expenses. They do not normally sell to statistically monitored shrimp houses, consequently the extent of this activity is unknown and their catches remain unreported.

In 1973 approximately 1.1% (900,823 lb) of the Texas shrimp harvest was taken by recreational fishermen (King, 1975). They harvested 5.7% (845,747 lb) of the total bay harvest and 0.1% (55,077 lb) of the total harvest from the Gulf adjacent to Texas. King (1975) believed that adverse weather severely affected the recreational harvest in 1973.

Seasons and Geographic Location of the Shrimping Industry. The shrimp fishery along the Gulf coast is seasonal. Availability of the shrimp is governed by the life cycle of the shrimp and the influence of environmental factors. Fishing effort is dependent upon market conditions, availability, weather and state statutes. In order to protect growing shrimp, the Gulf states have enacted statutes establishing regulations restricting or prohibiting shrimping activities seasonally and geographically (see Chapter 3).

There are three fishing zones along Florida's west coast. The major zone is the Tortugas-Sanibel area and has accounted for as much as 80% of total west coast production until recent increases in northwest coast pink shrimp production. Some shrimping takes place all year in the Tortugas-Sanibel region but the major shrimping season is from fall through spring (Joyce and Eldred, 1966). Various depths are fished depending upon the size, quantity and current market prices. This region has been

*Size counts are expressed as heads-on unless otherwise noted.

clearly defined by Iversen and Idyll (1959), Ingle et al. (1959), Kutkuhn (1966) and Costello and Allen (1966). Another fishing zone, the central west coast area (Tampa Bay), usually produces shrimp in the spring as overwintering pink shrimp leave the bay. Occasionally there is some production during fall as the shrimp are just reaching legal size. The northwest coast, particularly Apalachicola Bay and offshore, comprises the third fishing zone. This area produces three species: pink shrimp from March-April through summer; brown shrimp from April-May through summer; and white shrimp during fall. Shrimping starts in the bays as pink and brown shrimp become legal size and moves offshore with the shrimp. White shrimp catches are high in fall as the shrimp move out of brackish water areas into bays. Catches decrease as the migration continues from the bays into nearshore overwintering areas such as St. George Sound.

In Alabama, commercial quantities of shrimp usually appear in inside waters during April or May (depending upon flood conditions) as overwintering populations of white and pink shrimp return to the bays. The commercial season is set by regulation and is closed when juvenile brown shrimp become mixed with the other two species. There is a 2 to 3 week difference in the time when brown shrimp reach harvestable size in upper Mobile Bay and in lower Mobile Bay and Mississippi Sound, so inside waters are opened area by area as shrimp attain legal count. The greatest trawling activity is during late June, July and August. As shrimp become less abundant in late July and August, many Alabama boats move into Mississippi and Louisiana waters. Many Alabama boats, in fact, shrimp to the west almost exclusively after the first 2 or 3 weeks of the Alabama season. Many Alabama boats also fish in Louisiana waters in the spring after the Alabama season is closed.

The principal fishing area is Mississippi Sound during the first 3 weeks of the open season, followed later by lower Mobile Bay, principally in the Mobile ship channel. By July and August most activity is in the ship channel, stretching from lower to upper Mobile Bay, and in the Gulf. During the fall most shrimping is for white shrimp in upper Mobile Bay and the entire length of the ship channel.

Only 13% of the 1975 landings were taken from inside waters in Alabama (H. A. Swingle, pers. comm.). This percentage has declined from 21% during 1965 due to the change in composition of the Alabama shrimp fleet, from smaller bay boats to mostly offshore vessels. The commercial catch from Mobile Bay during 1973 was composed of 54% brown, 45% white and 1% pink shrimp. Because the state's landings are mostly from offshore, brown shrimp make up 75% or more of the total.

In Mississippi, pink shrimp in sufficient quantities to be fished commercially usually appear in February and

disappear in April or May. The commercial season is closed annually on April 30 for protection of juvenile brown shrimp moving from the shallow bays to the Sound. The season is then re-opened early in June of the same year when the shrimp reach 68-count or larger. At this time approximately 90 to 95% of the catch consists of brown shrimp with the remainder being large overwintered white shrimp.

The greatest trawling activity in Mississippi occurs in the summer months. During this period of time many boats replace their single net with double rigs and follow the brown shrimp into the nearby Gulf. An area extending from the mainland to one-half mile offshore is closed for the protection of juvenile white shrimp migrating out of the bays. During the fall months most shrimping is for white shrimp in Mississippi. In mid- to late fall many Mississippi boats move to Louisiana, west of the Mississippi River, and fish for white shrimp and seabobs. Most of these boats have the advantage of being able to use a single net in the large bays or use a double rig along the outside beaches.

Commercial quantities of shrimp begin appearing in Louisiana's inland waters during April or May, depending upon climatic conditions. This movement is composed of late recruited white shrimp from the previous winter. The white shrimp remaining offshore during the colder months are generally more abundant west of the Houma navigation channel. Some quantities are found in the central coastal areas and in inland waters east of the Mississippi River, however, this population is small by comparison. Following the spring movement of commercial size white shrimp into Louisiana's inland waters, the next period that commercial quantities of penaeid shrimp are available to the fisheries is during mid- to late May. At this time brown shrimp reach commercial size (100-count). Peak abundance of these shrimp generally occurs in the area west of the Mississippi River and east of the Atchafalaya River. West of the Atchafalaya and east of the Mississippi Rivers, brown shrimp populations normally reach commercial size in June (Gaidry and White, 1973). The fall season beginning on the third Monday in August, represents the final period of inland production for the year. With the August opening, production of white shrimp increases to peak levels in October and November, followed by a decrease until the season is closed (December 21).

The offshore fishery in Louisiana is apparently coordinated with the migrational patterns of both brown and white shrimp. The conduct of the offshore fleet assumes an east to west movement in its fishing efforts. In July brown shrimp production offshore normally increases off the east central and central coast. Louisiana's offshore fleet generally drifts west through July and early August, completing the circuit off extreme west Louisiana or the

Texas coast below Galveston. Generally, the same pattern is repeated for the fall movement, with the exception that the fleet's initial efforts are slightly west of the spring pattern.

The central Louisiana coast from the Mississippi to the Atchafalaya Rivers, both inshore and offshore, constitutes the major area of production for both brown and white shrimp. Major offshore production occurs in 0 to 18 m (0 to 10 fm) with landings reported from as deep as 403 m (220 fm) in 1975.

The limited pink shrimp landings in Louisiana are centered along the east central coast west of the Mississippi River to 20 to 27 m (11 to 15 fm). Seabobs occur primarily off the central and western Louisiana coast in a depth of 9 m (5 fm) or less. Royal red landings in 1975 were reported south of Barataria Bay from 185 to 192 m (101 to 105 fm). These landings are relatively small and represent only a fraction of the total Louisiana shrimp landings.

The harvest of shrimp in Texas is by statute directed toward large shrimp with a minimum size of 39 whole shrimp (65 tails) to the pound. This is a larger minimum size than in most other Gulf fisheries. The count is statutory and applies to all shrimp except bait shrimp and those taken during a limited spring season in designated major bays. Closed seasons assist in protecting the undersized shrimp in areas where they occur in abundance.

Designated major bays in Texas are open to the taking of limited quantities of any size shrimp during the spring bay season (May 15 through July 15). This fishery is directed toward some few large white and abundant juvenile brown shrimp. The fall bay season extends from August 15 through December 15 and is directed toward large white shrimp in major bays. A count law is in effect and culling may become increasingly necessary in October and November. The onset of cold weather will often end the season early by driving shrimp from the bays.

Texas Gulf waters up to 17 km (9 nautical mi) offshore are closed from June 1 through July 15 to protect migrating juvenile brown shrimp and permit growth to the minimum count size of 39 whole shrimp per pound. This closed period may be extended by Commission action up to 60 days. The principal brown shrimp fishery off Texas begins in mid-July and extends into October. Culling small shrimp may be necessary within 34 km (18 nautical mi). Gulf waters within a depth of 13 m (7 fm) are closed from December 16 through February 1 and this area is closed to night shrimping throughout the year. This is to afford protection to small white shrimp flushed from the bays in the winter and small brown shrimp the rest of the year.

Bait Shrimp Harvesting. The live bait fishery along the Gulf coast depends upon the three inshore *Penaeus*

species. The species predominating the catch varies with season and locality.

Most bait shrimp harvesting along Florida's west coast is based upon pink shrimp and is concentrated from Tampa Bay north to Apalachee Bay. In Alabama, brown shrimp taken during the spring and summer, and white shrimp taken in the fall, comprise the majority of the bait shrimp catch. Pink shrimp are taken to some extent, but only in Perdido Bay. Brown and white shrimp also account for the majority of shrimp used for bait in Mississippi, Louisiana and Texas. In Louisiana, brown shrimp comprise the major portion of the bait industry in the eastern half of the state while white shrimp dominate in the western half.

Several types of gear are used by bait shrimp fishermen; however, most of the catch is taken with trawls. Roller frame trawls, fished either singly or in pairs, are utilized in Florida while otter trawls, generally limited to about 4.9 m (16 ft), are used in the remaining Gulf states. Licensed bait dealers in some states must have facilities aboard the boat and on shore for maintaining live shrimp and they are generally restricted in the amount of dead shrimp which may be carried on board while fishing.

Bait shrimp production varies among the several Gulf states. Although the number of permits have increased, total live shrimp production in Florida has decreased by 17 million individuals since 1969:

Year	Permits	Total live (millions of individuals)	Value (millions of dollars)
1968	182	87.02	1.49
1969	182	88.55	1.76
1970	399	78.72	1.40
1971	401	67.04	1.23
1972	544	73.64	1.32
1973	361	70.31	1.34
1974	761	61.30	1.29
1975	699	71.43	1.55

Most of the production was from Tampa Bay and the decrease is a direct result of reduced landings from this area. During 1968 there were 24 licensed live-bait shrimp dealers in Alabama who sold 1.5 million live shrimp and 22,200 lb of dead shrimp. The fresh and frozen bait shrimp industry in Louisiana constitutes a minute, but profitable, segment of the shrimp fisheries. Although composed of small-size shrimp, these specialty packages demand a relatively high price. Separated by volume, fresh or frozen bait shrimp exceeds the live shrimp market by a considerable margin. In Texas from 1964 to 1973, Galveston Bay annual bait shrimp landings were 785,900 to 1,248,100 lb, with fishing effort ranging from 15,910 to 37,880 hours annually (Jim Lyon, pers. comm.). Value of this bait fishery is approximately

\$1 million per year. In the Laguna Madre, Texas, the combined catch of brown, white and pink shrimp was 53,181 quarts, worth \$265,905.

Competition between bait shrimpers and other commercial shrimpers has presented some problems. Other commercial shrimpers are generally opposed to bait shrimping activities. They feel these shrimp would be worth more money if allowed to grow to a larger size and that bait shrimping operations destroy the shrimp before other commercial fishing operations begin. Serious protests have also been directed at the sale of dead bait shrimp to fish houses, restaurants and individuals for human consumption. State statutes governing the amount of dead shrimp which can be on board the shrimping vessel and/or restrictions on bulk sales attempt to alleviate this problem. The extent of utilization of the catch from the bait fishery for purposes other than bait is not known.

Extent of Participation in Complementary or Supplemental Fisheries. Many of the commercial shrimpers in the Gulf states, particularly those who have larger vessels, prefer to shrimp seasonally across the Gulf. Small boat owners cannot move to other areas and turn to other fishing activities during the "off season."

In Florida, a few of the large-boat operators fish for royal red shrimp off the Tortugas. Small-boat operators enter the oyster fishery, hook-and-line spotted sea trout fishery or gill net fishery in the bays. During the "off season," some Alabama shrimp boats trawl offshore for Atlantic croaker, however, these croaker landings have declined in recent years because of a reduced demand and recovery of Atlantic Coast croaker populations. Most of the shrimp fleet is idle during the months when shrimping is not profitable. Fishermen seek temporary work in the oyster fishery and shipyards or other industries to supplement their income. Mississippi shrimpers exhibit a similar pattern. Those shrimpers not moving to the west usually participate in the oyster fishery.

During the closure of the inland shrimp season in Louisiana from December 22 to mid- or late May (with a possible short experimental April season) some shrimping effort reverts to near offshore waters in pursuit of seabobs and overwintering white shrimp. Since there is no closure of offshore waters, the large offshore vessels normally shrimp throughout the year, reducing their efforts from January through March in response to low available shrimp stocks and bad weather. The smaller size vessels do participate to some degree in various other fisheries. A large number of the gill net fishermen in Louisiana as well as a majority of oyster tonging license holders also hold commercial shrimping licenses. This is also true for many of the professional trappers in Louisiana. Some shrimpers enter industrial construction, shipbuilding, net making and commercial freshwater

fishing during the "off season." In Texas, small boat operators may use their boats for dredging oysters on public reefs or for running crab pots.

As a supplement to shrimping, some species including croaker, sheepshead, sea trout, kingfish and blue crabs are trawled for intentionally when concentrations are found offshore but most of this catch is incidental to shrimping. In late fall sizeable catches of migrating flounders are landed by Louisiana butterfly net fishermen in addition to the shrimp catches. These supplemental catches account for only a small portion of the landings. The principal supplemental fishery of Texas Gulf shrimp boats is probably for red snapper. If a captain finds a wreck, rock or hole with fish traces around it on his fathometer, he will frequently stop to fish the area because of the high value of this fish. Few fishes other than snapper and grouper are worth the time and effort of offshore shrimp fishermen.

Bay shrimp vessels, which make short trips, frequently retain food and scrap fish when there is a ready market. Croaker and mullet are sold for crab bait. Cutlassfish are prized as bait for king mackerel. Trawl-caught blue crabs are also retained and sold for food.

2.3 DESCRIPTION OF INDUSTRY: ECONOMIC STRUCTURE

The Gulf of Mexico has the most valuable fisheries in the United States today. In 1976 U.S. fishermen landed over 4.8 billion lb of fish for a total ex-vessel value of \$970.8 million. U.S. shrimp landings were 343.6 million lb for a value of \$226.2 million. That is, while U.S. shrimpers landed only 7% of the poundage, these landings amounted to 23.3% of the total dollar value of the seafood landed in the U.S. The total value of shrimp landed in the U.S. is more valuable than the next two fisheries combined, salmon and tuna, with a total value of \$224.7 million of fish landed in 1975. Gulf fishermen landed 170 million lb (heads-on) of shrimp which is 49.5% of the total shrimp landed in the U.S. The value of shrimp landed in the Gulf was \$178.3 million, 78.8% of the total value of shrimp landed in the U.S. (U.S. Department of Commerce, 1976).

Harvesting Sector. The shrimp catch from Gulf waters has increased significantly over the past 50 years due to improved technology. In 1912 to 1915, the introduction of the otter trawl freed the fisherman from the seasonal landings that generally ran from June to December. In 1930, 15 years after the otter trawl was introduced, 61.9 million lb (heads-on) of shrimp were landed at an average ex-vessel price of 3.2 cents per pound in the Gulf States (Lacewell et al., 1974).

Total pounds and value of shrimp landings for the period 1950 to 1975 are shown in Table 5 and the corresponding Figure 9. Shrimp landings increased for the period 1950 to 1954 from 90 million lb to 141 million lb,

GULF SHRIMP MANAGEMENT PLAN

TABLE 5.

Gulf of Mexico commercial shrimp landings, days fished and value, 1950 to 1975.

Year	Heads-off (Mil. Lbs.)	Value (Mil. \$)	Price Per Pound (Heads-off)	Days Fished	Pounds Per Day Fished	Value for Day Fished (\$)
1950	90.3	33.1	0.37			
1951	115.3	44.1	0.38			
1952	118.0	48.2	0.41			
1953	133.6	66.3	0.49			
1954	141.2	53.7	0.38			
1955	126.4	54.5	0.43			
1956	109.0	62.5	0.57	163.7	666	382
1957	99.1	62.7	0.64	152.5	650	411
1958	101.9	63.8	0.63	184.9	551	345
1959	114.7	50.3	0.43	175.8	652	286
1960	122.2	57.5	0.57	186.3	656	309
1961	79.5	43.4	0.56	164.7	480	262
1962	89.0	60.3	0.69	184.5	482	327
1963	124.7	61.3	0.49	177.7	702	345
1964	113.3	62.6	0.56	200.7	565	312
1965	123.4	71.2	0.58	198.3	622	359
1966	113.6	83.6	0.74	193.3	588	432
1967	140.6	90.1	0.64	196.7	715	458
1968	128.2	95.7	0.75	214.4	598	446
1969	126.6	101.2	0.80	217.2	583	466
1970	145.3	108.1	0.74	215.4	675	502
1971	143.1	136.1	0.95	219.7	651	619
1972	143.8	163.7	1.13	245.6	586	667
1973	114.8	171.0	1.49	255.7	449	669
1974	117.1	137.5	1.17	241.4	485	570
1975	107.0	178.2	1.66	228.0	469	782

Source: *Gulf Coast Shrimp Data* and Unpublished Shrimp Data, NMFS.

TABLE 6.

Gulf of Mexico commercial shrimp landings, value and days fished from U.S. waters, 1956 to 1975.

Year	Million Pounds (Heads-off)	Value (Million dollars)	Days Fished (1000)	Pounds Per Day Fished	Value Per Day Fished (\$)	Index of Days Fished (1962 = 100)	Price Per Pound (\$)
1956	84.2		127.2	661.9		87	
1957	72.0	42.6	113.4	534.9	375.6	77	
1958	82.1		143.8	570.9		98	
1959	92.7		138.5	669.3		95	
1960	106.3	48.3	159.5	666.4	302.8	109	0.45
1961	59.1	30.4	134.8	438.4	226.6	92	0.53
1962	69.9	44.7	146.5	477.1	305.1	100	0.63
1963	110.7	51.1	151.4	731.1	337.5	103	0.46
1964	95.9	51.3	169.8	564.7	302.1	116	0.63
1965	107.1	59.6	170.4	628.5	349.7	116	0.56
1966	103.7	74.5	175.9	589.5	423.5	120	0.72
1967	130.7	81.0	182.1	717.7	444.8	124	0.62
1968	113.9	81.8	191.5	594.7	427.1	131	0.72
1969	118.3	92.4	200.4	550.3	461.0	137	0.78
1970	136.3	99.1	200.0	681.5	495.5	137	0.73
1971	134.1	124.6	204.9	654.4	608.1	140	0.93
1972	132.1	147.7	228.9	577.1	645.2	156	1.12
1973	104.7	152.3	238.0	539.9	639.9	162	1.45
1974	106.9	122.5	222.7	480.0	550.1	152	1.15
1975	99.5	161.9	266.5	466.0	748.0	182	1.64

Source: *Gulf Coast Shrimp Data* and Unpublished Shrimp Data, NMFS.

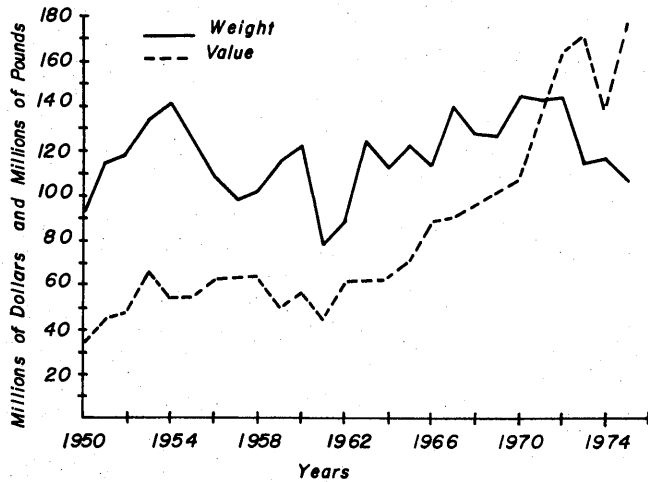


Figure 9. Gulf of Mexico commercial shrimp landings and values, 1950-1975.

then declined steadily through 1957 to 99 million lb. Production then increased steadily except for the years 1961 and 1962 from 100 million lb in 1958 to a peak in 1971 at approximately 144 million lb. Landings then dropped sharply again in 1973 to around 115 million lb through 1975. Value, however, increased from 1950 to 1953 from \$33 million to over \$60 million and then remained approximately \$60 million through 1963. Value of landings increased steadily to over \$171 million by 1973. In 1974 they decreased to around \$138 million but bounced back to over \$178 million in 1975. In Table 5, the price per pound increased from around 40 cents in 1950 and 1951 to \$1.66 by 1975.

Since Mexico has gone to 320-km (200 mi) extended jurisdiction, U.S. vessels are projected to be phased out in a 3-year period. Therefore, it is important to know which landings came from U.S. waters and which came from Mexican waters. Table 6 shows pounds landed, value and days fished in U.S. waters for the period 1956 to 1975. Table 7 shows pounds landed, value and days fished in Mexican waters for the same period (1956 to 1975). Figure 10 shows pounds harvested for the total Gulf, for U.S. waters, and Mexican waters. Landings from Mexican waters declined over this 20-year period, from over 20 million lb to less than 10 million lb in 1975. Landings from U.S. waters were rather erratic, but there was a general increase from around 80 million lb to 130 million lb by 1972. However, in 1973, 1974 and 1975 landings from U.S. waters were below 110 million lb. The value of shrimp landed (Figure 11) from Mexican waters remained relatively stable for the period 1960 to 1975 whereas value of shrimp from U.S. waters increased steadily over the 16-year period, from around \$30 million to over \$150 million by 1973. In 1974 the value declined substantially to \$125 million but increased to over \$161 million in 1975.

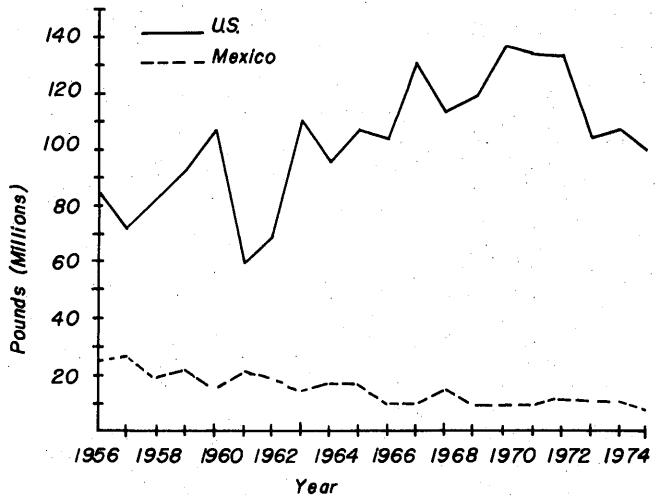


Figure 10. Commercial pounds of shrimp landed (heads-off) from U.S. and Mexican Gulf waters, 1956-1975.

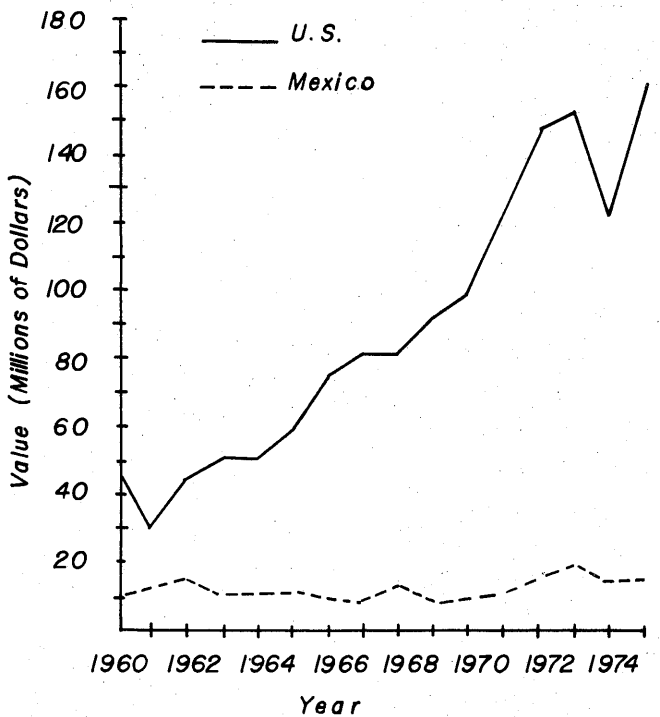


Figure 11. Commercial value of shrimp landed from U.S. and Mexican Gulf waters, 1960-1975.

Figure 12 shows a comparison of total days fished by U.S. vessels for the Gulf of Mexico including U.S. and Mexican waters. As with landings, days fished in Mexican waters declined over the entire period. Days fished in Mexican waters declined from around 40,000 days fished in 1958 to around 12,000 days fished for 1975. Days fished in U.S. waters increased steadily from 1956 to 1975, from approximately 120,000 days fished to over 265,000 days fished. Comparing the index of days fished, with 1962 as the base year, indicates that days fished

TABLE 7.

Gulf of Mexico commercial shrimp landings, value and days fished from Mexican waters by U.S. vessels 1956 to 1975.

Year	Million Pounds (Heads-off)	Value (Million \$)	Days Fished (1000)	Effort (1000)	Pounds Per Day Fished	Pounds Per Unit Effort	Value Per Day Fished (\$)	Value Per Unit Effort (\$)	Index of Days Fished 1962 = 100	Index of Effort 1962 = 100	Price Per Pound (\$)
1956	24.8		36.5		679				96		
1957	27.1	20.1	39.1		693				103		
1958	19.8		41.1		482				108		
1959	22.0		37.3		590				98		
1960	15.9	9.2	26.8		593		360		71		0.58
1961	20.4	13.0	30.9		660		371		81		0.64
1962	19.1	15.7	38.0	61.7	502	309	411	253	100	100	0.82
1963	14.0	10.2	26.3	43.6	533	322	388	234	69	71	0.73
1964	17.4	11.4	31.9	51.6	561	337	366	220	81	84	0.64
1965	16.3	11.7	28.0	46.6	584	350	417	250	73	76	0.71
1966	10.1	9.1	17.5	29.8	480	430	522	305	46	48	0.90
1967	10.8	9.1	14.6	33.2	582	300	622	273	38	54	0.91
1968	14.4	13.9	23.0	42.4	625	338	605	327	60	69	0.97
1969	8.3	8.9	16.9	31.8	495	262	528	279	44	51	1.07
1970	9.1	9.1	15.5	28.3	586	320	585	320	41	46	1.00
1971	9.1	11.5	14.8	38.9	610	313	771	396	39	47	1.26
1972	11.7	16.0	16.8	32.8	697	357	956	489	44	53	1.37
1973	10.1	18.8	17.7	34.7	671	291	1,058	540	47	55	1.85
1974	10.2	15.0	18.7	25.2	547	290	802	426	49	59	1.47
1975	7.5	16.3	11.5		652		1,417		30		2.15

TABLE 8.

Gulf of Mexico commercial shrimp landing data from U.S. waters by vessels, 1962 to 1974.

Year	Million Pounds (Heads-off)	Value (Million \$)	Total Days Fished (1000)	Effort (1000)	Avg. Effort Index Per Vessel ¹	Pounds Per Day Fished	Pounds Per Unit Effort	Value Per Day Fished (\$)	Value Per Unit Effort (\$)	Index of Days Fished 1962 = 100	Index of Effort 1962 = 100	Price Per Pound (\$)
1962	45.4	33.4	88.5	144.0	1.63	513	315	377	232	100	100	0.74
1963	77.0	41.5	112.9	181.8	1.61	682	423	367	228	128	126	0.54
1964	71.0	40.7	114.4	186.3	1.63	621	381	356	218	129	129	0.57
1965	80.1	49.1	113.7	187.6	1.65	704	427	432	262	129	130	0.61
1966	78.3	61.9	113.7	190.5	1.67	688	411	544	325	129	132	0.79
1967	99.7	68.5	116.0	201.7	1.74	859	494	590	339	131	140	0.69
1968	83.7	68.4	121.5	218.1	1.80	688	383	563	313	137	151	0.82
1969	82.4	74.3	147.8	273.6	1.85	557	301	502	271	167	190	0.90
1970	96.1	81.4	134.6	249.1	1.85	713	386	605	327	152	173	0.85
1971	91.3	100.8	137.0	259.0	1.89	566	352	735	389	155	180	1.10
1972	94.3	120.1	146.8	282.6	1.93	642	333	818	424	166	196	1.27
1973	71.0	118.6	140.0	269.7	1.93	507	263	847	439	158	187	1.67
1974	73.9	99.8	132.4	243.6	1.84	558	303	753	409	150	169	1.35

¹Relation of fishing power compared to a standard vessel.

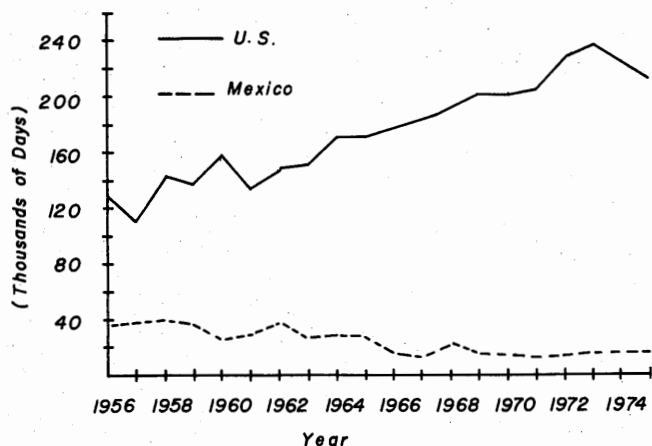


Figure 12. Days fished in U.S. and Mexican Gulf waters, 1956-1975.

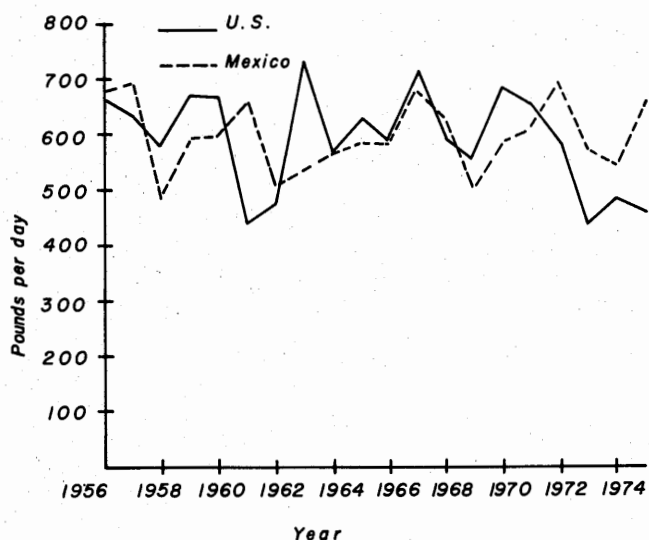


Figure 13. Pounds per day fished for U.S. and Mexican Gulf waters, 1956-1975.

have increased about 82% in the U.S. waters since 1962 and decreased to 30% of the days fished in 1962 in Mexican waters.

Figure 13 shows that for the period 1956 to 1975 that pounds landed per day fished in general ranged from 450 to 700 lb in U.S. waters and from 500 to 700 lb in Mexican waters. However, there appears to be no upward or downward trend in either curve. Figure 14 indicates that value of landings per day fished in both U.S. and Mexican waters increased over time. It also shows that return per day fished is higher in Mexican waters. This is surprising since it generally takes more travel time to get to the Mexican shrimp grounds; therefore, cost per days fished would be higher. The reason the value is higher for shrimp from Mexican water is that the price per pound is higher due to the larger average size of shrimp taken (Tables 6 and 7).

There are two types of crafts fishing in U.S. waters.

These are vessels of 5 gross tons and larger, which are registered with the Coast Guard, and boats of less than 5 gross tons, which are not registered with the Coast Guard. Vessels usually fish the offshore areas and boats usually fish the bays.

Table 8 shows commercial pounds landed, value, days fished and effort for vessels operating in U.S. waters. Table 9 shows commercial pounds landed, value and days fished for boats operating in U.S. waters. Effort (a standard day fished) is only calculated for vessels since characteristic data are available for vessels only.

Pounds landed generally increased over the 14-year period, 1962 to 1975 for both vessels and boats (Figure 15). With the exception of the years 1962, 1973, 1974 and 1975 when Mississippi River discharge was high, vessel production increased from just over 70 million lb to over 90 million lb. See Barrett and Gillespie (1973), Griffin et al. (1976) and Griffin (1976) for a discussion of the relationship of Mississippi River discharge and shrimp production in the Gulf of Mexico. Boat landings increased over this same time period from about 25 million lb to approximately 40 million lb.

Value of landings tripled from 1962 to 1975 for both vessels and boats (Figure 16). Value landed for vessels increased from approximately \$40 million to over \$120 million with 1974 being the only drastic reversal in the value trend. Value landed for boats increased from around \$10 million to \$30 million again with 1974 being a reversal year. Pounds landed by all vessels are on the average two and a half times the pounds landed by boats whereas the value of pounds landed is over four times larger for vessels than boats due to the larger average size of the shrimp taken by vessels.

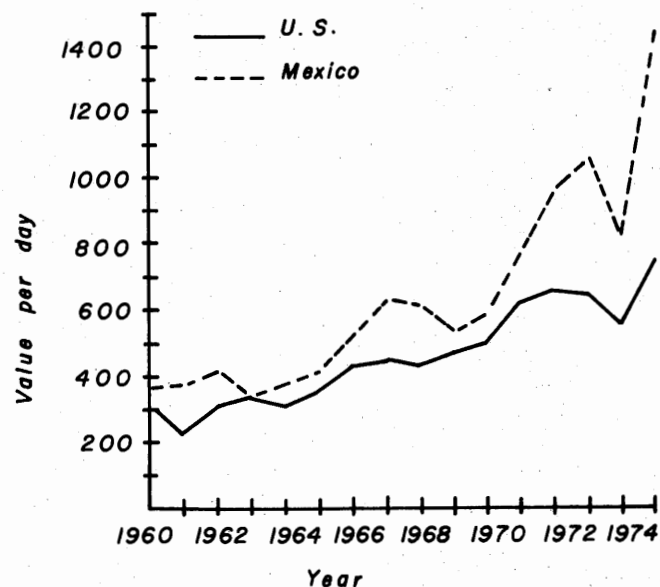


Figure 14. Value per day fished for U.S. and Mexican Gulf waters, 1960-1975.

TABLE 9.

Gulf of Mexico commercial shrimp landing data from U.S. waters by boats, 1962 to 1974.

Year	Million Pounds	Value (Million Dollars)	Price Per Pound	Total Days Fished (1000)	Pounds Per Day Fished	Value Per Day Fished (\$)
1962	25.2	11.9	0.47	58.0	434	205
1963	33.3	9.4	0.28	38.5	865	244
1964	23.5	9.6	0.41	55.4	424	173
1965	25.5	9.5	0.37	56.7	450	168
1966	24.6	12.2	0.50	62.2	395	196
1967	30.6	12.1	0.40	66.1	463	183
1968	29.9	13.2	0.44	70.0	427	189
1969	35.5	17.8	0.50	52.6	675	338
1970	40.1	17.6	0.44	65.4	613	269
1971	42.5	23.7	0.56	67.9	626	349
1972	37.7	27.5	0.73	82.1	459	335
1973	33.6	34.3	1.02	98.0	343	350
1974	33.0	22.7	0.69	90.3	363	251

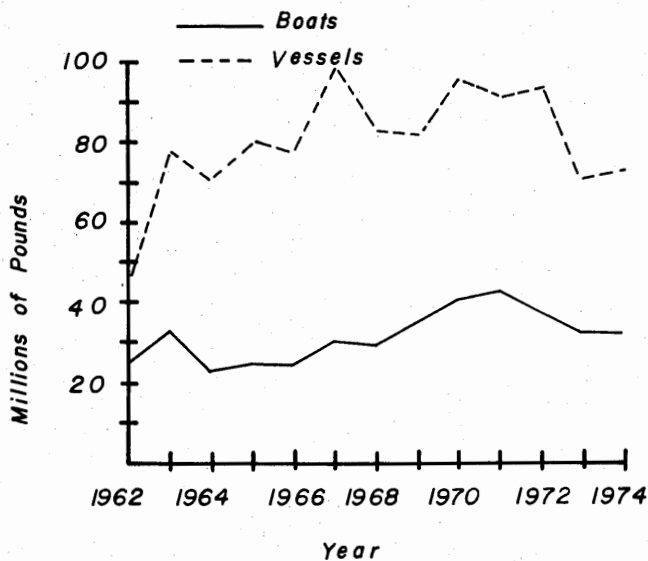


Figure 15. Pounds of commercial shrimp landed by vessels and boats from U.S. Gulf waters, 1962-1974.

Days fished for vessels and boats have increased substantially in the last 14 years (Figure 17). Vessel effort has increased from approximately 110,000 days fished (excluding 1962) to around 140,000 days fished, approximately a 25% increase. Boat effort has increased from approximately 50,000 days fished to 95,000 days fished, a 90% increase.

Catch per day fished (Figure 18) varied considerably over the time period with no apparent trend. Catch per day fished for vessels ranged between 450 and 650 lb except for 1967 when it exceeded 800 lb. For boats, catch per day fished ranged between 400 and 600 lb except for 1963 when it exceeded 800 lb.

Value per day fished (Figure 19) is much less erratic over time than catch per day fished. Also, value per day fished has an apparent upward trend for both vessels and

boats. Value per day fished doubled for vessels in the 14-year period increasing from just under \$400 to over \$800. Boats also doubled their value per day fished, from approximately \$175 to \$350. Value per day fished is almost twice as great for vessels as for boats.

The main reason that total days fished by all vessels increased is because the total number of vessels landing shrimp increased. Figure 20 shows that the number of vessels (not including boats) steadily increased from 2,542 in 1962 to 3,346 in 1968. The number of vessels varied around 3,300 through 1973. Not only are there more vessels in the shrimp fleet as indicated, but old, less powerful vessels have dropped out of the shrimp fleet and new, more powerful vessels have entered, causing the average power that vessels exert in a day fished to also

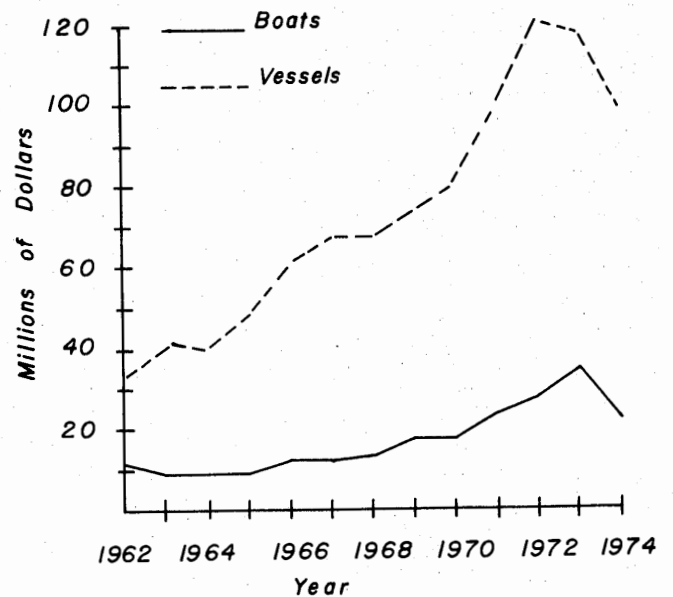


Figure 16. Value of commercial shrimp landed by vessels and boats from U.S. Gulf waters, 1962-1974.

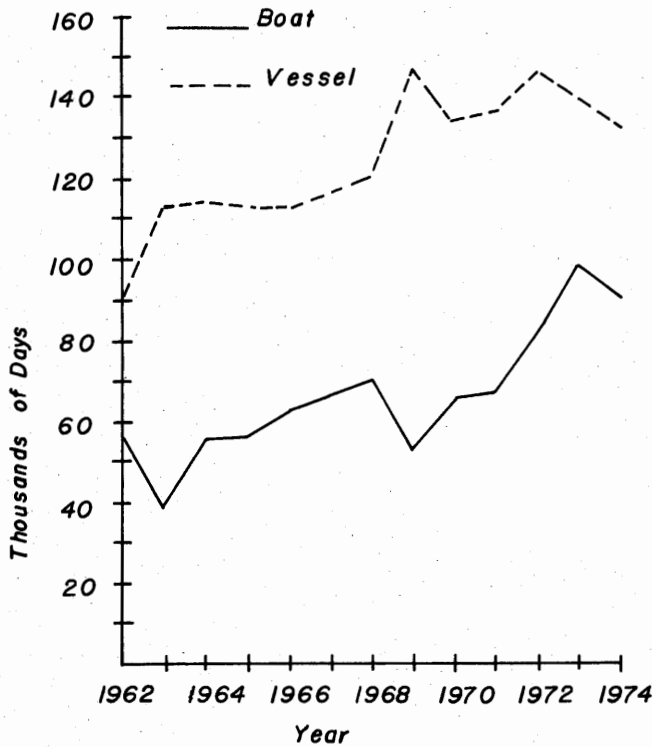


Figure 17. Days fished by vessels and boats from U.S. Gulf waters, 1962-1974.

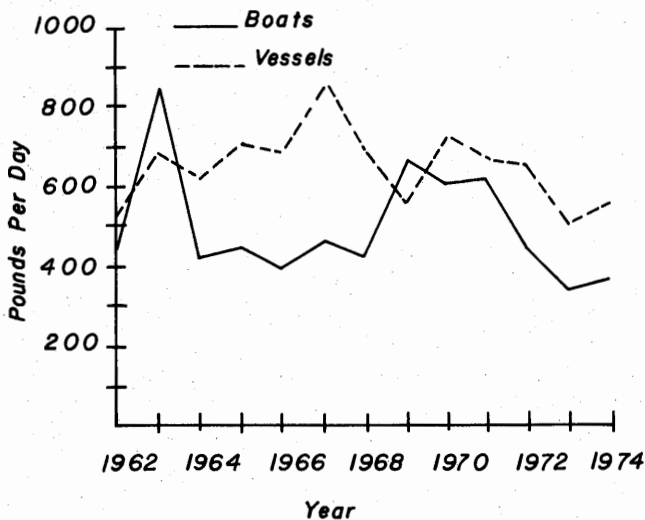


Figure 18. Pounds per day fished by vessels and boats in U.S. Gulf waters, 1962-1974.

increase (Griffin et al., 1973). Since characteristic data is available for vessels, an effort index* (relative fishing power) has been estimated so that days fished can be converted to effort.

Figure 21 shows total measured effort compared to total days fished in U.S. waters. Total effort increased more rapidly over the 12-year period than days fished. This is seen more easily in Figure 22 which shows effort increased approximately 90 to 100%. The actual increase

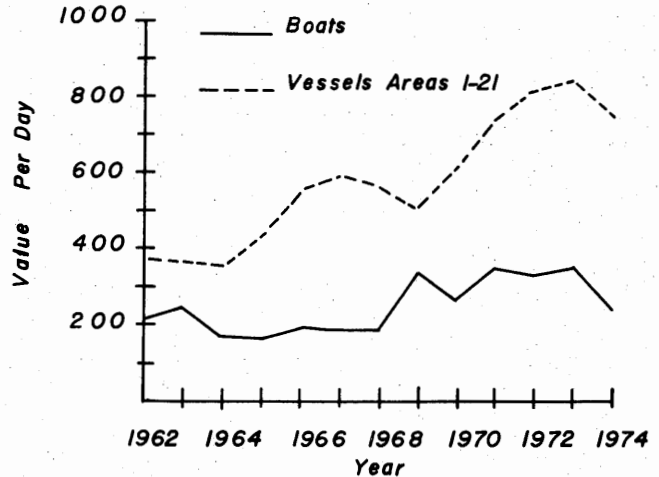


Figure 19. Value per day fished by vessels and boats in U.S. Gulf waters, 1962-1974.

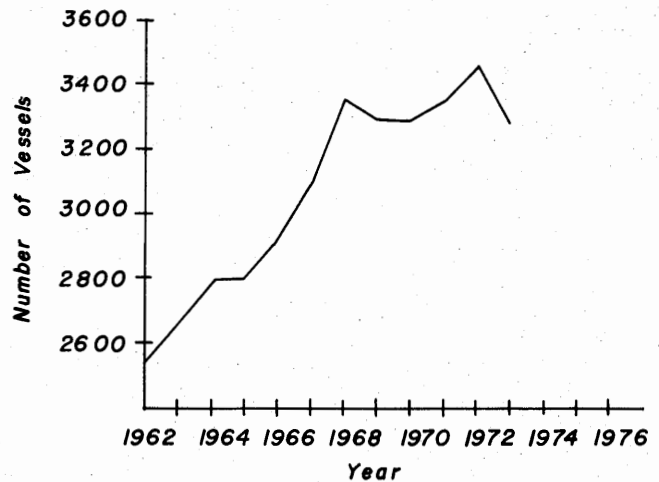


Figure 20. Total number of vessels landing shrimp, 1962-1974.

in the fishing power of the vessel has been the basic cause of the nontrend in catch per day discussed earlier, while effort per day fished declined from about 400 lb to 300 lb per unit from 1962 to 1974 (Figure 23).

Thus far, this description has been concerned with the

*The effort index is defined as the amount of fishing power that a vessel can exert in a day fished relative to that of a standard vessel. The value for the effort index for each vessel was calculated using the formula:

$$EI_i = \frac{(HP)_i^{0.0385} (LFR)_i^{0.4064}}{(38)^{0.1385} (14.6)^{0.4064}}$$

where EI_i = effort index for vessel i , $(HP)_i$ = horsepower for vessel i , $(LFR)_i$ = sum of the lengths of the footropes measured in yards for vessel i , (38) = average horsepower of the smallest class of vessels operating in the Gulf from 1962 to 1971, and 14.6 = average net size measured in yards of footrope used by the smallest class of vessels for the same period.

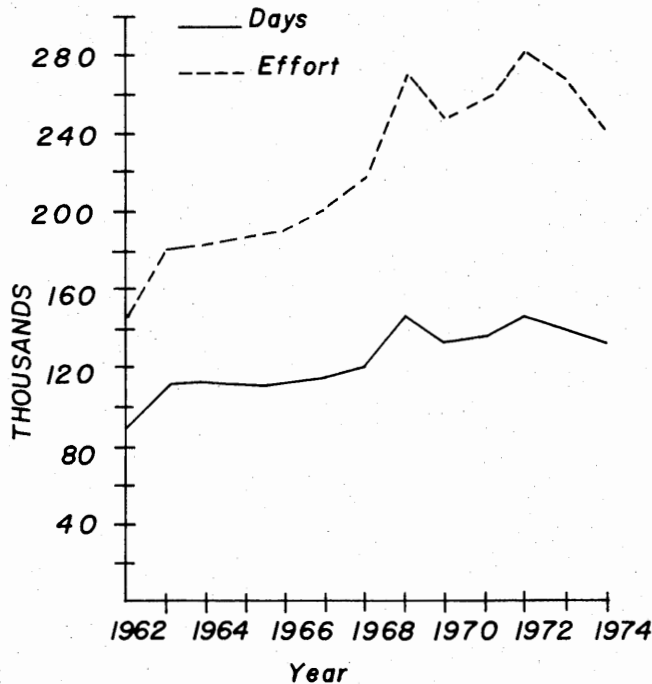


Figure 21. Effort and days fished by vessels in U.S. Gulf waters, 1962-1974.

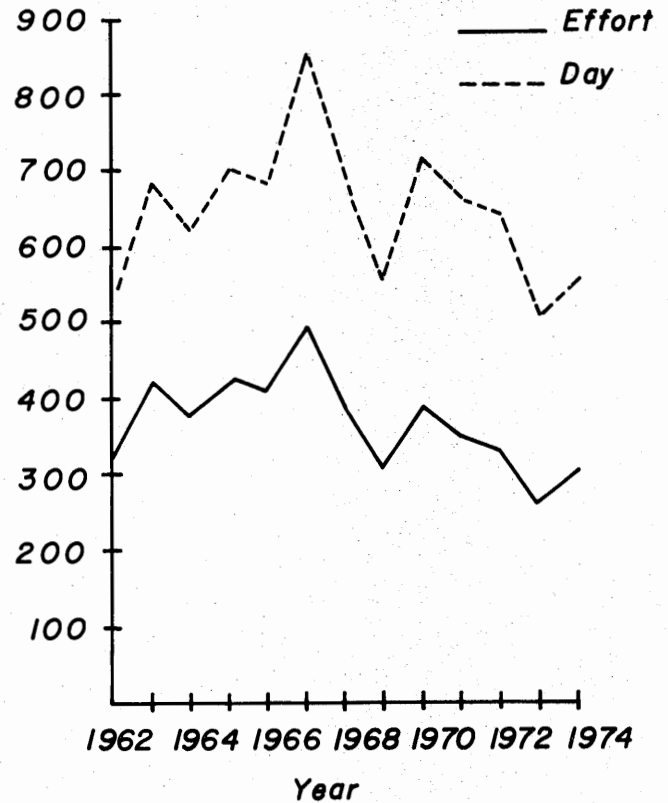


Figure 23. Pounds per day fished and pounds per unit of effort by vessels in U.S. Gulf waters, 1962-1974.

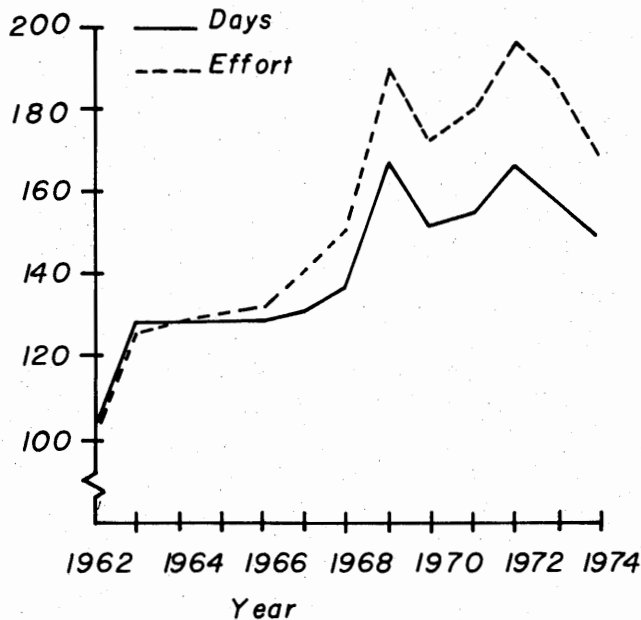


Figure 22. Index of effort and index of days fished by vessels in U.S. Gulf waters, 1962-1974.

entire shrimp industry. Attention is now turned to the individual vessel's cost and returns for operating in the Gulf of Mexico. Table 10 shows annual cost and returns data for years 1971, 1973, 1974 and 1975. These data were collected on personal interview with vessel owners. The data for 1971 and 1973 contain both Florida and Texas vessels whereas data for 1974 and 1975 include

Texas vessels only.

Average gross receipts from the sale of shrimp ranged from a low of \$60,742 in 1971 to a high of \$101,324 in 1975. Average landings per vessel were highest in 1971 at 50,656 lb. The lower landings in 1973, 1974 and 1975 are partly due to high Mississippi River discharge. The price per pound received for shrimp landed by these vessels almost doubled from \$1.20 in 1971 to \$2.30 by 1975.

Variable cost items not proportional to catch include ice, fuel, nets, supplies and groceries, and repair and maintenance. Fuel, net, supply and grocery costs increased dramatically during this time period (1971 to 1975). Fuel costs tripled from \$6,561 to \$19,114, while cost of nets, supplies and groceries increased almost five times from \$2,358 to \$11,211. Total variable cost not proportional to catch almost doubled from \$22,014 in 1971 to \$43,734 in 1975.

Costs proportional to catch include crew shares, payroll taxes and packing charges. When adding these costs to variable costs not proportional to the catch, total variable cost of harvesting shrimp from the Gulf of Mexico almost doubled from \$44,250 in 1971 to \$80,876 in 1975. Returns above variable cost remained relatively constant from 1971 to 1975 at approximately \$20,200 except for 1974 when they dropped to only \$8,557. Thus, in 1974,

TABLE 10.

Annual costs and returns for Gulf of Mexico vessels of steel and wood construction
(51 to 80 feet in length; 104 to 425 horsepower).

	1971 ¹	1973 ¹	1974 ²	1975 ²
Returns:				
Gross Receipts from				
Shrimp Sales	60,742	74,135	78,864	101,324
Lbs. Landed	50,656	39,907	46,270	44,070
Price/Pound	\$1.20	\$1.86	\$1.70	\$2.30
Costs:				
Variable Costs:				
Ice	1,387	1,579	1,541	1,766
Fuel	6,561	9,539	18,976	19,114
Nets, Supplies, Groc.	2,358	6,747	8,885	11,211
Repairs & Maintenance	11,708	9,953	9,337	11,643
Subtotal Variable Costs				
Not Proportional to Catch	22,014	27,458	39,739	43,734
Crew Shares	19,437	23,723	26,593	32,422
Payroll Taxes	388	474	1,547	1,815
Packing	2,411	1,899	2,428	2,905
Total Variable Costs	44,250	53,554	70,307	80,876
Returns Above Variable Costs	16,492	20,581	8,557	20,448
Fixed Costs:				
Insurance	3,632	4,291	4,306	4,840
Depreciation	5,333	8,177	11,228	12,607
Overhead	0	2,415	3,201	3,073
Interest	2,256	2,611	5,604	6,984
Total Fixed Costs	12,221	17,494	24,339	27,504
Total Costs of Operation	56,471	71,048	94,646	108,380
Total Profit/Loss				
From Operations	4,271	3,087	-15,782	-7,056
Number of Vessels in Class	25	103	109	101

¹Data include Florida and Texas vessels.

²Data are on Texas vessels only.

after paying for variable cost, very little was left over to pay for fixed cost.

Fixed cost includes insurance, depreciation, overhead and interest. Of these four items the significant increase is in depreciation and interest since these two items reflect the cost of a new vessel. Depreciation charges were calculated using straight-line depreciation in nominal dollars, with an 8-year depreciable life assuming a 35% salvage value. Interest was calculated using 67% financing, for 8 years, with 12 equally amortized payments per year, at the approximate rate of interest appreciable for each year. The specific amount of interest reported is for the fifth year of vessel life. Thus, based on new vessel prices, depreciation and interest more than doubled. This caused fixed costs to increase from \$12,221 in 1971 to \$27,504 in 1975.

Total costs (variable plus fixed) doubled during this 5-year period from \$56,471 to \$108,380. Since revenues increased at a slower rate than cost, this caused negative returns in 1974 and 1975 of \$15,782 and \$7,056, respectively.

To get a better picture of increasing cost and revenue for the period 1971 to 1975, Table 11 shows the index of increasing total cost and total revenue for vessels. Indices

TABLE 11.

Index of increasing total cost and total revenues for vessels operating in the Gulf of Mexico shrimp fishery, 1971 to 1975. 1971 = 100

	1971	1972*	1973	1974	1975
Variable Cost					
Not Proportional to Catch	100	105	125	181	199
Proportional to Catch	100	105	121	159	183
Fixed Cost	100	105	143	199	225
Total	100	105	106	167	191
Revenue	100	103	122	129	166

*Estimated

are calculated to reflect nominal percentage increase in each item. Also included is an estimate of 1972 to give the reader some idea when significant increases began. All items showed the first significant increase in 1973. Fixed cost shows the most increase of 125% where revenue shows the least increase of 66%.

Processing. Shrimp processing is an important source of income in the five Gulf states. The wholesale values of processed shrimp products for the period 1970 to 1974 are:

Year	Million \$
1970	224.8
1971	253.7
1972	282.6
1973	333.0
1974	259.9

Within the Gulf region the value in millions of dollars of wholesale shrimp products by state is as follows:

State	1970	1971	1972	1973	1974
Florida	63.6	70.2	70.9	86.0	69.5
Alabama	13.9	11.6	23.2	30.7	20.3
Mississippi	11.7	12.7	13.4	15.7	16.9
Louisiana	58.2	65.7	64.8	76.9	72.4
Texas	77.5	93.6	110.2	120.6	80.7

Texas is the leading state in value of processed shrimp products with Florida second and Louisiana third (U.S. Department of Commerce).

In terms of shrimp supplies processed, there has been a dependency on raw shrimp from outside the region. Louisiana, Texas, Alabama, Mississippi and Florida fishermen supply approximately 97, 84, 76, 57 and 35%, respectively, to their processors. Even though Texas processes more dollars worth of shrimp, Florida's deficit of raw products is much more critical (Prochaska and Andrew, 1974).

The serious deficit supply position raises several important researchable questions. First, locating processing firms in the Gulf states is questionable from an economic feasibility standpoint. Second, the processing industry depends upon competition from raw products produced outside the area, particularly imports, for economic growth potential. Third, the growing dependence on an external supply (Prochaska and Andrew, 1974) impacts on the market structure of the shrimp processing industry. Prochaska and Cato have conducted considerable research in this latter area for Florida (Alvarez et al., 1976; Anderson et al., 1975; Prochaska and Cato, 1975; and Prochaska and Andrew, 1974).

According to Prochaska and Andrew (1974):

Shrimp handling and processing in Florida represent an output expanding industry, yet firms are continually withdrawing from the industry at a rate in excess of new entrants. Lack of demand for shrimp products and excessive processing difficulties don't appear to be responsible for this trend. The retail market is strong, and most processors indicate they can market all the shrimp that they can buy and process. Capital and labor requirements don't appear to be restrictive considering that entry into the industry has been common. Supply of raw products, the remaining factor, appears to explain past changes in the industry and probable future changes.

Table 12 shows the entry and exit of firms in the Florida shrimp industry. From 1959 to 1971, a total of 49 handlers and 32 processors were involved in the shrimp industry. Only 15 of the 49 handlers and eight of the processors were in business for the entire period. The average biennial entry rate was 9.6% for handlers and 15.3% for processors whereas the exit rate was 16.1 and 14.2%, respectively (Prochaska and Andrew, 1974).

Table 13 shows the frequency of firm size change in the Florida shrimp industry. Over the 6-year period, 3.7% of the handlers were increasing in size of employment while 4.7% were decreasing. Processors were more active in that 14.5% were decreasing (Prochaska and Andrew, 1974).

In terms of concentrations from 1959 to 1971, the five largest handlers grew from 48 to 66% of total labor employed with the two largest growing from 24 to 37%. The five largest processing firms grew from 74% employment to 91% with the two largest firms increasing from 39 to 60%. Prochaska and Andrew (1974) conclude that changes in the market structure were associated with changes in raw product supply conditions. The shrimp processing industry is expected to further concentrate if supply deficits do not ease.

In 1973 Anderson et al. (1975) surveyed 19 shrimp processing firms in Florida to determine their purchase and sale channels. The 14 processors who responded to the survey represented 85% of Florida's production.

To process this 72.8 million pounds, Florida processors purchased 56.7 million pounds of raw shrimp (Figure 4) [Figure 24]. Florida processors bought over 10 million pounds of fresh Florida shrimp for processing. This represents 18 percent of the total needs of the processors included in the survey. Other U.S. shrimp made up of 17.1 million pounds of fresh shrimp and 6.7 million pounds of frozen shrimp accounted for 42 percent of the shrimp entering Florida processing plants. The 22.8 million pounds of foreign shrimp used by Florida processors represented 40 percent of the shrimp entering their plants.

Over 73 percent (7.4 million pounds) of Florida landed shrimp moved through shoreside plants (unloading houses) before reaching Florida processors (Figure 4) [Figure 24]. With the exception of a small amount handled by brokers, the remainder of fresh Florida shrimp moved directly from the shrimper to the processing plant. Ninety-three percent of other U.S. fresh shrimp moved through the shoreside plant before reaching the Florida processor. The remaining fresh U.S. (non-Florida) shrimp moved through brokerage and wholesale channels on its way to Florida processors. Frozen U.S. (non-Florida) shrimp moved through similar channels as

TABLE 12.
Entry and exit of firms in the Florida shrimp industry, 1959 to 1971.

Year	Handlers			Processors			All Firms		
	Total	Entry	Exit	Total	Entry	Exit	Total	Entry	Exit
1959	36.0			16.0			52.0		
1961	38.0	2.0	0.0	15.0	1.0	2.0	53.0	3.0	2.0
1963	33.0	1.0	6.0	15.0	3.0	3.0	48.0	4.0	9.0
1965	29.0	3.0	7.0	20.0	7.0	2.0	49.0	10.0	9.0
1967	30.0	6.0	5.0	21.0	3.0	2.0	51.0	9.0	7.0
1969	28.0	2.0	4.0	19.0	2.0	4.0	47.0	4.0	8.0
1971	24.0	4.0	8.0	17.0	0.0	2.0	41.0	4.0	10.0
Totals		18.0	30.0		16.0	15.0		34.0	45.0
Average	31.0	3.0	5.0	17.6	2.7	2.5	48.7	5.7	7.5
Rate of Change		9.6	16.1		15.3	14.2		11.7	15.4

Source: Shrimp Processing in the Southeast: Supply Problems and Structural Change, by Fred J. Prochaska and Chris O. Andrew, in, *Southern Journal of Agricultural Economics*, July, 1974.

TABLE 13.
Frequency of firm size (employment) changes in the Florida shrimp industry, 1961 to 1971.

Year	Handlers				Processors			
	Total	Increase	Decrease	Same	Total	Increase	Decrease	Same
1961	36.0	0.0	1.0	35.0	14.0	0.0	1.0	13.0
1963	32.0	1.0	1.0	30.0	12.0	0.0	2.0	10.0
1965	26.0	1.0	1.0	24.0	13.0	4.0	2.0	7.0
1967	24.0	2.0	1.0	21.0	18.0	2.0	2.0	14.0
1969	26.0	1.0	0.0	25.0	17.0	3.0	2.0	12.0
1971	20.0	1.0	4.0	15.0	17.0	4.0	2.0	12.0
Average	27.3	1.0	1.3	25.0	15.2	2.2	1.8	11.2
% of Total Average		3.7	4.7	91.6		14.5	11.8	73.7

Source: Shrimp Processing in the Southeast: Supply Problems and Structural Changes, by Fred J. Prochaska and Chris O. Andrews, in, *Southern Journal of Agricultural Economics*, July, 1974.

did fresh shrimp with 5.3 million pounds or 79 percent coming directly from the shoreside plant. Foreign frozen shrimp moved through a somewhat different channel. Eighty-five percent of the foreign shrimp moved through brokers and importers on the way to Florida shrimp processing plants. In summary, the survey shows that a total of 28.8 million pounds (51 percent) moved directly from shoreside plants to Florida processors. Thirty-six percent of the shrimp purchased for processing moved through brokerage channels, and the remainder came directly from shrimpers or through wholesalers.

The lower half of Figure 4 [Figure 24] shows the distribution of Florida processed shrimp products. Regional consumption was distributed fairly equally between the Northeast, Southeast and Western regions of the U.S. (Figure 5) [Figure 25]. Florida processed shrimp were sold to these regions, respectively, in relative shares of 37, 33, and 30 percent.

In all three regions, sales to institutional markets exceeded sales at retail. Sales to institutional markets in the Southeast were more than twice the sales to retail markets. The distribution between

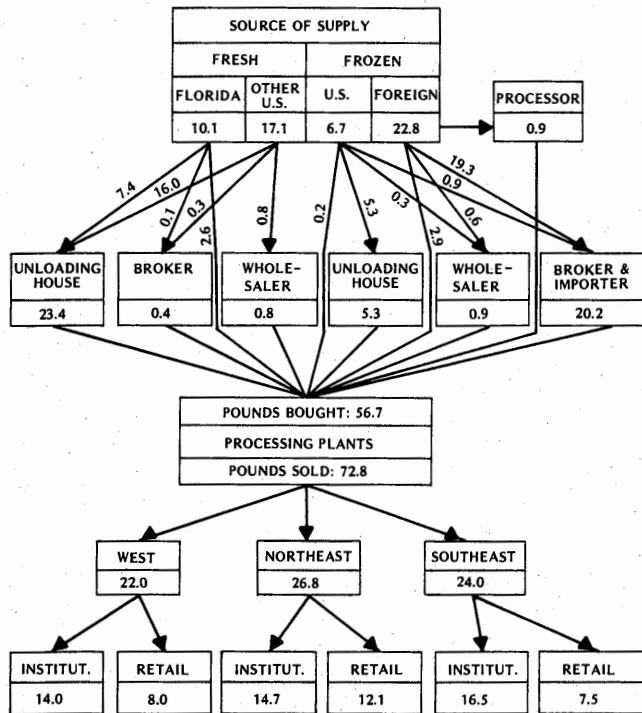


Figure 24. Marketing channels for Florida processed shrimp, 1972 (numbers indicate millions of pounds).

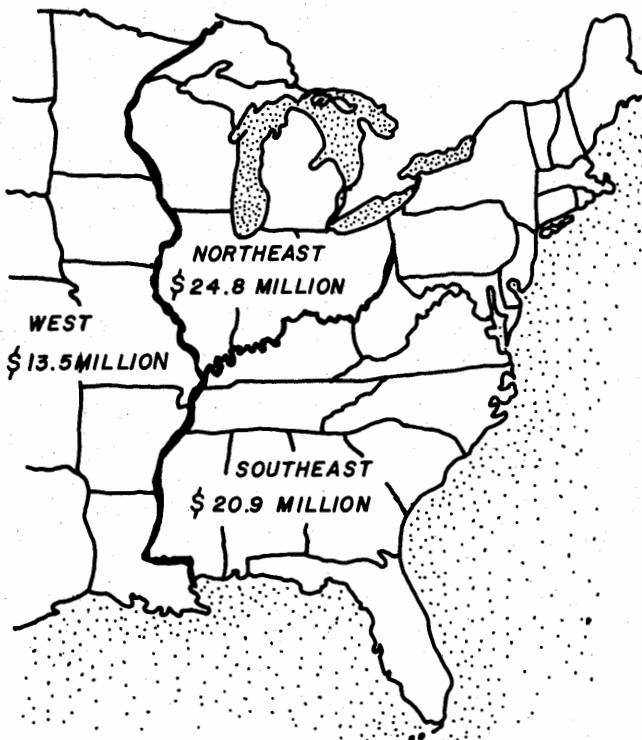


Figure 25. Distribution of Florida processed shrimp products.

types of market outlets was similar in the West. Only about 56 percent of the sales in the Northeast were to institutional markets. Shrimp processors

participating in the study indicated that these distributional patterns were similar for each particular product type. (Anderson et al., 1975)

The information presented above on the Florida shrimp industry needs to be updated since it is a dynamic industry. Also, similar analyses need to be undertaken immediately to obtain this same information for the other Gulf states. Further management decisions will have direct impact on the harvesting sector but will also affect the processors and handlers of shrimp. Thus, it is important to know the impact of decisions on the entire marketing channel. This cannot be done unless marketing channels are made known through research.

Products. Table 14 shows the weight and value of shrimp products produced in the five Gulf States for the 5-year period, 1970 to 1974. Table 15 is the same except in percentage terms. Quantity for each product for each state over the 5-year period does not increase whereas the dollar value generally does increase except for the year 1974 (Table 14). In fact, value declined in 1973 and 1974 basically because landings from the Gulf were down for those two years. Based on this 5-year period potential growth seems to be nil. Growth of an individual processor could only occur by horizontal or vertical integration.

Texas produces about 40% of the raw headless shrimp while Louisiana is a close second, producing about 30%. Florida produces about 45% of the peeled shrimp and Texas produces about 40%. Florida specializes in breaded shrimp and produces about 55% of the Gulf total. Louisiana has the market of specialty products, and also does around 85% of the canned shrimp processing. Rock shrimp were processed as frozen, raw, headless in Florida for the first time in 1973.

Other U.S. Landings and Imports. As was shown in the discussion of the processing sector, all five Gulf states are dependent on raw product other than those landed in their state. Two important sources of that raw product are landings from non-Gulf states and imports.

Figure 26 shows U.S. shrimp landings other than Gulf landings. Other U.S. landings were about 25 million lb for the period from 1960 to 1974, and then they began to increase annually at a constant rate reaching a yearly peak in 1973 of just under 115 million lb. Figure 27 shows U.S. imports of shrimp. U.S. imports increased at a constant rate from just under 120 million lb in 1960 to almost 220 million lb in 1969. Since 1969, imports have been very erratic, but they have maintained an upward trend. U.S. exports have also increased during this same time period (Figure 28) to an average of between 40 and 50 million lb.

This leads to an annual balance of trade deficit in shrimp products of between \$150 and \$200 million. (Prochaska and Cato, 1975).

Prochaska and Cato (1975) examine an interesting

TABLE 14.

Pounds and value of shrimp products produced in the five Gulf states, 1970 to 1974.

Year	Item	Florida		Alabama		Mississippi		Louisiana		Texas		Total	
		Quantity	Mil. \$	Quantity	Mil. \$	Quantity	Mil. \$	Quantity	Mil. \$	Quantity	Mil. \$	Quantity	Mil. \$
1970	Raw Headless	5.5	6.5	12.3	13.9	4.5	5.3	31.2	30.6	34.2	34.9	88.0	91.3
1971	(Mil. Pounds)	6.2	8.8	8.3	11.5	5.5	7.4	31.6	37.6	36.0	47.4	87.8	112.8
1972		5.4	9.2	12.8	20.1	5.0	7.5	24.5	32.7	38.9	55.4	86.8	125.1
1973		6.3	12.0	14.3	28.8	4.8	10.9	18.1	36.4	31.0	61.2	74.6	149.4
1974		5.5	9.0	11.0	19.0	5.7	9.8	17.6	33.4	25.5	42.7	65.5	114.0
1970	Peeled	17.9	25.8	—	—	—	—	3.7	5.2	12.7	19.0	34.3	50.1
1971	(includes deveined)	15.4	25.7	—	—	—	—	3.3	7.1	12.7	22.6	31.4	55.3
1972	(Mil. Pounds)	10.2	19.7	1.7	3.1	—	—	3.6	5.8	12.1	22.8	27.7	51.4
1973		8.3	20.3	0.8	1.8	—	—	2.9	6.8	8.6	19.5	20.7	48.4
1974		9.7	17.6	0.8	1.2	0.5	0.5	3.2	6.6	6.2	12.8	20.4	38.7
1970	Breaded	30.8	31.3	—	—	—	—	1.4	1.3	24.1	23.4	56.2	56.0
1971	Raw & Cooked	31.5	35.7	—	—	—	—	1.7	1.9	24.0	23.4	47.2	61.0
1972	(Mil. Pounds)	32.5	41.9	—	—	—	—	2.2	2.6	26.9	32.0	61.6	76.4
1973		33.9	52.8	—	—	—	—	1.6	3.0	29.0	40.0	64.6	95.8
1974		27.5	42.6	—	—	—	—	4.4	7.4	20.3	25.1	52.2	75.1
1970	Specialties	—	—	—	—	—	—	0.8	0.6	—	—	0.8	0.7
1971	Cocktails, Creoles,	—	—	—	—	—	—	0.6	0.6	—	—	0.6	0.6
1972	Gumbo, Stuffed,	—	—	—	—	—	—	0.3	0.3	—	—	0.3	0.3
1973	Patties, etc.)	—	—	—	—	—	—	0.2	0.4	—	—	0.2	0.4
1974	(Mil. Pounds)	—	—	—	—	—	—	0.5	0.5	—	—	0.5	0.5
1970	Canned	—	—	—	—	0.5	6.4	2.1	20.4	—	—	2.5	26.8
1971	Regular	—	—	—	—	0.4	5.3	1.7	18.5	—	—	2.1	23.8
1972	(Standard Cases	—	—	—	—	0.3	5.8	1.9	23.3	—	—	2.2	29.2
1973	in Millions)	—	—	—	—	0.2	4.8	1.8	33.2	—	—	2.0	38.0
1974		—	—	—	—	0.3	6.6	1.6	24.5	—	—	1.9	31.1
1970	Rock	—	—	—	—	—	—	—	—	—	—	—	—
1971	Frozen, raw	—	—	—	—	—	—	—	—	—	—	—	—
1972	headless	—	—	—	—	—	—	—	—	—	—	—	—
1973	(Mil. Pounds)	0.6	0.9	—	—	—	—	—	—	—	—	0.6	0.9
1974		0.3	0.3	—	—	—	—	—	—	—	—	0.3	0.3

TABLE 15.
Percentage of processed shrimp by states, 1970 to 1974.

Year	Item	Florida		Alabama		Mississippi		Louisiana		Texas	
		Quantity	Dollars	Quantity	Dollars	Quantity	Dollars	Quantity	Dollars	Quantity	Dollars
1970	Raw Headless (Lbs)	0.06	0.07	0.14	0.15	0.05	0.06	0.36	0.34	0.39	0.38
1971		0.07	0.08	0.10	0.10	0.06	0.07	0.36	0.33	0.41	0.42
1972		0.06	0.07	0.15	0.16	0.06	0.06	0.28	0.27	0.45	0.44
1973		0.08	0.08	0.19	0.19	0.07	0.07	0.24	0.25	0.42	0.41
1974		0.08	0.08	0.17	0.17	0.09	0.09	0.27	0.29	0.39	0.37
1970	Peeled	0.52	0.52	-	-	-	-	0.11	0.10	0.37	0.38
1971	(Includes Deveined)	0.49	0.46	-	-	-	-	0.11	0.13	0.40	0.41
1972	Raw & Cooked (Lbs.)	0.37	0.38	0.06	0.06	-	-	0.13	0.11	0.44	0.45
1973		0.40	0.42	0.04	0.04	-	-	0.14	0.14	0.42	0.40
1974		0.47	0.46	0.04	0.03	0.02	0.01	0.16	0.17	0.31	0.33
1970	Breaded	0.55	0.56	-	-	-	-	0.02	0.02	0.43	0.42
1971	Raw & Cooked (Lbs.)	0.55	0.58	-	-	-	-	0.03	0.03	0.42	0.39
1972		0.53	0.55	-	-	-	-	0.03	0.03	0.44	0.42
1973		0.52	0.55	-	-	-	-	0.03	0.03	0.45	0.42
1974		0.53	0.57	-	-	-	-	0.08	0.10	0.39	0.33
1970	Specialties (Lbs.)	-	-	-	-	-	-	1.0	1.0	-	-
1971		-	-	-	-	-	-	1.0	1.0	-	-
1972		-	-	-	-	-	-	1.0	1.0	-	-
1973		-	-	-	-	-	-	1.0	1.0	-	-
1974		-	-	-	-	-	-	1.0	1.0	-	-
1970	Canned Regular	-	-	-	-	0.19	0.24	0.81	0.76	-	-
1971	(Standard Cases)	-	-	-	-	0.19	0.22	0.81	0.78	-	-
1972		-	-	-	-	0.16	0.20	0.84	0.80	-	-
1973		-	-	-	-	0.11	0.13	0.89	0.87	-	-
1974		-	-	-	-	0.18	0.21	0.82	0.79	-	-
1970	Rock (Lbs.)	-	-	-	-	-	-	-	-	-	-
1971	Frozen, Raw, Headless	-	-	-	-	-	-	-	-	-	-
1972		-	-	-	-	-	-	-	-	-	-
1973		1.0	1.0	-	-	-	-	-	-	-	-
1974		1.0	1.0	-	-	-	-	-	-	-	-

Source: U.S. Department of Commerce, *Processed Fishery Products Annual Summary*. NOAR, XCFSA-5883 MF-4, Washington, D.C.

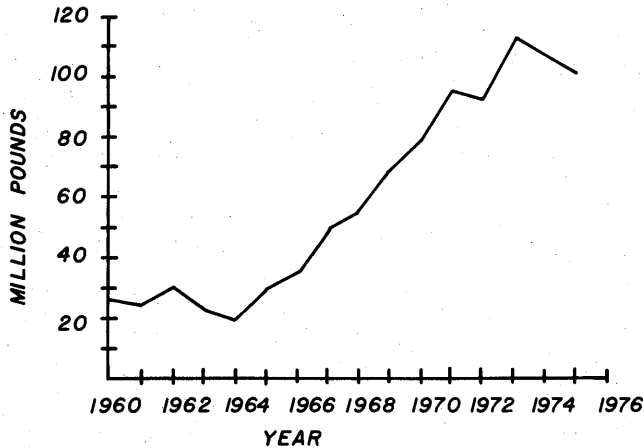


Figure 26. U.S. shrimp landings excluding the Gulf of Mexico.

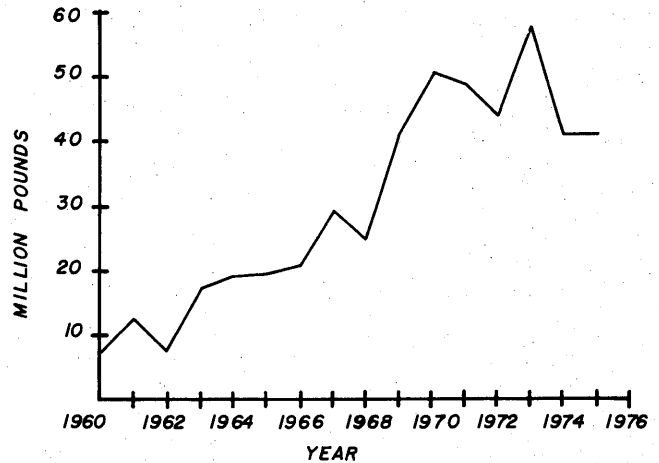


Figure 28. U.S. exports of shrimp.

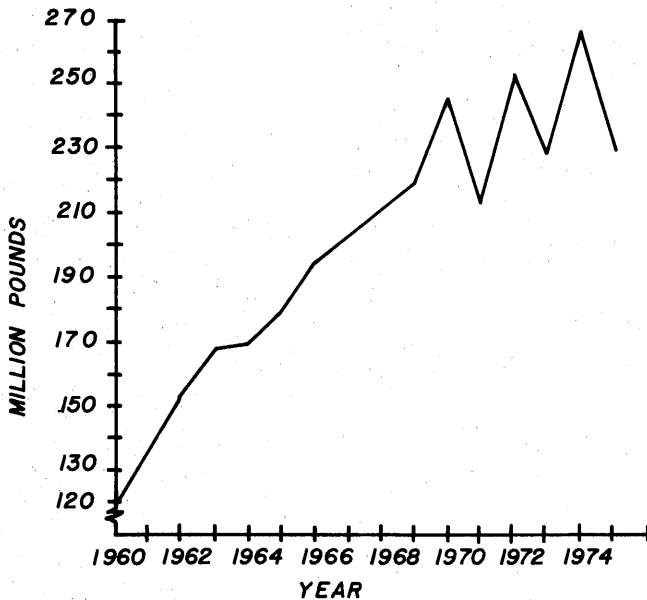


Figure 27. U.S. imports of shrimp.

question in this economic dilemma.

Questions such as future location, growth potential, and dependence on external supply are of utmost importance. Growth in the processing industry and the shrimp fishery to a large part depends on the competition for raw products produced outside of Florida. Domestic shrimpers who supply processors are facing fuel problems. This cost-price squeeze will be another growth-limiting factor in the processing industry through its direct effect on the production sector. Also important is the question of who gets hit the hardest during economic hard times—the shrimper or the processing industry.

Producers claim imports cause their dockside prices to be lower—yet, the processors cannot survive at the current level without imports. And,

if the processors go—to whom does the vessel owner sell the shrimp he catches? It's almost a can't live with 'em—can't live without 'em situation for both producer and processor.

International Considerations Under Extended Jurisdiction. In 1976, the Mexican Government extended its jurisdiction over fisheries from 19.2 to 320 km (12 to 200 mi) with an effective date of August 1. Mexico intends that its own fleet will be harvesting the total allowable catch from its Gulf waters by the end of 1979. A plan has been proposed to phase out foreign vessels by that time.

Although shrimp can be found all along the Mexican Gulf coast, the principal shrimp fishing areas may be separated into three regions.

1. "The 24-10 Grounds" (Tampico grounds), so called because of its location around Latitude 24° 10' N, extends some 280 km (75 statute mi) along the northern Mexican coast from a point about 120 km (75 mi) north of Tampico to 32 km (20 mi) south of the Rio Grande River. Brown shrimp is the major species. This area is contiguous to the Texas brown shrimp grounds and thus has supported a substantial fishery for Texas-based vessels. It contains some 920,000 ha (2.3 million ac) of trawlable bottom according to Hildebrand (1954).

2. The Campeche Area lies in the southern Gulf from Ciudad Carmen to Campeche. Pink shrimp is the predominant species.

3. The Contoy Area is located in the vicinity of Isla Contoy at the eastern end of the Yucatan Peninsula and yields pink shrimp and rock shrimp. The majority of the U.S. catch in this area is landed in Florida. Allen et al., (1976).

In 1975, some 530 U.S. vessels landed 7.6 million lb of shrimp valued at \$15.7 million from waters off Mexico. Increasing fuel costs since 1973 have reduced long trips. From 1962 to 1972, 632 to 860 U.S. vessels fished off the Mexican coast annually (Allen et al., 1976).

In more recent years, most of the U.S. fishing effort has been directed to the 24-10 grounds north of Tampico.

The United States and Mexico have negotiated a proposed treaty by which Mexico would initially reduce U.S. shrimp catch and vessels by 40%. In the first year, no more than 318 U.S. vessels would be licensed, with fees in excess of \$2,000 per annum per vessel to take up to 6.0 million lb of shrimp. Mexico has zoned its waters into three zones with a "Tampico Zone" west of 94°W longitude, "Contoy Zone" east of 88°W longitude, and "Campeche Zone" in between the "Tampico" and "Contoy" zones. No U.S. fishing is to be permitted in the Campeche Zone.

The impact of the eventual loss of the Mexican shrimp grounds can be viewed two ways. First, in terms of the loss of total landings and value of the landings to each Gulf state, and second, in terms of the economic impact on the U.S. Gulf of Mexico shrimp fisherman. Since both involve the total Gulf of Mexico shrimp fishery, a yield function for U.S. water will be needed to evaluate both matters.

Yield Function. In most fisheries, the yield function is affected by both stock and crowding externalities. While the Gulf of Mexico shrimp fishery does experience crowding externalities, it does not experience the stock externalities since shrimp is an annual crop. Thus, assuming a constant population from year to year, as effort is increased catch approaches some annual maximum yield (Schaefer model).

The natural environment in the estuaries has a significant effect on annual shrimp production. Barrett and Gillespie (1973) have shown that temperatures and salinities of bays and estuaries are important factors affecting the production of shrimp. High Mississippi River discharge during the period that shrimp are in their nursery grounds reduces the temperature and salinity and causes the shrimp population to be reduced and in turn the catch. Therefore, included in the analysis is the average of the three highest months of Mississippi River discharge from January to May which is the period when the majority of the shrimp are in the nursery grounds. Brown and white shrimp comprise the majority of the shrimp landed by U.S. fishermen in the Gulf and their nursery areas are concentrated around the Mississippi River system.

With the existence of these conditions, the following yield relationship was used

$$Y = b_0 D^{b_2} [1.0 - (b_1)^E], \quad (\text{Equation 1})$$

where $b_0 D^{b_2}$ is the maximum yield the function approaches for a given level of average monthly river discharge, D , (U.S. Army Corps of Engineers 1961-1974) and b_1 indicates the ratio by which marginal products of E (effort) decline. This Spillman type function seems

to be ideally suited to the biological relationship exemplified by Gulf shrimp fisheries (Heady and Dillon, 1966).

The catch-effort data used to estimate this relationship were developed from individual vessel records collected by the National Marine Fisheries Service for the period 1962 to 1974 and is shown in Table 8 (U.S. Department of Commerce, 1962 to 1974). Catch is total pounds (heads-off) landed by vessels in the Gulf of Mexico and total effort is measured by days fished standardized by the relative fishing power of the individual vessels.

Equation (1) was estimated using regression analysis* and time series data for the period 1962 to 1974 for vessels as follows:

$$Y = 6593 D^{-0.60134} [1.0 - 0.995701^E], \quad (\text{Equation 2})$$

where Y is in million pounds and E is in thousand units.

Setting average daily river discharge at its mean value of 696 cubic feet per second, the maximum yield for vessels in the shrimp fishery is estimated to be 128.7 million lb annually (Figure 29, upper panel). Assuming the level of effort extended by U.S. Gulf of Mexico shrimp fishermen in the U.S. portion of the Gulf of Mexico to be the 260,800 units (1970 to 1974 average, Table 8), the associated expected yield (or catch) is 86.9 million lb. With an anticipated increase of 30,600 units of effort by U.S. shrimpers diverted from Mexican waters (1970 to 1974 average, Table 7), the new effort level will be 291,400 with expected shrimp yield of 91.9 million lb. Thus, while the loss of shrimp landings from Mexican waters will cause a decrease in total landings by U.S. vessels (9.6 million lb average, 1970 to 1974, Table 7), the 30,600 units of effort formerly exerted in Mexican waters and diverted to U.S. waters will have an expected increase in yield from U.S. waters of 5 million lb ($91.9 - 86.9 = 5.0$). This will be a net decrease of 4.6 million lb for the shrimpers in the five Gulf States.

Effect of Annual Landings by States. Using the yield function (Equation 2) and the percent of total landings by vessels for each state it is possible to look at the situation in the Gulf shrimp fishery *before* Mexico's extended jurisdiction and then estimate the new situation in the Gulf shrimp fishery *after* Mexico's extended jurisdiction. Upon estimating the *before* and *after* situation, the net effect is determined. The results of these situations are shown in Table 16. It is assumed that the effort diverted from Mexico is uniformly distributed and that no adjustment is made for seasonality of harvesting.

Florida's expected net reduction in landing vessels is 0.72 million pounds. The net decrease in value of shrimp

*Coefficients were significant at the 99% level. R^2 was 78.5. Durbin-Watson was 2.25. The simple correlation coefficient between landings and effort is 0.64 and landings and discharge is -0.63.

TABLE 16.
Net effect for pounds landed and value of landings (at 1975 prices)
based on total pounds landed by vessels by state.

Item	Florida	Alabama	Mississippi	Louisiana	Texas
1. Before Extended Jurisdiction					
a. Production from U.S. waters					
Pounds	14.08	8.08	3.04	19.99	41.71
Dollars	22.39	16.48	4.59	33.18	86.34
b. Production from Mexican waters					
Pounds	1.7	0.0	0.0	0.0	7.9
Dollars	3.0	0.0	0.0	0.0	18.0
c. Total Gulf					
Pounds	15.78	8.08	3.04	19.99	49.61
Dollars	25.39	16.48	4.59	33.18	104.34
2. After Extended Jurisdiction					
Production in U.S. Waters					
a. From effort diverted from Mexican waters					
Pounds	1.74	0.0	0.0	0.0	7.91
Dollars	2.77	0.0	0.0	0.0	16.38
b. From effort originally exerted in U.S. waters					
Pounds	13.32	7.65	2.88	18.92	39.48
Dollars	21.18	15.61	4.35	31.41	81.72
c. Total Gulf					
Pounds	15.06	7.65	2.88	18.92	47.39
Dollars	23.95	15.61	4.35	31.41	98.10
3. Net Effect of Extended Jurisdiction					
Pounds	-0.72	-0.43	-0.16	-1.07	-2.22
Dollars	-1.44	-0.87	-0.24	-1.77	-6.24

Source: Griffin, 1977.

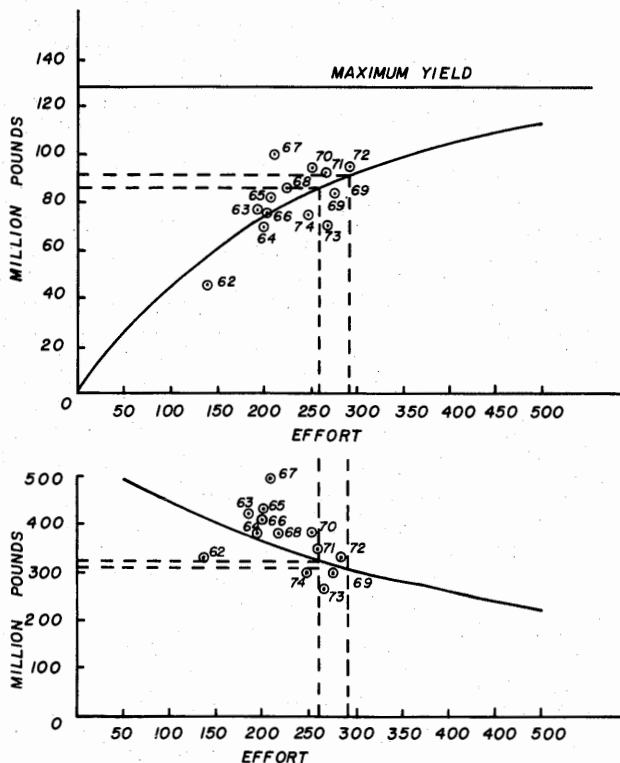


Figure 29. Estimated catch-effort relationship of vessels in the Gulf of Mexico

landing is \$1.44 million (1975 prices). The price per pound in the net decrease is \$2.00 which is higher than the average price per pound of \$1.59 for shrimp landed in Florida by vessels. This reflects the marginal cost per pound to the vessel owner for not shrimping in Mexican waters. The total economic impact on Florida using a total value added multiplier of 3.4 (Centaur Management Consultants, Inc, 1975), would be \$4.9 million.

The net decrease in Texas landings is 2.22 million lb at a reduction in value to shrimpers of \$6.24 million (1975 prices) to the vessel owner. The loss of those 2.22 million lb of shrimp occurs at a marginal cost of \$2.81 per lb. Total impact on the Texas economy using the output value of 3.08 would be \$19.19 million (Jones et al., 1974). Alabama, Mississippi and Louisiana had a net reduction in landings of 0.43 million, 0.16 million and 1.07 million, respectively, a net reduction in value of \$0.87 million, \$0.24 million and \$1.77 million, respectively; and using a total value added multiplier of 3.4, these three states would have an estimated economic impact of \$2.96 million, \$0.82 million and \$6.02 million, respectively.

Economic Effect on Industry. It is assumed that when Mexico's extended jurisdiction goes into full effect in 1980, 30,600 units of effort (E_m in Figure 30) will be diverted to U.S. waters. Assuming that the U.S. Gulf of

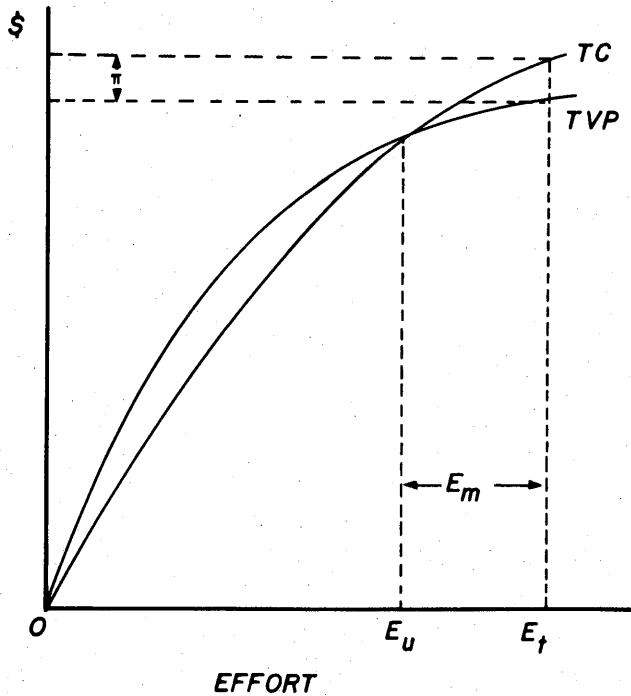


Figure 30. Hypothetical curves showing industry equilibrium in an open access fishery.

Mexico fishery is currently in open access equilibrium at E_u (Figure 30) where total value product (TVP) equals total cost (TC), we should expect a temporary disruption of that equilibrium to E_t .

Since rent is zero at equilibrium in an open access common property resource (Gordon, 1954), rent (π) will be temporarily negative due to the excess effort. The efficiency cost of this excess effort is given by the present value of the stream of negative rent over the period of time it takes to shift E_m units of effort out of the fishery and return to equilibrium. To estimate this cost we consider first the impact on the estimated yield function (Equation 2).

When the 30,600 units of effort presently exerted in Mexican waters are diverted to U.S. waters, the industry will temporarily incur negative rents. The expected increase in effort ($E_m = 30,600$) will result in an increase in TVP from \$147.6 million to \$156.4 million and in TC from \$147.6 million to \$161.4 million. At 291,400 units of effort, rent accruing to the fishery would be a negative \$5.1 million per year.

Since the industry is no longer in equilibrium, it will move toward the equilibrium effort level of 260,800 units if cost-price relationships do not change. The magnitude of the real cost to the industry is the annual stream of net loss over that period of time until equilibrium is reached. Table 17 shows the present value of the stream of losses for alternative adjustment periods, the prices per pound of shrimp landed assuming a 10% discount

TABLE 17.

Present value of U.S. cost to the Gulf shrimp fishery due to Mexico's extended jurisdiction for alternative adjustment periods, and product prices (assuming equilibrium effort at 260,800 units and a ten percent discount rate).

Years to Adjust	Ex-Vessel Price Per Pound			
	\$1.70	\$2.00	\$2.50	\$3.00
	(Million Dollars)			
1	4.6	5.5	6.9	8.3
3	8.6	10.1	12.8	15.4
5	12.1	14.3	18.0	21.8
7	15.2	18.0	22.7	27.4

Source: Griffin and Beattie, 1977.

rate. Adjustment is assumed to take place in equal increments of effort each year until equilibrium is reestablished (i.e., 260,800 units of effort).

At a price of \$1.70 per lb of shrimp landed, a discount rate of 10% and a 3-year adjustment period, the present value of the stream of net losses would be \$8.6 million. Assuming the same price and discount rate but 5 years to adjust, the net present value of the stream of losses would be \$12.1 million. Obviously, the longer the adjustment period, the larger the loss. The average shrimp price received in 1973 was \$1.70 per lb. Both price and cost have increased since then. The average price received is now closer to \$2.50 per lb, thus the present value of the stream of net losses would be larger.

The above is based on the assumption that shrimp prices and costs of production increase so that the same equilibrium effort level is maintained. If the price of shrimp increases relatively faster than the cost of harvesting shrimp, equilibrium effort will increase beyond the originally assumed 260,800 units for the U.S. waters. When the U.S. effort expended in Mexican waters is diverted to U.S. waters (implying approximately 290,000 units of effort exerted in U.S. waters), the achievement of open access equilibrium *without* a reduction in effort in 1976 would require a price of \$2.17 per lb landed (Griffin and Beattie, 1977).

2.4 THE GULF SHRIMP FISHERY: HISTORICAL FISHERY STATISTICS

Gunter and McGraw (1973) wrote the following account concerning the history of the Gulf of Mexico shrimp fishery:

From 1902 the shrimp production in this country increased into the early 1950's. In the 1940's an extreme drought caused a great shortage of white shrimp, especially in Texas waters, and there fishermen turned to the previously unfished brown shrimp which were caught predominantly at night. Most states had laws against shrimping at

night for the protection of the white shrimp, the idea being that they should not be harassed all hours of the twenty-four. The large brown shrimp generally bury in the bottom during the day. Recognition of these facts led to exploitation of the brown shrimp and after the early '50's it has yielded more than the white shrimp. This development began in Texas waters in 1947 and spread quickly to other areas on the Gulf and South Atlantic Coast. Even so, the separation of the brown and white shrimp was not begun in the federal statistics until 1957. Therefore, we may say that the shrimp production figures used here were comprised almost entirely of white shrimp from 1903 to 1948, with about 1% being seabobs. From 1948 to 1957 there was a period of production when the brown shrimp and white shrimp were not separated. After 1957 these shrimp have been separated in the catch statistics of the South Atlantic and Gulf Coasts. At that time the seabobs were also separated in the statistics.

From 1951 to 1956, inclusive, the heads-off weight of white and brown shrimp produced ranged between 126 and 146 million lb and in the 1967-71 period it ranged from 125 to 137 million lb. These are the only years, except for 1963, that the United States shrimp production has ever ranged above 100,000,000 lb of headless shrimp. The 1951-56 high production was due to the exploitation of the previously unfished population of brown shrimp plus the white shrimp. The more recent high production seems to be due to an increase in the white shrimp population, caused possibly by a recent hyperfertilization of the bays.

Beginning in 1956, the U.S. Bureau of Commercial Fisheries and its successor, the National Marine Fisheries Service, have published *Gulf Coast Shrimp Data*. These data provide monthly information by species, size, depth, area fished, actual days fished in number of days and dockside value. These data were transformed onto computer tapes by Dr. Wade Griffin, TAMU and subjected to extensive computer studies by Mr. Richard Condrey, LSU. These studies are too extensive for inclusion in this management plan, however copies will be available from Gulf Coast Research Laboratory until such time as the author recalls the report for further work and/or publication. A summary of this report is presented in the remaining paragraphs of this section.

Statistical areas utilized in *Gulf Coast Shrimp Data* were grouped by the Task Force into environmentally similar regions (Figure 31) that may have regional management requirements. The area comprising each of these regions is given in Table 18. Inshore and offshore regions were treated as distinct units. Data from 1963 to 1975

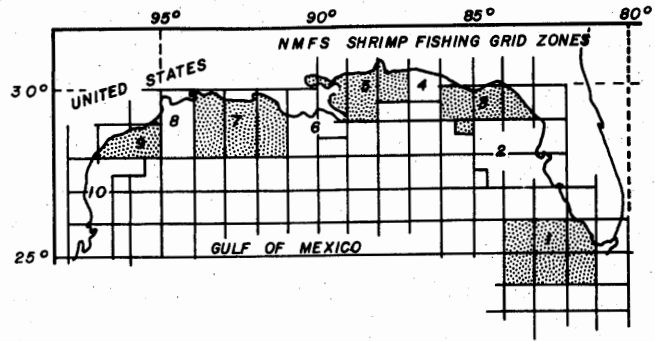


Figure 31. Regions selected by the Task Force for analyses of related inshore and offshore data from *Gulf Coast Shrimp Data* (1959 to 1975).

TABLE 18.

Composition of environmentally similar regions selected by the Task Force.

Region	Geographic Area
1F ¹	Florida Keys—Cape Romano, Florida
2I ² , F	Cape Romano, Florida—Cedar Keys, Florida
3I, F	Cedar Keys, Florida—West Bay, Florida
4I, F	East Bay, Florida—Pensacola Bay, Florida
5I, F	Pensacola Bay, Florida—Garden Is. Bay, Louisiana
6I, F	Garden Is. Bay, Louisiana—Four League Bay, Louisiana
7I, F	Four League Bay, Louisiana—Sabine Lake, Louisiana
8I, F	Sabine Lake, Louisiana—Lower Galveston Bay, Texas
9I, F	Lower Galveston Bay, Texas—Copano Bay, Texas
10I, F	Copano Bay, Texas—Mexican Border

¹F—offshore waters

²I—inshore waters

were utilized in the study. Except where stated, ex-vessel value was standardized to the 1967 dollar with the wholesale price index. Catch is expressed in pounds of heads-off (tails) shrimp.

The average annual catch (1963 to 1975) for the seven species of shrimp considered in this plan is compared in Figure 32. The largest and most valuable is the brown shrimp fishery, followed by white and pink shrimp fisheries. Seabob, royal red and rock shrimp fisheries are smaller industries of local importance.

Three major species are fished by two distinct fishing fleets, the inshore and offshore fleets, and as such comprise six major fisheries. The offshore brown shrimp catch averages 47.1 million lb annually (average value of \$40.5 million) and is the largest and most valuable fishery. The second largest and most valuable is the offshore white shrimp catch (an average of 22.3 million lb valued at \$19.5 million). The third and fourth largest catches are from the inshore brown and white shrimp fisheries. Offshore pink shrimp catches are the fifth most valuable (averaging \$9.1 million) with an average annual catch of 12.2 million lb.

The average yearly value per pound (1963 to 1975) of

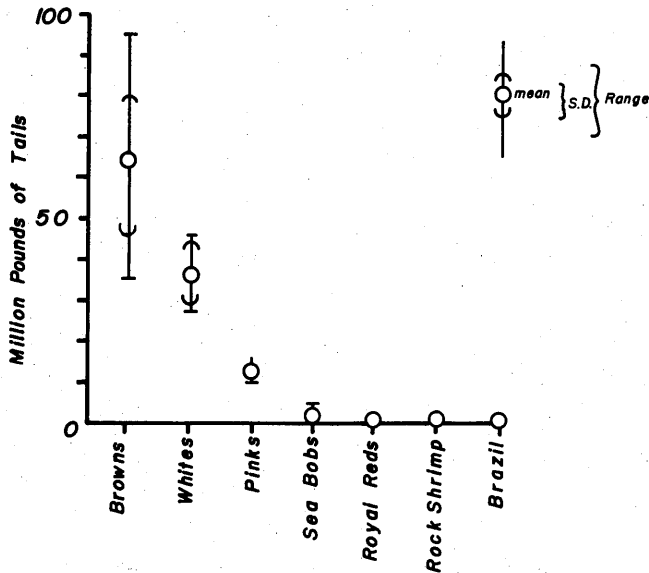


Figure 32. Average annual commercial catch of major shrimp species in the northern Gulf (1963-1975).

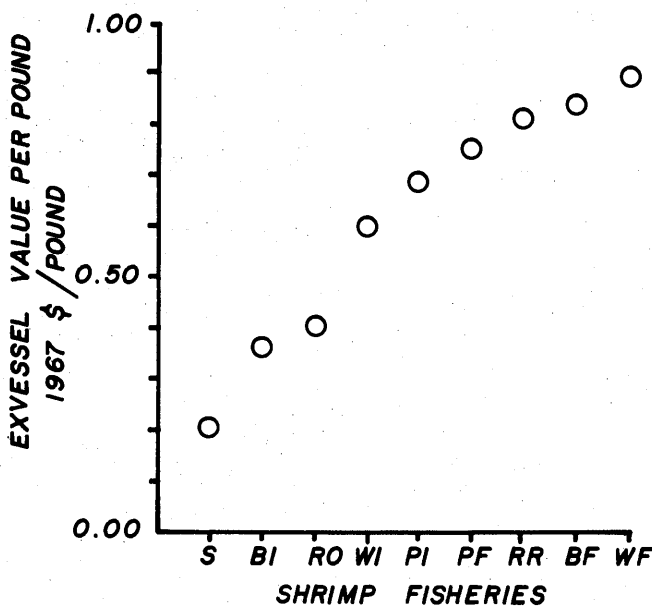


Figure 33. Average ex-vessel value (per pound in 1967 dollars) of the major shrimp fisheries in the northern Gulf (1963-1975).

each fishery is compared in Figure 33. Greatest value per pound is obtained in offshore fisheries for white, brown, royal red and pink shrimp. Inshore white and pink shrimp were of intermediate value per pound while a low value per pound was characteristic of seabobs, inshore brown and rock shrimp.

Regional Distribution of the Catch. The average annual catch and value of the three main species by region are compared in Figures 34 and 35. Except for Region 3 (Florida panhandle), there is little overlap of pink shrimp with white and brown shrimp. A large overlap exists in

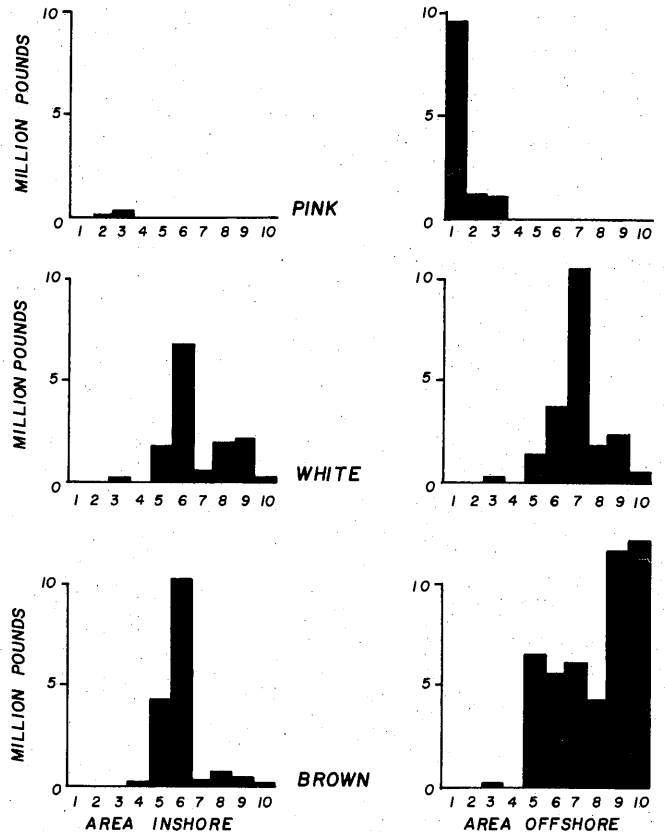


Figure 34. Average catch of pink, white and brown shrimp by major shrimping grounds in the northern Gulf (1963-1975).

the brown and white shrimp fisheries and regions of peak catch are very similar in the inshore fisheries. This co-occurrence requires careful management to assure optimum harvest of each species.

Both the brown and white shrimp inshore fisheries have maximum catches along the Louisiana coast west of the Mississippi Delta (6I). Although the brown shrimp catch is larger in this area, the value of the annual harvest of white shrimp is higher. The region from Pensacola Bay, Florida to the Mississippi Delta (5I) contains the only other substantial inshore catch of brown shrimp. The inshore white shrimp fishery is also relatively large in this area as well as along the upper Texas coast (8I and 9I). There is no substantial inshore pink shrimp fishery along the U.S. Gulf coast.

A substantial offshore brown shrimp fishery occurs in the Gulf of Mexico from Pensacola Bay, Florida to Brownsville, Texas (5F, 6F, 7F, 8F, 9F and 10F) with maximum catches occurring along the Texas coast. The offshore white shrimp fishery occurs in the same regions as the brown shrimp fishery, however, the maximum catch is recorded from the Mississippi Delta to Sabine, Texas. The value for both of these fisheries is generally proportional to the catch. The offshore pink shrimp fishery is limited mainly to the Sanibel-Tortugas region in Florida (1F).

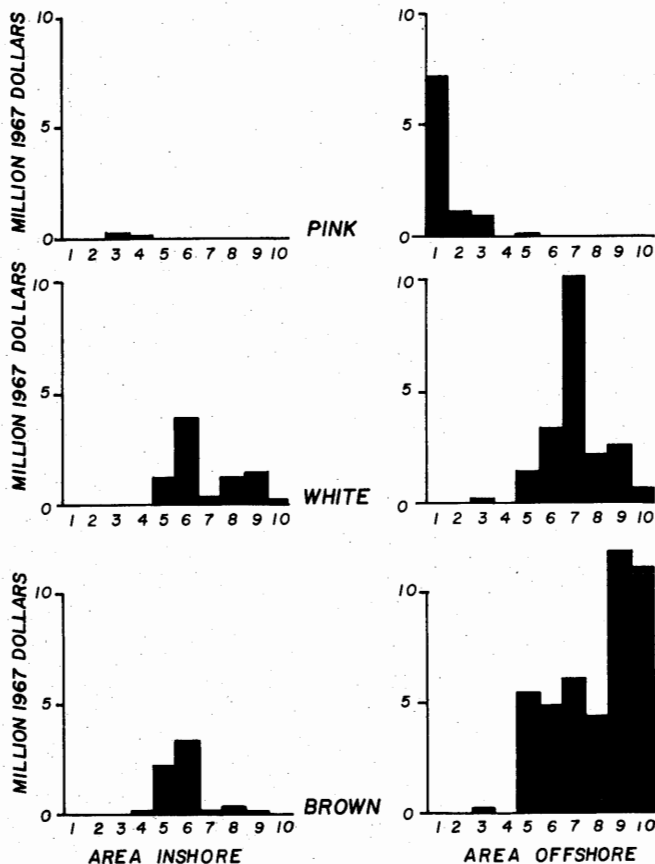


Figure 35. Average ex-vessel value of pink, white and brown shrimp by major shrimping grounds in the northern Gulf (1963-1975).

The region of maximum inshore catch for both brown and white shrimp does not coincide with the region of maximum offshore catch for either species. For both fisheries this pattern may be due either to a westward and southward migration, to the local closure of inshore areas in regions where the offshore concentrations are high, or both.

The three minor species are compared in Figure 36. The seabob fishery is concentrated in the north central Gulf (Regions 6 and 7). Rock shrimp are predominantly taken along the Florida panhandle (Region 3) and royal red shrimp are mainly taken offshore in the Sanibel-Tortugas area of Florida and off the Mississippi Delta.

Yearly Harvest. Yearly variability in catch of the inshore and offshore brown shrimp is shown in Figure 37. The yearly harvest of these two fisheries is similar and is in accordance with observations that the offshore catch can be predicted by the density and size of the inshore bay populations. The offshore catch averages 2.8 times larger than the inshore catch.

Record catches for brown shrimp were reported in 1967 and 1968 and 1970 to 1972 in both the offshore and inshore fisheries. The high offshore catch in 1959 and 1960, however, is not reflected by a similar high inshore

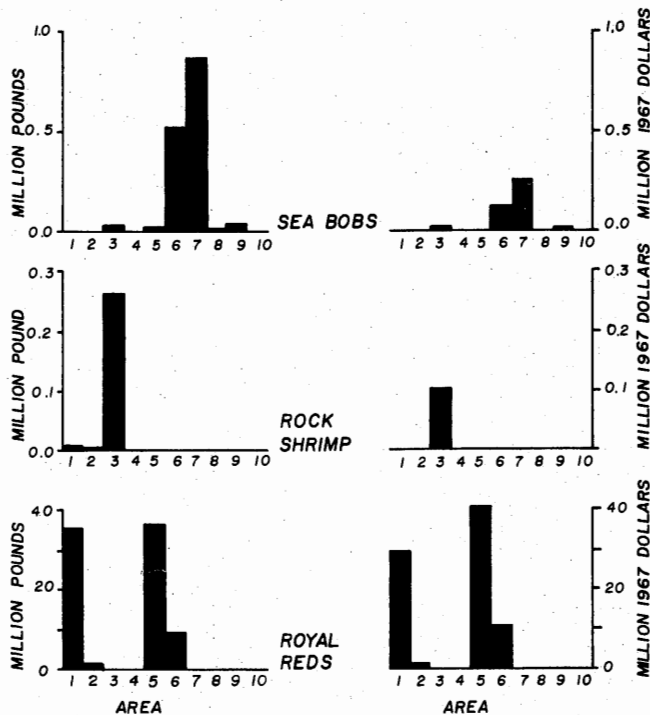


Figure 36. Average catch and ex-vessel value of seabob, royal red and rock shrimp in the major fishing areas of the northern Gulf (1963-1975).

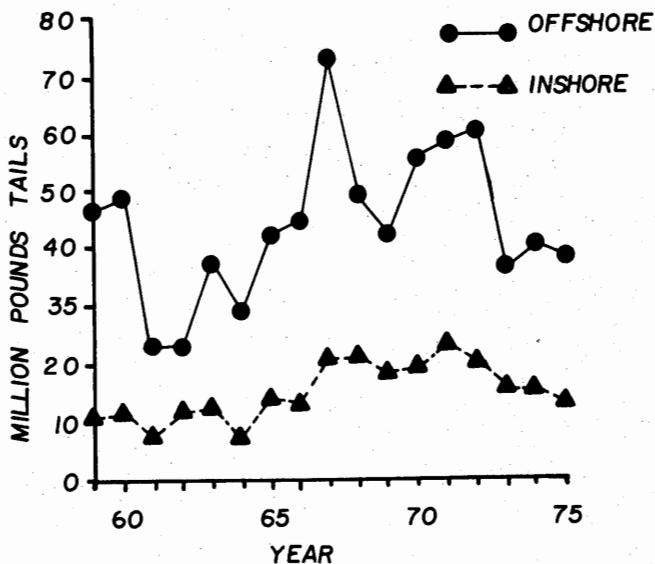


Figure 37. Yearly trends in the catch of brown shrimp from inshore and offshore northern Gulf fisheries.

catch. Catch in the offshore and inshore fisheries fell during 1973 to 1975, apparently as a result of high Mississippi River discharge during the spring.

The yearly brown shrimp catch by area is shown in Figure 38. The correlation between the catch of the major area fisheries on a one-to-one basis was investigated with the Spearman rank correlation coefficient.

A strong correlation exists in the brown shrimp fishery

BROWN SHRIMP

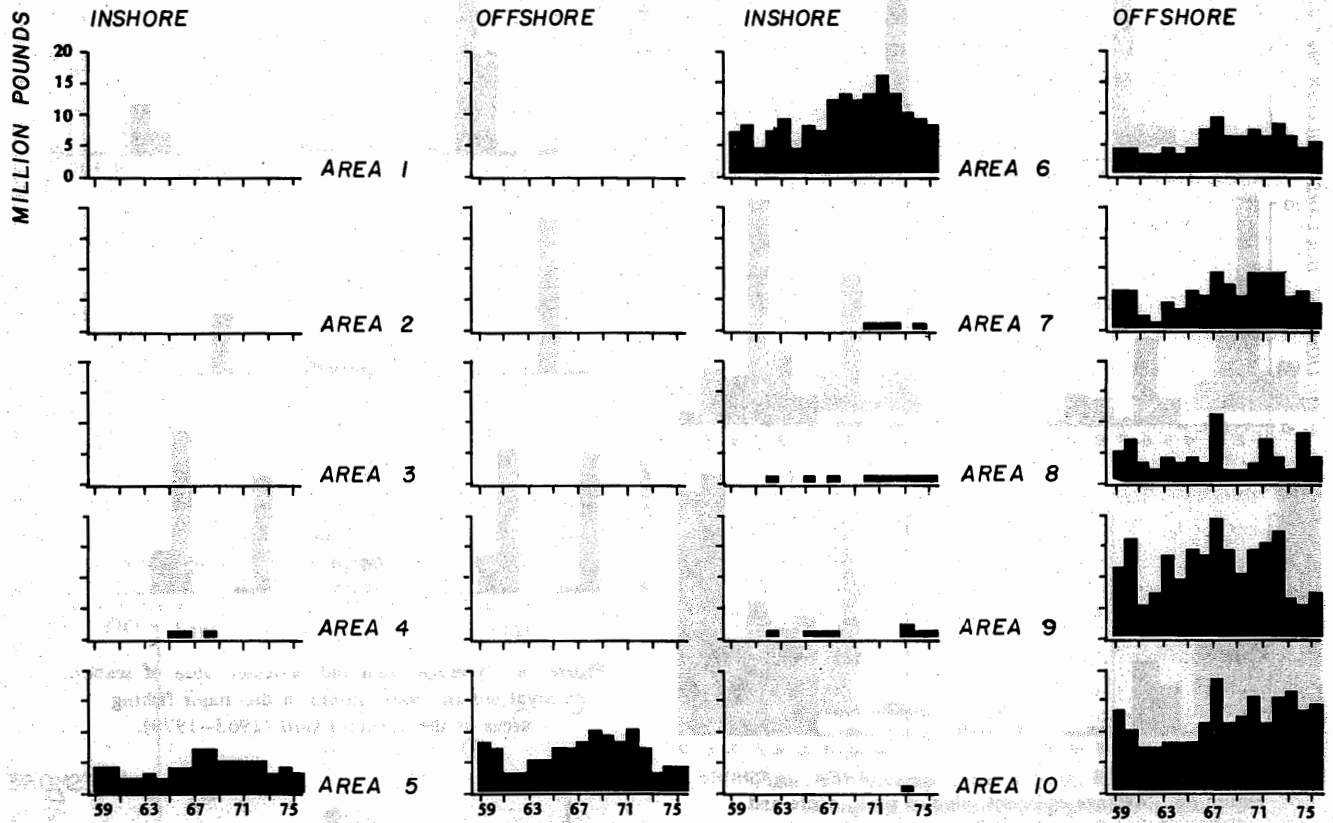


Figure 38. Yearly brown shrimp catch in the major fishing areas of the northern Gulf.

between the inshore and offshore areas of the north central Gulf (Regions 5 and 6). On the average, the catch in Region 5I is 0.63 times the catch in Region 5F while the catch in Region 6I is 1.8 times the catch in Region 6F. These two regions are also correlated with the offshore fishery from central Louisiana to Sabine, Texas (7F). This correlation indicates the possibility of a dependence of the brown shrimp fishery upon environmental functions. In each of these areas, managers have long noted the effect of spring warming and river discharge on the annual catch of the fishery. For example, in Louisiana high catches of brown shrimp are predicted when March and April temperatures and salinities are above normal and spring Mississippi River discharges low (Barrett and Gillespie, 1973 and 1975).

Yearly variability in the inshore and offshore catch of white shrimp is shown in Figure 39. As with brown shrimp, the yearly catch of these two white shrimp fisheries is similar. The offshore catch is related to the inshore catch by the following regression ($R^2 = 0.77$):

$$\text{Offshore catch} = 3.78 \times 10^6 + 1.27 (\text{Inshore catch})$$

Low catches were reported in the late 1950's and early 1960's with an extremely low catch of 4.2 million lb in

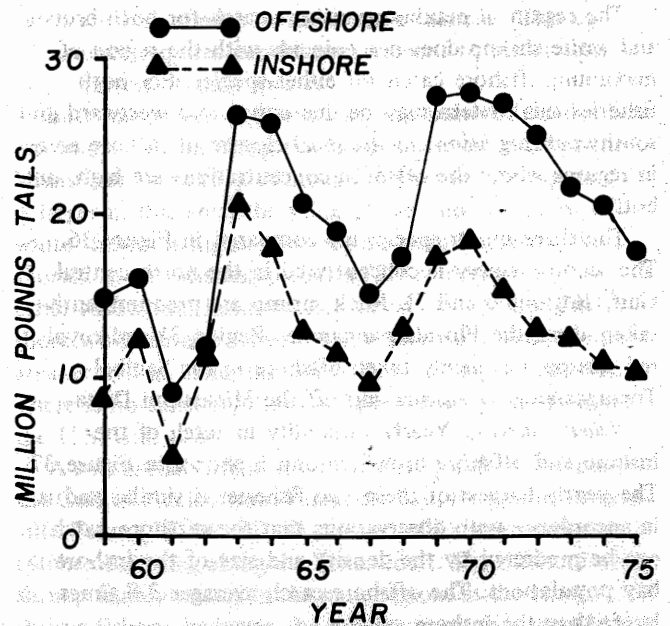


Figure 39. Yearly trends in the catch of white shrimp from inshore and offshore northern Gulf fisheries.

1962 in the inshore fishery and 9.2 million lb in the offshore fishery. Peak catches occurred in 1963 and 1964

and 1969 to 1971 with annual averages of 26.7 million lb in the offshore fishery and 17.8 million lb in the inshore fishery. Both fisheries experienced a steady decline from these peaks, and a rapid recovery occurred after both declines, indicating the strong effect of the 0-year class.

The yearly catch of white shrimp by region is shown in Figure 40. The 1963 and 1964 peak is seen mainly from the Mississippi Delta to Sabine, Texas (Regions 6I, 7I and 7F). The low catch in 1961 can be seen in most regions but it is most dramatic in the north-central Gulf. In general, the 1969 to 1971 peak is seen in most fisheries, but the later decline is not. While the catch generally declined in the north-central Gulf (Regions 5I to 6F) it did not decline along the Texas coast (Regions 8I to 10F). When the offshore fishery in Regions 6 and 7 are compared, it appears that the relative catch in 7F has increased over that in 6F in recent years, particularly 1971 to 1975. The reason for the decline in 6F and/or the increase in 7F is not apparent.

The correlation between the catch of white shrimp in the major areas was examined with the Spearman rank correlation analysis. As with the browns in Regions 5 and 6, the inshore white shrimp fisheries are fairly well correlated with the offshore fisheries for each major region

with the exception of Regions 7 and 8. The reduced correlation in Region 8 appears to be due to the unusually high catch in the offshore fishery in 1974 as compared to a less than average catch in the inshore fishery. Possible explanations for the reduced correlation in Region 7 are inadequate statistics of the inshore fishery, the closed waters of Rockefeller Wildlife Refuge or a westward migration of the white shrimp. As with the brown shrimp, there appears to be little correlation between the north-central Gulf fisheries (5I and 7F) and those in Texas (8I to 10F).

Variation in the inshore and offshore yearly catch of pink shrimp is shown in Figures 41 and 42. Unlike the brown and white shrimp fisheries, the patterns for the inshore and offshore catches are not similar. The inshore fisheries increased from a low in 1959 to a minor peak in 1968, declined to a new low in 1971 and rose to a high in 1973 to 1975. The offshore catch peaked in 1960 and 1964 to 1966 with low catches in 1959, 1962 and 1971 and 1972. As with brown and white shrimp, a good year can be followed or preceded by a poor year.

Yearly patterns in the area catch of pink shrimp are seen in Figure 43. The magnitude of the catch in the offshore Sanibel-Tortugas area of Florida (1F) dominates

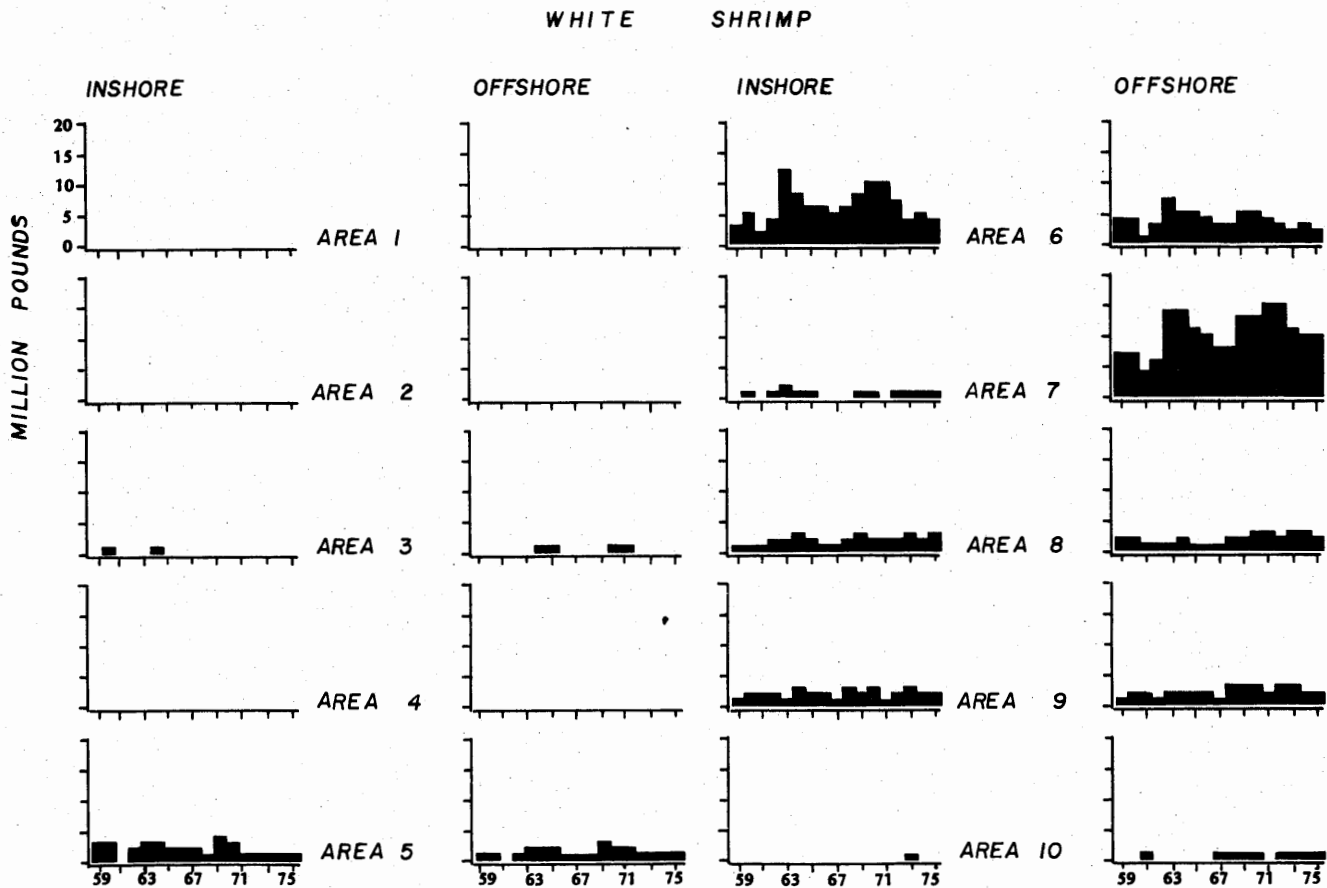


Figure 40. Yearly white shrimp catch in the major fishing areas of the northern Gulf.

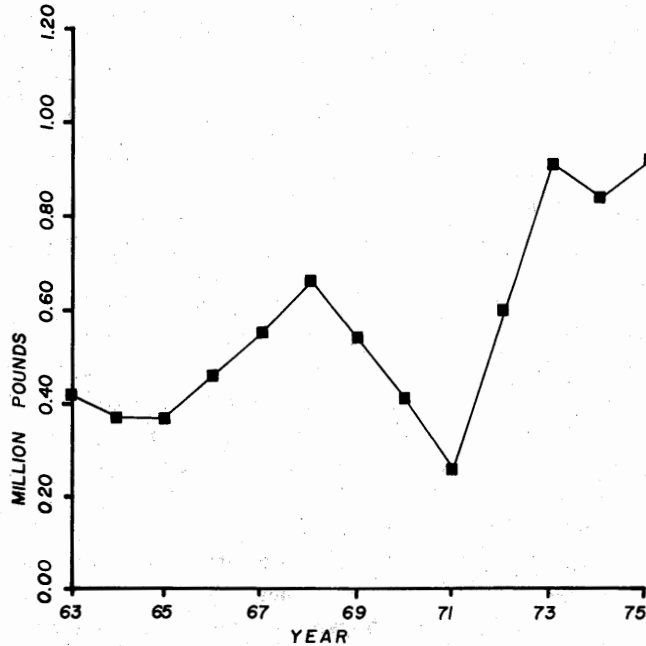


Figure 41. Yearly trends in the catch of pink shrimp from the inshore northern Gulf fisheries.

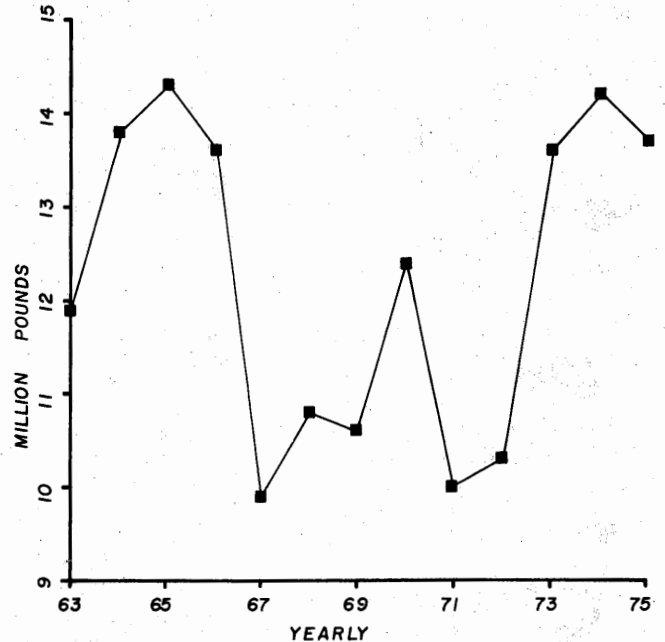


Figure 42. Yearly trends in the catch of pink shrimp from the offshore northern Gulf fisheries.

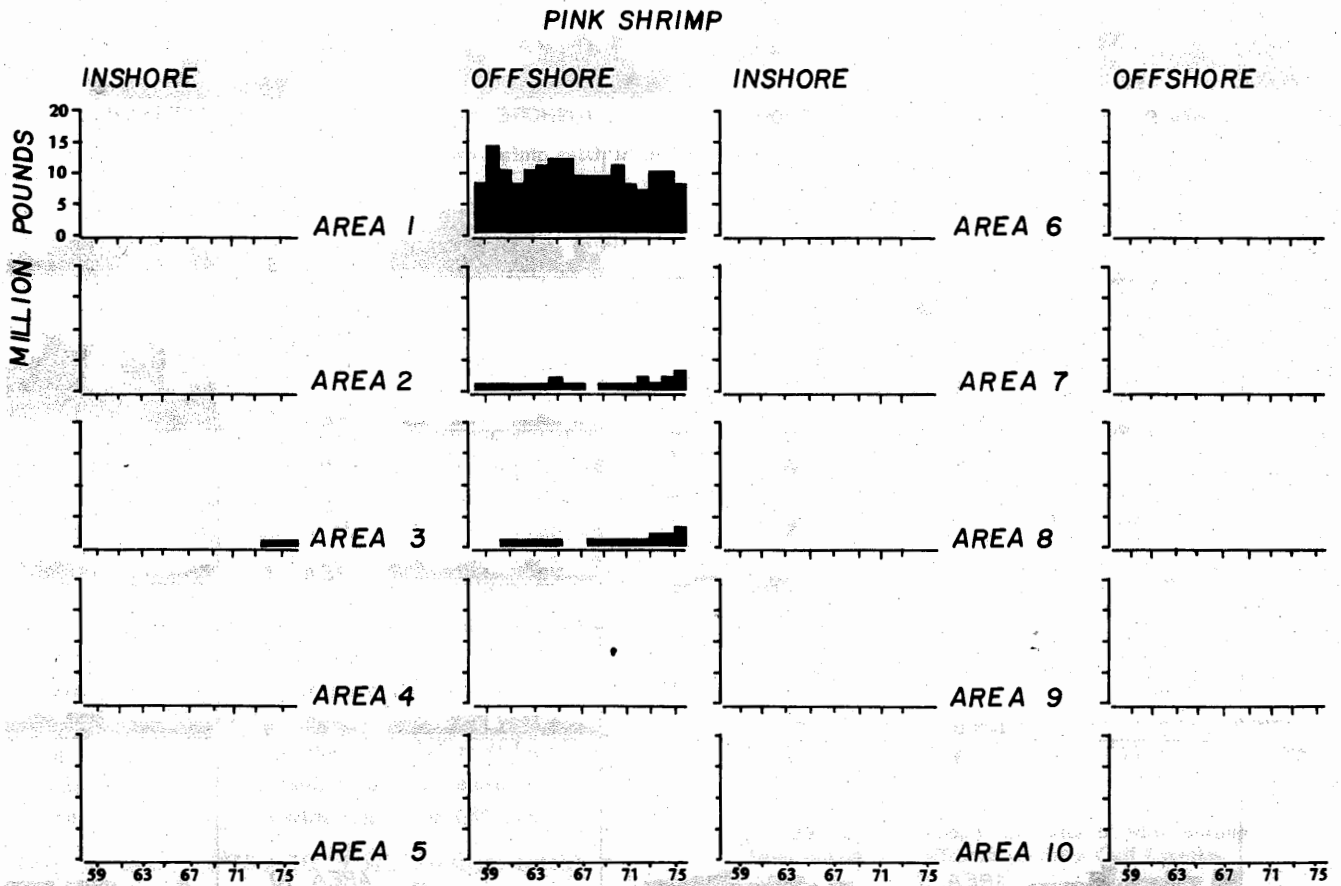


Figure 43. Yearly pink shrimp catch in the major fishing areas of the northern Gulf.

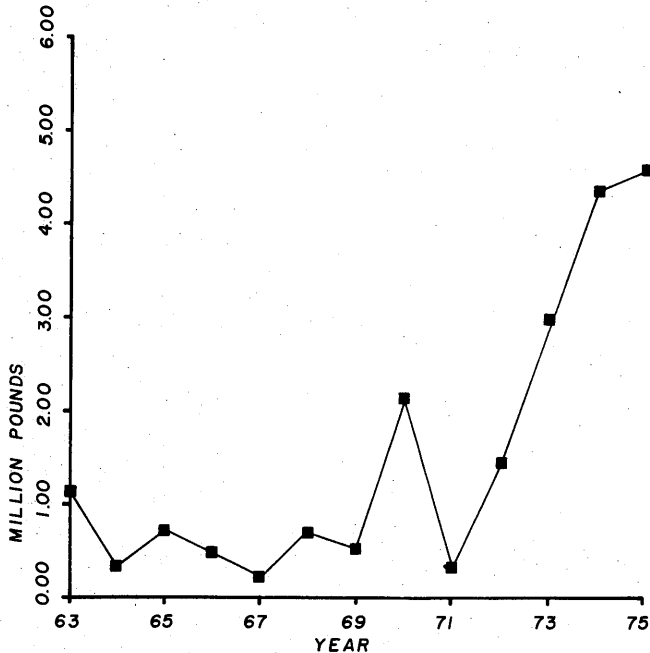


Figure 44. Yearly catch of the northern Gulf seabob fisheries.

the pattern. In most inshore regions, pink shrimp constitute a minor fishery and at this scale the inshore areas cannot be seen. However, from Charlotte Harbor to West Bay, Florida (2I and 3I) the catch appears to be increasing and is relatively important in these areas.

The yearly catch of seabobs is shown in Figure 44. Beginning in 1970, the catch of these shrimp indicates an erratic increase and reaches a maximum of 4.6 million lb in 1975. The catch is felt to be primarily a function of the value per pound to the fisherman and the supply of other shrimp in the area. The 1972 and 1973 record price for seabobs correlates well with this assumption as does the limited supply of white and brown shrimp in the northern Gulf. The variation in the catch of seabobs by area is shown in Figure 45. The majority of the catch is taken from the Mississippi Delta to Sabine, Texas and reflects yearly variation in the Gulf catch.

Yearly variation in the royal red catch is shown in Figure 46. The catch gradually increased from 1963 to 1968. It peaked sharply in 1969, then dropped abruptly in 1970 and remained low until 1973 and 1974 when it temporarily increased again. As shown in Figure 47, the

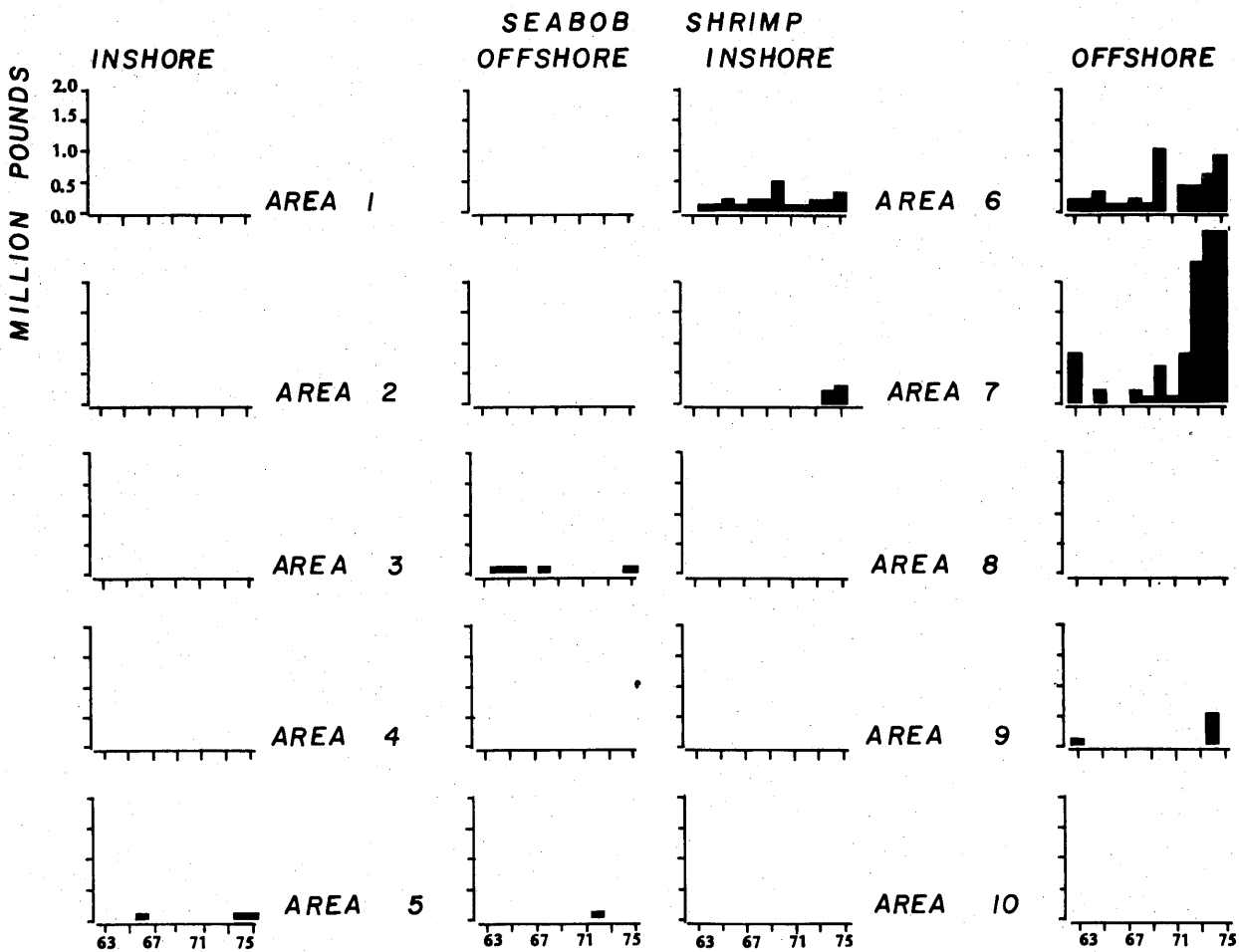


Figure 45. Yearly seabob catch in the major fishing areas of the northern Gulf.

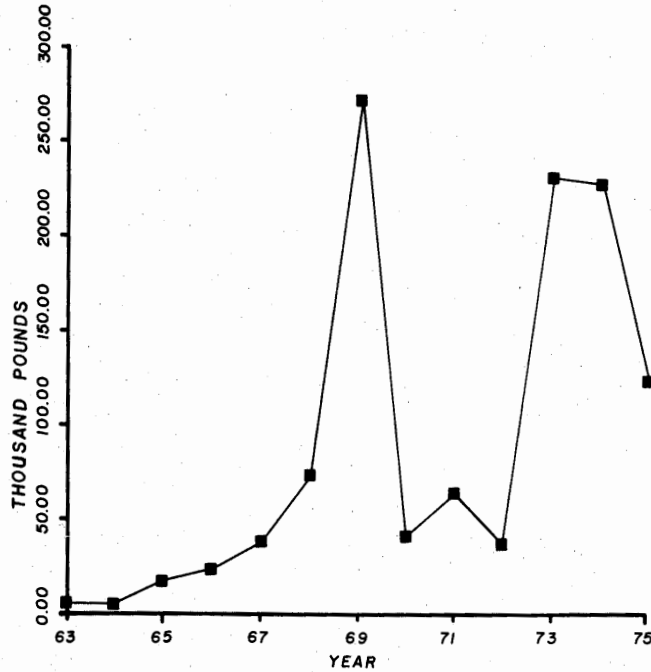


Figure 46. Yearly catch in the northern Gulf royal red shrimp fishery.

1963 and 1964 fisheries for royal red shrimp were limited to 5F. In 1965 the fishery expanded to 1F. Both of these areas are currently the major producers of this species although the fishery has also expanded to 6F and 2F.

The rock shrimp fishery is a relatively new one with the first reported catch in 1971. Substantial catches occurred in 1972, 1973 and 1975 (Figure 48). This species is almost exclusively taken in Florida and the catch from 3F dominates the yearly trends in catch by area (Table 19).

2.5 THE GULF SHRIMP FISHERY: YIELD

The term yield is defined by Webster's 3rd New International Dictionary, Unabridged as "the quantity of a product resulting from exploitation of natural resources." A number of yield strategies have been described for managers of commercially exploited species. Ricker (1975) defines several of these strategies as follows:

Equilibrium (or Sustainable) Yield: The yield in weight taken from a fish stock when it is in equilibrium with fishing of a given intensity, and

ROY RED SHRIMP

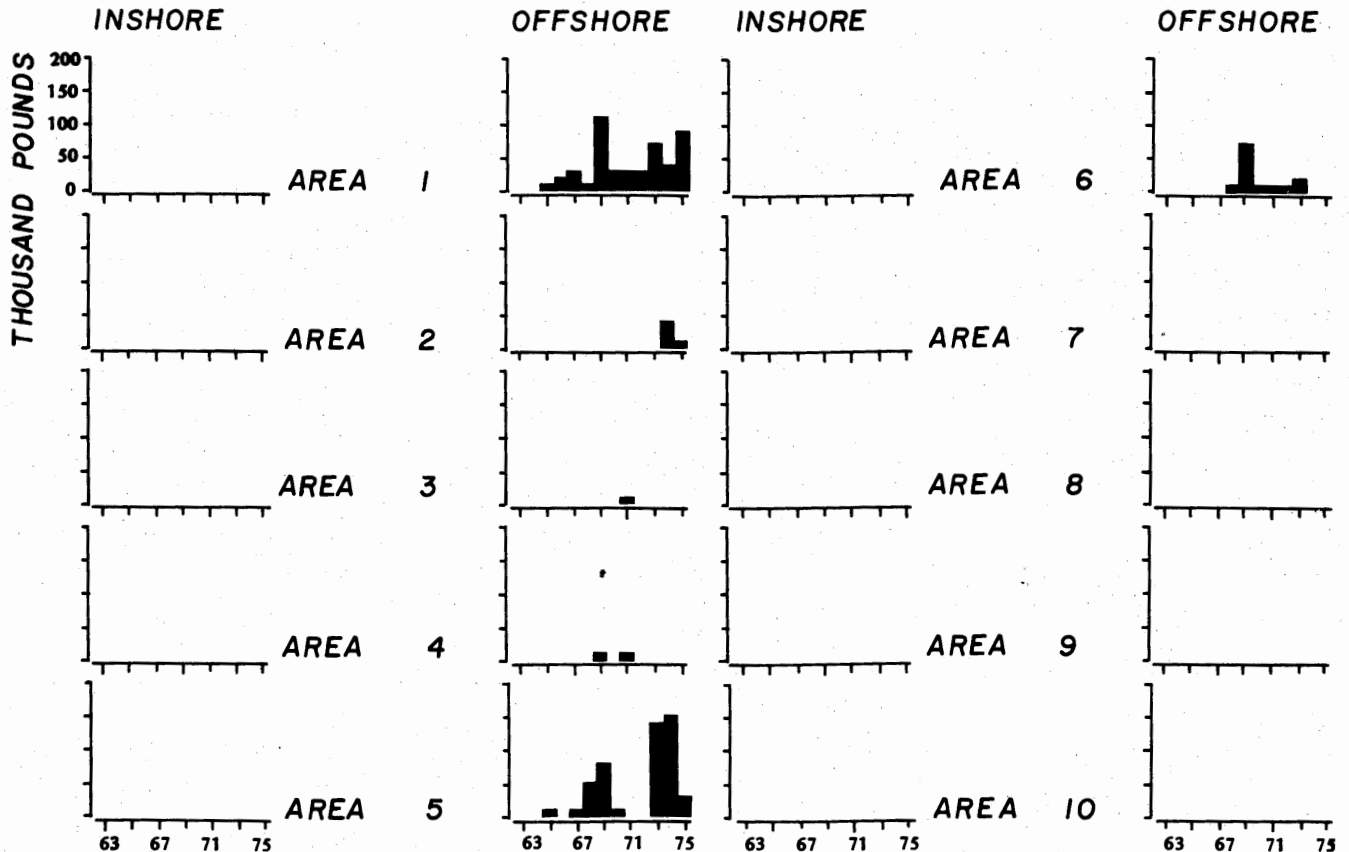


Figure 47. Yearly royal red catch in the major fishing areas of the northern Gulf.

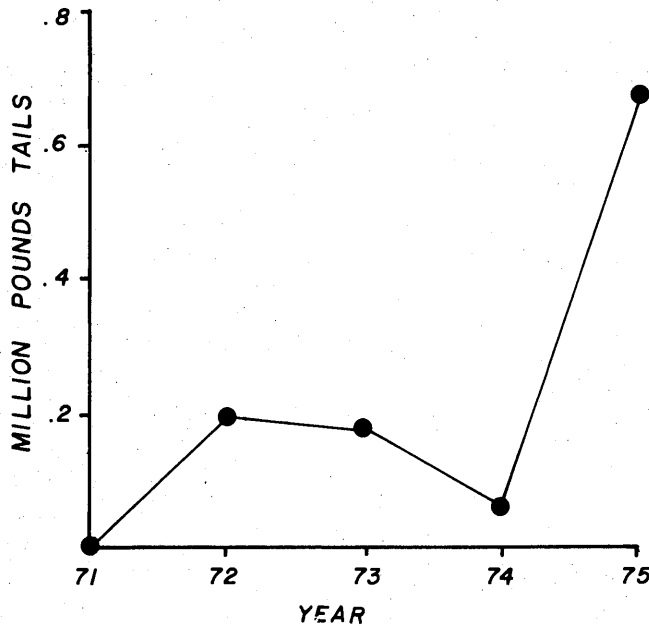


Figure 48. Yearly catch in the northern Gulf rock shrimp fisheries.

TABLE 19.

Catch of rock shrimp from shrimping grounds adjacent to Florida, in pounds.

Year	1F (lb)	2F (lb)	3I (lb)	3F (lb)
1971	0	0	113	0
1972	2,795	2,400	395	186,491
1973	20,575	3,889	456	152,625
1974	451	8,247	0	51,293
1975	29,550	9,816	0	634,376

(apart from effects of environmental variation) its biomass is not changing from one year to the next.

Maximum Sustainable (or Maximum Equilibrium) Yield: The largest average catch or yield that can continuously be taken from a stock under existing environmental conditions. For species with fluctuating recruitment, the maximum might be obtained by taking fewer fish in some years than in others.

Maintainable Yield: The largest catch that can be maintained from the population, at whatever level of stock size, over an indefinite period. It will be identical to the sustainable yield for populations below the level giving the MSY, and equal to the MSY for populations at or above this level.

Two other yield strategies which have gained popularity over the past decade are maximum economic yield (MEY) and optimum sustainable yield (OSY). The MEY model is based upon the MSY model, and superimposes "cost" on the effort coordinate and "value" on the "equilibrium" (or sustainable) catch coordinate (Radovich, 1975).

Optimum sustainable yield must be arrived at by some subjective decision, usually involving a variety of economic, social and ecological factors as well as biological factors. Public Law No. 94-265 defines the term "optimum" with respect to the yield from a fishery, as the amount of fish which will provide the greatest overall benefit to the Nation, with particular reference to food production and recreational opportunities; and which is prescribed as such on the basis of the maximum sustainable yield from such fishery, as modified by any relevant economic, social or ecological factors.

Some comments are warranted relative to the properties and limitations of the various yield strategies, and if they are applicable to the Gulf of Mexico shrimp fishery. However, before this can be accomplished, several characteristics of the fishery relative to yield strategies should be considered.

The Gulf of Mexico shrimp fishery is based upon several species. Even though the abundance of one species may be greatly reduced during a season, total landings may be equivalent to normal years with the catch consisting almost entirely of one or more of the other species. This suggests that yield strategies should attempt to optimize the total yield in multispecies fishing rather than maximize the yield of individual species. This particular point is discussed extensively by Dickie (1973), and should be considered when managing any multispecies fishery. Second, it appears that the abundance of shrimp in this fishery changes annually, apparently independently of any prior level of fishing activity. There is also little evidence of a clearly defined relationship between parents and progeny, except that recruitment of a particular species can be severely affected temporarily by extreme environmental stresses. Finally, the abundance of white shrimp has apparently changed dramatically during the development of the fishery.

There are significant problems associated with MSY when applied to the Gulf of Mexico shrimp fishery. This concept treats the population as a single unit and ignores all disturbing influences on the population other than removals by man (Gulland and Boerema, 1973). Silliman (1971) discussed the advantages and limitations of "simple" fisheries models which have been used extensively to estimate MSY. All of these models assume instantaneous recruitment (Silliman, 1971) and that the exploited population will attain states of equilibrium permitting a rather constant level of recruitment for a given size of parental stock (Eldridge, 1974). Eldridge (1974) further discusses the limitations of simple models as follows:

The simple models do not have the capability of coping with significant lags in recruitment, pronounced changes in climatic conditions which may alter the basic growth curve of the population, or

the situation in which the pattern of exploitation is such that the exploited component of the population never achieves a state of equilibrium. Moreover, these models are generally employed in fisheries where the catch has significant components of two or more year classes, and there is evidence that the level of exploitation on one year has an impact on the abundance of the stock in future years.

The greatest advantage in using the simple model is that it requires only catch and effort data (Silliman, 1971). This advantage should not be taken lightly since the data needed by other models are difficult and sometimes impossible to obtain.

The MEY model is based upon a MSY model and suffers from most of the inadequacies of MSY since it usually superimposes economic values over an MSY model. MEY does have an advantage over MSY in that it frequently occurs at a larger population size which gives a greater protection against the possibility of over-fishing (Radovich, 1975).

Optimum sustainable yield is not a new concept. Management for OSY of a number of fish species in small impoundments has been very successful. However, the difficulties of managing fishery resources for OSY in larger areas increases as the size of the environment increases until we reach the open oceans of the world, where our scientific knowledge is most limited and the practices of resource utilization by fishermen are often in conflict with one another (Mauermann, 1975). Within the Gulf of Mexico shrimp fishery, the offshore shrimper, bait fishermen, bay fishermen and recreational shrimper all depend upon the same resource but harvest this resource at different stages in its development. Thus there are conflicts within the industry on when and at what size shrimp should be harvested.

If the abundance of recruits is independent of the abundance of the parent stock, as appears to be the case in the Gulf of Mexico shrimp fishery, all that management can do is make the best use of whatever recruitment happened to occur, that is, to maintain fishing at whatever level is considered the optimum position on the yield-per-recruit curve (Gulland and Boerema, 1973). An important condition for these calculations is that the instantaneous rates of natural mortality and of growth, at any given age, be constant over the range of conditions examined (Ricker, 1975).

Under the present system, managers have generally chosen to open seasons and fishing areas based upon the availability of 39 to 100 count whole shrimp. This is

primarily due to the lack of yield-per-recruit curves of sufficient precision for management decisions. Quotas are not used for this fishery nor do they appear appropriate at present because (1) there does not appear to be any clearly defined relationship between fishing and future levels of recruitment; (2) at least some shrimp escape the fishery to become the spawning population for the next year's crop; and (3) state agencies regulate fishing in the bays and estuaries to insure survival of the small shrimp. Griffin, et al. (1973b) suggested the Gulf of Mexico shrimp fishery is operating at a level which approximates MSY. Additional fishing effort will only result in a continuing decrease in catch per unit of effort.

Management policies might be devised that will increase the net economic yield substantially. Although total poundage landed may or may not be increased by sound management strategy, the size distribution of the landed product can be profoundly influenced. Some management also could greatly increase the catch per unit of fishing effort. It might even protect the fishery from biological decline. At present, parent-progeny relationships are not well enough understood to determine if over-fishing would produce a biological decline; but, sound management would reduce the hazard if it exists. Political and social attitudes will ultimately determine whether innovative management strategies with the above objectives are accepted.

Other factors which may affect future commercial landings of shrimp along the Gulf Coast include (1) utilization of presently under-exploited shrimp species; (2) recreational catch of shrimp; and (3) degree of coastal wetlands alteration.

The increased exploitation of rock shrimp and other underutilized species could increase commercial landings of shrimp.

The recreational shrimp catch probably represents a substantial portion of the total catch and any increase in this fishery could reduce the commercial catch. Recreational landings, together with growth and mortality rates of shrimp in the estuaries, will aid in determining what effect, if any, this fishery has upon the commercial catch.

As stated by Eldridge (1974) for the Southeastern Atlantic, the alteration and/or destruction of the coastal wetlands will ultimately decide whether or not there will be viable shrimp resources. Shrimp management programs can only succeed if adequate safeguards are taken by appropriate governmental agencies to maintain suitable nursery grounds for these valuable resources.

Chapter 3. Present Management System and Associated Problems

Shrimp fishery data have been collected along the Gulf of Mexico in one form or another since about 1880. The management systems in the various states have been based on available biological knowledge tempered by social considerations. Managers of state systems have been pressured by conflicting interests in various segments of the harvesting sector, particularly since the inception of the offshore fishery. Inadequate catch and effort statistics, fluctuating markets, gaps in life history data and well-meaning but often disabling legislation have further handicapped the managers.

Despite these handicaps, the resource remains healthy as evidenced by a general upward trend in reported landings and continued existence of a large recreational fishery in which the landings are largely unreported.

The fishery has generally been economically sound; however, large increases in fuel costs, construction costs, general inflation and a dropping catch per unit of effort (CPUE) have begun to erode the economic base of the fishery. Overcapitalization and a return to the domestic fishery by vessels from foreign waters for various reasons were not matched by a correspondingly large increase in shrimp prices until mid-1975.

The general objectives of the present state management systems have been to protect the resource and maximize catch among the various user groups. Regulation of the size of harvestable shrimp has increased the economic return but has also led to needless waste due to the discarding of undersized shrimp. Currently most States regulate the harvestable size by opening and closing seasons; however, enforcement of regulations has always been a problem.

The fishery has principally been managed within the several Gulf States with little communication between the States until the inception of the Gulf States Marine Fisheries Commission (GSMFC) in 1949. Since that time the GSMFC has been able to resolve some differences between the various states, recognizing that the resource itself is not cognizant of state boundaries. The GSMFC has no regulatory power, and reluctance by State legislatures to yield authority within their State boundaries has hampered implementation of a regional approach to management of the shrimp resource.

3.1 PRESENT STATE MANAGEMENT SYSTEMS

A synoptic review of the State's management structures and other features pertinent to the Gulf shrimp fishery is presented in Table 20. A more comprehensive review by State follows. An overview of State laws and regulations is presented in Table 21 and a detailed account is presented in Appendix B.

3.1.1 Florida (Knight and Jackson, 1973 and Calder et al, 1974)

Administrative Organization. The agency charged with the administration, supervision, development and conservation of the natural resource is the Department of Natural Resources which is headed by an Executive Director. Within the Department, the Division of Marine Resources has duties that include the preservation, management and protection of marine fisheries and the regulation of all fishing operations in the state and of its citizens engaged in fishing activities within and without the State. The Governor and the Cabinet sit as a board which approves or disapproves all rules and regulations promulgated by the Director of the Department. The Division of Law Enforcement is responsible for enforcement of all rules and regulations of the Department.

Legislative Authorization. The rules applicable to coastal fisheries are contained in Chapter 370 of the Florida Statutes Annotated. The statutes encompass: (a) license and licensee fee provisions; (b) enforcement; (c) seafood dealers; and (d) general gear restrictions. Shrimp management provisions in the statutes include size limit regulation and prohibitions on shrimping in areas where undersized shrimp exist in specified quantities, gear restrictions on an areal and seasonal basis, licensing and special restrictions based on geographical location. The Florida shrimp management system as listed in the statutes is inflexible and allows very little administrative discretion.

A unique feature of Florida statutory law, at least in the past, has been the existence of "local laws" and "general bills of local application." The 1973 Florida Legislature passed Bill 73-208 which provides:

The power to regulate the taking or possession of salt water fish. . . is expressly reserved to the state. It should be noted, however, that the preemption bill

GULF SHRIMP MANAGEMENT PLAN

TABLE 20.
Synoptic overview of state management systems

	Florida	Alabama	Mississippi	Louisiana	Texas
Administrative Organization	Department of Natural Resources, Division of Marine Resources. All rules and regulations are promulgated through the executive director and must be approved by the governor and cabinet.	Department of Conservation and Natural Resources, Division of Marine Resources	Mississippi Marine Conservation Commission	Louisiana Department of Wildlife and Fisheries	Parks and Wildlife Department, Fisheries Division, Branch of Coastal Fisheries
Legislative Authorization	Chapter 370: Florida Statutes Annotated. Allows for local laws and "General Bills of Local Application."	Title 8, 1940: Code of Alabama. All statutory laws concerning fisheries.	Chapter 15: Article I Mississippi Code of Statutes, annotated. Some statutes concerning fisheries.	Louisiana Constitution, Article VI, Section I. Some statutes concerning fisheries.	"Uniform Wildlife Regulatory Act" (Vernon's Ann. P.C. Art. 978j-1). Two counties are excluded.
Licenses	Boat License Length <12'—\$2.00 12—16'—\$6.00 16—26'—\$11.00 26—40'—\$31.00 40—65'—\$51.50 65—110'—\$61.50 >110'—\$76.50 Dealer classification—\$10.50 Dealer License Resident Wholesale—\$100.00 Non-Resident Wholesale—\$150.00 Alien Wholesale—\$500.00 Resident Retail—\$10.00 Non-resident Retail—\$25.00 Alien Retail—\$50.00 Alien and non-resident commercial fishermen—\$25.00	Each boat—\$7.50 Live bait dealer—\$25.00 Vehicle transport—\$5.00 Shipper or canner—\$15.00 Trawl License <30'—\$7.50 >30'—\$15.00 Seine License <30'—\$7.50 30—300'—\$15.00 300—900'—\$22.50 >900'—\$37.50 Non-residents pay double fees unless residents of states with reciprocal agreements.	Boat License <30'—\$7.75 30—45'—\$15.25 >45'—\$25.25 Live bait dealer—\$7.50/boat (not to exceed 3 boats) Shipping or processing—\$50.00 Handler—\$20.00	Boat License <40'—\$5.00 >40'—\$10.00 Trawl license variable with size—\$10.00—\$20.00 Seine license variable with size \$10.00—\$30.00 Wholesale dealer—\$50.00 Wholesale agent—\$10.00 Retailer—\$5.00 Interstate shipper—\$200.00 Freight vessel <40'—\$5.00 >40'—\$10.00	Boat License Gulf shrimp—\$50.00 Bay shrimp—\$40.00 Bait shrimp—\$40.00 Commercial fisherman—\$10.00 Retailer—\$6.00—\$20.00 Live Bait Dealer—\$40.00 Individual Bait—Shrimp (Recreational) Trawl License—\$5.00 Wholesale Fish—\$250.00 Wholesale Truck—\$125.00 Shrimp House—\$150.00
Taxes	None	Shrimp catch in Alabama Exported—\$0.20/bbl (210 lbs) Severance—\$0.12/bbl	Severance—\$0.25/bbl	Severance—\$0.15/bbl Out of State Shipping—\$0.50/bbl	None
Reciprocal Agreements	Limited to fishery access, may not extend to management agreements	Limited to fishery access, may not extend to management agreements	Possible in all areas of fishery access, research and management	Limited to fishery access	No statutory provisions
Regulations (see individual state, present system and Table 21)	Most are statutory provisions, little flexibility within the management agency	Statutory and considerable flexibility, within the management agency	Statutory and considerable flexibility within the management agency	Most are statutory with some flexibility within the management agency.	Most are statutory with little flexibility within the management agency—complicated by "county option" system.
Legal Count Size (heads-on)	47/lb all areas	68/lb all areas	68/lb all areas 100/lb live bait	68/lb on white shrimp in Fall season only. No count on brown shrimp after November 15.	39/lb in outside waters and in inside waters during the Fall season only.
Limited Entry	No provisions	No provisions	No provisions	Provisions are available under the law	No provisions

TABLE 20 (Continued).
Synoptic overview of state management systems

	Florida	Alabama	Mississippi	Louisiana	Texas
Penalties	A fine of not more than \$500 and/or 1 year in county jail and possible confiscation of any equipment used in illegal fishing. 5% count law and permit Requirements 1st offense—\$100—\$500 2nd or more—license suspension 6 mo to 1 year	\$25—\$100 and confiscation of boat or vessel if not paid. \$100—\$500—bait violation.	1st—\$50 to \$100 2nd—\$100 to \$500 and/or up to 30 days imprisonment 3rd—Revocation of license for 1 year	1st—\$200—\$500 and/or 30 days imprisonment 2nd—\$500 to \$1,000 and 60 to 90 days imprisonment 3rd—\$750 to \$1,000 and 90 to 120 days imprisonment and revocation of license for 1 year. Provisions for seizure and forfeiture of equipment	1st—\$20 to \$100 and possible license suspension. 2nd—\$50 to \$500 and possible license revocation
Data Reporting Requirements	Processors and bait shrimp must report statistics monthly	No provisions	Vessel captains must report: catch/species, area and depth fished, number of hours fished and size of shrimp. Out-of-state vessels must report catch of each trip. Bait dealers must keep daily records on sales.	Processor and wholesale dealers must maintain records of date, quantity, and point of origin of each lot of shrimp received, from whom purchased and to whom sold.	Monthly reports by dealers.

only affects those local laws and general bills of local application which have actually been adopted as county ordinances. No local laws and general bills of local application that apply to the west coast were affected by the preemption bill.

Licenses and Taxes. Licenses on motorboats are as follows:

Class 1: Less than 12 ft	\$ 2.00
Class 2: 12–16 ft	6.00
Class 3: 16–26 ft	11.00
Class 4: 26–40 ft	31.00
Class 5: 40–65 ft	51.00 + \$0.50
Class 6: 65–110 ft	61.00 + 0.50
Class 7: 110 + ft	76.00 + 0.50
Dealer Classification	10.00 + 0.50

An additional fee of \$50.00 per vessel is required of aliens or non-residents. Individual and dealer licenses are:

Resident Wholesale	\$100.00
Non-resident Wholesale	150.00
Alien Wholesale	500.00
Resident Retail	10.00
Non-resident Retail	25.00
Alien Retail	50.00

Alien and Non-resident Commercial Fisherman's License (applies to persons engaged in the taking and sale of fishery products but does not apply to crew or employees not involved in the sale of catch) 25.00

Shrimp fishery permits which specify the type of gear to

be used in different sections of open areas are required by the Director but at no cost to the applicant. There are no taxes on the shrimp caught and a shrimp gear license is not required.

Reciprocal Agreements. Authorization to enter into reciprocal agreements is contained in Fla. Stat. Ann. 370.18. The authority contained in this section is limited to matters of access to fishery resources and does not appear to extend to management in general. Provision is made whereby the citizens of Florida may be permitted to catch shrimp or prawn from waters under the jurisdiction of another state upon similar agreements to allow non-residents to fish or catch seafood in Florida.

Regulations. The rules applicable to coastal fisheries are contained in Chapter 16B of the Florida Administrative Code. The regulations concerning shrimp generally reiterate the statutory provisions, or amplify them, with very little management discretion being left to the Department. Limit of State jurisdiction is shown in Figure 49 (see Table 21).

Penalties for Violations. Section 370-021(2) specifies general penalties for violations of the provisions of Chapter 370, unless otherwise provided. This section provides for a fine of not more than \$500.00 and/or imprisonment for one year in the county jail. Other sections provide that fishing gear, vessels, catch and vehicles shall be seized upon arrest and conviction for illegal taking, sale, possession, etc., of saltwater fish or fishery products in Florida and provides a fine of \$100 to

TABLE 21.

Selected State laws and regulations pertaining to Gulf shrimp.
(See Appendix B for details and other laws and regulations)

Laws and Regulations	Florida (County Option)	Alabama	Mississippi	Louisiana	Texas
Count Size	47/lb—heads on 70/lb—heads off	68/lb—heads on 114/lb—heads off	68/lb—heads on	68/lb—heads on (fall seasons). No count on brown shrimp after Nov. 15.	No count during spring open season. 39/lb heads on; 65/lb heads off during other seasons.
Net Size	Legal trawl size varies by areas and application (see Appendix B, pp. 95–97)	1. Nets, seines, or trawls, whether used singly or in pairs may not exceed 50 ft across the cork lines. 2. "Try nets" must not exceed 10 ft across the cork line.	Trawls shall not exceed 50 ft across the cork line or 60 ft across the lead line.	1. Trawls shall not exceed 50 ft across the cork line in "inside" waters. 2. Seines must not exceed 3,000 ft in length.	1. Trawls may not exceed 25 ft in width in bays during spring open season and 65 ft in width during the fall open season in bays. 2. "Try nets" must not exceed 12 ft in width.
Number of Nets	See Appendix B, pp. 96 and 97	Trawls may be used in pairs so long as their combined cork line length does not exceed 50 ft.	Only one trawl may be used in waters north of the barrier islands.	Only one trawl may be used in inside waters except that twin trawls may be used in Chandeleur and Breton Sounds.	Only one trawl may be used in inside waters.
Seasons	---	Seasons are set by the Commissioner of Conservation and natural resources.	The shrimp season will open the first Wednesday in June; however, the MMCC by majority vote, may open the season earlier or later. The season closes April 30th of each year.	1. Spring season—not later than May 25 extending 50 days unless technical data warrants early closure to protect young white shrimp. 2. Fall season—Third Monday in August—December 21.	"Major Bays" Spring—May 15—July 15 Fall—August 15—December 15 "Outside Waters" 1. Closed 1 June—15 July and may be extended to a 60 day closure. 2. Closed within 7 fathoms 16 Dec.—1 Feb. (see Appendix B, pp. 118 and 119)
Areas closed to shrimping	---	See Appendix B, pp. 99, 102, 104 and 105	All areas within one-half mile of the mainland including bays and bayous except for live bait fishing	---	Any pass leading from inside to outside waters.

\$500 for first offense violations of the 5% count law and shrimp permit requirements (licenses may be suspended six months to one year on subsequent offenses).

Scientific Permits. Scientific permits are issued through the Division of Marine Resources.

Limited Entry. There are no provisions or precedents for limited entry.

Data Reporting Requirements. The processor license requires monthly reports to the Division of Natural Resources which reports to the Statistics Section of the National Marine Fisheries Service. Bait shrimp processors are required to report monthly to the Division.

3.1.2 Alabama

Administrative Organization. The administrative

organization of the State of Alabama with respect to coastal fisheries begins with the Department of Conservation and Natural Resources which is headed by a Commissioner appointed by the Governor. He is advised by Division Directors and a citizens Conservation Advisory Board. The Advisory Board consists of certain state officers, ex-officio and gubernatorial appointees. In general, the Commissioner consults with the Advisory Board and secures the Board's approval concerning the promulgation of rules and regulations which involve controversial issues. Within the Department there exists a Division of Marine Resources which has jurisdiction over marine fisheries matters with approval by the Commissioner. The Division has two sections: enforcement and marine biology.

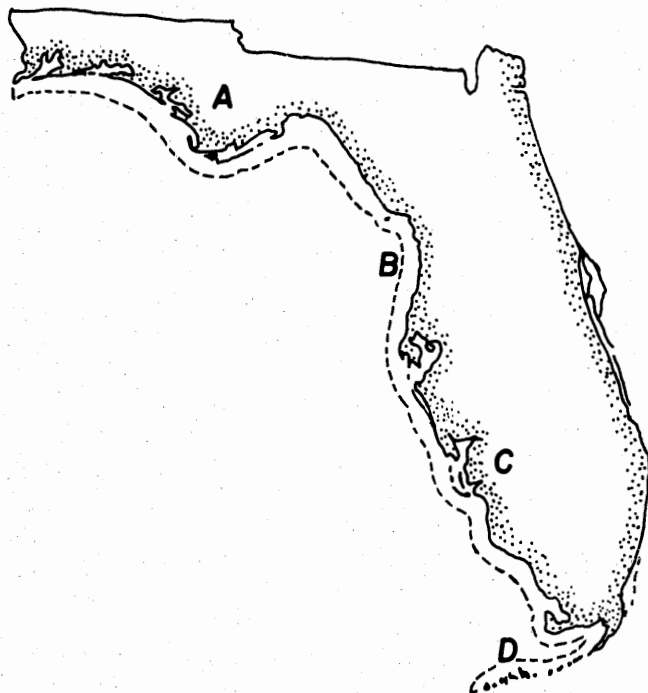


Figure 49. Extent (9 statute miles) of territorial waters in Florida.

Legislative Authorization. Detailed statutory provisions are contained in Code of Ala., Tit. 8, Sections 111–117 as amended, although substantial latitude for management remains with the Department and the Commissioner. It thus appears that Alabama has a relatively flexible management system which would lend itself to a reciprocal or coordinated interstate fisheries management plan.

Licenses and Taxes. With respect to shrimp, licensing requirements and fees are set forth in the statutes but the Commissioner retains authority to set by regulation the weight requirements within specified limits. License requirements are:

- Each boat—\$7.50
- Live Bait Dealer—\$25.00
- Vehicle transport license—\$5.00
- Shipper's or Canner's license—\$15.00
- Trawl license: up to 30 ft—\$7.50; over 30 ft—\$15.00
- Seine license: up to 30 ft—\$7.50; 30–300 ft—\$15.00; 300–900 ft—\$22.40; over 900 ft—\$37.50.

No license is required for the retail sale of shrimp. Non-residents pay double license fees unless they are residents of states which have a reciprocal agreement with Alabama. Taxes on shrimp caught are as follows:

- Shrimp caught in Alabama and exported—\$0.20/bbl (210 lb)
- Shrimp caught in Alabama and not exported—

\$0.12/bbl.

Taxes are not enforceable because of problems in establishing origin of catch.

Reciprocal Agreements. The authority to enter into reciprocal agreements with respect to coastal fisheries is contained in Code of Ala., Tit. 8, Section 171 (13a). Like some other reciprocal agreement authorizing statutes, this section contemplates only an arrangement permitting non-residents to fish within Alabama waters on a reciprocal basis. It does not extend to management issues in general such as coordinated regulations concerning a fishery which may be common to Alabama and other states.

Regulations. Most of the regulatory authority of the Department is specified by statute, although the Division, through the Commissioner, has considerable flexibility in setting commercial shrimp seasons, area where shrimping is permitted, time of day when shrimping is permitted, size count of legal shrimp and may prohibit imports of shrimp smaller than Alabama's legal size. The Division has no authority to establish regulations affecting bait shrimping or recreational shrimpers which are covered by statutes. Limit of State jurisdiction is shown in Figure 50 (see Table 21).

Penalties for Violations. Title 8, Section 171 (12) provides that a violation of Title 8 is a misdemeanor punishable by fines not less than \$25.00 nor more than \$100.00, unless otherwise provided. Title 8, Section 5 specifies that a violation of the bait shrimping law is punishable by fines not less than \$100.00 nor more than \$500.00. The Department has no confiscation law, but if a fine is not paid the court may condemn the boat or vessel and order it sold (Title 8, Section 168, 1940 Code).

Scientific Collection Permits. These permits are issued by the Commissioner, Department of Conservation and Natural Resources.

Limited Entry. No specific provisions for limited entry are contained in the Alabama Code of Laws.

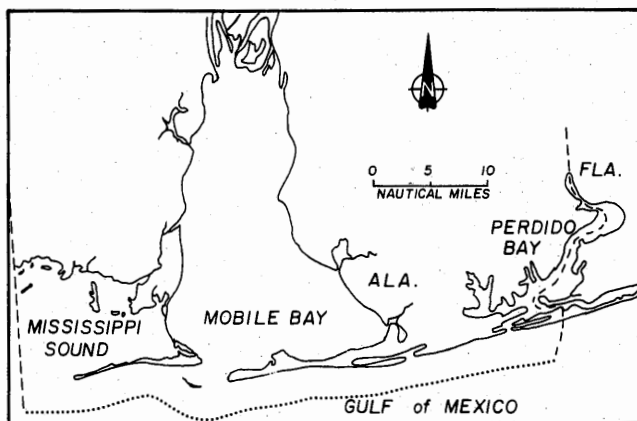


Figure 50. Extent (3 nautical miles) of territorial waters in Alabama.

Data Reporting Requirements. Except for wholesale fish dealers, there are no data reporting requirements.

Law Enforcement. There are 13 enforcement officers in the Alabama Marine Resources Division stationed in the two coastal counties. Equipment includes 10 radio-equipped cars, two 4.9-m (16-ft) boats, two 6.1-m (20-ft) boats and one 11.6-m (38-ft) boat. The 11.6-m (38-ft) boat is equipped with radar but the boat is often inoperable because of insufficient funds for repairs. Enforcement radios are presently on a unique frequency handicapping communications with conservation enforcement officers in other divisions working within the coastal area. During 1976, 137 cases involving violations of conservation laws and regulations were taken to court resulting in a 93% conviction rate. While the conviction rate was high, penalties set by the court averaged only about \$40 which did little to deter further offenses. Alabama does not have legislation authorizing confiscation and sale of illegally taken seafood. This encourages shrimping in closed waters and during the closed season when monetary gains are possible. Of the 137 cases made in 1976, 92 were violations of shrimp laws and regulations.

An increasing amount of time was spent on search and rescue operations and on occasional arrests involving contraband. More than 300 hours were spent on search and rescue during 1976. The greatest need in enforcement is better communications and better watercraft.

3.1.3 Mississippi

Administrative Organization. The administrative organization of the State of Mississippi with respect to coastal fisheries is the Mississippi Marine Conservation Commission. The Commission consists of thirteen members, nine of which are appointed by the governor. The remaining four are directors of the following agencies: Boat and Water Safety Commission, Marine Resources Council, Gulf Coast Research Laboratory and State Board of Health. The executive power of the Commission is vested in a director hired by the Commission. The Commission has full power to "manage, control, supervise and direct any matters pertaining to all salt water aquatic life not otherwise delegated to another agency" [Miss. Code Ann. 49-15-11(1)].

Legislative Authorization. Statutory provisions are set forth in Chapter 15, Art. 1, paragraphs 49-15-1 through 49-15-69 of the Mississippi Code annotated (1972). Although fishing seasons and minimum size of shrimp are set by statute, the Commission may, by majority vote, open or close the season at an earlier or later date. The Commission may also, by majority vote, close designated areas where the shrimp count exceeds the statutory maximum, 68 per pound. It thus appears that Mississippi has a relatively flexible management system which would lend itself to a reciprocal or coordinated interstate fisheries

management plan.

Licenses and Taxes. License requirements for shrimping operations conducted in Mississippi waters as follows:

Boats less than 30 ft	\$ 7.50 + \$0.25
Boats 30-45 ft	15.00 + 0.25
Boats over 45 ft	25.00 + 0.25
Live Shrimp Dealer	7.50/boat (not to exceed 3 boats)
Shipping and Processing Handler	50.00 20.00

The only tax presently levied is \$0.25/bbl on all shrimp which are taken or processed within the jurisdiction of the State of Mississippi.

Reciprocal Agreements. The Mississippi reciprocal agreement provision is found in Miss. Code Ann. 49-15-15 (i) which provides that the Mississippi Marine Conservation Commission:

May enter into advantageous interstate and intrastate agreements with proper officials, which agreements directly or indirectly result in the protection, propagation and conservation of the seafood of the State of Mississippi, or continue any such agreements now in existence.

Unlike the reciprocal agreement authorizations in some states, this clause would clearly contemplate agreements relating to resource management as well as to reciprocity concerning access by residents to the respective states' waters.

Regulations. The Commission has the power to promulgate regulations not set forth by legislative act. Any regulations or ordinances, before becoming effective, are to be published in a newspaper having general circulation in counties affected by such a regulation. Right of appeal through a public hearing and the circuit court is granted to "any person aggrieved by an order of the Commission."

Limit of State jurisdiction is shown in Figure 51 (see Table 21).

Penalties for Violations. General penalties for violation are set forth in paragraph 49-15-63 of the Mississippi Code Annotated (1972). Upon conviction of a violation the offender shall be fined not less than \$50.00 nor more than \$500.00, or imprisonment in jail for a period not exceeding 30 days for any subsequent offense; and upon conviction of a third offense, the license of the convicted party and of the boat shall be revoked for a period of one year following the conviction.

Scientific Collection Permits. These permits are issued by the Director, Mississippi Marine Conservation Commission.

Limited Entry. No precedents warranting a discussion of limited entry in the context of Mississippi coastal fisheries management were found.

Data Reporting Requirements. Employees of the

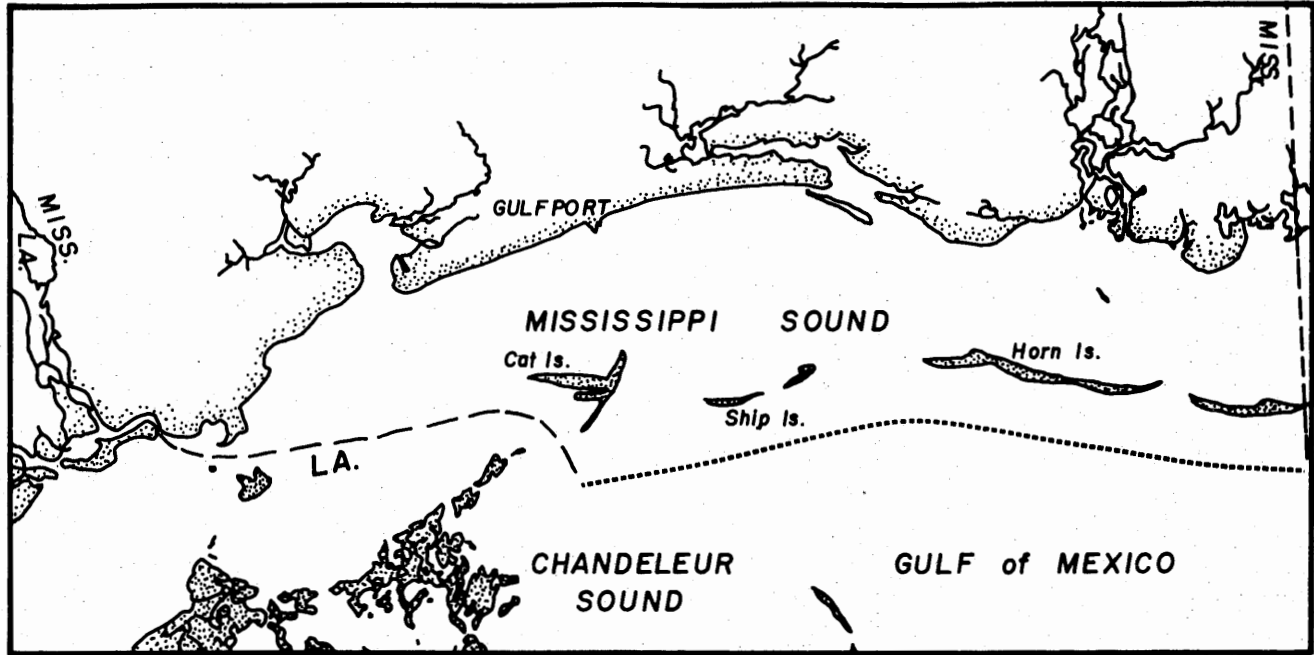


Figure 51. Extent (3 nautical miles) of territorial waters in Mississippi.

Mississippi Marine Conservation Commission are authorized and empowered (Ordinance 71) to obtain information on each vessel or boat trip landed in Mississippi. Data obtained from the captain or other crewmen is as follows: total catch by species, area in which the vessel fished, depth fished, the number of hours fished in each area and the size of the shrimp. Since it may be impossible to interview every fishing craft, copies of the purchase slip at the processing or landing firm will be obtained. All out of state vessels shrimping in Mississippi waters will be required to report catch of each trip.

Daily records on sales of bait and other shrimp as well as other bait products will be kept and reported to the Mississippi Marine Conservation Commission. Authority is vested in the Commission to require reporting for any research project and persons receiving questionnaires are required to report factually.

3.1.4 Louisiana

Administrative Organization. The Department of Wildlife and Fisheries is one of 21 major administrative units of Louisiana state government. The secretary of Wildlife and Fisheries is "the executive head and chief administrative officer of the department" and has "sole responsibility for the policies of the department and 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 and serves at the governor's pleasure. The Secretary may be advised by a seven-member board, the Louisiana Wildlife and Fisheries Commission, which

exercises control and supervision of the wildlife of the state, including all aquatic life.

Within the administrative system, an assistant secretary is in charge of the Office of Coastal and Marine Resources. In this office, the Seafood Division, headed by the Division Chief, performs "the functions of the state relating to the administration, operation and law enforcement of programs, including research, relating to oysters, water-bottoms, and seafoods, including but not limited to the regulation of the oyster, shrimp and marine fishing industries; . . . the control of the shrimp fishery and shrimp industry of the state; and the licensing of persons engaged therein. . .".

Legislative Authorization. Louisiana statutory law covers mesh size for seine and trawl, licensing of commercial fishermen, nets and vessels and the size limits on taking of shrimp. There exists an elaborate statutory scheme with respect to shrimp, providing little departmental discretion save some flexibility in opening the season.

The constitution places the policy-making authority solely with the Secretary, but because of the requisite procedures that must be followed in formulating that policy plus the existence of a substantial amount of statutory law, the state management system probably would not be very responsive to an effective coordinated fisheries management plan.

Licenses and Taxes. Louisiana license fees include:

1. Trawls:
 - a) 16 ft or less —\$10.00 Commercial
 - b) 16 ft or less—No fee—Noncommercial (see

- Appendix B, p. 112, item 12)
- c) 16 ft–40 ft—\$15.00 All Trawls
 - d) over 40 ft—\$20.00 All Trawls
2. Shrimp Seines:
 - a) 100 ft or less—\$10.00
 - b) 100 ft–500 ft—\$15.00
 - c) 500 ft–2000 ft—\$25.00
 - d) 2000 ft–3000 ft—\$30.00
 3. Vessel:
 - a) 40 ft or less—\$5.00 Commercial
 - b) Over 40 ft—\$10.00 Commercial
 - c) Non-commercial—No Fee
 4. Shrimp Freight Vessel:
 - a) 40 ft or less—\$5.00
 - b) Over 40 ft—\$10.00
 5. Interstate Shipper—\$200.00
- Severance tax—\$0.15/bbl
 Out of state shipments other than common carrier—
 \$0.50/bbl.

Reciprocal Agreements. The Louisiana Department of Wildlife and Fisheries has authority to enter into “reciprocal fishing license agreements” with the authorities of any other state. Further, La. R.S. 56:673 authorizes the Department to enter into reciprocal agreements with the states of Arkansas, Mississippi and Texas pertaining to “seasons, creel limits and all other rules and regulations pertaining to the taking or protection of any species of fish or other aquatic life” in bodies of water which form the “common boundary” with the reciprocating states. The former appears to be restricted to fishing license agreements only and would not contemplate broader management systems. The latter statute does not seem to be applicable to coastal fisheries management agreements since the Gulf of Mexico is not a body of water which forms “the common boundary” between Louisiana and the reciprocating states.

Regulations. The constitution places regulation-making authority solely with the Department, but there are many requisite procedures that must be followed in formulating these regulations. Because of an elaborate statutory scheme with respect to shrimp there is limited Departmental discretion with respect to flexibility in opening and closing the season.

Limit of state jurisdiction is shown in Figure 52 (see Table 21).

Penalties for Violations. Unless otherwise specified, a mandatory fine of from \$200 to \$500 or jail sentence of from 15 to 30 days or both is provided for first offenders; a fine from \$500 to \$1,000 and from 60 to 90 days in jail for second offenders; and for third and subsequent offenses a fine of from \$750 to \$1,000 and from 90 to 120 days in jail plus revocation of licenses for 1 year. There are also provisions for seizures and forfeiture of vessels or equipment used illegally.

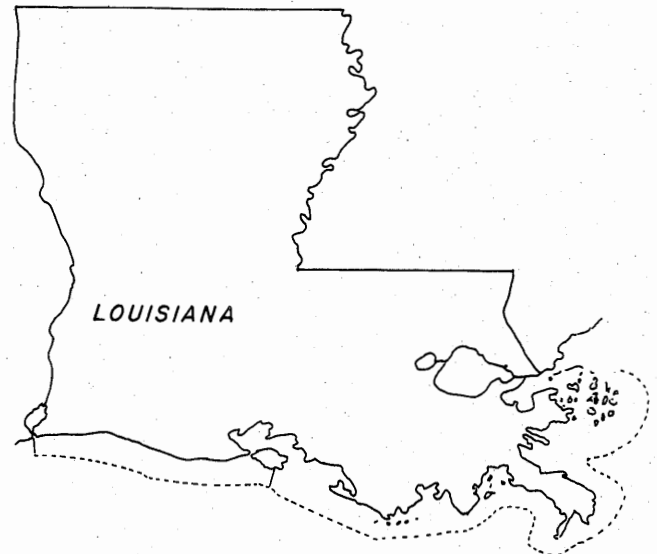


Figure 52. Extent (3 nautical miles) of territorial waters in Louisiana.

Limited Entry. Louisiana law provides that “ownership of all fish. . .remains in the state for purpose of regulating and controlling the use and disposition within its borders.” Moreover, there is judicial precedent to the effect that the taking of fish is a “privilege” subject to regulation by the state “for any. . .cause it deemed sufficient.” Thus, having cognizance of the fact that the state, as trustee for the people, has the obligation to assure that the marine fishery resources benefit the people as a whole, the issue is whether economic regulation via limited entry constitutes a valid recognition in the public interest. If it may be assumed that legislation providing for an adequate livelihood to fishermen, improving fisheries management efforts and eliminating economically inefficient regulations involves a public interest, limited entry in Louisiana may be a viable and legally sound approach. The presumption that “the Legislature must have acted only after a thorough investigation and upon a finding that the interest of the public required the legislation” lends credence to the validity of a limited entry statute.

Data Reporting Requirements. Processors or any other first purchasers must report purchases by the tenth of the month following. A statement of the quantity of shrimp purchased, vessels and owners thereof and other dealers from whom purchased or received shall be made under oath on blanks furnished by the Department and shall accompany each severance tax payment. All wholesale processors and first purchasers shall at the time and in the same report make a full statement of the disposition thereof, including sales and persons to whom made.

Taxes. There is levied a severance tax on all saltwater shrimp taken from the waters of this State of \$0.15/bbl of 210 lb. Out-of-State shipments other than by common

carrier shall be taxed \$0.50 /bbl of 210 lb.

The severance tax on shrimp is to be computed when in the fresh state as delivered to the first purchaser and shall be paid by him, provided that processors operating boats as producers shall pay as required by the first purchaser.

Law Enforcement. To secure the effective protection of shrimp in Louisiana waters, the Louisiana Department of Wildlife and Fisheries shall appoint wildlife agents whose entire time shall be, under the direction of the Department, devoted to the performance of the official duty under Title 56, Sub-Part E. Shrimp Section 493. Louisiana Revised Statutes of 1950, Acts through 1975. The Department head may also appoint as many special or cooperative officers, to be designated special wildlife agents or special agents, as he deems proper. Special agents, in the enforcement of the provisions of Sub-Part E (shrimp) have all the rights, powers and duties of agents, except as hereinafter mentioned. Special agents serve without expense to the State or to the Department in excess of a salary of one dollar per year.

The Department, agents, and the various sheriffs, constables, deputy constables and other police officers may without warrant arrest any person committing a violation of Sub-Part E (shrimp) of the Revised Louisiana Statutes of 1950 through 1975 Legislature in his presence or view, and may take such person in custody immediately for examination or trial before any officer or court of competent jurisdiction of this state or the United States.

Agents may examine records, visit or examine, with or without search warrant, any cold storage plant, warehouse, boat, store, car, conveyance, automobile, or other vehicle, airplane, basket, or other receptacle or any place of deposit for shrimp, whenever they have probable cause to believe that any provisions of this Sub-Part have been violated.

Agents shall at frequent intervals visit and inspect cold storage plants, warehouses, public restaurants, public and private markets, stores and places where shrimp are likely to be kept and offered for sale in violation of the provisions of Sub-Part E (shrimp). Such visitations and inspections are lawful without search warrant. They shall take proceedings in any court of competent jurisdiction, state or federal, against any offender.

Special agents have all the rights and duties conferred or imposed upon agents, but have no authority to make any contracts for the Department.

3.1.5 Texas (taken from Knight and Jackson, 1973)

Administrative Organization. The lead agency for coastal fisheries management in Texas is the Parks and Wildlife Commission. The Commission appoints an Executive Director who serves as the chief executive officer of the Department. Within the Department there

exists the Fisheries Division and within that Division the Branch of Coastal Fisheries Operations. These are administratively functional offices.

The Commission has authority to establish all rules and regulations permitted by statute concerning coastal fisheries within its jurisdiction. The Director and the remainder of the Department staff are concerned with the development of recommendations for regulations, and with their enforcement.

Legislative Authorization. The basic fisheries management law in Texas is the "Uniform Wildlife Regulatory Act." However, six of the 17 Texas coastal counties are excluded from the Uniform Act. The Texas Shrimp Conservation Act is in force in all non-regulatory counties and has been adopted by the Commission in all regulatory counties.

Licenses and Taxes. Licenses necessary for catching, processing and selling of shrimp include:

Commercial Gulf Shrimp Boat License	\$ 50.00
Commercial Bay Shrimp Boat License	40.00
Commercial Bait Shrimp Boat License	40.00
Commercial Fisherman's License	10.00
Shrimp House Operator License	150.00
Bait Shrimp Dealer License	40.00
Individual Bait-Shrimp Trawl License	5.00
Retailer	6.00—
	20.00
Wholesale Fish	250.00
Wholesale Truck	125.00

There are no taxes levied on shrimp taken in Texas waters.

Reciprocal Agreements. The State of Texas has, at the present time, no statutory authorization for any of its agencies or departments to enter into reciprocal agreements with other jurisdictions concerning access to or management of marine fisheries. Such a provision apparently did exist but that provision, which also contained a differential fee schedule for residents and non-residents with respect to commercial fishing activities, was repealed in 1949 and the authority in a subsection of that article concerning reciprocal agreements for such license fees was also repealed since the necessity therefore was obviated under a new uniform fee schedule.

The department may, however, negotiate reciprocal agreements with another state with respect to the application of one state's shrimping regulations in its contiguous zone to citizens of the other state. "Contiguous zone" is defined as that area of the Gulf of Mexico lying adjacent to and offshore of the jurisdiction of the state and in which penaeid shrimp are found.

Regulations. The Commission has authority to establish all rules and regulations permitted by statute concerning coastal fisheries within its jurisdiction. The annual fishing proclamation usually emanates from the June meeting of

the Commission. In fact, however, the proclamation consists of little more than a reiteration of the statutory laws for shrimp and the political climate dictates that the regulatory system is essentially statutory in nature. Thus Texas has both little flexibility and complications arising from the "county option" regulatory system now in effect. (see Table 21).

Limit of state jurisdiction is shown in Figure 53.

Penalties for Violations. First offense: \$50 to \$200. Second offense: \$100 to \$500 or confinement of from 10 to 60 days or both. Third offense: \$500 to \$2,000 and confinement for 30 days to 6 months and subject to license forfeiture. Captain of vessel is primarily responsible.

Limited Entry. In 1949 the Texas Legislature enacted a law providing a quota on the licensing of commercial fishing vessels. The provision allowed the Fish and Game Commission discretion to set a limit on the number of licenses to be issued for the succeeding year, if in its opinion, it was deemed necessary to preserve the maximum sustainable yield. Anyone holding a commercial license prior to April 1949 was entitled to a renewal and no new licenses could be issued until all renewals were filled. The statute also provided resident priority for the issuance of any new licenses. The Supreme Court of Texas struck down the measure on the grounds that it violated the due process clause of the State Constitution. It may be, had the legislature been more careful in

enacting the quota scheme (eliminating, for example, the favoritism specifying the maximum size boats to be used, and providing for more than one kind of fishing license), the provision could have been upheld. Nonetheless, the decision affords a legal precedent against the use of licensing quotas or other limited entry schemes for purposes of fisheries management.

Data Reporting Requirements. Texas law provides that the Texas Parks and Wildlife Department shall gather statistical information on harvest of marine fishery products directly from fishermen.

State law also provides that the department conduct continuous research and study of the shrimp fishery and submit findings of fact to the Governor and legislature before each regular session.

Enforcement. The responsibility of enforcing shrimping regulations in Texas waters to 9 nautical miles offshore rests with the Enforcement Division of the Texas Parks and Wildlife Department. The law also provides that Texas shrimp fishermen are subject to Texas regulations beyond State waters. However, if the Department finds that shrimp are being taken in significant quantities by others not subject to Texas jurisdiction in the contiguous zone (beyond Texas waters) then it will not enforce the regulations on Texas vessels in that zone.

3.2 IDENTIFICATION OF PROBLEMS

To properly develop a management plan for any fishery resource, an awareness of problems and potential problems within the fishery is necessary.

The Shrimp Management Task Force addressed this question and identified the following problem areas. The numerical arrangement does not imply an attempt to list these items in terms of any priority or subsequent research timetables.

3.3 PROBLEMS ANNOTATIONS

3.3.1 Biological

1. Lack of information on natural mortality rates. A knowledge of natural mortality rates is needed to aid decision makers in selecting the size of shrimp and/or time of harvest that will maximize yield. Because natural mortality rates are not well established, these decisions must be made subjectively until more information is available.

2. Inability to delineate the offshore spawning grounds of commercial shrimp species in the Gulf of Mexico and inadequate information on stock identification (postlarval recruitment). Spawning stocks of brown, pink and white shrimp are exploited by the commercial fishery. Precise location of these spawning areas would facilitate protection of the spawning stock from overfishing and would determine the geographic area or areas which contribute to the postlarval migration into given

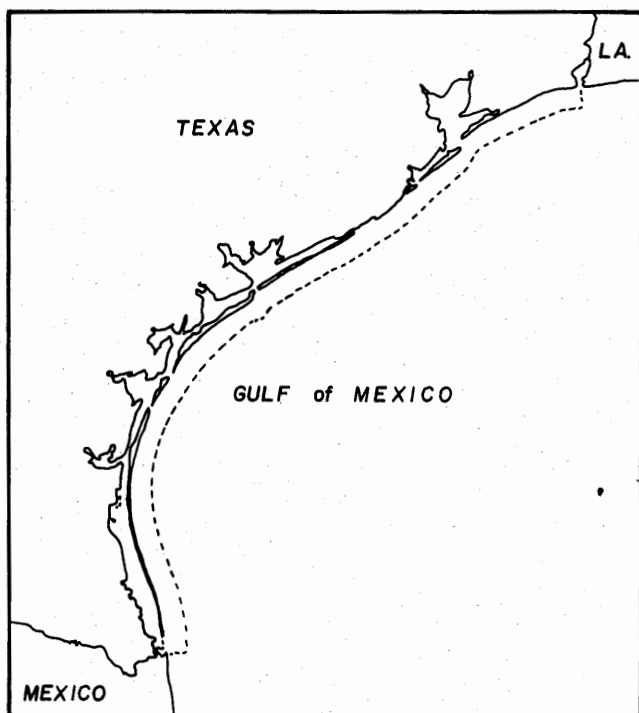


Figure 53. Extent (9 nautical miles) of territorial waters in Texas.

nursery areas and would be an integral part in developing parent-progeny relationships.

3. Exploitation of nursery and staging grounds in inside waters. No clear delineation of shallow nursery grounds exists, consequently, indiscriminate fishing effort in nursery areas destroys countless numbers of small unusable juveniles. This is particularly true when the fishery for one species has an adverse effect on juveniles of another.

4. Need for determining the validity of present landing statistics including the accuracy and precision of data collecting techniques. A considerable portion of the commercial shrimp landings are not reported to statistical agents. Many changes have taken place in the methods of collection and processing of landings and effort data from the Gulf shrimp fishery since 1956 when an improved system was established by the U.S. Bureau of Commercial Fisheries. These changes have been assumed to be "improvements," but their impacts on accuracy and precision of landings and effort estimates have not been evaluated statistically. Adequate catch and effort statistics are needed to estimate abundance, monitor biological and economic trends and evaluate management decisions.

5. The extent and effect of recreational trawling on the shrimp resource. Recreational shrimping is assumed to make up a large portion of the shrimp fisheries in some areas and will probably continue to increase in popularity. Thus the need for precise accounting for the harvest effort and extent of recreational trawling is necessary in developing a management system.

6. Overwintering patterns. Economic and management questions arise from the lack of information concerning the fate of shrimp, particularly whites, during the winter. Annual assessments of overwintering populations in the Gulf of Mexico would facilitate predictions concerning the size of the spring fishery. This would help managers to decide when the fishing season should be opened and aid industry to make wise investment decisions.

7. Incidental harvest of non-target species. Other species, including large numbers of finfish and crabs, are taken by the gear presently in use. At present these species, which may have recreational or commercial value, may be discarded or in some cases retained. Since large numbers of juveniles are taken, long range adverse effects* may be felt by these other fishery resources.

8. Yield models. In order to more fully utilize available stocks and achieve maximum benefits, it would be necessary to determine yield relationships, including maximum sustainable yield, without damage or detrimental effects to the resource.

3.3.2 Economic

1. Seasonality of fishing and dislocation of the

commercial fleet and facilities for processing. Vessels have traditionally shrimped Mexican and other foreign waters during the winter and spring months. For example, the phasing out of the U.S. high seas shrimping fleet by Mexico's extension of jurisdiction has left the Brownsville—Port Isabel area (largest shrimp port) with a fringe location. Without a new treaty a substantial portion of the fleet may have to relocate and abandon plant facilities because shrimping will be primarily limited to the summer and fall months. This will adversely affect marketing, capital will be tied up in idle equipment for a portion of the year and the labor force will be unemployed during parts of the year.

2. Economic impact of uncontrolled shrimp imports on U.S. industry. The arrival of large quantities of foreign shrimp causes instability in the U.S. market. Without a quota system or marketing program for U.S. shrimp products, imports may continue to have an adverse effect on the price structure of domestic shrimp.

3. Inadequate understanding of industry, market structure and behavioral relationships among economic units. The imposition of any fishery management plan will greatly impact most of the economic units involved in harvesting, processing, wholesaling and retailing. Understanding how they are impacted and the design of a plan which considers these potential impacts require a knowledge of the industry which we do not now have.

4. Lack of boat inventories. A comprehensive inventory of boats less than 5 gross tons used in commercial shrimp harvesting and their characteristics would provide economic managerial information to fishermen, enhance the ability to include economic factors in any determination of OY and provide a comprehensive current statement of the number of fishermen through economic status and factors affecting economic performance.

5. Lack of cost and earnings data for vessels and boats. The costs involved in the shrimping industry, particularly below the processor level, are highly variable and depend upon many factors. As a result, the fishermen's incomes also fluctuate widely. The accumulation of costs (including vessel construction costs) and earnings data would aid in determining which factors contribute significantly to this variation and thus help industry make wise managerial decisions. It would also supply needed economic information which could be incorporated into the decision-making process of a regional management program.

6. Fishery development of underutilized species and diversification of the fleet. Fish, including large numbers of sciaenids, are taken by the gear presently in use, and deep-water species such as the royal red shrimp are not being utilized to their full potential. Management can reveal to the industry, through available information, stocks of potential importance and recommend how these

might be utilized. Management might also work with other agencies or processors to initiate utilization of potentially valuable species.

7. Lack of information on marine recreational fisheries benefits. Recreational shrimping will probably continue to increase in popularity and may have an impact on commercial landings depending upon the natural mortality rates of shrimp. The development and demonstration of methodologies for measurement of recreational benefits is necessary so that they may be reflected in any determination of OY.

8. Maximum economic yield. To determine cost and returns to fishing effort at the industry level. Data collected should be that necessary to calculate economic sustainable yield and open access equilibrium. Separate calculations should be made by species for inshore and offshore areas and size class of vessels.

3.3.3 Social

1. Sociological information on the shrimp fishermen's communities. Management of the Gulf shrimp fishery under optimum yield or any other comprehensive management objective should include an adequate and documented knowledge of the social and cultural structures in the fishermen's communities; their preferences, traditions, values and lifestyles. This information is largely unresearched and in any case unrecorded for the Gulf shrimp fishery.

2. Delineation of user interest groups. Several different user groups in the Gulf are involved with the shrimp resource in different ways; differences which many times lead to competition or conflict over use of the resource. Vessels operating offshore and taking larger shrimp for freezing, boats operating inshore and taking smaller shrimp for canning and boats which operate in the bayous in Louisiana or in a particular geographical proximity to a delta or river mouth are examples of these different users. These users and their operations must be described before their interests can be taken into account in a management plan.

3. Labor force statistics. Since the Gulf shrimp industry is based upon a seasonal harvest, special needs and problems arise for the industry's labor force. Labor force statistics such as size, composition, residence patterns, employment skills, migration patterns, occupational mobility and others are not well documented. This information is necessary to predict the impact of these factors on the harvesting, product flows and fishermen's communities which may result from alternative local or regional management options.

4. Political and legal problems in Gulf Regional management. A regional plan will most probably be initiated through existing political and legal structures. Working with these structures will involve familiarity with

jurisdictional problems, conflicting laws and regulations and traditional working relationships. Without knowledge of these political and legal systems, management may be based on misinformation, uninformed opinion or historical perceptions which create artificial and unnecessary impediments to cooperation and coordination.

3.3.4 Environmental

1. Effects of habitat alteration on penaeid shrimp populations. Changes in estuarine and offshore habitats through oil exploration, pollution, river controls, dredge and fill activities, industrial and farm drainage and freshwater usage have altered nursery area available to penaeid shrimp. Without effective coastal zone management to supervise future development of coastal areas, loss of nursery areas is likely to continue, consequently production losses may be experienced.

3.3.5 Administrative

1. Formal system of information collection and display for monitoring and reviewing the effects of management policies, decisions and implementation. With a system as complicated as the Gulf shrimp fishery, many of the effects and ramifications of management alternatives and actions, both beneficial and adverse, may go undetected or uncommunicated in the absence of a formal mechanism for their display.

2. Determination of the effects of discarding undersized shrimp. In states that have a minimum size limit on shrimp, vessel operators will discard undersized shrimp and keep those which make the count. The discard may be substantial depending on the season.

3. Determination of the effects of unrestricted entry. Shrimpers have no ownership rights over the shrimp resource thus entry into the fishery is unlimited. Displaced U.S. fleet fishing foreign waters will increase effort on domestic territories. An unrestricted fishery will move to a level of effort at which total costs equal total income. Investments in vessels and equipment will exceed an optimum level creating economic stress on the harvesting sector of the industry.

4. Limited jurisdiction. States have jurisdiction over territorial waters; however, problems frequently arise because each of the states has its own set of fishing laws and regulations. Without the co-ordination of a state-regional management plan these problems cannot be overcome.

5. Lack of adequate coordination and communication among data gathering and analysis programs. Despite many attempts to coordinate various activities of data gathering and analysis, coordination and communications have not been adequate to eliminate unnecessary duplication of efforts among groups interested in shrimp fisheries of the Gulf. For this reason efforts have been

diluted and less effective.

6. Optimum yield. In order to more adequately manage the shrimp resources of the Gulf of Mexico, it is necessary to determine optimum yield involving biological, sociological and economic factors.

3.3.6 Other

1. Need for measuring the change in efficiency of fishing craft in the Gulf of Mexico shrimp fishery. Improvements in fishing vessels and gear have influenced effective fishing effort. This influence has not been sufficiently accounted for in available measures of fishing effort. This is required to express measurements of fishing effort, in the entire time series, in comparable or standard units.

2. Conversion of pertinent biological and environmental data to an accessible computerized form. Development of a regional management plan would be aided by a coordinated assimilation of data relative to the shrimp fisheries which would be readily available to all concerned and at little or no cost to the user. Part of this effort would entail the identification and possible computerization of available time-series data on shrimp, shrimp environments and associated species. Data amenable to such computer analysis would be processed and stored in data banks available to all users, on a timely basis.

3. Identification of jurisdictional boundaries. There is an enforcement problem within the territorial waters of the Gulf states near the vicinity of state lines because these boundaries are not determined in many cases.

4. Examination of the problems associated with adequate law enforcement programs. Effective law enforcement is a problem because of understaffed enforcement agencies, lack of local court convictions and an uninformed public. A study is required to understand how these factors interact so that enforceable laws can be maintained.

5. Need for locating and marking underwater obstructions and determining their impact on the shrimp industry. Unmarked obstructions on the shrimping grounds of the northern Gulf cause serious damage to shrimping operations. Equipment loss and downtime annually cost boat operators considerable income. An accurate system of marking obstructions as they occur is necessary to alleviate this problem.

3.4 ONGOING AND PROJECTED RESEARCH AND MONITORING

3.4.1 Florida

Florida has two ongoing projects relating to penaeids. Both are based on supplemental data collected during 2-year sampling programs, one in the Gulf (Hourglass) and the other along the east coast (rock shrimp project). These projects will provide data on reproduction, age and

growth, morphometrics and some population dynamics for *Trachypenaeus*, *Solenocera*, *Hymenopenaeus* and *Metapenaeopsis* and supplementary information on off-shore large *Penaeus duorarum*. There is one proposed project. It will be a data collection contract from NMFS, Southeast Fisheries Center for collection of Gulf shrimp fleet bycatch data.

3.4.2 Alabama

An ongoing shrimp monitoring program extends from April through September each year. All the territorial waters are closed when small juvenile brown shrimp show in the open waters, and areas are reopened when brown shrimp average 68 count heads-on. Certain areas of Mobile Bay are temporarily closed during the fall for protection of juvenile white shrimp.

Projected research needs are (1) tagging to determine migratory patterns from different nursery areas and time required for migration, (2) study of postlarval abundance and distribution and (3) studies of the effects of spring exploitation of mixed penaeids on juvenile brown shrimp and roe white shrimp.

3.4.3 Mississippi

Ongoing research includes a fisheries monitoring and assessment investigation of all of Mississippi's marine resources. Already with 3 years of background data, this program involves collection of postlarvae as they enter the island passes and monitoring of their relative abundance on the nursery grounds. From this, estimates of the summer catch are made.

Associated with this year-round program is an intensive sampling of juveniles from mid-April through the summer which provides growth and count/size data to the state management authority. Opening of the brown shrimp season and closing of certain areas, due to a preponderance of small browns or whites, are based on these data.

Projected research needs include a tagging program to determine migratory and overwintering patterns.

3.4.4 Louisiana

Ongoing projects include two studies which are recently completed and nearing publication: "Development of an Areal Management Concept for Gulf Penaeid Shrimp" and "A Study of the Seabob in Louisiana." The first study developed new and improved management techniques for the Louisiana shrimp fishery. These include: a zone system for opening the brown shrimp season, extended seasons and special seasons. The second study is developing basic information on the seabob in Louisiana.

The ongoing shrimp monitoring program extends from March through October. In March and April a "crash"

program provides data to set the opening of the brown shrimp season. After April, weekly trawl and plankton net samples along the entire coast provide information for special management decisions, should the need arise.

Ongoing research also includes a tagging project to determine movement and migratory patterns of white and brown shrimp in Louisiana. Associated with this project is a study of the effects of tagging on penaeid shrimp; tagged and untagged shrimp are placed together in a quarter-acre pond and mortality and growth between the two groups are compared.

Projected research studies are: (1) establishing a practical generic key to larval and postlarval stages of commercial species of shrimp found in the Gulf of Mexico, (2) determination of effects on sampling results of mesh size and gear size, (3) continuation of monitoring program and (4) an evaluation of the wing net fishery.

3.4.5 Texas

The Texas Parks and Wildlife Department began sampling all bay systems for juvenile brown and white shrimp in 1959. Bar seines were used in the shallow marsh and trawls in the tertiary, secondary and primary bays. These data were compared each year with samples taken in the same area in previous years. The abundance of the brown shrimp crop was found to be dependent on continuously high water temperatures in March, April and May (no cold snaps) and relatively high salinities.

In recent years the number of bay systems sampled was reduced to four key systems. This was found to give a good overall estimate at reduced cost and manpower. Sampling periods are March–May for brown shrimp and June–September for whites.

Attempts were made to compare abundance of post-larval shrimp entering the estuaries with later production. Because of the many environmental factors which had overriding influence on survival of juveniles in the nursery areas, sampling of postlarvae was found to be premature and unreliable.

The Department also has a Gulf trawler to monitor the size, distribution and abundance of shrimp on the Gulf fishing grounds.

3.4.6 National Marine Fisheries Service, Southeast Fisheries Center

1. Fishery Analysis—Multispecies—Gulf and Caribbean. The shrimp fishery resources that are exploited by U.S. fishermen off the coasts of foreign nations are studied. These resources include shrimp off Mexico.

Shrimp catch and effort and size composition data that are collected for the U.S. fishery off the Mexican coast are analyzed on a continuing basis to assess the contribution of these stocks to U.S. fishery interests and to monitor changes in stock size and productivity.

Specific objectives:

A. Monitor current fishery activity (distribution of fishing, catch, effort) in shrimp fishery off Mexico.

B. Prepare synopsis on the biology of stocks of shrimp off Mexico (Gulf of Mexico), emphasizing the parameters required for fishery management.

C. Participate in formulating management plans for shrimp fisheries off Mexico (Gulf of Mexico).

Reports:

A. Allen, Donald M. and Albert C. Jones. 1975a.

B. Allen, Donald M. and Albert C. Jones. 1975b.

C. Allen, D. M., J. E. Tashiro, A. C. Jones. 1976.

2. Determination of the Volume of Groundfish and Shellfish Landed and Discarded by Commercial Shrimp Fleets Operating in the U.S. Gulf of Mexico.

3. Determination of Seasonal Species Composition and Sizes of Discarded Fish and Species Ranks in the Discard.

4. Determination of the Weight of Groundfish and Shellfish Discarded.

5. Determination of the Volume of Undersized Shrimp Discarded by the Shrimp Fleet. The study is being conducted through data collection contracts and inhouse surveys.

Preliminary reports written thus far include:

A. Status Reports—for GSMFC and constituency

B. Topic of the month report for Center monthly

C. "Shrimp Bycatch Investigations in the U.S.A.—

A Status Report" by Juhl and Drummond for CICAR II Symposium.

6. Development of a Selective Trawl Such as a Shrimp Separator Trawl to reduce the sizable bycatch in Gulf of Mexico shrimp trawls.

7. Development of Shrimp Trawl That Will Selectively Eliminate Capture of Sea Turtles (task initiated 8/1/76).

8. Development of an Off-Bottom Shrimp Trawl that will allow the assessment of shrimp resource potential in areas probably inaccessible to conventional shrimp trawls, such as the extremely large Florida west coast area obstructed by loggerhead sponge and coral. System will be oriented toward harvesting of the shrimp should adequate stocks be discovered.

9. Development of an Electric Shrimp Trawl.

Objectives:

A. Harvesting System. Very low activity level; work is directed toward finding a solution to the power supply cable failure problem which is the major restricting factor preventing use of this system.

B. Resources Assessment System. Development completed but no demonstration because of the above problem. Defines an accurate catch efficiency for shrimp trawls used in resource assessment.

10. Application of RUFAS II technology that could indirectly benefit assessment of deepwater shrimp resources.

Objective: To complete operational development of this system for deepwater assessment of bottom

resources such as royal red (*Hymenopenaeus robustus*) shrimp.

11. Preparatory Study for Development of Bio-Socio-Economic Models of the Gulf Coast Shrimp Fishery.

Objectives. The first step in the evolution of the resource management strategy should be a preparatory study designed to accomplish the following:

A. Review the relevant literature on fishery economics, fishery management, population dynamics and shrimp market models.

B. Specify the general characteristics of the bio-socio-economic models to be constructed, and identify any modeling objectives not already given.

C. Segment the model development into easily-managed sequential phases, with associated time frames.

D. Describe the theory and statistical/mathematical techniques to be used in each phase.

E. Evaluate the adequacy and degree of readiness of the needed data.

F. Estimate time and cost to complete each future phase, if done by this agency.

G. Prepare report.

12. Plans for Expanded Shrimp Research Conducted Through the NMFS Galveston Laboratory, 1977 and 1978.

Problem. As outlined in the Shrimp Resource Assessment proposal of June 1976, additional information in the biological, economic and social areas is required for management of the Gulf shrimp fishery. In the biological realm, improved estimates are needed on yield per recruit, predictions of recruitment and migration patterns for brown and white shrimp.

Objectives.

A. Define growth of brown and white shrimp cohorts entering the fishery, including possible seasonal differences in such growth rates.

B. Determine migration routes of recruits to offshore stocks of brown and white shrimp.

C. Obtain estimates of natural and fishing mortality, with initial emphasis on offshore brown and white shrimp.

D. Refine techniques of predicting recruitment by relating abundance to environmental conditions.

Rationale.

a. Existing data on brown and white shrimp must be supplemented to provide a firm basis for management decisions. Improved growth data are necessary to estimate mortality rates from catch data. Tagging experiments also provide opportunities to determine mortality rates. Reliable growth and mortality estimates are needed to determine yield per recruit and the optimum size at harvest for a range of fishing intensity. Given this information, economic and social considerations can be viewed in terms of effects on both shrimp stocks and people.

b. Forecasts based on the relative abundance of juvenile shrimp in estuaries are reasonably accurate. These estimates, however, cannot be made with accuracy until 3 or 4 weeks previous to the fishing season. Therefore they are of limited value; insufficient time is available to make management decisions and regulate fishing strategy before fishing begins. We believe the abundance of incoming recruits, and thus the offshore stocks, may be significantly affected by environmental factors at sea and in estuaries. We plan to define such relationships and employ them to estimate abundance well in advance of the fishing season.

Proposed Studies.

a. Sequential tagging experiments on white (1977) and brown (1978) shrimp in offshore waters to measure seasonal growth, mortality rates and migration patterns.

b. Relate existing catch-effort data to environmental data to develop and improve predictions of recruitment, determine relative importance of oceanic and estuarine environments in affecting year-class strength and determine need to protect offshore spawners.

E. Inshore tagging experiments—contractual/cooperative arrangement between NMFS/Galveston and the State of Louisiana.

a. The roles of NMFS and the State will be determined through discussions in the future. It appears that NMFS will develop general plans in the form of a work statement, the State will formulate and carry out detailed plans for capturing, marking, releasing and recovering tagged shrimp, and NMFS will be responsible for data processing, analysis and preparation of reports of results. Also, NMFS will provide technical assistance, specialized equipment and tags.

b. A tentative schedule of activities and responsibilities are depicted in Table 22.

c. The location for proposed experiments is Caillou (Sister) Lake, Louisiana.

d. NMFS will assume responsibility for insuring that all aspects of experimental design are compatible with analytical requirements. Also, NMFS will host workshops for detailed planning and for demonstrations of tagging procedures. A NMFS representative will be on-site during field operations to provide technical and logistic support as needed.

e. The goals of the inshore experiments are to tag up to 10,000 shrimp per month with plastic streamer tags. Marking will be accomplished within a 10-day period each month from July through October in 1977 with primary emphasis on white shrimp. A similar series of tagging experiments will be conducted from April through July in 1978 for brown shrimp. A schedule of inshore and offshore tagging goals appears in Table 23.

TABLE 22.

1977-78 mark-recapture experiments. N = NMFS, S = states (agencies or institutions).

	1977												1978					1979					
	M-M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	
Planning	N	N	N	N	N	N	N				N	N	N	N	N	N	N						
Publicity	S	S	S	S	S	S	S				S	S	S	S	S	S	S						
Capture and release of shrimp																							
Inshore			S	S	S	S					S	S	S		S								
Offshore					N	N	N								N	N	N						
Marking of shrimp																							
Inshore			S	S	S	S					S	S	S		S								
Offshore					N	N	N								N	N	N						
*Recovery (returns) and rewards			S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
**Catch-effort sampling and catch sampling					N	N	N	N	N	N					N	N	N	N	N	N			
Data processing and analysis			N	N	N	N	N	N	N	N					N	N	N	N	N	N			
Report preparation and dissemination											N	N										N	N

*Recovery and rewards continue until no further tags are returned (usually 3 months) at which time reanalysis of data begins.

**Increased catch/effort sampling and catch sampling (for offshore fishery) by the Division of Statistics and Data Management, NMFS.

TABLE 23.

Maximum numbers (thousands) of shrimp to be marked and released by species, zone (inshore, offshore) and month

Year/ Month	White Shrimp		Brown Shrimp	
	Inshore	Offshore	Inshore	Offshore
1977				
July	10			
August	10			
September	10	10		
October	10	10		
November		10		
1978				
April			10	
May			10	
June			10	
July			10	10
August				10
September				10
TOTAL	40	30	40	30

f. Rewards will be paid for returned tagged shrimp.

F. Offshore tagging experiments—to be conducted by NMFS, with possible assistance of the States.

a. Tagging will be done in offshore areas adjacent to estuaries where the inshore experiments are conducted.

b. Planning, logistics, field operations and analysis are the responsibility of NMFS/Galveston. However, since these experiments will be conducted in the same general area as the inshore studies and will follow similar procedures, it may be practical for the State to assist in areas of publicity, shrimp recovery, reward payments, etc.

G. Analysis of catch-effort and environmental

data.

a. Selected data-rich area for initial analysis (Galveston Bay and adjacent offshore area, brown and white shrimp).

b. Selected anomalous production years (high- and low-year consecutive pairs—1960-61, 1969-70 and 1972-73).

c. Examine environmental variables for anomalous production years:

- (1) Ekman transport—related to migration of larval shrimp (spawning ground to estuary),
- (2) Coastal weather,
- (3) Coastal currents,
- (4) Other.

d. Correlate reported shrimp catches (by sex, size, time and area) and fishing (or sampling) effort with environmental variables (by time and area), using time series analysis with time lags, if appropriate.

e. Evaluate results and determine whether to continue with analyses expanded to other areas and years.

13. A Graduate Program in Environmental Studies and Shrimp Biology and Mariculture.

Program goals:

A. Offer advanced degrees (M.S. and Ph.D.) with a specialty in marine environmental quality and/or shrimp biology and mariculture.

B. Increase knowledge of the marine environment and shrimp biology and mariculture through basic and applied research.

C. Increase man's ability to develop and utilize the marine environment including the adjacent coastal zone without altering its delicately balanced natural resources so that a sustained commercial and recreational yield to man from the marine environment can be maintained.

D. Provide leadership in these areas so important to Americans.

3.4.7 Other

1. Economics of Production and Marketing in the Commercial Fish Industry.

Objectives:

A. Describe structure of seafood markets important to Texas fishermen by identifying major components and the relationships among them and to estimate performance in these markets.

B. Evaluate decision-making processes in seafood firms and analyze critical economic decisions faced by managers in these firms.

C. Evaluate impacts of alternative management strategies for the Gulf of Mexico shrimp fishery.

2. Economic Evaluation of Proposed 200-Mile Off-shore Fishing Zone on the Gulf of Mexico Shrimp Fishery.

Objectives:

A. Estimate the average annual reduction in shrimp landed in the U.S. by the Gulf of Mexico shrimp fleet as a consequence of a 200-mile offshore fishing zone.

B. Estimate the expected increase in effort that will be exerted off the coast of the U.S. by the Gulf of Mexico shrimp fleet as a consequence of a 200-mile offshore fishing zone.

3. A Profile of Bio-Economic Models of the Gulf of Mexico Shrimp Resource

Objectives:

A. To develop a profile of various bio-economic models of the Gulf of Mexico shrimp resources, determine the data requirements of each model, the cost of each

model and the time frame in which each can be developed.

B. To provide a framework for coordination and development of multidisciplinary studies of the shrimp fishery of the Gulf of Mexico and related management strategies.

4. Bio-Economic Evaluation of Mixed Penaeid Shrimp in Pamlico Sound—Phase 2.

Objectives:

A. To determine the biological effects of harvesting commercial-sized brown shrimp on sub-commercial pink shrimp during late fall, and to determine survival of overwintering pink shrimp during the following spring.

B. To assign potential economic values to pink shrimp discarded during the fall brown shrimp fishery.

C. To develop and evaluate options for achieving management goals.

5. Mobility of Shrimp Vessels in the South Atlantic States. The primary objective of this project is to develop socio-economic information concerning mobility of shrimp vessels in the South Atlantic States.

Objectives:

A. To determine the extent of vessel mobility.

B. To identify factors affecting vessel mobility.

C. To compare the productivity and profitability of vessel mobility classes.

D. To evaluate impacts of alternative management options on vessel mobility.

6. The Economic Impact on the White Shrimp Fishery by Opening and Closing Sounds to Commercial Shrimping.

Objectives:

A. The origin of shrimp harvested.

B. The value of shrimp harvested.

C. The social values assigned to recreational shrimping by fishermen.

Chapter 4. Goal and Objectives

The goal and objectives developed are shown below:

Goal. To manage the U.S. shrimp resources of the Gulf of Mexico to provide for optimum sustained benefits for the Gulf States and the Nation.

Objectives.

1. Describe the fishery.
2. Identify, preserve and improve shrimp producing zones of the Gulf region.
 - a. Identify and preserve (maintain) high value "natural" shrimp habitats.
 - b. Provide protection of the spawning and juvenile populations of those shrimp where data indicate possibility of overharvesting.
 - c. Identify offshore shrimp stocks and their relationships to estuarine systems.
 - d. Identify habitats that might be altered to enhance shrimp productivity.
3. Facilitate the collection of improved statistics regarding the commercial and recreational shrimp fishery that will include at least catch, effort, price and cost.
 - a. Develop a fishing information acquisition, processing and dissemination system with sufficiently short turn-around time to be of use to management.
 - b. Determine the interaction between shrimp and other fisheries.
 - c. Encourage coordination and standardization of sampling programs.
4. Facilitate research in the development of a bio-socio-political-economic model to assess the impact of various management strategies.
 - a. Test the sensitivity of the model to define areas of research needed to continually update and improve the management schemes and to determine various data requirements.
 - b. Identify those items that a management authority might affect and the resulting impact on the fishery, including its participants.
 - c. Determine optimum sizes for harvest.
 - d. Determine optimum organizational structure for marketing shrimp.
 - e. Monitor and predict fluctuations in abundance and geographic distribution.
 - f. Determine causes (fishery and/or environmental) of fluctuations in yield.
5. Develop a regional management plan.
 - a. Determine institutional and legal barriers to regionalized management.
 - b. Incorporate where possible individual State management plans for internal waters into regional management plan.
 - c. Encourage standardization of state management regulations as biological and socio-economic considerations allow.
 - d. Identify criteria, methods and schedule for evaluating effectiveness of management scheme.
6. Facilitate extension education to the shrimp industry that will promote:
 - a. Management techniques that will provide efficiency in harvest.
 - b. Changes in the industry to enhance implementation of optimum organizational structures for marketing shrimp.
 - c. Knowledge of alternatives with regard to diversification in the fishery.

This plan has been developed to show what inputs are needed and how these inputs may be used to arrive at policies to improve the shrimp fishery through better and more timely decision making. Because dynamic conditions will change some of the stated objectives, as well as their order of importance, the management system must be capable of responding both when and where necessary. The users of this plan should consider that the goal and objectives are guidelines for the future management of the Gulf shrimp fishery, and that adjustments will be required from time to time.

Chapter 5. Proposed System

Under the proposed system, the Gulf States will continue to manage the shrimp fishery within their territorial waters, but will cooperate in managing those aspects of the fishery which can be best managed as a regional venture. Gulf States, working under the Gulf State-Federal Fishery Management Board (GS-FFMB), will be assisted by appropriate federal agencies as may be required by the Board.

The State-Federal Fishery Management Program (S-FFMP) was established in 1971 to provide a mechanism for cooperative management of marine fisheries that transcend State and State-Federal jurisdictional boundaries.

State-Federal Fishery Management Boards were established for the purpose of determining fisheries in need of management, developing management plans, identifying data requirements and implementing action programs necessary to achieve management goals and objectives.

In the Southeast Region, two State-Federal Boards were organized—one for the South Atlantic States and one for the Gulf States—under the authority of the respective interstate marine fisheries compacts existing within those areas.

The GS-FFMB was organized in April 1976, and since that time two significant planning efforts have been launched; namely, the development of management plans for the Gulf menhaden and Gulf shrimp fisheries.

Congress enacted PL 94-265, The Fishery Conservation and Management Act (FCMA) of 1976, establishing a Fishery Conservation Zone (FCZ) existing seaward from the outer limit of state territorial waters to a line 200 nautical miles from shore (Figure 54). In the Gulf of Mexico, state fisheries jurisdiction extends from the beach gulfward 3 nautical miles except for Texas (9 nautical miles) and the west coast of Florida (9 statute miles).

Responsibility for fishery management within the FCZ is delegated to the Secretary of Commerce. A Gulf of Mexico Fishery Management Council (GMFMC), appointed by the Secretary is responsible for development of fishery management plans for all fisheries in the FCZ.

Under the FCMA, states will continue to manage the shrimp fishery within their waters with provision for Federal preemption only when fishing is predominantly in the conservation zone, if a state fails to take action

or takes action the results of which would adversely affect implementation of a fishery management plan. The FCMA requires (as a national standard) that to the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and inter-related stocks of fish shall be managed as a unit or in close coordination.

The orderly development and implementation of management plans will require a close working relationship between the Councils, the Boards and State agencies if fisheries are to be addressed throughout their range.

Any proposed system for Gulf shrimp fishery management should provide for the interfacing and coordination of State and Federal responsibilities. This plan provides options through which a management plan is to be accomplished. Because the GMFMC has designated the fishery for shallow-water shrimp as one for which a management plan is to be developed, management options proposed in this plan include a mechanism for coordination with that body of shrimp management. Various organizational structures for coordinating inshore management among the States are suggested as options.

Existing organizational structures for fishery management or coordination include:

A. State Conservation Agencies—Responsible for fishery planning and management in State waters.

1. Alabama Department of Conservation and Natural Resources

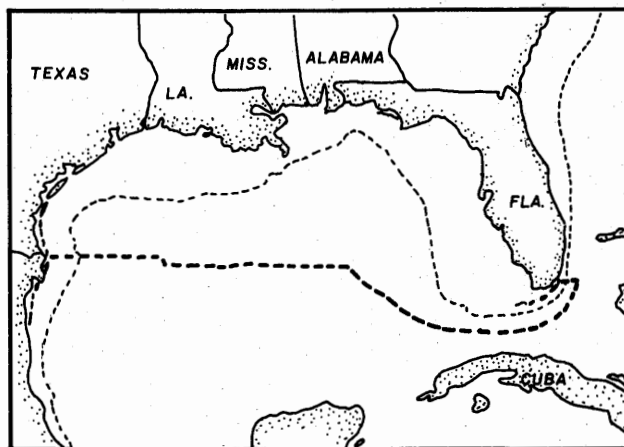


Figure 54. Extent of the Fishery Conservation Zone in the Gulf of Mexico.

2. Florida Department of Natural Resources
3. Louisiana Department of Wildlife and Fisheries
4. Mississippi Marine Conservation Commission
5. Texas Parks and Wildlife Department

B. Federal

1. Department of Commerce—Secretary is responsible for approval of fishery management plans and management in FCZ (Figure 54).

National Marine Fisheries Service—Responsible for marine fishery research for Federal Government, GMFMC, GSMFC.

Sea Grant Program
Coastal Zone Management

2. Department of Interior
Fish and Wildlife Service

C. Regional Institutions

1. Gulf of Mexico Fishery Management Council—Responsible for fishery plan development in FCZ.

Membership:

Voting.

Five state fishery administrators (one each state)

11 Appointees by Secretary of Commerce (one each state, six at large)

Regional Director NMFS (Southeast Region)

Non-Voting.

U.S. Coast Guard

Gulf States Marine Fisheries Commission,

Executive Director

U.S. State Department

U.S. Department of Interior, Fish & Wildlife

Service

2. Gulf States Marine Fisheries Commission—Reviews and coordinates needs of fisheries for Congress and States.

Membership:

Five State fishery administrators (one each state)

Five Appointees by Governors (one each state)

Five Legislative members (one each state)

3. Gulf State-Federal Fishery Management Board—Coordinates fishery research and planning in territorial sea.

Membership:

Voting (one vote per state).

Five State fishery administrators (one each state)

Five other Gulf States Marine Fisheries Commissioners (one each state)

Non-Voting.

Regional Director NMFS (Southeast Region)

Executive Director GSMFC

The proposed system (Figure 55) is contingent upon a regional data base providing information for: (1) popula-

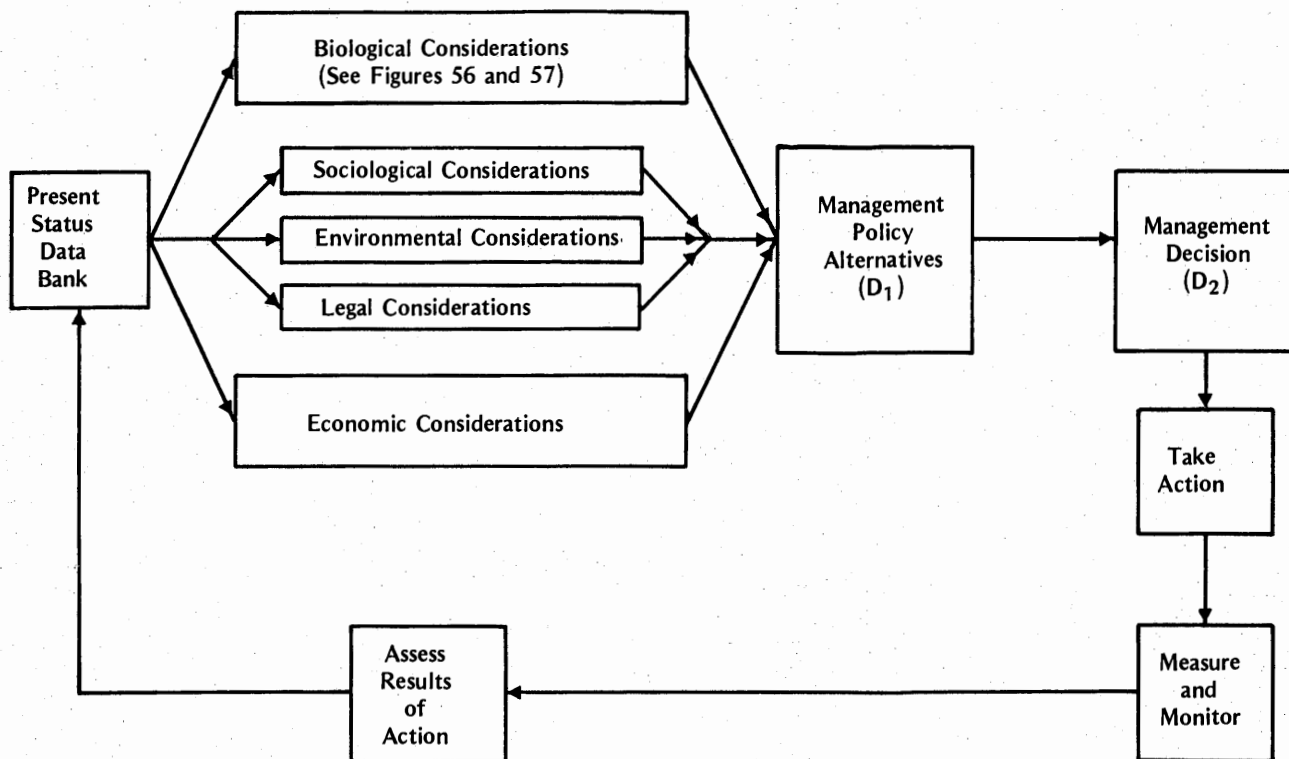
tion dynamics models; (2) development of knowledge of the economic structure of the industry; (3) determination of social attributes of the fishing community; and (4) determination of hydrological and environmental parameters to be monitored, providing continuous information concerning the status of the resource. This information in turn will be used to: (1) develop harvest prediction models; (2) develop economic criteria to allow managers to judge the health of the fishing industry and evaluate the impact of management decisions; (3) formulate social and political criteria which can be used to determine (a) the potential acceptance of management policies and (b) the social and legal impact of management decisions; and (4) suggest guidelines to advise members of industry and the public concerning current status of the shrimp resources and fishery. While these tasks are being accomplished, management policies will be developed that will consider biological, social and economic conditions in the fishery. The next step of this process will be to decide on the proper techniques for implementing policies. After implementation, policies will be evaluated for their effectiveness and relevance to changing conditions.

The principal advantage of the new system is that management will coincide with geographic distribution of the resource and fishing industry. Other advantages are: (1) it may serve as a model for regional management of other fisheries; and (2) it will lead to development of a predictive capability that (a) should reduce economic loss resulting from over investment, thereby improving the financial climate of the fishery, (b) increase the effectiveness of management through coordinating field monitoring of the resource, (c) enable managers to evaluate the biological, economic, social and political effects of their decisions, (d) allow States to coordinate administrative, research and enforcement policies, (e) enable managers to advise industry concerning costs of fishing, (f) allow managers to document biological and economic trends in the shrimp fishery, (g) provide adequate catch and effort data should it be necessary for negotiations between the Federal government and other nations fishing in this area and (h) establish a regional fisheries management information system data base that can be retrieved quickly and used to identify information gaps needed for significantly improving resource management.

Disadvantages of the new plan include, but are not necessarily limited to, a high initial cost, particularly for a regional fisheries management information system. Also, there is a possibility that certain elements of the industry will oppose the plan on the grounds that their time is being taken up with few tangible benefits in return and that their privacy is being invaded.

5.1 SHRIMP BIOLOGICAL MODELS

In the Gulf there are three principal commercial



EXPLANATION OF DECISIONS TO BE MADE

D₁ At this point biological, sociological, environmental, legal and economic considerations must be taken into account to produce alternative actions which may be used to solve the problem under examination. All forms of action should be considered, ranging from the null alternative (the "do nothing" alternative) to drastic action. Those alternatives which appear to have the best chance of solving the problem, along with each options' advantages and disadvantages should be used for decision (D₂).

The Technical Committee investigating the problems will develop these alternative solutions.

D₂ The Fishery Management Council will make this decision by choosing the best alternative in accordance with previously set policies.

Figure 55. Conceptual model of future management systems.

species: white shrimp, brown shrimp and pink shrimp. Production management schemes, if directed at only one particular species, could possibly be in conflict with management schemes for the others.

One of the problems encountered in shrimp studies involves the fact that two species of equal value that have overlapping life cycles exist in the same waters. An important decision must then be made, not concerning one species at its optimum value at the time, but rather the overall effect of the fisheries and the total value that may be achieved.

Also, maximum value per pound may not reflect maximum profit or the economic impact on the fishing community. An example is that the cost of harvest in offshore waters is substantially greater than in inshore waters. A small inshore trawl boat may cost as little as 1/20 the amount of a large offshore vessel and the operating and maintenance costs are of the same proportion. Therefore, because of the various biological,

economic, social and political factors involved, a management program must be flexible to function, sustain and improve the economy of the entire fishing community.

This section will provide a more elaborate overview of the management of the major shrimp species. The biological models that will be discussed fall under Biological Considerations in Figure 55. Similar models should be developed for other species as well as economic, social and political elements in this system. However, it is not possible to construct accurate models at this time because of the lack of information.

Figure 56 shows the interactions of the management of white and brown shrimp in the region. The model represents activities for a year, essentially covering one biological cycle of shrimp. Sampling throughout the year provides data on patterns of migration, growth and abundance and distribution by size in inshore and offshore waters. Information derived from this activity will also be used to construct a detailed model of overwintering

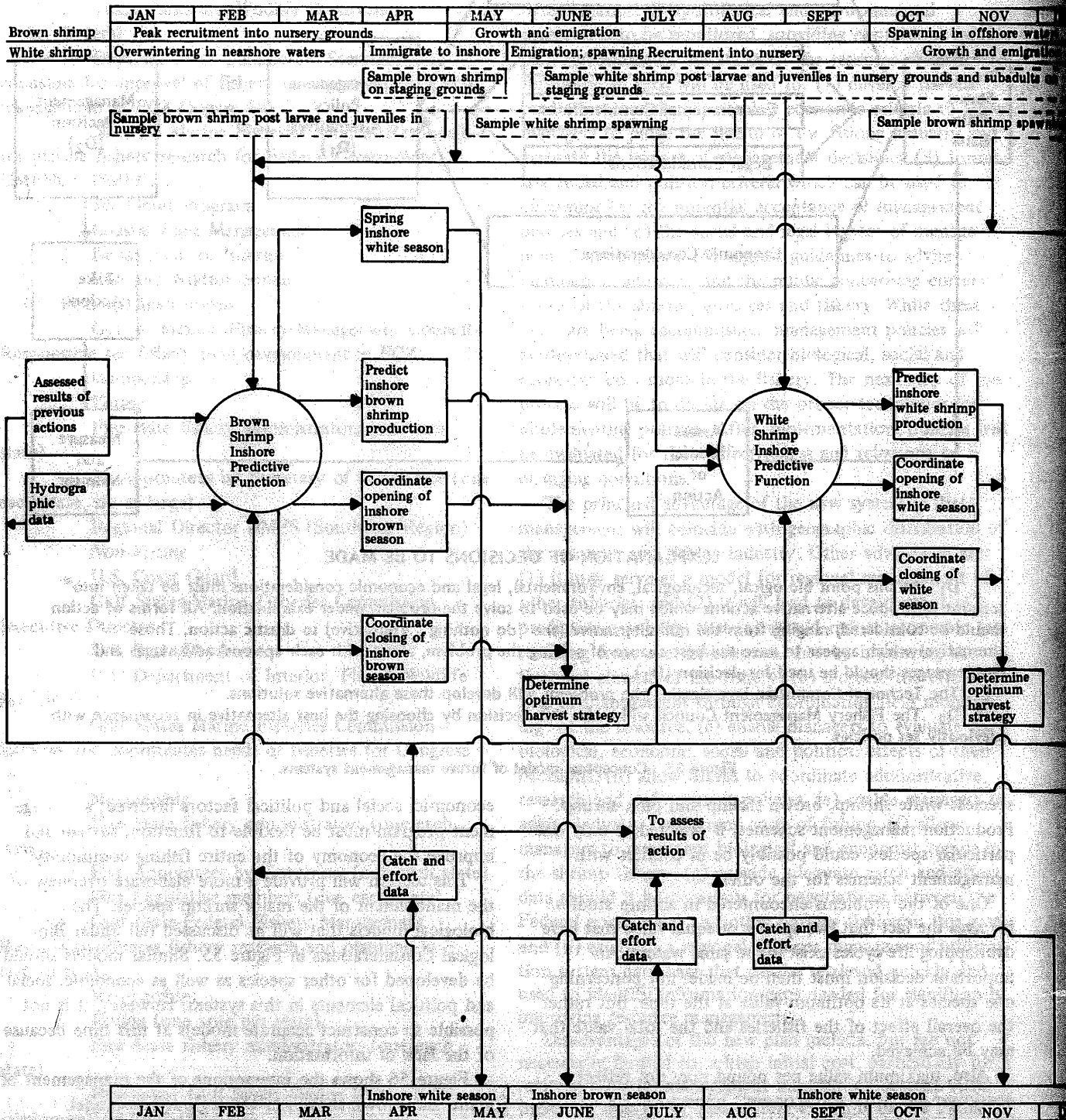
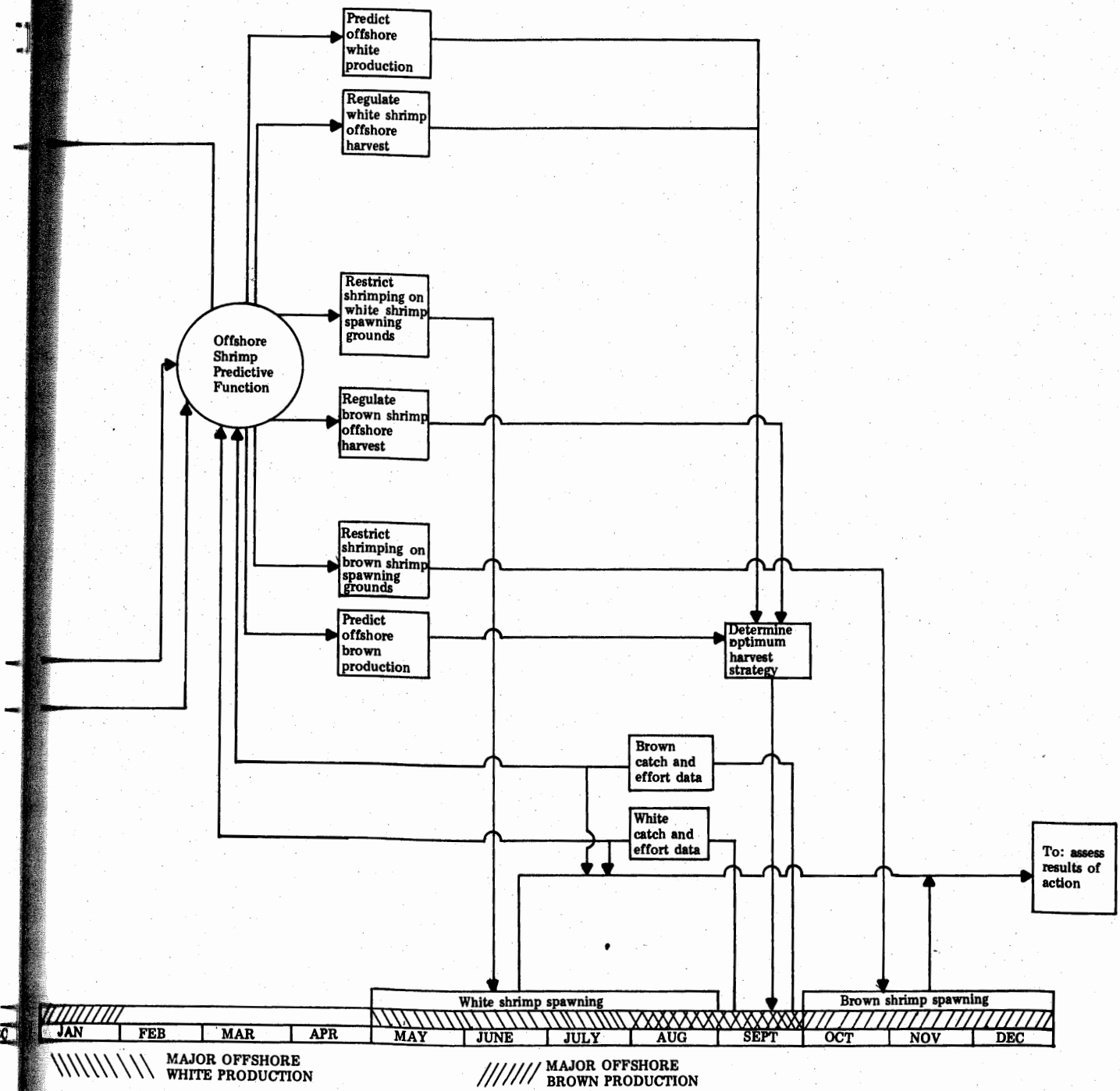


Figure 56. Interaction of proposed brown and white shrimp management practices in the Gulf of Mexico.



patterns of white shrimp for predictions of availability and abundance for consideration of an early spring white shrimp season. Managers may open the spring season and estimate the potential value of the spring catch on the basis of this information. Analysis of catch and effort statistics will allow managers to evaluate and improve their spring prediction. Also, in the spring, brown shrimp postlarvae enter the nursery grounds. These shrimp are monitored in order to obtain information for managerial decisions (i.e., setting seasons). This monitoring becomes especially important when juvenile shrimp of one species and adults of another are on the same fishing grounds.

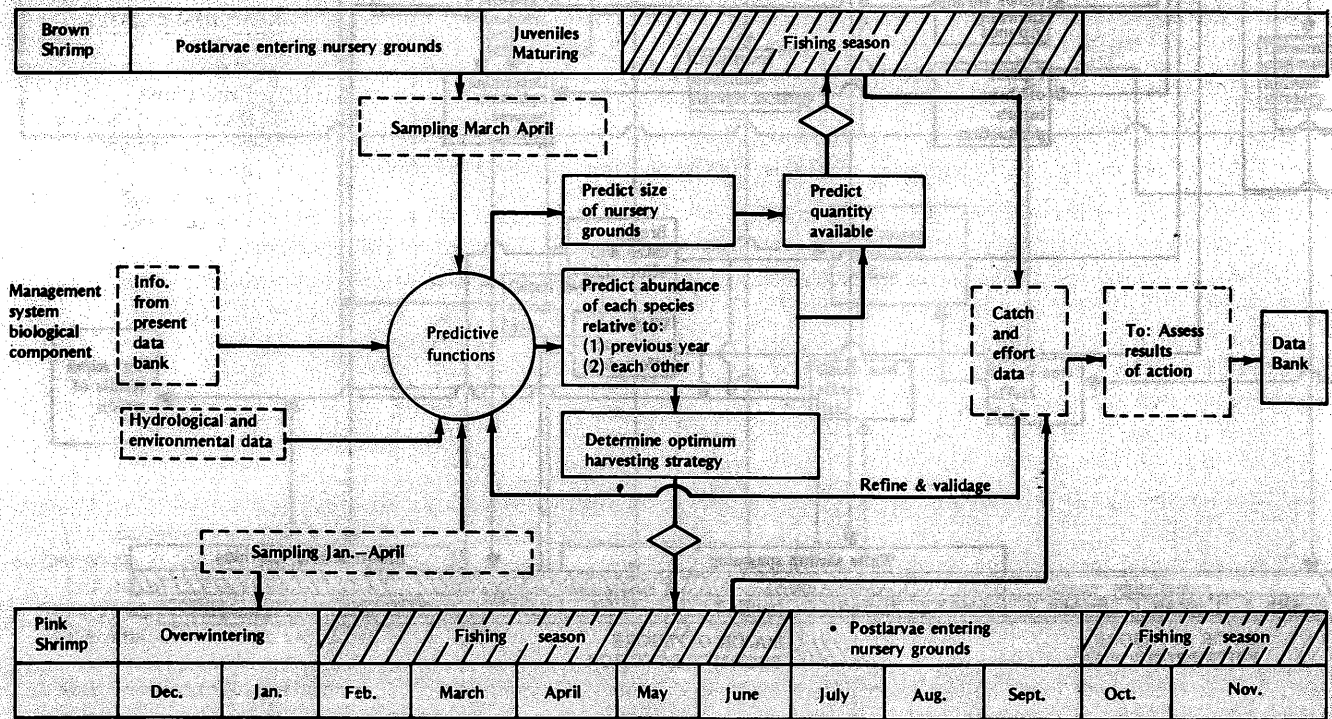
Predictive models will be developed for all segments of the Gulf shrimp fishery, and refined as additional data become available. This information will also be used to develop decisions for regulating seasons by geographic area. At the end of the summer fishery for brown shrimp, catch and effort data will be analyzed to evaluate catch predictions as well as to monitor biological, social and economic trends.

Monitoring activities throughout the year will enable biologists to detect immigration of shrimp, monitor growth and abundance of juveniles while in inshore waters and consequently better predict subsequent catch (harvest). These activities will also provide information permitting managers to develop criteria for regulating seasons by geographic area. Finally, the results of stock monitoring, in addition to catch and effort data, will

provide information necessary to support decisions on closure or extension of seasons and/or areas. This will complete one management cycle except for the evaluation of procedures, a continuous process that dictates procedural change, due to changes in hydrological and/or environmental factors and refinement of technique. Therefore, the management plan must be flexible, if and when the need arises.

Whenever pink, brown and white shrimp occur together along the United States Gulf coast, the relative abundance of pink shrimp is so low that management decisions relating to interactions appear unnecessary. However, co-occurrence of pink and brown shrimp in relatively small areas could result in an interaction of management practices. Such an interaction scheme is shown in Figure 57.

Information derived from this activity will be used to construct a detailed model of overwintering patterns of pink shrimp which can be used to predict the availability and abundance of this species for the spring seasons. Managers will use this information to regulate the spring seasons. Analysis of catch and effort data will allow for evaluation of predictions. Also, in the spring, monitoring of juvenile brown shrimp on nursery grounds will provide information for development of harvesting strategies and predictions. Analysis of catch and effort data as well as monitoring activities will permit managers to evaluate predictions.



*During mild winters the fishing seasons for pink shrimp may extend through the winter.

Figure 57. Interactions of proposed brown and pink shrimp management practices in the Gulf of Mexico.

As previously mentioned, a problem exists when juvenile pink enter an area occupied by adult browns. Then, managers must devise harvesting strategies to optimize yields, recognizing the possibility that their decision may favor one species over the other.

5.2 MANAGEMENT SYSTEMS CONSIDERED

This section contrasts the capabilities of management systems for solving problems associated with the shrimp fishery of the Gulf of Mexico. The first of these, the Present System, was discussed in Chapter 3 of this document.

Another system examined is a modification of the Present System. Under this modified system there would be no formal attempt at regional management and there would be no regional catch and effort data acquisition. Instead states would continue to manage the resource and fishery on an individual basis and would attempt to better coordinate research, management and administrative activities.

Another system examined is the Proposed System, which is as follows.

The basic organization of the recommended management structure is shown in Figure 58 which illustrates the preferred choice of the Shrimp Task Force. The basic structure is the GS-FFMB which will recommend management actions in the territorial sea. The Management Board will establish appropriate procedures and policies to take necessary actions to design, evaluate and recommend shrimp management activities.

It is recommended that GS-FFMB utilize the existing TCC as its advisory committee. Each year there should be at least two meetings of the TCC dealing specifically with Gulf shrimp regional technical problems and solutions and additional meetings as deemed necessary by two or more members or at the discretion of GS-FFMB.

The chief advantages of this option are that members of the Board have knowledge of and an interest in fishery management problems and the State agency administrators regularly advise the heads of their respective management bodies on fishery management problems as well as make recommendations to their legislators and/or governors. Also, they are members of the GSMFC and, therefore, can coordinate the activities of the Board and

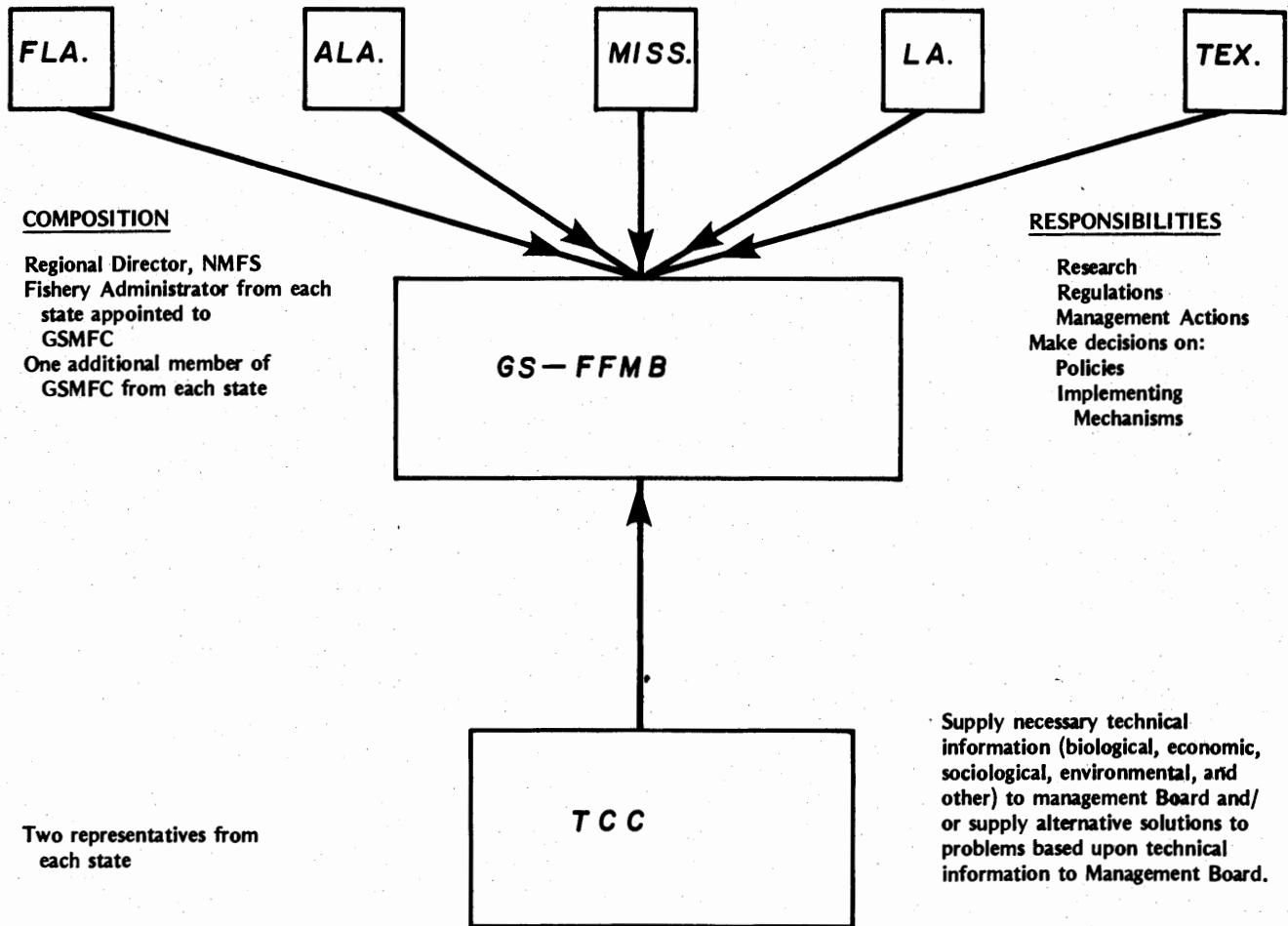


Figure 58. Management structure recommended by Gulf Shrimp Management Task Force.

GSMFC. Inclusion of the NMFS Southeast Regional Director as a member provides representation of Federal interests.

There are two disadvantages of this alternative. The first is that the member state administrators can commit their respective State agencies to a course of action only with the approval of the head of their department or management body and through legislative or executive action. Second, this or any formalized regional management scheme would require legislative approval of reciprocal management programs in most cases.

Other management structure options considered by the Task Force were:

A. Continue to manage the Gulf shrimp fishery in the same manner that currently exists (no action).

1. Advantages
 - a. With limitations, the system is working.
 - b. The cost of management under the present system is relatively low for a fishery of such great value.
2. Disadvantages
 - a. Management responsibility in the territorial sea has not been delegated to a regional agency that can provide for implementation of the proposed system.
 - b. Economic, environmental and social factors are not usually considered adequately under the present system nor is any concentrated effort underway to acquire necessary data from a Gulf-wide approach.
 - c. Conflicts will continue to plague the industry if states continue to act separately.
 - d. It is difficult for states to coordinate with GMFMC on an individual basis.

B. Manage the fishery by the GMFMC

1. Advantages
 - a. The Council is funded and required to develop management plans and to recommend management practices for fisheries in the FCZ.
 - b. The Secretary of Commerce may accept, implement and enforce regulations in the FCZ as recommended by the Council.
 - c. The shrimp population spends part of its life cycle offshore.
2. Disadvantages
 - a. A large portion of the penaeid shrimp harvest is taken in territorial waters where states have jurisdiction.
 - b. The shrimp industry prefers to communicate with state agencies on pertinent matters where possible, rather than a central body.
 - c. Shrimp production depends on maintenance of estuarine nursery areas located in territorial waters as well as successful spawning in offshore waters.

C. Manage the Gulf shrimp fishery by some regional body yet to be created.

1. Since several regional management bodies are already established, neither the Task Force nor

participating industry personnel found any advantages in the creation of a new management body.

With the passage of PL 94-265 and the formation of the GMFMC for the Gulf, it is important and appropriate to address the interrelationships between management authority in the state territorial sea and the FCZ. Configuration A depicts such a relationship and is presented as an approach toward coordination of a common resource. There is no attempt in this plan to presuppose any authority by the GS-FFMB with respect to the GMFMC or the FCZ. However, while the authorities are separate and distinct, some type of coordinated activity is important. This plan recommends consideration of an action of the nature of Configuration A.

Configuration A is a dual process flow model depicting the States territorial sea shrimp management flow in the top half of the model and the Gulf Council's FCZ shrimp management flow in the lower half of the model. In order to enhance compatibility of the territorial sea and the FCZ management plans, the common steps of Coordination and Constituency Review have been added in the right center of Figure 59 with NMFS affording inputs to both plans.

As both the territorial sea and the FCZ management plans go into effect, this model (Figure 59) may continue to be used for consideration of changes which may be recommended by either or both entities. Also, along both paths of the flow model, such as at the GS-FFMB and the GMFMC, there currently exists personnel common to both bodies. Adoption of a formal model of this nature will enhance coordination and communications of all relevant plan initiations and changes thereto.

Advantages and disadvantages of the configuration represented by Figure 59 are:

- A. Advantages
 1. Territorial sea treated as a continuum, rather than a group of five adjacent territorial-seas.
 2. Uniformity in management strategy within territorial sea.
 3. Management units treated for the most part without regard to state boundaries. (Split by territorial sea and FCZ boundaries)
 4. Enforcement less difficult.
 5. State cooperation expanded.
- B. Disadvantages
 1. More than one authority (GMFMC and GS-FFMB) required for management of the fishery.
 2. Potential conflicts between management strategies within territorial sea and FCZ.

In addition to Configuration A, members of the Gulf Shrimp Task Force considered four other management configuration relationships. These are presented for reference in supplementary form at the end of this chapter, along with advantages and disadvantages of each.

CONFIGURATION A

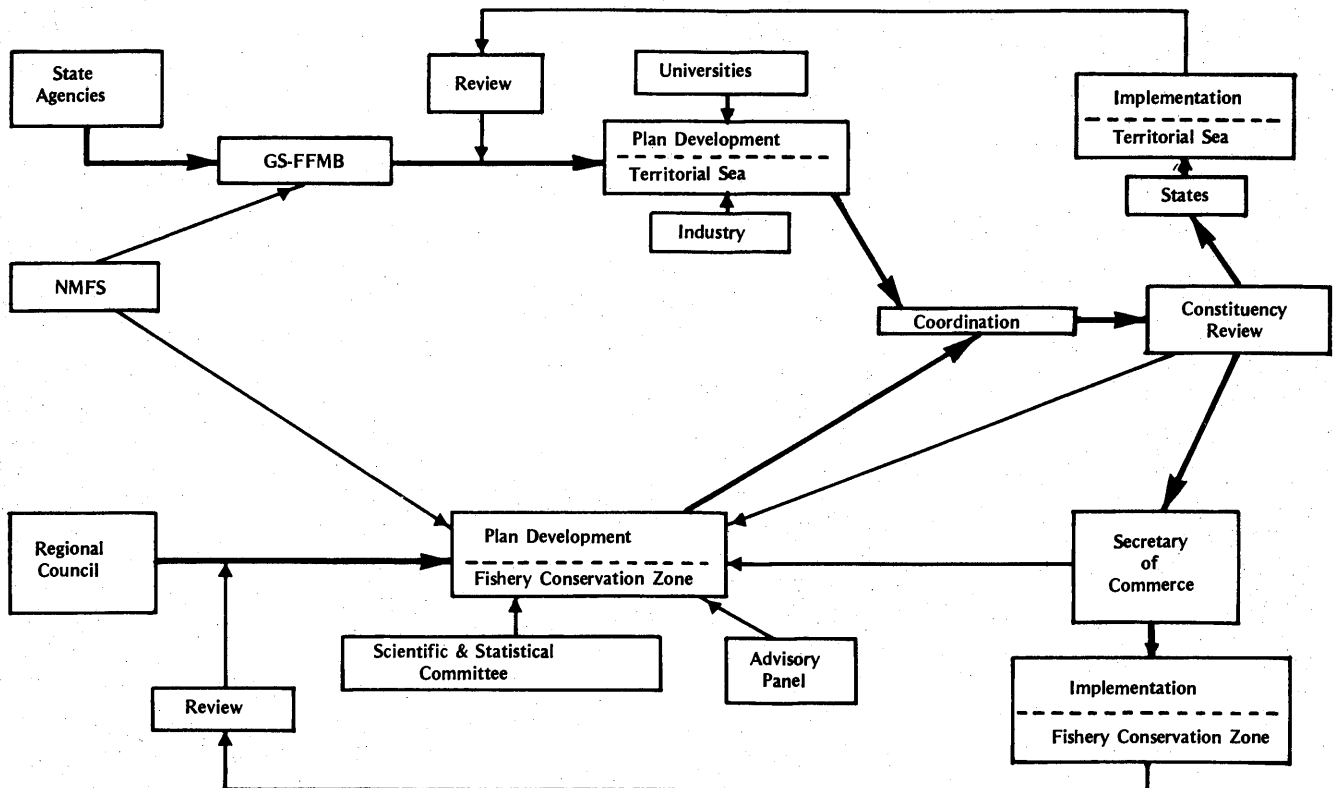


Figure 59. Dual process flow model—Configuration A.

In management of Gulf shrimp, it is imperative that adequate funding be made available for implementation of the necessary research and development programs. A listing of recommended programs is presented in Chapter 7 of this document.

Also, it must be emphasized that because of the cyclic nature of shrimp populations and associated hydrological and/or environmental changes and fluctuations, monitoring is an ongoing program; therefore, funding must be available on a continuing basis.

5.3 STATISTICAL INFORMATION OPTIONS

Catch and effort statistical information is necessary for a successful management program. The amount necessary is dependent on needs of the management system. Conversely the amount of information available will be a constraint in the development and use of a management system. The following options may be considered for gathering necessary statistical information.

Current System. The State-Federal Catch and Effort Data is the system currently in operation in the Gulf of Mexico. Advantages of this system are its relatively low cost and its acceptability to industry. Its primary disadvantages are the lack of biological and economic data, and the failure to verify the accuracy of data that are

gathered. Also, a significant time period elapses between collection and publication of data.

Alternative Systems.

1. Improved State-Federal Catch and Effort Data—This system would be an improvement and expansion of the current system. The State would continue to assist in data collection; the Federal Government would intensify sampling efforts, improve data analysis and provide for more rapid dissemination. The Federal Government would provide the bulk of the cost. This system would allow managers to monitor biological and economic trends to document changes in efficiency of vessels and gear, better estimate fishing and natural mortality rates, evaluate management decisions such as closing certain areas to fishing, estimate abundance of roe shrimp and evaluate forecasting techniques derived from biological sampling of postlarvae, juveniles and overwintering stocks of shrimp. Additional advantages would be improved verification of data and the quantitative experience gained by States. Disadvantages would include increased cost and the possibility that it might not be acceptable to some members of industry.

2. Improved Federal-State Catch and Effort Data—This system would be essentially the same as no. 1, but the Federal Government would pay for the entire cost of

the program. This program would have the same advantages and disadvantages as no. 1. Moreover, this system could be implemented relatively quickly by States if Federal funds were available

3. States Only Catch Data—This system would cost approximately the same as the State-Federal system but would be paid for entirely by the States. Its advantages and disadvantages are basically the same as the first option. However, States would be collecting data, while NMFS would be processing it. Thus, personnel collecting data would not be verifying it. Moreover, the increased cost per State would make it less attractive to States due to difficulty of budgeting funds specifically for statistics.

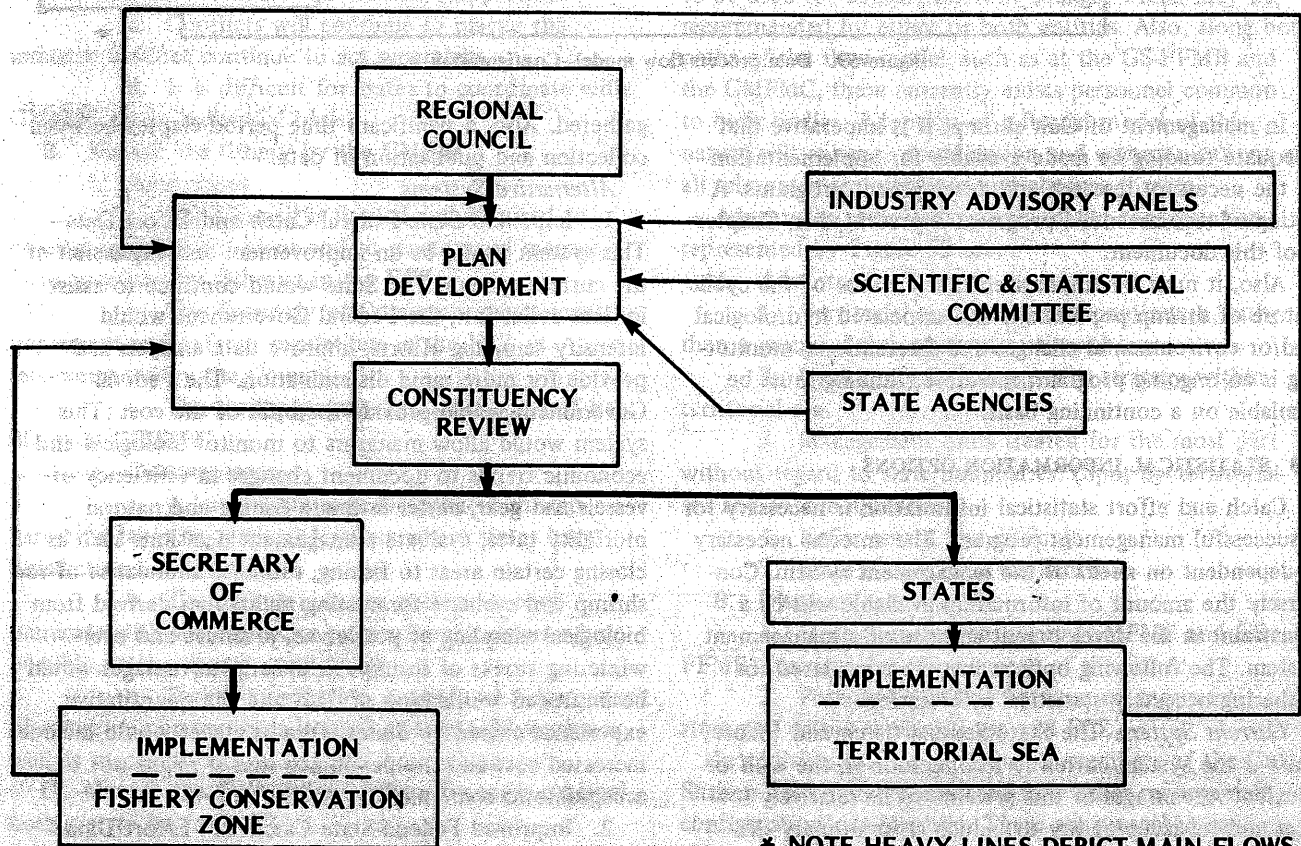
5.4 PLAN IMPLEMENTATION AND EVALUATION

Implementation will begin after appropriate approvals of the plan. The plan will be administered by the designated GS-FFMB. The first steps in implementation

will consist of those recommendations given the highest priority. The GS-FFMB will review research proposals for applicability, as well as evaluating results obtained by actions taken to satisfy recommendations. The project evaluations process will allow the group not only to judge the success of individual projects concerning their impact on regional fishery management, but also to readjust priorities of other projects should this be appropriate. Also, the group at appropriate intervals will evaluate the effectiveness of the entire regional management system, particularly concerning solution of problems identified.

One way of evaluating and ascertaining the success of projects and the plan as a whole is to develop a work breakdown structure for each objective of the plan. The group can use the technique of work breakdown structures to coordinate projects, to judge their success concerning their contribution to satisfying plan objectives and their relevance to solution of problems confronting the shrimp fishery.

SUPPLEMENT TO CHAPTER 5 ALTERNATE CONFIGURATIONS CONSIDERED (for reference only)



* NOTE HEAVY LINES DEPICT MAIN FLOWS.

Figure 60. Configuration B.

Configuration B—Advantages:

1. States have direct input into plan development and management of territorial sea.
2. States participate in the plan development of management in the FCZ.

Configuration B—Disadvantages:

1. Territorial seas management remains fragmented, with individual States responsible for their own waters (no regional body).

2. More difficult to achieve cooperative uniformity with six separate entities.
3. Timeliness of decision making hampered with six separate input entities.
4. No input from the GS-FFMB or the GSMFC.

Gulf of Mexico Fishery Management Council would manage in concert with Gulf State conservation agencies. Authority to manage within territorial sea remains with each State.

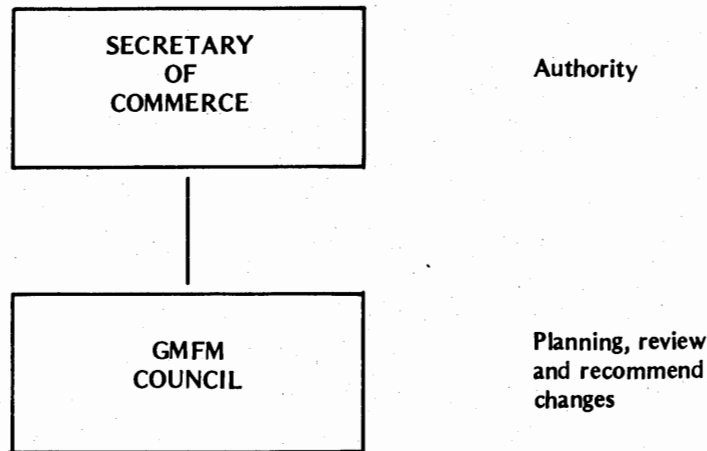


Figure 61. Configuration C.

Configuration C—Advantages:

1. Council already has the responsibility for developing a plan.
2. Only one authority to develop management plans for the entire range of the resource (territorial seas and conservation zone).
3. Enforcement simplified and costs shared.
4. Uniformity in management strategy and regulations easier to achieve.

Configuration C—Disadvantages:

1. Difficulty in achieving authority transfer from states.
2. Overall optimization may result in certain segments (States) being sacrificed to the benefit of others, so local interests may not be best served.
3. No input from the GS-FFMB or the GSMFC. Sole authority will rest with the Gulf of Mexico Fishery Management Council.

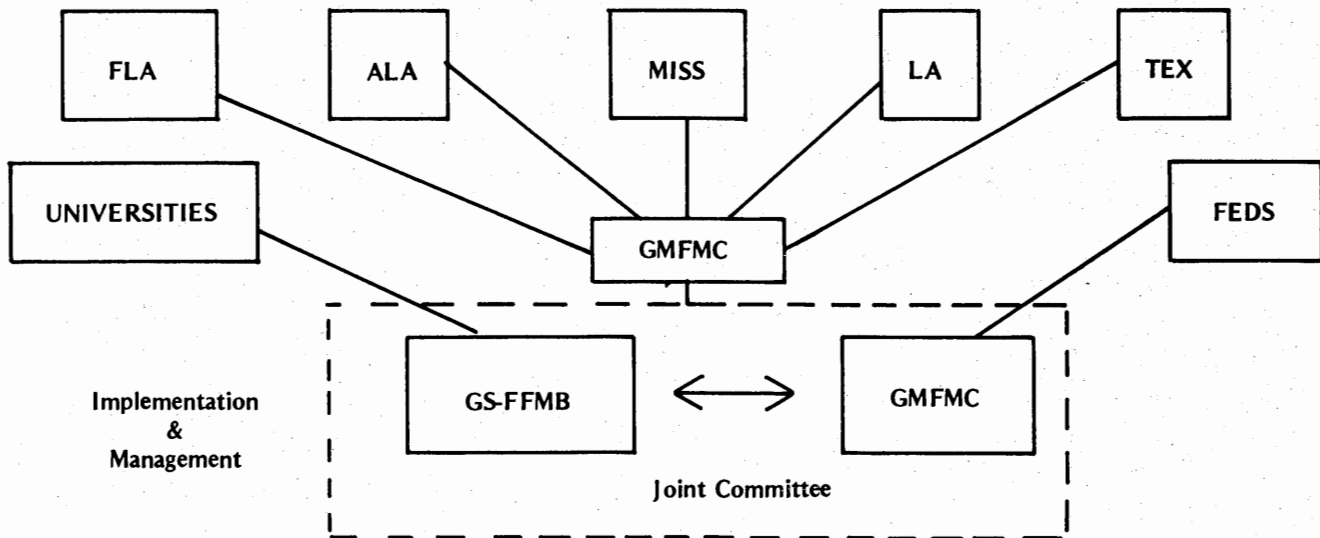


Figure 62. Configuration D.

Configuration D—Advantages:

1. Input from the Gulf States will continue to come through their respective conservation agencies, and be coordinated through the GSMFC.
2. States have enjoyed some success with previous coordination through the GSMFC.
3. Territorial seas and FCZ can be managed by a

single entity.

4. Enforcement less difficult.

Configuration D—Disadvantages:

1. States would relinquish exclusive regulatory authority in the territorial sea.
Establish a joint committee for implementation and management of Gulf shrimp resource throughout its range.

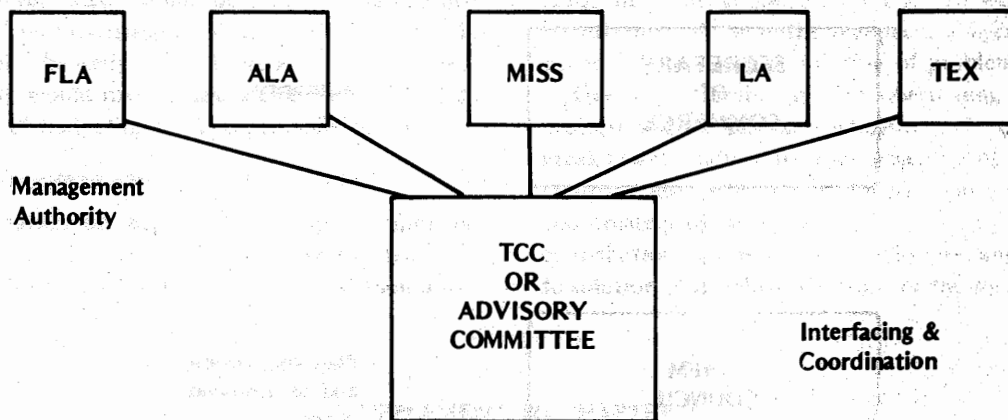


Figure 63. Configuration E.

Configuration E—Advantages:

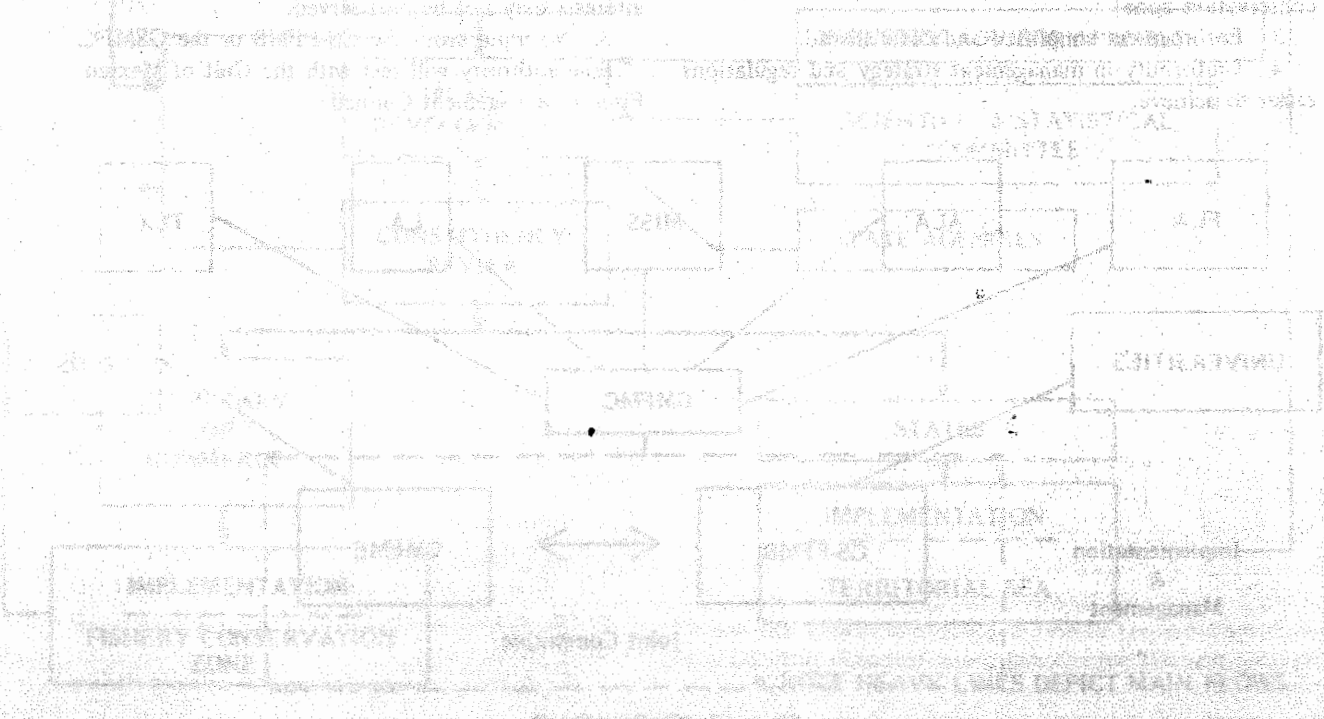
1. Essentially, this is the current method in use.
2. Requires no changes or legislative action.

Configuration E—Disadvantages:

1. Management authority remains fragmented.
2. There is no positive coordinating body with respect to the GMFMC and the FCZ.

3. Territorial seas management remains fragmented, with individual States responsible for their own waters (no regional body).

States will manage inside waters as well as the territorial seas. Interfacing and coordination can be accomplished through an Advisory Committee.



Chapter 6. Recommendations

The following recommendations have been developed by the Task Force for consideration of the Gulf State-Federal Fishery Management Board (GS-FFMB). Recommendations are classified as high, medium or low priority.*

6.1 HIGH PRIORITY

1. That the Technical Coordinating Committee (TCC) of the Gulf States Marine Fisheries Commission (GSMFC) continue its present function at least until the Management Board assumes responsibility for regional management in territorial waters.

This is necessary to maintain the program in that interval between completion and implementation of the plan.

2. That each State participate in and support a Gulf regional management plan in territorial waters.

This is essential because management authority in territorial waters is vested in the several Gulf States.

3. That an advisory committee be appointed by the Board.

This committee is needed to supply input to the Board and/or to supply alternative solutions to current problems. (May be the same as the existing TCC).

4. That the advisory committee should meet at least twice each year.

This is necessary to review current conditions and to make appropriate recommended changes to the Board to improve plan implementation.

5. That the Management Board interface with the Gulf of Mexico Fishery Management Council (GMFMC) on management problems and plans that involve both territorial and Fishery Conservation Zone (FCZ) waters.

Management in the FCZ is a Council responsibility. Cooperative efforts of the Board and the Council will be required to accomplish Optimum Yield (OY) in the Gulf shrimp fishery.

6. That a study be conducted to develop data on natural mortality rate, age and growth rate. (B-1)**

Information would result in more efficient management of the shrimp resources, aid decision makers in selecting size and time of harvest and facilitate

achievement of maximum sustainable yield (MSY).

7. That a study be conducted to delineate the off-shore spawning grounds of commercial shrimp; and to determine recruitment patterns for larvae and postlarvae (B-2).

Spawning stocks of brown, pink and white shrimp are exploited by the commercial fishery. This information will be essential in maintaining adequate spawning stocks for the perpetuation of the shrimp fisheries in the northern Gulf. This information would aid in development of seasonal regulations correlated with peak spawning period and area. Delineation of primary spawning grounds and larval recruitment patterns for commercial species of shrimp in the Gulf would allow the development of proper management techniques and regulations.

8. That a study be conducted to determine those commercial landings not reported, and the accuracy and precision of data collection techniques (B-4).

Accuracy in landing figures will allow the evaluation of large scale management practice changes. It will provide measures of reliability (statistical confidence) in estimates of catch (c), effort (e) and c/e. Reliability of MSY estimates, derived from surplus production analysis of these data, could also be determined.

9. That a study be conducted to determine a more satisfactory estimate of yield, including MSY of various shrimp stocks (B-8).

Information and data collected in reference to yield would allow management to more fully utilize available stocks without damage to the resource.

10. That a study be conducted to determine the impact of seasonality of fishing and the consequences of dislocation of portions of the commercial fleet (E-1).

The phasing out of the U.S. high seas shrimping fleet due to extended jurisdiction by Mexico and other countries will leave the foreign shrimp fleet with limited fishing opportunities. Without renegotiation of treaties or development of supplemental fisheries for the idle fleet and processing facilities, economic hardships will occur. This information will create a more viable industry with year-round fishing for shrimp or other species.

11. That a study be conducted to determine the economic impact of uncontrolled shrimp imports on U.S. industry (E-2).

A comprehensive review of existing shrimp

*See Chapter 7 for priority determinations.

**The letters and numbers in parentheses identify the corresponding proposed research study, as designated in Table 24, Chapter 7.

import implications will facilitate the development of an equitable plan for shrimp imports compatible with the domestic market structure.

12. That a study be conducted to determine cost and earnings data for vessels and boats, including vessel construction costs (E-5).

The accumulation of costs (including vessel construction) and earnings data would aid in determining which factors contribute significantly to cost variations within industry and thus help industry make wise managerial decisions. This information could be used to project rates of return on new investments in the harvesting sector and thus aid industry in making wise investment decisions. It would also supply needed economic information which could be incorporated into the decision-making process of a regional management program.

13. That a study be conducted to establish an estimate of maximum economic yield (MEY) (E-8).

Optimum yield management cannot be given proper administrative consideration without development of this data.

14. That a study be conducted to collect sociological information on shrimp fishermen's communities (S-1).

This action program plan will provide a knowledge of the impacts of management decisions, or lack thereof, on the people involved in the fishery.

15. That a study be conducted to compile labor force statistics (S-3).

This information will benefit not only fishery management agents in the various governmental organizations but also fishermen and managers in the shrimp industry themselves. It will enable them to have a clearer, more complete picture of the potentials of labor in their operations.

16. That a study be conducted to determine the effects and consequences of habitat alterations on penaeid shrimp populations (En-1).

This information will be essential in maintaining the highly productive estuarine areas of the northern Gulf coast. It will restrict adverse estuarine changes that pose potential dangers to fisheries production. It would also aid State-Federal action teams to evaluate and determine allowance of certain physical activities in the coastal areas (dredging, filling, channelization).

17. That a study be conducted to develop a formal system of information collection and display for the monitoring and review of the effects of management policies, decisions and implementation (A-1).

This system would provide users and managers with a clear and convenient display package. It would enable them to assess as completely as possible the biological, ecological, economic and social effects of their plans and policies before making subsequent

management decisions.

18. That a study be conducted to determine the biological and economic effects of discarding undersized shrimp (A-2).

This information would determine the scope and impact that the practice of discarding undersize shrimp has on the shrimp stocks in the Gulf. Managers would be better informed as to proper management measures to correct or eliminate unnecessary waste.

19. That a study be conducted to determine the effect of unrestricted entry (A-3).

This study would provide information vital in the maintenance of a viable shrimp fishery and provide guidelines necessary for industry in avoiding over capitalization by investors.

20. That a study be conducted to examine problems of limited jurisdiction (A-4).

Information will be developed so that comprehensive rules and regulations may be adopted on a State-regional basis to facilitate a proper regional management scheme for the Gulf shrimp fishery.

21. That a study be conducted to improve coordination and communication among data gathering and analysis programs (A-5).

More timely information on the status of Gulf shrimp stocks and prediction of impacts of alternative management strategies could be provided.

22. That a study be conducted to obtain adequate data to determine OY of various shrimp stocks (A-6).

Information collected would allow for better management toward OY as influenced by biological, economic, sociological and environmental factors.

23. That a study be conducted to examine problems associated with developing adequate law enforcement programs (O-4).

Strengthening enforcement within State waters and the FCZ will increase compliance with management decisions. Problems of understaffed enforcement agencies, lack of local court convictions and problems of an uninformed public will be addressed.

6.2 MEDIUM PRIORITY

1. That a study be conducted to determine the effect of fishing the shrimp nursery grounds (B-3).

A delineation of the shallow nursery grounds and a properly applied management scheme will minimize destruction of unutilized juvenile shrimp and result in increased production.

2. That a study be conducted to determine the extent and effect of recreational trawling on the shrimp resource (B-5).

This information will be beneficial in developing proper management guidelines for recreational trawling and developing accurate landing statistics for this section of the shrimp fishery.

3. That a study be conducted to increase understanding of industry, market structure and behavioral relationships among economic units (E-3).

The imposition of any fishery management plan will impact greatly on most economic units involved in harvesting, processing, wholesaling and retailing. Understanding how they are impacted and the design of a plan which considers these potential impacts requires a knowledge of the industry which we do not now have.

4. That a study be conducted to determine boat inventories (E-4).

The end product would be a comprehensive current statement of the number of fishermen, their economic status and factors affecting economic performance. It would provide economic managerial information to fishermen, especially regarding the best vessel size for investment purposes. It would also enhance the ability of managers to include economic factors in their determination of OY for the shrimp fishery.

5. That a study be conducted to develop information on marine recreational fisheries benefits (E-7).

The development of methodologies for measurement of recreational benefits will aid in the determination of OY.

6. That a study be conducted to delineate various user interest groups within the Gulf shrimp fishery (S-2).

The result of this research will enable assessing and taking into account localized interests, problems and constraints and integrating them into the larger regional management picture.

7. That a study be conducted to determine what political and legal problems occur in Gulf regional shrimp management (S-4).

This research will clarify and present as a package the various state laws and management practices which each State presently uses to deal with its own shrimp fishery industries and those of other States. This will enable regional management bodies to fully take advantage of the State's experience, and at the same time work to eliminate unnecessary conflicts or inconsistencies in those laws, policies and practices.

8. That a study be conducted to identify jurisdictional boundaries (O-3).

A precise determination of jurisdictional boundaries will result in the development of both regional and reciprocal management schemes more consistent with the proper utilization of the Gulf shrimp resources.

6.3 LOW PRIORITY

1. That a study be conducted to determine annual assessments of overwintering populations in the Gulf of Mexico (B-6).

Determination and definition of annual overwintering populations would aid in predicting the potential extent of the spring fishery. This would enable managers to have a better understanding concerning starting times and length of early spring seasons.

2. That a study be conducted to determine the implications of incidental harvest of non-target species (B-7).

Development of better information through such a study would aid in determining long-range effects on species which may also have recreational or commercial value.

3. That a study be conducted to develop a use and market for underutilized species (E-6).

Potentially valuable stocks are at present being overlooked or underutilized. Investigations along these lines may reveal to the industry information on stocks of potential importance. Studies may also provide data which would allow both management and industry to better utilize these potentially important stocks.

4. That a study be conducted to measure the change in the efficiency of fishing craft in the Gulf of Mexico shrimp fishery (O-1).

Recent improvements in gear, refrigeration, vessels and other equipment have been highly instrumental in increasing effective fishing effort. Information and studies concerning changes in effective effort would provide managers with better information on catch per effort and the resultant effects on biologic, economic and social aspects of the industry.

5. That a study be conducted to convert biological and environmental data to accessible computerized forms (O-2).

Conversion of environmental and biological data to accessible computerized forms would allow for better overall or regional management as well as aid in local management.

6. That a study be conducted to identify locations of underwater obstructions and determine the extent of damage caused by these obstructions. (O-5).

Locating, marking and identifying potentially dangerous underwater obstructions in the Gulf of Mexico would enable industry to decrease losses due to net, vessel and other gear damage. Information on the extent of damage caused by these obstructions could provide index data such as gear loss, downtime, etc. and aid in dealing with these matters.

Chapter 7. Management Action Program Summary

This section describes the cost and time horizons of the first five years of implementation of the Gulf of Mexico Regional Shrimp Management Plan. All projects and recommendations are important to the accomplishment of goals and objectives. Criteria for assigning research priorities (1) are based solely on the relative importance of the research activity for management, and (2) provide for rational sequencing of implementation of recommended research activities without consideration of cost or time of beginning in assignment of priorities.

The reader should note that Table 24 describes only the first five years of the plan. High priorities, in general, were assigned to projects that are essential to the development of Optimum Yield (OY). Special consideration has been given to certain projects considered to be especially important by the fishery constituency.

Table 24 includes information in addition to cost, time horizons and type of action. The Function of Task column denotes a short statement about each research project. For a more detailed description, refer to Section 3.2 of Chapter 3, as well as Chapter 6 (Recommendations).

The Responsibility column relates to Task Force recommendations as to who(m) should have prime responsibility for carrying out the research once it is funded. The Homogeneous Area column refers to the magnitude of the problem area, such as state, international, range of stock or section of Gulf. Those projects which have an association with other projects are shown by a denoted cross reference.

The Priority column shows assigned priority as high, medium or low. Projects are grouped in priority categories in Chapter 6.

The entire cost of the plan for the first five-year period based on the 1977 dollar value will be approximately \$14,349,250. This total amount of money includes all costs necessary to perform the research projects, but is not necessarily new money in all cases. Some of the projects, or part of them, are already in process. In addition, some efforts may be reduced, due to inadequate funding or other factors. This will lower the costs and the confidence of the results.

Costs broken down by type of action are as follows (in thousands of dollars):

Type of Action	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Biological	\$6,425.00	\$2,118.00	\$1,043.00	\$293.00	\$202.00	\$10,081.00
Economic	263.35	217.35	137.35	52.35	79.85	750.25
Social	172.50	138.50	121.50	87.25	—	519.75
Environmental	410.00	360.00	335.00	345.00	—	1,450.00
Administrative	131.75	148.50	126.00	124.00	85.00	615.25
Other	469.00	216.00	146.00	66.00	36.00	933.00
Total	\$7,871.60	\$3,198.35	\$1,908.85	\$967.60	\$402.85	\$14,349.25

Approximate dollar percentages of totals by type of action:

Biological	70.25%
Economic	5.24%
Social	3.62%
Environmental	10.10%
Administrative	4.29%
Other	6.50%
Total	100.00%

Potential sources of funding are:

- | | |
|------------------|---------------------------------|
| 1. NOAA/NMFS | 5. Coastal Zone Management |
| 2. States | 6. U.S. Army Corps of Engineers |
| 3. State-Federal | 7. Other funding agencies |
| 4. Sea Grant | |

TABLE 24 (Continued)

Management action program summary¹ (thousands of dollars)

Type of Action	Function of Task ²	Identification Number	First Year Amount	Second Year Amount	Third Year Amount	Fourth Year Amount	Fifth Year Amount	Responsibility ³	Priority	Homogeneous Area	Cross Reference
Economic (Continued)	To develop a use and market for underutilized species.	E-6	17.50	—	17.50	—	17.50	Fed/State	Low	International	B-5
	To develop information on marine recreational fisheries benefits.	E-7	67.00	34.00	34.00	34.00	34.00	Fed/State	Medium	Gulf	
	To determine the MEY for the Gulf shrimp fishery.	E-8	10.00	40.00	10.00	10.00	10.00	Univ/Sea Grant	High	Range of stock	
Sociological	To collect sociological information on shrimp fishermen's communities.	S-1	96.00	60.00	63.00	44.25	—	GS-FFMB/TCC NMFS/Sea Grant	High	Gulf	
	To delineate various user interest groups within the Gulf shrimp fishery.	S-2	9.50	9.50	9.50	—	—	States/GS- FFMB/TCC	Medium	Gulf	
	To compile labor force statistics.	S-3	41.50	42.50	25.50	24.00	—	NMFS/GS-FFMB/ TCC	High	Gulf	
	To determine what political and legal problems occur in Gulf regional shrimp management.	S-4	25.50	26.50	23.50	19.00	—	NMFS/GS-FFMB/ TCC	Medium	Gulf	
Environmental	To determine the effects and consequences of habitat alteration on penaeid shrimp populations.	En-1	410.00	360.00	335.00	345.00	—	NMFS/States	High	Range of stock	
Administrative	To develop a formal system of information collection and display for the monitoring and review of the effects of management policies, decision and implementation.	A-1	9.25	31.00	18.50	4.00	—	GS-FFMB/TCC	High	Gulf	
	To determine the biological and economic effects of discarding undersized shrimp.	A-2	15.00	15.00	—	—	—	NMFS/States/ Sea Grant	High	Gulf	B-1, B-7 E-5
	To determine the effect of unrestricted entry.	A-3	47.50	47.50	47.50	—	—	NMFS/States/ Sea Grant	High	Gulf	
	To examine problems of limited jurisdiction	A-4	25.00	25.00	—	—	—	Management Authority	High	Gulf	
	To improve coordination and communication among data gathering and analysis programs.	A-5	35.00	15.00	—	—	—	NMFS	High	Gulf	
	To determine an estimate of the OY for the Gulf shrimp fishery	A-6	—	15.00	60.00	120.00	85.00	NMFS/States/ Univ	High	Range of stock	

¹Funding may be cross referenced between several programs.²For detail on task description, refer to Chapter 3, Section 3.2.³Many of these items may relate to or be Gulf of Mexico Fishery Management Council responsibilities.

TABLE 24 (Continued)

Management action program summary¹ (thousands of dollars)

Type of Action	Function of Task ²	Identification Number	First Year Amount	Second Year Amount	Third Year Amount	Fourth Year Amount	Fifth Year Amount	Responsibility ³	Priority	Homogeneous Area	Cross Reference
Other	To measure the change in the efficiency of fishing craft in the Gulf of Mexico shrimp fishery.	O-1	115.00	-	-	-	-	NMFS	Low	Gulf	
	To convert biological and environmental data to an accessible computerized form.	O-2	235.00	160.00	105.00	-	-	NMFS	Low	Gulf	A-5
	To identify jurisdictional boundaries.	O-3	44.00	11.00	16.00	11.00	11.00	NMFS/States/Univ.	Low	Gulf	
	To examine problems associated with developing adequate law enforcement programs.	O-4	50.00	20.00	-	30.00	-	States/Coast Guard/Univ	High	Gulf	
	To identify locations of underwater obstructions and determine the extent of damage caused by these obstructions.	O-5	25.00	25.00	25.00	25.00	25.00	Coast Guard/Industry	Low	Gulf	

¹ Funding may be cross referenced between several programs.

² For detail on task description, refer to Chapter 3, Section 3.2.

³ Many of these items may relate to or be Gulf of Mexico Fishery Management Council responsibilities.

Appendix A. Planning Methodology and Chronology

Methodology.

Methodology used in development of the Gulf Shrimp Regional Management Plan is described in the following excerpt from "Scope of Work" included in the contract:

The Gulf States Shrimp Management Plan will contain a clear statement of mission and objectives, utilizing the "Management by Objectives" technique. Problem identification will focus on profile work already completed; for example, the discussion paper on shrimp fishery management, NMFS. Problems will be identified by type (administrative, legal, institutional, legislative, biological, technical, economic, social, environmental, etc.) by degree, and homogeneous area (State, international, range of stock, or section of Gulf). Problems will be analyzed, and potential alternative solutions will be developed, which will in turn reflect needs for problem solution. An action program will then be developed to delineate and prioritize the most feasible actions necessary to meet the established mission and objectives.

Funds required to implement the proposed actions will be estimated, together with who should provide the funds and the responsibility for taking the necessary actions, and the potential benefits that may accrue to the fishery if the funds are spent. Priorities for action will be scheduled, as required, for task(s) accomplishment.

A recommended approach for coordinating the management program will be outlined, including responsibilities for assuring plan implementation. A system for monitoring and evaluating the effectiveness of the management program will be designed.

The Gulf Coast Research Laboratory, working with the aid of representatives from the Gulf States (Florida Department of Natural Resources, Alabama Department of Natural Resources, Mississippi Marine Conservation Commission, Louisiana Wild Life and Fisheries Commission and Texas Parks and Wildlife Department), National Marine Fisheries Service Laboratories and other agencies as appropriate will develop from existing secondary data and necessary interview data a concise description of the Gulf shrimp fishery.

Consultants with expertise in areas such as planning, statistical analyses, economic and social and/or other specialties will be employed as required (within the limits of available funds). Periodic planning and workshop conferences will be conducted in cooperation with the Gulf States Marine Fisheries Commission.

Chronology

National Marine Fisheries Service issued a contract dated 1 June 1976 for the development of a fisheries management plan for Gulf shrimp.

Dr. David Etzold, University of Southern Mississippi (USM) and Mr. J. Y. Christmas, Gulf Coast Research Laboratory (GCRL), worked with TCC and NMFS personnel to develop the proposal. On completion of the contract, a letter of agreement provided that GCRL and USM would jointly conduct the project in accordance with contract requirements with Mr. Christmas as Principal Investigator and Dr. Etzold as Chief Planner. The USM agreed to provide all planning services required for successful completion of the project.

Dr. Terry McBee, GCRL, was subsequently assigned duties as Assistant Principal Investigator.

This staff proceeded with planning for plan development using "Management by Objectives" techniques. Dr. Etzold was in residence at GCRL from 21 June through 1 July 1976.

Florida Department of Natural Resources, Alabama Department of Conservation and Natural Resources, Mississippi Marine Conservation Commission, Louisiana Wild Life and Fisheries Commission and Texas Parks and Wildlife Department assigned personnel for workshop participation. GSMFC, under contract with NMFS, paid travel costs for State representatives to attend Task Force Workshops. NMFS Regional Office and Gulf Coastal Fisheries Center assigned personnel to the project. These assignments represented an additional contribution to the planning effort by the respective agencies in addition to contractual costs.

Also, several industry workshops were conducted in Louisiana, Florida, Mississippi (included Alabama) and Texas to solicit inputs from personnel in the shrimping industry.

A mailing list including all State agency directors, TCC members and other persons known to have an

interest in Management Plan Development was prepared so that current information could be provided.

After preliminary canvas of Task Force members, July 8, 1976 was announced as the date for the first workshop. The agenda and appropriate materials, including Scope of Work, were mailed to all persons on the mailing list.

Workshop I.

The first workshop was opened on schedule with all Task Force members present. Workshop procedure, following the agenda, resulted in the following conclusions and action:

1. Task Force is not a committee but functions as a Task Force whose output will be subject to approval by the Technical Coordinating Committee.
2. In the event any questions could not be resolved by consensus in workshops, options would be presented to the TCC for decision.
3. Proxy members would be qualified by notice to the chairman at the beginning of a workshop. All workshops are open meetings.
4. Log sheets would be maintained to accumulate cost of contributions to management plan development that are not funded under NMFS contract for this project.
5. Description of the fishery, to be included in the plan, would be based on the draft "Gulf of Mexico Shrimp Resource Analyses (SRA) Program" released by NMFS in May 1975. Numerous changes were suggested in the review process.
6. Two options for statement of the Mission (or Main Goal) were developed.
7. A list of 21 objectives was generated.
8. A preliminary Gulf shrimp planning schedule, including dates for monthly workshops through December 1976, was adopted.
9. A plan flow diagram prepared by the planning staff was adopted with minor changes.

10. "Homework" assignments to be carried out in preparation for Workshop II were accepted by Task Force members as follows:

- a. Review of each state's management procedures.
- b. Development of input for the industry description or "profile."
- c. Development of problems to be considered by the Task Force.
- d. Compilation of existing data files.
- e. Preparation of a listing of pertinent papers.

In the period following Workshop I, the planning staff had several sessions to prepare for Workshop II and worked on assignments developed in Workshop I. Task Force members provided significant input from "Homework" assignments.

Workshops were held each month thereafter as follows:

August, Mobile, Alabama;

September, Kenner, Louisiana;

October, Kenner, Louisiana;

November, Kenner, Louisiana;

December, Kenner, Louisiana;

January, Kenner, Louisiana;

February, Fort Myers, Florida;

March, Biloxi, Mississippi;

April, Corpus Christi, Texas;

May, New Orleans, Louisiana;

June, New Orleans, Louisiana.

Procedures established in Workshop I were successfully applied in all other workshops. Rigorous scheduling, updated for each workshop and specific "homework" assignments with beginning and completion date, enhanced completion on schedule.

Participation by Task Force members in all workshops was utilized in plan formulation, which contributed greatly to a coordinated regional plan. Ad hoc subcommittees were formed and utilized as required.

Appendix B. State Laws and Regulations

FLORIDA

Laws

Shrimp, regulation —

1. **GENERAL AUTHORITY; CONSERVATION.** The department is authorized and directed to adopt, promulgate and enforce rules and regulations consistent with the provisions of this section and the general policy of encouraging the production of the maximum sustained yield consistent with the provisions of this section and the general policy of encouraging the production of the maximum sustained yield consistent with the recommendations of the various marine laboratories, as well as those of interested and experienced groups of private citizens. Such rules and regulations are to control the method, manner and equipment used in the taking of shrimp or prawn, as well as limiting and defining the areas where taken.

2. SHRIMP CATCH REGULATION, PENALTY.

a. It is unlawful for any person, firm, or corporation to catch, kill, or destroy shrimp or prawn within or without the waters of this state, or have in his possession on board his vessel, any small shrimp or prawn taken in such waters, provided such small shrimp or prawn constitute at least five percent of all such shrimp or prawn in such possession. Small shrimp or prawn are defined as those that require more than forty-seven with the heads, or seventy without the heads, to make a pound of shrimp count. The words "shrimp count" shall refer to the number of shrimp, heads off, seventy to make a pound or forty-seven with the heads on to make a pound. This count shall be determined by random sampling in five different locations in the catch, at as widely separated distances and depths as practicable. Each sample shall consist of at least one pound of shrimp. The average counts of these five samples shall be the established count for the cargo. In the event shrimp, which when caught and landed were of legal size under the terms of this subsection, are thereafter graded for size for the purpose of packing, processing, or for other lawful purpose, and the smaller shrimp making up the average count of such entire lot as herein provided are graded out into separate lot or lots, and such shrimp so segregated from such entire lot are above the average count as herein provided, the possession, purchase, sale, unloading, transporting, or handling of such particular smaller graded shrimp shall not be unlawful. This provision shall exclude any product

which has been processed and imported into the state. "Processed" is defined as frozen, canned, or packaged in up to ten pound packages. It is further provided that this section shall not apply to live bait shrimp.

b. Any person, firm, or corporation convicted of violating the provisions of this subsection shall be guilty of a misdemeanor of the second degree, punishable as provided in 775.083. In the event of a second or subsequent conviction of a violation of this subsection within twenty-four months, the division shall suspend the license of the violator for a period not to exceed 1 year.

3. **REGULATION OF BREEDING AREAS.** Any areas or places as defined in subsection 2. shall be designated sanctuary areas for shrimp and prawn to be opened or closed to the taking of shrimp or prawn according to the provisions of this section or the rules and regulations of the division.

4. **CATCHING SHRIMP AT NIGHT.** It shall be unlawful to catch or attempt to catch shrimp or prawn in the territorial waters of the state in any county whose coastal boundary borders solely on the Atlantic ocean, by use of trawl nets during night hours except during the months of June, July and August.

5. SHRIMP FISHING; PERMITS; PENALTY.

a. All persons, firms and corporations desiring to fish for commercial or bait shrimp within areas in which trawling is permitted shall first apply to the division of marine resources for a permit. Such applications shall be made on forms to be supplied by the division and which shall require the applicant to furnish such information as may be deemed pertinent to the best interest of salt water conservation. Provided, that the division may refuse to grant permit when it shall be apparent that the best interests of salt water conservation will be served by such denial. Provided further, that permits so granted shall remain on board at all times and will be subject to immediate revocation upon conviction for violation of this section or when it shall be apparent that the best interests of salt water conservation will be served by such action. Provided further, that due to the varied habitats and types of bottoms and hydrographic conditions embraced by the open fishing area, the division shall have the authority to specify and regulate the types of gear that may be used in the different sections of the open areas.

b. Any person, firm, or corporation convicted of

violating the provisions of this section shall be guilty of a misdemeanor of the second degree, punishable as provided in 775.083. In the event of a second or subsequent conviction of a violation of this subsection within twenty-four months, the division shall suspend the license of the violator for a period not to exceed 1 year.

6. a. (1). It is unlawful to take or catch shrimp, other than bait shrimp with any type net or other method, in the following area: That portion of Santa Rosa sound lying in Escambia, Santa Rosa and Okaloosa counties and between Brooks bridge as the east boundary and Bascule Bridge in Santa Rosa County as the west boundary.

(2). Live bait shrimp may be caught at any time but only under permit issued by the division. Permittees must fish with gear and under those conditions specified by the division. Application for such permits shall be on forms supplied by the division and no charges may be made for issuing said permits. Permits shall be revocable when holder does not comply with the laws and regulations applicable to saltwater conservation. All vessels fishing for live bait shrimp must be equipped with live bait shrimp tanks and no more than five pounds of dead shrimp will be allowed on board each vessel per day.

b. Any person convicted of violating the provisions of this subsection shall, for the first or second convictions, be guilty of a misdemeanor of the second degree, punishable as provided in 775.082 or 775.083. A third or any subsequent violation by any person of this subsection within a three-year period shall be a felony of the third degree, punishable as provided in 775.082 or 775.083.

Tortugas shrimp beds; closed areas; permits; penalties.

1. It is the intention of the legislature that action should be taken to conserve the supply of shrimp in the large shrimp beds which lie in and around the coast of the lower Keys of Florida and in the vicinity of the islands of Dry Tortugas in the Florida Keys, hereinafter referred to as the Tortugas shrimp bed, and which furnish more than fifty percent of the shrimp in waters adjacent to the coast of Florida. It is further the sense of this legislature that the shrimp industry is a valuable industry to the economy of this state and deserved adequate protection.

2. Tortugas shrimp bed is described as follows:

a. Begin at Coon Key Light in Collier County; thence proceed on a straight line to a point which is located at twenty-four degrees, fifty-four minutes, thirty seconds ($24^{\circ}54'30''$) north latitude and eighty-one degrees, fifty minutes, thirty second ($81^{\circ}50'30''$) west longitude; thence proceed on a straight line to a point located at twenty-four degrees, forty-eight minutes, 00 seconds ($24^{\circ}48'00''$) north latitude and eighty-two degrees ($82^{\circ}00'00''$) west longitude; thence proceed on

a straight line to a point located at twenty-four degrees, forth-five minutes, 00 seconds ($24^{\circ}45'00''$) north latitude and eighty-two degrees, twenty-two minutes, thirty seconds ($82^{\circ}22'30''$) west longitude; thence proceed on a straight line to Rebecca Shoals Light; thence proceed on a straight line to R. B. Bell buoy; thence proceed on a straight line to Cosgrove Shoal Line; thence proceed on a straight line to Sand Key Light; thence proceed northerly to the abandoned lighthouse located in the southwest portion of Key West; thence along the south and east meandered shoreline of the Florida Keys and the connecting viaducts between said Keys to eighty degrees, thirty minutes, 00 seconds ($80^{\circ}30'00''$) west longitude, thence north until a point on the mainland is reached; thence proceed west and north along the coast of the mainland of Florida until a point is reached which is located due north of the aforementioned Coon Key Light located in Collier County; thence, due south to Coon Key Light, the point of beginning.

b. No shrimping shall be permitted at any time except live bait production as provided in this chapter in the above described area.

3. a. The division of marine resources is authorized to take title in the name of the state to any vessel or vessels suitable for use in carrying out the inspection and patrol of the Tortugas bed which may be offered as a gift to the state by any person, firm, corporation, or association in the shrimp industry for the purpose of carrying out the provisions of this section. In the event such title is taken to such vessel or vessels, the division is authorized to operate and keep said vessel or vessels in proper repair.

b. The division is further authorized to accept the temporary loan of any vessel or vessels, suitable for use in carrying out the provisions of this section for periods not exceeding one year. However, the state shall not assume any liability to the owner or owners of said vessels for any damage done by said vessels to other vessels, persons, or property. In the operation of said loaned vessels, upkeep and repair shall consist only of minor repairs and routine maintenance. The owner or owners shall carry full marine insurance coverage on said loaned vessel or vessels for the duration of the period during which said vessels are operated by the state.

4. It is unlawful to land or attempt to land any shrimp in the territorial waters of the state without a permit issued by the division. Such permit shall be issued without charge. The division may revoke such landing permit upon a violation of any portion of this section. Such revocation of permit by the division may be reviewed by the department of natural resources, and the decision of the department may be reviewed by the circuit court under the procedure prescribed for appeals in the Florida appellate rules.

5. It is unlawful for any person, firm, or corporation to receive any shrimp from any vessel not in possession of

a valid permit issued by the division. Any person violating this subsection of this section shall be guilty of a misdemeanor of the second degree, punishable as provided in 775.083.

6. The owner or master of any vessel not equipped with live shrimp bait tanks dragging shrimp nets in the above defined area without a live bait permit for this area is guilty of a misdemeanor of the second degree, punishable as provided in 775.083, and the nets and shrimping door shall be confiscated. A second violation by any person under this subsection shall be a misdemeanor of the second degree, punishable as provided in 775.082 or 775.083. A third or any subsequent violation by any person under this subsection within a three-year period shall be a felony of the third degree, punishable as provided in 775.082 and 775.083.

7. Each offense under all subsection, except subsection 5. and 6., shall be a misdemeanor and punishable as follows:

a. For the first offense the owner or the master shall be guilty of a misdemeanor of the second degree, punishable as provided in 775.083, and the nets and shrimping door shall be confiscated as provided in 370.061.

b. For the second offense the owner or master shall be guilty of a misdemeanor of the second degree, punishable as provided in 775.083, and the vessel shall be confiscated as provided in 370.061.

c. For the third offense within a three-year period the owner or master shall be guilty of a felony of the third degree, punishable as provided in 775.083, and said equipment and instruments shall be confiscated as provided in 370.061.

d. In addition to the fines enumerated above, the court may punish the master as provided in 775.082.

8. a. Nothing in this section shall apply to the taking of live shrimp for bait. All persons, firms, and corporations desiring to fish for live bait shrimp within any area shall first apply to the division for a permit. Such applications shall be made on forms to be supplied by the division which shall require the applicant to furnish such information as may be deemed pertinent to the best interests of salt water conservation.

b. The division may refuse to grant permits when it is apparent that the best interests of salt water conservation will be served by such denial.

c. Permits so granted will be subject to immediate revocation upon conviction for violation of this subsection or when it shall be apparent that the best interests of salt water conservation will be served by such revocation.

d. Due to the varied habitats and types of bottoms and hydrographic conditions, the division shall have the authority to specify and regulate the types of gear that may be used in the area. Such specifications and

regulations shall be consonant with sound salt water conservation.

Shrimp regulations; closed area; suspension of license, etc.

Any person convicted of taking shrimp in a closed area who is punishable under 370.15(6) or 370.151(5) shall, in addition to the penalties set forth therein, have his permit and the permit of the boat involved in the violation, issued pursuant to 370.15(5), revoked, if he holds such a permit, and he shall be ineligible to make application for such a permit for a period of two years from the date of such conviction. If a person not having a permit is convicted hereunder, that person and the boat involved in the violation shall not be eligible for such a permit for five years.

Regulation of shrimp fishing in a designated area.

1. It shall be unlawful to catch or take, or attempt to catch or take, with nets in excess of 18 feet on the cork line and in excess of 24 feet on the lead line and in excess of 3 feet on the leg line with trawl doors or otter boards which exceed 36 inches in length by 18 inches in width, shrimping from April 1 to June 15 of each year in the following area, to wit: Beginning at a central point on Cape San Blas, proceeding thence 180 degrees to a point 3 miles seaward, thence southeasterly along a meandering line 3 miles from the shoreline to a point 3 miles due south of Cape St. George, proceeding thence zero degrees to Cape St. George, thence following the shoreline bordering the Gulf of Mexico to the point of beginning. It is unlawful for any person to have in his boat more than one net of the required size at one time to take shrimp in the area herein defined. Provided, however, the department of natural resources shall issue such permits as are necessary for harvesting roe shrimp in pursuance of mariculture programs.

2. Any person violating this section shall, upon conviction, be adjudged guilty of a misdemeanor of the second degree, punishable as provided in 775.082 or 775.083.

Regulations

Individual counties pass and enforce ordinances within their boundaries.

ALABAMA

Laws

1. JURISDICTION AND AUTHORITY OVER SEAFOODS, ETC. The department of conservation shall have full jurisdiction and control of all seafoods existing or living in the waters of Alabama, and of all public and natural oyster reefs and oyster bottoms of the State of Alabama, and it shall ordain, promulgate and enforce all rules, regulations and orders deemed by it to be necessary for the protection, propagation or conservation of same; the department may by order duly made and published

prescribe the manner of taking or catching, the time when, and designate the places from which sea foods may or may not be taken or caught, during certain periods of the year, or entirely, as it may deem to be for the best interest of the seafood industry. It shall have full authority to prohibit the catching or taking of oysters from reefs designated by it by order duly made and promulgated during the entire open season or any part thereof, and may open and close said reefs or portions thereof to tonging or dredging or both, and at any time deemed by it to be to the best interest of the public welfare. It shall receive and audit the accounts of oysters bought and caught of all canners and dealers, and the accounts of all inspectors, employees and members of said department, and of all expenses incident to carrying into effect this title, and shall see that all privilege taxes and license fees are paid, that the inspectors and other officers and employees faithfully discharge their duties, and that all provisions of this title are properly complied with and enforced, and the director shall hear the complaints of any person aggrieved by the action of any officer. It shall have authority to cooperate with the commissioner of the bureau of fisheries of the department of commerce of the United States government in the carrying out of the provisions of any act of congress for the sale, distribution or propagation of all sea foods and the extension of the producing areas thereof. It shall have authority to make rules and regulations requiring all catchers, factories, purchasers, dealers or any persons dealing in shrimp and oysters to make reports to the department, containing the number of barrels caught or sold, and any other information said department may require; to designate the dates for opening and closing of the seasons for catching shrimp and the waters from which the same may be taken. To cause surveys to be made of the coastal regions to the State of Alabama for the purpose of determining the economic soundness of the development of the oyster industry in the location; to make plans and estimates of the cost of such developments and improvements and in connection therewith to enter on any lands, waters, and premises for the purpose of making such surveys, soundings and examinations. [Title 8, Section 4, 1940 Code; 1939 Gen. Acts, page 255.]

2. DUTIES OF EMPLOYEES OF DIVISION OF SEAFOODS: CONFISCATION OF SEAFOODS ILLEGALLY TAKEN, ETC. The employees of the Division of Seafoods shall diligently enforce all laws and regulations of the Department now existing or which may hereafter be enacted or promulgated for the protection, propagation, preservation or conservation of the seafoods of the State of Alabama and shall prosecute all persons who violate any of such laws or regulations. Such employees shall, at any and all times, seize any and all oysters, salt water fish

or other seafoods which have been caught, taken or transported in a manner contrary to the laws or regulations based thereunder of this State. All seafood which is seized by such employees shall be held as evidence and used in the trial of the violation for which it was seized. After the trial of such violation, the seafood which has been so seized shall be disposed of by order of the court in which the case was set or tried. [Title 8, Section 111 (12), 1940 Code; 1951 Gen. Acts, page 843, Act No. 476.]

3. CHIEF AND EMPLOYEES OF DIVISION OF SEAFOODS CONSTITUTED PEACE OFFICERS: FURTHER POWERS AND DUTIES. The Chief of the Division of Seafoods and other employees of said Division are hereby constituted peace officers of the State of Alabama with full police power and jurisdiction to enforce all laws with reference to the seafoods of the State of Alabama and all rules and regulations promulgated by the Department of Conservation, and they may exercise such powers in any county of the State of Alabama and on any waters of this State. And they are hereby authorized to carry firearms or other weapons when they are actually in the discharge of their duties as such officers. They shall be clothed with the power to arrest with or without warrant any person who shall violate any of the laws of the State of Alabama or any rule or regulation of the Department, with reference to the protection, preservation, propagation or conservation of its seafoods, and take him before a justice of peace or proper court for trial. They shall visit the various factories and all places of business where seafoods are dealt in and there inspect the oysters, fish and other seafoods on hand, the "barrel measures" used at said places of business and all nets, trawls and other devices for the taking or catching of seafoods, and they shall prevent and prosecute all violations of this title and all laws on this subject hereafter enacted. [Title 8, Section 111 (13), 1940 Code; 1951 Gen. Acts, page 843, Act No. 476.]

4. SEA FOODS ARE PROPERTY OF STATE AND UNDER EXCLUSIVE CONTROL OF DEPARTMENT. All sea foods existing or living in the waters of Alabama not held in private ownership legally acquired, and all beds and bottoms of rivers, streams, bayous, lagoons, lakes, bays, sounds, and inlets bordering on or connecting with the Gulf of Mexico or Mississippi Sound, within the territorial jurisdiction of the State of Alabama including all oysters, and other shell fish and parts thereof, grown thereon, either naturally or cultivated, shall be, continue, and remain the property of the State of Alabama, to be held in trust for the people thereof, until title thereto shall be legally divested in the manner and form hereinafter authorized, and the same shall be under the exclusive control of the department of conservation until the right of private ownership shall vest therein as hereinafter

provided. [Title 8, Section 112, 1940 Code; 1936-37 Ex. Sess., page 193.]

5. **STANDARD MEASURE FOR OYSTERS OR SHRIMP: BY INSPECTOR; RECORD OF MEASURES.** A standard measure for oysters is established, which said measure shall consist of a tub or other round vessel of the following dimensions: It shall measure seventeen inches in diameter inside at the bottom and twenty-one and a half inches in diameter, inside at the tip, and fourteen and a half inches inside from the bottom to top perpendicularly. Two of these measures filled to the top shall make one barrel, and all oysters bought and sold in the State in the shell shall be measured in a measure of these dimensions, or a measure holding a fraction or multiple thereof. A standard measure for shrimp is established, which said measure shall consist of a container holding not less than two hundred ten pounds of raw shrimp with heads or one hundred twenty-five pounds of raw shrimp without heads. It shall be unlawful for any person to have in his possession any measure for oysters in the shell or shrimp which shall differ from the measure herein provided for, or demand or require a greater or less measure in buying or selling; and no vessel, container or measure shall be used in buying or selling oysters or shrimp until it has been measured and stamped by an inspector of the Division of Seafoods. The said inspector shall visit from time to time each place where oysters or shrimp are bought and sold for the purpose of determining whether the terms of the provisions of this Section are complied with. [Title 8, Section 116, 1940 Code; 1953 General Acts, page 966.]

6. **SOLICITOR TO SUE FOR FEES DUE DEPARTMENT.** The solicitor of any county bordering on salt or brackish waters or within whose boundary there is a body of salt or brackish water shall institute in the name of the State of Alabama any necessary proceedings to collect any sums due the department of conservation for any fees, licenses, taxes, penalties or other charges that may be levied under this title, or any rules and regulations made by said department under powers conferred on said department. Any sums collected in said proceedings shall be paid into the general fund of the department of conservation. The solicitor shall also prosecute the offender for any violation of the laws of this state pertaining to the taking, canning or shipment of oysters. [Title 8, Section 117; 1940 Code; 1919 Gen. Acts, page 242.]

7. **WHEN LICENSE CANCELLED.** It shall be unlawful for any person to sell, barter, exchange, give or deliver to any person, firm or corporation doing business in Alabama, any salt water shrimp or oysters after having been notified in writing by the department of conservation or its agent to the effect that such person, firm or corporation which the department of conservation shall name in its notice, has failed or refused to pay the tax on

salt water shrimp or oysters, or to make the reports in writing required by law, or fail to comply with the other provisions of this title, and in the event such salt water shrimp or oyster catcher, or master of a boat handling salt water shrimp or oysters sells, exchanges, barter, gives or delivers salt water shrimp or oysters to the person, firm or corporation named in the notice, as not having complied with the provisions of this title, the department of conservation shall enter a cancellation of the license to take or catch salt water shrimp or oysters, or do business against the person, or master of the boat offending against this section, which license shall not be re-issued except at the discretion of the director of conservation. [Title 8, Section 121, 1940 Code; 1919 Gen. Acts, pages 242, 252.]

8. **SEINES NOT DRAGGED OVER PUBLIC REEFS OR PRIVATE GROUNDS.** It shall be unlawful to drag any seines over the public reef or private oyster grounds in this state. [Title 8, Section 122, 1940 Code; 1919 Gen. Acts, page 242.]

9. **PORTS OF ENTRY ESTABLISHED BY DIRECTOR OF CONSERVATION.** The director of conservation shall have power to establish ports of entry which shall include Alabama Port, Cedar Point, Mobile, Dauphin Island and Bayou La Batre, and such ports so established shall be the only ports used by persons or boats, landing oysters or shrimp in Alabama by water, and it is unlawful to so use any other port than those regularly established by the said director of conservation. [Title 8, Section 123, 1940 Code; 1931 Gen. Acts, page 424.]

10. **PERSON TAKING OYSTERS OR SHRIMP MUST HAVE LICENSE IN POSSESSION.** All persons to whom a license is issued to catch oysters or shrimp must have the same constantly in their possession while taking oysters or shrimp, and it shall be unlawful to take oysters or shrimp unless a properly issued license to do so is in the possession of the person operating a boat, engaged in taking oysters or shrimp, or other persons engaged therein. [Title 8, Section 124, 1940 Code; 1919 Gen. Acts, page 242.]

11. **TAXES; BY WHOM AND HOW PAID.** All taxes in this title shall be paid by the person, firm or corporation, commonly known as dealers, factories or shippers, first marketing the oysters, shrimp, terrapin, turtle or other seafood products, and any person who has purchased same from a dealer, factory, shipper or any other person, who has paid the tax thereon shall not be taxed again. Said taxes shall be paid to the chief enforcement officer or any other officers of the department charged with enforcing the provisions of this title. All taxes, licenses and fines collected under this title shall be forwarded on the first of the following month to the treasurer to be placed to the credit of the conservation fund. [Title 8, Section 128, 1940 Code; 1931 Gen.

Acts, page 424.]

12. **CAPTAIN OF LICENSED VESSEL TO ASSIST INSPECTOR.** It shall be the duty of every captain of every licensed vessel, when called upon by an inspector so to do, to assist that officer, both in person and with his boat and crew, in making any arrest for any violation of this title, and such captains shall use such force at their command as may be necessary in making the arrest when such persons attempts to escape or resist arrest and any captain or member of any crew failing or refusing to aid any inspector, when called on, shall be guilty of a misdemeanor. [Title 8, Section 129, 1940 Code; 1936-37 Ex. Sess., page 192.]

13. **LICENSE FOR SHIPPERS.** Each shipper of raw oysters or shrimp, or both shall pay a tax of fifteen dollars and shall receive from the department of conservation a license therefor upon the payment of said sum to said department of conservation, and it shall be unlawful for any person to can or ship raw oysters without first having paid said tax and received said license. [Title 8, Section 138, 1940 Code; 1939 Gen. Acts, page 891.]

14. **LICENSE FOR PACKING, CANNING OR PROCESSING SEAFOOD.** Before any person, firm, corporation or association shall engage in the business of packing, canning or processing oysters, crabs, shrimp or other seafood, which shall including cooking, boiling or frying of same and whether in a hermetically sealed container or not, he or it shall make application to the Department of Conservation accompanied by a fee of fifty dollars, and said Department shall issue to said applicant a license to engage in the business for which the application is made. Said license shall be dated and shall be effective only for the season issued. [Title 8, Section 142, 1940 Code; 1953 General Acts, page 1090.]

15. **LICENSE FOR HAULING BY MOTOR VEHICLE.** Before any person, firm, corporation or association shall engage in transporting or hauling by means of any motor truck or other motor driven vehicle raw oysters or raw shrimp for commercial purposes, he or it shall make application to the department of conservation, accompanied by a fee of five dollars, and upon approval of such application said department shall issue to said applicant a license to engage in the business for which the application is made. Such license shall be dated and shall be effective only for the season issued. [Title 8, Section 144, 1940 Code; 1936-37 Ex. Sess., page 192.]

16. **MULTIPLE LICENSES: POSTING OR ATTACHING OF LICENSES.** Wherever in this chapter two or more licenses on the same business or occupation are required, it is hereby declared to be the intention of the legislature that all such licenses are as herein levied shall be collected without credit or offset. Licenses provided in this chapter shall be posted in a conspicuous place at the

place of the license business during the effectiveness of such license and licenses provided for in section 144 of this title shall be securely attached to the vehicle in which said oysters are carried, hauled or transported or be carried on or be in the possession of the licensee at the time he is driving such vehicle or transporting or hauling oysters for sale. [Title 8, Section 147, 1940 Code; 1939 Gen. Acts, page 891.]

17. **GIVING FALSE STATEMENTS IN PROCURING SEAFOOD LICENSES.** Any person who willfully or knowingly makes to any officer authorized to issue a hunting, fishing, fur-bearing animal or seafood license a false statement as to his or her name, age, residence, or any other statement relevant to the purchasing of said license or any person who makes to any officer designated to issue hunting, fishing, fur-bearing animal or seafood licenses an incorrect statement when purchasing a license for another, and makes such a statement knowing it to be false, shall be guilty of a misdemeanor and upon conviction will be punished by a fine of not less than twenty-five dollars nor more than fifty dollars. [Title 8, Section 44 (1), 1940 Code; 1951 Gen. Acts, page 645, Act No. 356.]

18. **ALTERING LICENSE.** Any person who changes or alters duly issued hunting, fishing, fur-bearing animal or seafood licenses shall be guilty of a misdemeanor and upon conviction shall be punished by a fine of not less than twenty-five dollars nor more than fifty dollars. [Title 8, Section 44 (2), 1940 Code; 1951 Gen. Acts, page 645, Act No. 357.]

19. **LENDING, ETC., LICENSE.** The lending, borrowing, selling, buying, renting or using in any way the license of another to hunt, fish, trap, deal in furs or to take oysters or shrimp shall constitute a misdemeanor and shall be punishable by a fine of not less than twenty-five dollars nor more than fifty dollars. [Title 8, Section 44 (3), 1940 Code; 1951 Gen. Acts, page 645, Act No. 357.]

20. **THE DEPARTMENT OF CONSERVATION AUTHORIZED TO REGULATE TRANSPORTATION, ETC.** The department of conservation shall have the authority to regulate the time, manner and means for transporting raw oysters or shrimp except headless or canned shrimp and canned processed oysters, beyond the boundaries of the State of Alabama, and to require all persons, firms, corporation or associations to come to a designated port of entry and then and there pay all taxes on such oysters or shrimp as have been caught within the waters of the State of Alabama, and then and there to pay all taxes on such oysters or shrimp before the same are moved or transported or attempted to be moved beyond the boundaries of the State. [Title 8, Section 148, 1940 Code; 1936-37 Ex. Sess., page 192.]

21. **AUTHORITY TO BOARD AND INSPECT WATER CRAFT.** The department of conservation or its

duly authorized agent or agents shall have authority to board any boat, barge or other water craft which is engaged in the taking or catching of oysters or shrimp or to enter the place of business of any person, firm, corporation or association engaged in the sea food industry or sale of sea foods and by inspection or investigation determine whether such boats, barge or other craft or such business is in every respect being operated in full compliance with the provisions of the sea food laws of this state or regulations based thereunder, or whether oysters or shrimp or other sea foods are being taken, or canned, packed or processed, caught or transported in full compliance with the laws relating to oysters and shrimp or other sea foods or regulations based thereunder. [Title 8, Section 149, 1940 Code; 1936-37 Ex. Sess., page 192.]

22. **UNLAWFUL TO USE UNLICENSED WATER CRAFT TO TAKE OYSTERS OR SHRIMP.** It shall be unlawful for any person, firm, corporation or association to take or catch, or attempt to take or catch, any oysters or shrimp by the use of any boat, barge or water craft which has not been duly licensed by the department of conservation. [Title 8, Section 151, 1940 Code; 1936-37 Ex. Sess., page 192.]

23. **UNLAWFUL TO DEAL IN OYSTERS TAKEN BY UNLICENSED TONGER, OR SHRIMP BY UNLICENSED CATCHER, ETC.** It shall be unlawful for any person, firm, corporation or association to sell or offer for sale or to buy or offer to buy any oysters or shrimp which have been taken or caught by any unlicensed tonger or by an unlicensed dredge, or by an unlicensed boat, barge or other unlicensed water craft. [Title 8, Section 152, 1940 Code; 1936-37 Ex. Sess., page 192.]

24. **LICENSES FOR USE OF SEINES, TRAWLS AND OTHER DEVICES.** It shall be unlawful for any person, firm or corporation to catch or attempt to catch any salt water shrimp by the use of any trawl, seine or other device, except castnets, unless an annual license fee due and payable on or before the opening date of the season as set by the Director of Conservation in each and every year at the rate herein provided be paid, and the annual license shall be at all times in the possession of the party or parties operating same for the purpose of taking salt water shrimp, such licenses to be issued by the Department of Conservation and the proceeds thereof, to be placed to the credit of the Seafoods Fund. The following license tax shall be paid by persons operating seines or trawls for the purpose of taking or catching salt water shrimp. On all seines or trawls up to thirty feet, seven and one-half dollars, from thirty to three hundred feet, fifteen dollars, and from three hundred feet to nine hundred feet, twenty-two and one-half dollars, and over nine hundred feet, thirty-seven and one-half dollars, provided, however, any person using seines or trawls of

sixteen feet or less may catch or attempt to catch salt water shrimp for non-commercial purposes in an amount not to exceed twenty-five pounds. Provided, however, such shrimp taken for non-commercial purposes may only be taken during the same season and in the same sizes and in the same waters which govern commercial shrimping. Nothing herein contained shall be construed as preventing the taking of shrimp for bait, at any time, by duly licensed live shrimp bait catchers. [Title 8, Section 154, 1940 Code; 1953 General Acts, page 969.]

25. **LICENSES FOR SHRIMP CATCHERS' BOATS.** It shall be unlawful for any person to use any boat for the purpose of drawing a seine or trawl, used in catching shrimp, or hauling or carrying shrimp without first having secured an annual license due and payable on or before the opening date of the season as set by the Director of Conservation in each and every year as follows: For each and every boat owned by a resident of this State regardless of tonnage or capacity, there shall be an annual license fee of Seven and 50/100 (\$7.50) Dollars. Non-residents shall pay a license and double the amount provided for above, except where such non-resident is a resident of a State which has a reciprocal fishing agreement with the State of Alabama where such State does not itself charge residents of Alabama license fees in excess of those charged residents of that State. All proceeds from licenses under this section shall be placed to the credit of the Seafoods Fund. [Title 8, Section 155, 1940 Code; 1961 Acts of Alabama, page 2026, Act No. 106. Note: The 1961 amendment rewrote this Section.]

26. **DISPOSITION OF SHRIMP NOT FIT FOR FOOD.** No person shall purchase, sell, can, ship, or otherwise transport any fresh salt water shrimp which are not in prime condition, that is, suitable to be eaten by human beings as food, and upon condemnation by the chief oyster inspector or his assistants of any fresh salt water shrimp which have deteriorated to the extent that they are not suitable for human consumption, the person, firm, corporation or partnership having such fresh salt water shrimp so condemned in his possession shall make such disposition thereof as the chief oyster inspector or his assistants may direct. [Title 8, Section 156, 1940 Code; 1921 Gen. Acts, page 12.]

27. **TAX WHEN SALE IS FOR CANNING, DRYING OR SHIPPING.** It shall be unlawful to catch or market salt water shrimp for commercial purposes, that is for canning, drying or shipping within the State, unless a tax of twelve cents per barrel be paid by the person, firm, or corporation catching the same for the purpose of canning, drying, or shipping, or purchasing the same from independent shrimp fishermen for the purpose of canning, drying, or shipping and said tax to be paid at the Division of Seafoods' headquarters not later than the fifth day of each month. Any person, firm or corporation who is

delinquent in paying such tax as herein provided will be assessed a penalty in the amount of ten per cent of the total tax due and shall also be assessed, as interest, an amount equal to six percent per annum of the sum of the delinquent tax. The said tax each month must be accompanied by a form supplied by the Division of Seafoods stating thereon the number of barrels of oysters and shrimp handled by said person, firm or corporation during the preceding month, and said tax shall be considered delinquent unless accompanied by said form. [Title 8, Section 157, 1953 General Acts, page 968.]

28. **WHERE UNLAWFUL TO CATCH SHRIMP.** It shall be unlawful to catch or attempt to catch any salt water shrimp north of a line commencing at Arlington Docks, Mobile County, Alabama, and running in an eastwardly direction to the town of Daphne in Baldwin County. [Title 8, Section 160, 1940 Code; 1939 Gen. Acts, page 889.]

29. **MINIMUM SHRIMP WEIGHT REQUIREMENT.** The Director of Conservation shall set by regulation the minimum weight requirement of shrimp which are caught or taken from the territorial waters of Alabama for commercial purposes, or which are brought into Alabama from waters beyond the territorial jurisdiction of Alabama for commercial purposes. Provided, however, that such minimum weight requirement, as set by regulation of said Director, shall require not more than 68 shrimp with heads attached to weigh one pound and shall require not more than 114 headless shrimp to the pound, be 114 headless shrimp to the pound.

It shall be unlawful for any person, firm, corporation or association to sell, offer for sale or have in possession for sale for commercial purposes any shrimp which requires more in number to weigh one pound than the number per pound as set by regulation of the Director of Conservation.

Any person, firm, corporation or association who or which violates any of the provisions of this Act shall be guilty of a misdemeanor and upon conviction shall be punished by a fine of not less than twenty-five dollars nor more than one hundred dollars for each offense. [Title 8, Section 161, 1940 Code; 1951 Gen. Acts, page 1599, Act No. 931; 1967 Gen. Act, page 1322, Act No. 569.]

30. **SHRIMP WEIGHT REQUIREMENT FOR IMPORTED SHRIMP.** The Director of Conservation by regulation, may permit shrimp regardless of size to be imported into this State when such shrimp are legally taken from the waters of another state. Provided, however, any such shrimp when permitted by regulation to be imported into this State must be accompanied by satisfactory proof that such shrimp were legally taken within the territorial waters of another state. [Title 8, Section 161 (1); 1953 Gen. Acts, page 964.]

31. **TAX ON SHRIMP TO BE TRANSPORTED TO OTHER STATES.** Before any shrimp which have been taken or caught in the waters of this state, or the waters within the territorial jurisdiction of this state, shall be carried beyond the boundaries of the State of Alabama, they shall be brought to a port of entry designated by the department of conservation and then and there a tax of twenty cents per barrel must be paid. This section is intended to apply only to shrimp which are caught for the purpose of being transported to other states and shall not apply to canned or headless shrimp which have been caught and on which the tax has been paid. [Title 8, Section 163, 1940 Code; 1936-37 Ex. Sess., page 192.]

32. **TAX ON SHRIMP NOT TO BE EXPORTED.** A tax of twelve cents a barrel shall be paid at the office of the chief enforcement officer not later than the fifth day of each month on all shrimp taken or caught in the waters of Alabama or waters within the territorial jurisdiction of the State of Alabama or brought into a port in the State of Alabama which are not to be carried or transported beyond the boundary of the state. [Title 8, Section 164, 1940 Code; 1939 Gen. Acts, page 891.]

33. **BAIT SHRIMPING LAW.** Section 1. Nothing in the laws of the State of Alabama shall be so construed as to prevent any bonafide live shrimp bait dealer thereof from taking or catching, or attempting to take or catch, any shrimp at any time in any of the open waters of the State of Alabama south of the mouth of Mobile River and south of Battleship Causeway which is also known as Cochran Bridge Causeway, provided that such shrimp shall be taken only in the manner herein set forth. All waters north of said line are permanently closed to the taking of salt water shrimp for any purpose at any time.

Section 2. Such shrimp shall be taken or caught solely for bait; shall not be taken or caught by use of any net or trawl having a width of greater than sixteen feet, and shall not be taken or caught in quantities greater than five pounds for each person on or in any boat at any time, nor shall more than fifteen pounds be caught by any boat regardless of the number of persons therein; nor shall more than five pounds for each person, nor fifteen pounds for each boat, whichever is the lesser, be kept in possession at any time. Such shrimp shall not be sold, exchanged, bartered or otherwise disposed of for any purpose whatsoever except as provided hereinafter.

Section 3. Such shrimp may be sold for use as bait only when alive or with heads attached and may be sold only by persons who have previously purchased from the Department of Conservation an annual live shrimp bait dealers license, which licenses shall be sold and issued by the Department of Conservation to bona fide live shrimp bait dealers upon the payment of a charge of twenty-five dollars (\$25.00) for one boat and fifty dollars (\$50.00), for two boats. The Department of Conservation will not

issue a live shrimp bait dealers license until the applicant has furnished to the Director of Conservation such information as the director may prescribe showing that the applicant has the necessary equipment and facilities to properly keep shrimp alive for sale as bait. The Director, before the issuance of a license, may cause an inspection of the applicant's gear, equipment, place of business and vessel to ascertain if same meet the minimum requirements for keeping bait shrimp alive. The live shrimp bait dealers license may be revoked at any time during the issuing year that an agent of the Director of Conservation, after inspection, finds that the equipment, gear and vessel of the licensee no longer meet the minimum requirements for keeping shrimp alive for sale as bait. Any person who sells, exchanges, barter, or otherwise disposes of live shrimp or attempts to sell, exchange, barter, or otherwise dispose of live shrimp, shall be in violation of this Act unless he has first purchased the annual live shrimp bait dealers license. No holder of a live shrimp bait dealers license shall have more than two boats in use for the purpose of catching shrimp for sale as bait nor more than one originally constructed sixteen foot (16') trawl for each boat. No holder of a live shrimp bait dealers license may have in his boat more than fifteen (15) pounds of dead shrimp at any time including shrimp to be used for his personal, noncommercial use.

Section 4. Each live bait licensee must furnish the Seafoods Division of the Department of Conservation at the Dauphin Island office of same, with the Water Safety Registration numbers of the boat or boats he designates to use as a licensee hereunder, one boat for each \$25.00 license sought, not to exceed two boats to a license, and a live bait licensee hereunder is prevented from substituting another boat for a boat as designated above unless he gives a two-weeks written notice to the Seafoods Division of the Department of Conservation at Dauphin Island office of same, setting forth the Water Safety registration number of the designated boat to be replaced, and of the boat replacing same.

Section 5. Violation of any of the provisions hereof shall be an offense against the State of Alabama, and violators shall, upon conviction be fined not less than One Hundred (\$100.00) Dollars nor more than Five Hundred (\$500.00) Dollars; and any licensee hereunder who shall be found guilty of violating any of the provisions hereof shall have such license revoked forthwith, and the Department of Conservation shall not issue another license to such licensee for a period of six months after being convicted.

Section 6. Nothing in this law or in any of the laws of the State of Alabama shall be so construed as to prevent any citizen thereof from taking or catching or attempting to catch or take any shrimp not in quantities greater than five (5) pounds for each person in a boat, nor shall more than fifteen (15) pounds be caught by any boat each day

regardless of the number of persons therein, in any of the open waters of Mobile Bay below what is known as Battleship Causeway without a license therefor and within or without the closed seasons as declared by the Director of Conservation; provided that such shrimp shall be taken only in the manner provided for in Section 2 of Act No. 322, General Acts of Alabama 1947, page 212 as amended by Act No. 717 1953 of Alabama, page 970.

[Title 8, Section 164 (4), 1940 Code; 1947 Gen. Acts, page 212; 1953 Gen. Acts, page 970; Act No. 422 of 1969 Acts of Alabama.]

34. **WHO CONSIDERED NON-RESIDENT: BURDEN OF PROOF.** No person shall be considered a resident of this state, within the meaning of this term used in this title, who does not at the time reside in, and who shall not have resided in this state for twelve months next preceding the time when any offense with which he is charged may have been committed; and, in all questions arising as to residence under this title, the burden of proof shall rest on the defendant.

35. **SIZE OF MESH IN SALT WATERS.** It shall be unlawful to have in possession, or use, for the taking of salt water fish or other seafoods, seines, nets or trawls with a mesh of a size other than that prescribed by the rules and regulations of the department of conservation of the State of Alabama where practical to conform with Louisiana, Mississippi, and Florida laws. All measurements of seines, nets and trawls are to be taken from knot to knot after said nets have been tarred and shrunk. The size of the mesh of all seines, nets and trawls and the size of other devices which are used for the sole purpose of taking minnows, shrimp or other baits for use as bait, shall conform to the rules and regulations of the department of conservation of the State of Alabama. [Title 8, Section 171 (1), 1940 Code; 1943 Gen. Acts, page 590.]

36. **UNLAWFUL TO REFUSE TO SUBMIT TO INSPECTION OR EVADE THIS ARTICLE.** It shall be unlawful for any packer, commissionman, dealer-shipper or boatman to refuse to open his place of business or boat where fish, oysters or other seafoods may be dumped, kept or stored, except his actual residence, for inspection by any officer whose duty it is to inspect same, or to conspire or agree with any person to evade any of the provisions of this article or any laws hereafter enacted, or to knowingly connive or participate in any such violation. A violation of the provisions of this section shall constitute a misdemeanor and any person, firm, or corporation so violating shall be punished by a fine of not less than \$25.00 nor more than \$50.00 for each offense. [Title 8, Section 171 (7), 1940 Code; 1943 Gen. Acts, page 592.]

37. **POSSESSION OR USE OF ILLEGAL TACKLE OR FISHING DEVICES OR UNLICENSED BOAT OR VESSEL.** Possession or operation of any illegal tackle or

any illegal fishing devices, or use of any boat or vessel that is not licensed as required by this article, shall be considered prima facie evidence that it is kept or used for unlawful purposes, and such possession or operation or use shall be punishable by a fine of not less than \$25.00 and not more than \$500.00. [Title 8, Section 171 (8), 1940 Code; 1943 Gen. Acts, page 592.]

38. VIOLATION OF MISDEMEANOR. A violation of any of the provisions of this article shall be a misdemeanor and the person so violating, unless otherwise provided by this article, shall be punished by a fine of not less than \$25.00 nor more than \$100.00. [Title 8, Section 171 (12), 1940 Code; 1943 Gen. Acts, page 593.]

39. RECIPROCAL AGREEMENTS AS TO COMMERCIAL FISHING—AGREEMENTS AUTHORIZED. The director of the department of conservation shall have authority to enter into agreements of reciprocity with conservation commissioners or directors and other proper officials of other states, who have jurisdiction over the seafood laws and regulations of such states whereby the citizens of the state of Alabama may be permitted to catch or take fish, shrimp, crabs, or oysters from the waters under the jurisdiction of such other states, for commercial purposes, upon similar agreements whereby such non-residents are allowed to take or catch fish, shrimp, crabs or oysters from the public salt waters of the state of Alabama, for commercial purposes, regardless of residence. [Title 8, Section 171 (13a), 1940 Code; 1951 Gen. Acts, page 514, Act No. 238.]

40. LICENSE TAXES UPON NON-RESIDENTS. Upon the entering of such reciprocal agreement, the license tax upon non-resident fishermen and upon the owners of catching boats, freight boats or ice boats owned in whole or in part by such nonresidents, shall be the same as for residents of the state of Alabama. [Title 8, Section 171 (13b), 1940 Code; 1951 Gen. Acts, page 514, Act No. 238.]

41. RIGHTS AND PRIVILEGES TO BE EXERCISED IN ACCORDANCE WITH ALABAMA LAWS' RULES AND REGULATIONS. The fishing rights and privileges which may be granted by or through such reciprocal agreements shall be exercised in accordance with the laws of Alabama and the rules and regulations promulgated by the director or conservation of the State of Alabama which pertain to the taking, catching, possessing or handling seafood by residents of the State of Alabama. [Title 8, Section 171 (13c), 1940 Code; 1951 Gen. Acts, page 514, Act No. 238.]

Regulations

1. GULF AREAS WHERE NETS AND TRAWLS MAY NOT BE USED: From May 15 through Labor Day of each year it shall be illegal to use any net or seine, with the exception of dip nets and cast nets, in the following areas of the Gulf of Mexico.

a. Within one mile of the shore from the mouth of Little Lagoon, Baldwin County, Alabama, east to the Florida state line.

b. Within one mile of the shore from the black-topped road running south of the Gulf adjacent to the eastern end of the Fort Morgan Reservation westward to the end of Fort Morgan peninsula.

c. Within one mile of the shore from the eastern end of Dauphin Island to Buoy 38.

d. Within one mile of Sand Island.

Shrimp trawls may be used for the purpose of catching or taking shrimp, crab or other marine species which are consumed fresh or frozen by human beings.

Shrimp trawls may not be used for the taking, catching or attempting to take or catch marine species for industrial use.

For the purpose of this regulation possession of industrial species consisting of small fish in excess of ten (10) percent of seafood in storage holds shall be illegal and a violation of this regulation.

2. WASHING TRAWLS OR NETS IN AREAS CLOSED TO SHRIMPING PROHIBITED: It shall be unlawful to wash a trawl or net by pulling it or dragging it in any of the territorial waters of the State of Alabama which are closed to shrimping.

3. SHRIMP TRAWLS AND SAMPLE NETS, SIZE AND USE OF IN INSIDE WATERS: It shall be illegal for any person, firm or corporation to take or attempt to take shrimp in any of the inside waters of the state of Alabama by use of any nets, seines or trawls, whether singly or in pairs, the total length of which shall exceed fifty (50) feet in length when measured on the cork line. All such nets, seines or trawls used singly or in pairs shall be specifically made for the above lengths, the combination of which shall not exceed fifty (50) feet, and shall not be larger nets that have been folded back on the wings or temporarily altered to remain within the lengths specified.

In addition to the net or nets per vessel as provided above it shall be permissible to have available, and to operate one (1) "try net" per vessel, for sampling only. Such "try net" shall not have a cork line to exceed ten (10) feet in length, or be equipped with trawl boards exceeding eighteen (18) inches by twenty-four (24) inches in measurement.

The aforementioned measurements shall be made on shrimp trawls along the cork line and on purse seines and nets along the lead line. Such shrimp trawl measurements shall extend from the place where the net ties on to the cork line on one end, to the place where the net ties on to the cork line on the other end. There shall be no modifying of larger trawls or sampling nets to this size, such as folding the wings back to the limited size.

There shall not be a limit to the mesh sizes of

webbing used in the construction of shrimp trawls.

4. MODIFYING OF BAIT SHRIMP TRAWLS

PROHIBITED: The size of, and number of, bait shrimp trawls per boat shall be limited to one net per boat, the size of which net shall not exceed sixteen (16) feet on the corkline, the boards of which shall not exceed thirty (30) inches by sixteen (16) inches, and the leg lines of which shall not exceed four (4) feet in length. There shall be no modifying of the larger trawls to this size, such as folding the wings back or cutting the hangings back to the limited size. The measurement of such trawls apply to any net used on any boat taking or attempting to take shrimp for bait or for any unlicensed personal purpose, or to take or attempt to take shrimp for bait under a Live Shrimp Dealers license.

5. DRAGGING NETS OVER PUBLIC REEFS UNLAWFUL: It shall be unlawful for any person to drag any net, seine or trawl over the public oyster reefs or private oyster grounds in this State.

6. SEASON FOR TAKING SHRIMP: The shrimp seasons are set by regulation of the Commission of Conservation and Natural Resources who, by virtue of the authority contained in Section 4, Title 8 of the 1940 Code, may by order duly made and published, prescribe the manner of taking or catching, the time when, and designate the places from which seafoods may or may not be taken or caught during certain periods of the year, or entirely, as may be deemed to be for the best interest of the seafood industry; therefore, you should contact the Marine Resources Division, Box 188 Dauphin Island, Alabama 36528, for information on the latest regulation governing the taking of shrimp.

7. SHRIMPING IN PORTERSVILLE BAY PROHIBITED: The taking, catching or attempting to take or catch shrimp by trawl, seine or by any other means whatsoever for any purpose from the waters known as Portersville Bay in Mobile county, Alabama, shall be prohibited and is hereby made unlawful.

Portersville Bay is more particularly described as that body of water which lies within the area described as follows: beginning at the southwest point on Mon Louis Island, which is known as Barron Point, thence in a westerly direction along the south shore line of Cat Island, thence westerly along the south shore of Marsh Island, thence westerly along the south shore line of the Isle aux Herbes, also generally known as Coffee Island, thence in a northerly direction along the west shore line of the Isle aux Herbes, also known as Coffee Island, to a point on the mainland, which point is due north of the northerly tip of the Isle aux Herbes.

8. SHRIMPING IN HERON BAY PROHIBITED: The taking, catching, or attempting to take or catch shrimp by trawl, seine or by any other means whatsoever for any purpose from the waters known as Heron Bay in Mobile

County, Alabama, shall be prohibited and is hereby made unlawful.

Heron Bay is more particularly described as that body of water lying north of a line extending from Barry Point south southeast to Cedar Point in Mobile County, Alabama.

9. WHERE SHRIMP MAY BE TAKEN FOR BAIT: No person, firm or corporation shall take or attempt to take any shrimp, by any means, from any of the streams, rivers, bayous, and/or creeks within the territorial waters of the State of Alabama. Nothing in this regulation, however, shall be so construed as to prevent the taking of shrimp only for bait purposes in those waters of Mobile Bay lying south of Cochrane Bridge Causeway, and specifically including Mobile River on the west, and Blakeley River on the east, and those streams lying between said rivers, provided such shrimp are taken in the manner as set forth by law.

10. IMPORTATION OF SHRIMP REGULATED: Any person or corporation or association may import shrimp into the State of Alabama from another state even though such shrimp weigh less than the minimum weight requirements prescribed by the laws and regulations of the State of Alabama provided such shrimp were taken or caught outside the territorial waters of the State of Alabama.

Upon the importation of such undersize shrimp, the purchaser and/or processor thereof shall maintain a written record of the location of the source of such shrimp and such records shall be open for inspection to the Division of Marine Resources of the Department of Conservation and Natural Resources upon demand. In areas where written proof of the location of taking or catching such shrimp is unobtainable, such as International Waters, the above records of the purchaser and/or processor of such undersize shrimp will serve as proof of their being caught in such areas.

11. LIVE SHRIMP BAIT DEALERS MUST MEET MINIMUM REQUIREMENTS: The Department of Conservation and Natural Resources will not issue a live shrimp bait dealers license except to those live shrimp bait dealers whose equipment, facilities, and boat meet the following requirements:

Shore Facility

- a. A concrete, wooden or fabricated tank with a minimum capacity of 500 gallons or 64 cubic feet (i.e. 4' x 8' x 2').
- b. Tank must be aerated by one of the following:
 1. Circulating water sprayed on the surface which may be pumped from the bay, bayou, etc., or which may be recirculated from the shrimp tank.
 2. Any commercial fish aerator.
- c. The tank must be indoors or under a shed.

Boat Facility

- a. Tank with spray system operated by pump or

with a commercial fish aerator.

b. Boat equipped with live well which has been altered or constructed in the following manner:

1. Bottom hole has forward turned scoop or flange sticking below the hull which forces water into the well when the boat is underway.

2. An overflow to run excess water overboard.

c. Live wells without a system for forced water exchange are unsuitable unless a pump or aerator is provided.

d. Dealer must own a 16 ft. trawl (or trawls).

12. PAYMENT OF SEAFOOD TAXES AT CONSERVATION OFFICE: All persons, firms, corporations or associations, whether they be resident or non-resident, are required to come to any one of the Marine Resources Division offices of the Department of Conservation and Natural Resources, and then and there pay all taxes which are required by law on raw oysters and/or canned raw oysters and/or canned processed oysters, before such raw oysters or raw shrimp are transported beyond the boundaries of the State of Alabama. All persons, firms, corporations or associations, whether they are resident or non-resident are required to come to any one of the Marine Resources Division offices of the Department of Conservation and Natural Resources, and then and there pay the reasonable market value of the oyster shells which are to be transported beyond the boundaries of the State of Alabama, plus the cost of replanting the same, as provided for by Section 129, as amended, of the 1940 Code of Alabama.

MISSISSIPPI

Laws

49-15-11. Marine conservation commission — establishment — chairman — membership — rules and regulations — attorney — seal.

1. The Mississippi Marine Conservation Commission is hereby established and full power is vested in the commission to manage, control, supervise and direct any matters pertaining to all saltwater aquatic life not otherwise delegated to another agency.

49-15-15. Jurisdiction, authority and duties of commission.

1. Shall open, close and regulate fishing seasons for the taking of shrimp, oysters, fish taken for commercial purposes and crabs. However, the shrimp season shall open on the first Wednesday of June, 1974 and on and on the first Wednesday of June in each year thereafter; provided, however, that the commission by majority vote, may open the season at an earlier or later date only after sampling areas within its jurisdiction, where shrimp may be caught, for the purpose of determining the count of shrimp per pound. The commission may also, by majority

vote, close certain designated areas where the shrimp count is found, by sampling, to be in excess of sixty-eight per pound.

2. May enter into advantageous interstate and intrastate agreements with proper officials, which agreements directly or indirectly result in the protection, propagation, and conservation of the seafood of the State of Mississippi, or continue any such agreements now in existence.

3. Is authorized to enact all regulations necessary for the protection, conservation, or propagation of all shrimp, oysters, commercial fish and crabs in the waters under the territorial jurisdiction of the State of Mississippi. However, it shall be unlawful for any person, firm or corporation to take, catch or have in their possession weighing in the raw state less than one (1) pound to each sixty-eight (68) shrimp, except when valid permit or affidavit of another state identifies the catch as having been taken in non-Mississippi waters. This provision may be changed by a two-third (2/3) vote of the commission.

4. Shall prohibit the operation of double rigs in the waters lying between the mainland coast and the island chain.

49-15-29. Taxes and licenses to be collected by the commission.

The commission is hereby authorized and directed to assess and collect, under its direction and subject to its regulation, the following licenses and taxes:

1. On each net, seine, trawl or purse net used in catching or taking menhaden in the waters of the State of Mississippi, the sum of fifty dollars (\$50.00).

2. Every freight boat, ice boat, and catching boat used in catching or transporting salt-water shrimp taken from the waters of the State of Mississippi for sale in their fresh state, or for canning, packing, freezing, or drying, shall first obtain from the secretary of the commission an annual privilege license at the following rates:

Boats or vessels under thirty (30) feet
in length, over-all measurements ————— \$ 7.50

Boats or vessels over thirty (30) feet,
and under forty five (45) feet in
length, over-all measurements ————— \$15.00

Boats or vessels over forty-five (45) feet
in length, over-all measurements ————— \$25.00

and a fee of twenty-five cents (\$0.25) to the officer issuing such license.

3. In addition to the privilege licenses required, a tax and fee of twenty-five cents (\$0.25) per barrel, payable monthly, is hereby laid and levied upon all shrimp canned, packed, dried, or frozen in, and all shrimp shipped raw in or from this state, and on all shrimp caught or taken from the waters within the jurisdiction of the State of Mississippi. The tax levied under this subsection shall be paid by the person, firm, or corporation packing, canning, drying, or freezing such shrimp, and in case of shrimp sold or

shipped raw by the dealer selling or shipping same, that is to say, by the first dealer who handles such shrimp, and any shrimp sold by any person who has purchased same from a dealer who has paid the tax thereon, shall not again be taxed. The tax and fee levied by this subsection shall not apply to shrimp taken within the territorial waters of another state on which a processing tax has been paid to or levied by such state.

Taxes may be collected by the chief inspector under this section by distress, and all laws regulating the collection of taxes by distress, shall so far as practicable, apply to the collection of this tax, but the chief inspector, and not the tax collector, shall collect the same.

4. Each person, firm or corporation engaged in canning, packing, freezing, drying or shipping salt-water shrimp in the State of Mississippi shall pay an annual privilege tax of fifty dollars (\$50.00), and shall receive from the secretary of the commission a license therefor upon payment of such sum to the secretary, and it shall be unlawful for any person, firm or corporation to can, pack, freeze, dry or ship any salt-water shrimp without first having obtained such license. Such license shall be nontransferable and a separate license shall be required for each factory or place of business. This license shall not apply to, nor shall the payment of the annual privilege tax of fifty dollars (\$50.00) be due by, a dealer in fresh seafoods who merely preserves the same for future sale to prevent spoilage and is in competition with other retailers who are not required to pay this tax.

49-15-63. General penalty.

Any person, firm or corporation violating any of the provisions of this chapter or any act amendatory hereto, or any ordinance duly adopted by the commission, unless otherwise specifically provided for herein, shall, on conviction, be fined not less than fifty dollars (\$50.00), nor more than one hundred dollars (\$100.00), for the first offense; and not less than one hundred dollars (\$100.00), nor more than five hundred dollars (\$500.00), or imprisonment in jail for a period not exceeding thirty (30) days for any subsequent offense; and upon the conviction of a third offense, it shall be the duty of the court to revoke the license of the convicted party and of the boat or vessel used in such violation, and no further license shall issue to such person or for said boat to engage in catching or taking of any seafoods from the waters of the State of Mississippi for a period of one year following such conviction. Except as provided under subsection 5 of section 40-15-45, any fines collected under this section shall be paid to the secretary of the Mississippi Marine Conservation Commission, to be paid into the seafood fund.

Regulations

1. WASHING NETS IN RESTRICTED AREAS. It shall be unlawful to wash a trawl net by pulling it or by

dragging it in any of the territorial waters of the State of Mississippi which are closed to shrimping.

It is also illegal for double rigs to wash their trawls or nets in any area where double rigs are prohibited from shrimping.

2. LIVE BAIT DEALERS. All persons, firms or corporations, except licensed live bait dealers, as defined in Ordinance No. 67, are prohibited during the period beginning July 15 and ending August 31 of each year from shrimping North or on the inland side of a line beginning at a point on the Mississippi-Alabama line one-half (1/2) mile South of where said line intersects the mainland; thence running Westerly along the Mississippi Coast line and one-half (1/2) mile therefrom to Buoy No. 18 on the Northeast side of the Biloxi Channel; thence running Northwesterly along the Northeast line of said Biloxi Channel to Beacon No. 22; thence running Southwesterly to the mouth of Grand Bayou; thence running along the Northern shore of Deer Island to its Western tip; thence running Westerly to permanent Beacon No. 8; thence following the meanderings of the shore line one-half (1/2) mile therefrom to the Bay St. Louis Railroad bridge; thence running West along said Railroad bridge to a point one-half (1/2) mile from the shore line; thence following the meanderings of the shore line at a distance of one-half (1/2) mile therefrom to the red Beacon at Bayou Caddy; thence running Northerly to the end of the seawall at the mouth of Bayou Caddy.

Any person, firm or corporation violating any of the provisions of this Ordinance shall be guilty of a misdemeanor, and on conviction shall be fined not less than \$50.00 nor more than \$100.00 for the first offense, and not less than \$100.00 nor more than \$500.00 or imprisonment in jail for a period not exceeding thirty (30) days for any subsequent offense.

3. LIVE BAIT DEALERS DEFINED. A live bait shrimp catcher boat is a watercraft having suitable equipment to properly harvest and retain aboard in a live condition shrimp which are intended solely for use as live bait to be dispensed to recreational fishermen. Live bait shrimp catcher boats may operate in all waters under the jurisdiction of the Commission including waters lying North of the L&N Railroad except bayous. The season in waters North of the L&N Railroad shall open on July 1 of each year unless it has been determined by sampling that seventy-five percent (75%) of the shrimp are smaller than 90-100 count per pound. The season shall end on the 31st day of December of each year. The catcher boat shall also be regulated as follows:

a. Tows will be limited to fifteen (15) minutes. This does not include the time it takes to put out or pick up the trawl.

b. Trawls pulled in Mississippi waters to catch bait shrimp will be no larger than sixteen (16) feet on the

corkline. Bait catcher boats must be clearly marked by displaying in an easily visible position, both port and starboard sides, in letters at least six (6) inches high, the words: "Bait Boat" or "Live Bait".

c. The said vessels shall be equipped with shaded holding tank with water circulating system aboard using pumps capable of lifting water from near the bottom where shrimp are caught. Provided, however, that new applicants for valid bait trawling license may use a well skiff for a period not to exceed thirty days from the date of issuance of the license in lieu of on board holding tank.

d. All persons, firms, or corporations operating live bait catcher boats must have a valid bait trawling license issued by the Mississippi Marine Conservation Commission.

e. Bait catcher boat operators must keep records showing the number of tows made each day, time began trawling and time ended. The records shall be provided to the live bait retailer receiving the boat operator's catch.

f. Trawling hours shall begin at sunrise and end one hour before sunset each day.

g. Live bait boat operators may retain other fish caught coincidental to catching bait shrimp and may be sold as chum.

h. Live bait catcher boats may dispense or sell live bait while in the process of catching or transporting live shrimp when authorized in writing by the retailer who ordinarily purchases the catcher's supply.

4. **LIVE BAIT DEALERS, LICENSE.** A shrimp bait dealer-operator is a person, firm, or corporation that actively pursues the business of supplying the needs of sport fishermen with bait and/or tackle and other recreational fishing needs. No person, firm or corporation shall operate as a shrimp bait dealer unless he has first obtained a valid retail bait license issued by the Mississippi Marine Conservation Commission. An applicant for a license must have a place to do business or a contractual agreement for a place to do business which will be binding upon the parties upon issuance of a license. No person, firm, or corporation shall hold a valid retail bait license who does not have a suitable place of business and meet the following requirements:

a. Holding tanks for the live bait must be either circular or raceway type with adequate water flow, provided, however, that rectangular shaped tanks already in use may continue to be used when perforated boards are placed in corners to prevent live shrimp from congregating in corners.

b. Dead bait shrimp may be sold in containers only up to sixteen (16) ounces. No bulk sales shall be permitted.

c. Holding tanks must be cleaned of dead shrimp at least every twelve (12) hours.

d. There must be someone available to sell or dispense bait to customers on a regular basis during appropriate hours for that type of business.

e. Records will be kept by bait retailers of:

1. Total numbers of purchasers served bait shrimp each day.
2. Total number of live shrimp sold each day.
3. Total sales of chum and squid in pounds and value.
4. Total cartons of dead shrimp sold each day.
5. Total sales of soft crabs in number and value.
6. Total sales of hard crabs in dozens and value.
7. Total sales of bull minnows in number and value.

Failure to comply with any of the requirements listed in Section 8003 for live bait shrimp catcher boats, boat operators and shrimp bait dealer-operators respectively, shall result in revocation of the license.

5. **PENALTIES FOR VIOLATION OF NO'S 8101, 8103, 8107.** The Chief Inspector, or any other inspector of the Commission is hereby instructed and directed to make arrest of any person violating the provisions of this Ordinance, and shall seize any and all shrimp caught, taken or transported or kept in any manner contrary to the provisions of this Ordinance and upon conviction shall confiscate and dispose of same, and violators shall be subject to fine up to \$200 and six (6) months loss of license for the first offense and up to \$500 fine and up to permanent loss of license for boat operators or dealer-operators.

In addition to the penalty hereinabove set forth, any person, firm, or corporation violating any of the provisions of this Ordinance shall be guilty of a misdemeanor, and on conviction thereof, shall be subject to all the penalties provided under section 49-15-63 of the Mississippi Code of 1972.

6. **RESTRICTED AREAS.** It shall be unlawful for any person, firm, or corporation to take or attempt to take or have in his possession, sell, or offer to sell any shrimp taken from the waters of the State of Mississippi lying North of the Intercoastal Waterway under the jurisdiction of this Commission after sunset of April 30th of each year except during any period which shall be declared an open or closed season by Order or Ordinance of this Commission, duly spread upon its minutes with notice thereof published in a newspaper having general circulation in the County or Counties affected by such Order for the time required by law.

The taking and catching of shrimp for any purpose at any time is expressly prohibited in St. Martin, Davis, Poito, Fort and Graveline Bayous in Jackson County.

All persons, firms or corporations are prohibited

from shrimping North of a line formed by the Louisville & Nashville Railroad bridge in the three coastal counties, except for Biloxi Bay where shrimping shall be prohibited within the area formed by lines beginning at the Biloxi Lighthouse running southerly to Biloxi Channel Beacon "10" thence easterly to the West end of Deer Island, thence easterly along the North shore of Deer Island to Grand Bayou, thence northeasterly to Marsh point at the mouth of Davis Bayou, except as hereinafter provided.

7. TRAWL BOARDS. Except for a test or try trawl measuring not more than 12 feet along the cork line, and not more than 15 feet along the lead line, used with boards not more than 24 inches long, it shall be unlawful for any one boat engaged in the taking or catching of shrimp to use more than one trawl, said trawl to measure not more than 50 feet along the cork line and not more than 60 feet along the lead line, in the waters under the jurisdiction of the Commission north of a line from the Louisiana boundary to Cat Island to Ship Island to Horn Island to Petit Bois Island to the Alabama boundary. This regulation shall not apply to the waters under the jurisdiction of the Commission south of the line described herein.

The Chief Inspector or any other inspector of this Commission is hereby instructed and directed to inspect all boats within the waters under the jurisdiction of this Commission North of the islands of Cat, Ship, Horn and Petit Bois as hereinabove set forth in Section 1, as to the size and number of trawls used in the catching of shrimp, and to make arrests of any person aboard the vessel or in charge of the vessel violating the provisions of this ordinance. Such inspector may draft the aid of captains, crews, and boats or licensed vessels to enforce the provisions of this ordinance, and may, without warrant, board, search and inspect the vessel.

In addition to the penalty hereinabove set forth, any person, firm or corporation violating any provisions of this ordinance shall be subject to the penalties provided under House Bill No. 52 of the regular 1960 Session of the Mississippi Legislature.

Each section and sub-section of this ordinance shall be declared separable and if any section or sub-section or part thereof shall be held invalid or unconstitutional, the balance of said ordinance shall remain in full force and effect.

8. STANDARDS OF MEASURES, OFFICIAL. Official Standards of Measures to be utilized by the Mississippi Marine Conservation Commission, its inspectors, employees and all other persons connected therewith:

- One (1) Barrel of Whole Shrimp . . . 210 pounds
- One (1) Barrel of Headless Shrimp . . 125 pounds

9. STATISTICAL REPORTING REQUIREMENTS.

In compliance with the Commission order of December 1, 1975, establishing a statistical division, the following reporting requirements are spelled out. Data from each

firm processing any marine fishery products will be required annually.

Shrimp: Employees of the Marine Conservation Commission are authorized and empowered to obtain information on each vessel fished, depth fished, the total catch by species, area in which the vessel fished, depth fished, the number of hours fished in each area and the size of the shrimp. Since it may be impossible to interview every fishing craft, copies of the purchase slip at the processing or landing firm will be obtained. Interview data from vessels will serve as a sample while purchase slips will be the total landed. All out of state vessels shrimping in Mississippi waters will be required to report catch of each trip and pay all taxes due on shrimp caught in Mississippi waters.

LOUISIANA

Laws

1. DEFINITIONS. As used in this Title "salt water shrimp" includes all species of shrimp or commercial or economic value found in the coastal waters of the State and in the Gulf of Mexico contiguous to the Louisiana coast, including the white shrimp or "common salt water shrimp" (*Panaeous (sic) setiferus*), also called the "lake shrimp"; the brown shrimp (*Penaeus aztecus*); the pink shrimp (*Penaeus duorarum*); the "sea bob" (*Xiphopeneus kroyeri*), also called "six barbes"; the common river shrimp (*Macrobrachium ohione*); the Delta River shrimp (*Macrobrachium Acantherus*) (sic); and any other shrimp or shrimp like species which may be taken from coastal waters or sold through commercial channels.

"Take", in its different tenses, includes the act of pursuing, netting, capturing, trapping, wounding, or killing by any means or device whatsoever; and includes any attempt to seine, trawl for, or catch salt water shrimp.

"Possess" in its different tenses, includes the act of having in possession or control, keeping, detaining, restraining, or holding as owners, or as agent, bailee, or custodial of another and whenever possession, sale or purchase of shrimp is prohibited reference is made equally to such shrimp from without the state as to that taken within the state.

"Transport" in its different tenses, includes the act of shipping, attempting to ship, receiving or delivering for shipment, transporting, conveying, carrying, or exporting, by air, land, or water, or by any means whatsoever.

"Processing" includes any method of preparing shrimp for the market, including drying, canning, packing, beheading, freezing but not the simple packing of fresh shrimp in ice during transportation.

"Consumer" includes restaurants and other places where shrimp is prepared for consumption or otherwise utilized, and includes persons using shrimp for bait.

The "Length of seines, trawls, or other netting" is

the full measure of the extended net as in use or in possession on the fishing grounds, when measured along the cork line between the points where the webbing is attached to the rope at either end, and does not include the additional rope used for pulling the net or attaching it to the arm-poles or trawl boards.

The "size of the mesh" of netting means the full measure of the mesh as found in use or in possession on the fishing grounds, measuring the full "bar" stretched from the near side of one knot to the far side of the other. As amended Acts 1958, No. 53.

2. OWNERSHIP. The ownership of all salt water shrimp or the parts thereof existing in the waters of the state including their hulls or other products is in the state in its sovereign capacity. These shrimp shall not be taken, sold or had in possession except as otherwise permitted by this Sub-part. The title of the state to all such shrimp, even though taken in accordance with provisions of this Sub-part, always remains in the state for the purpose of regulating and controlling the use and disposition thereof.

3. CONTROL OF SHRIMP FISHERY AND INDUSTRY. The exclusive control of the shrimp fishery and the shrimp industry in Louisiana is vested in the department, which shall enforce the laws regulating same. All shrimp or parts thereof taken, possessed, or transported contrary to the provisions of this Sub-part shall, when found, be confiscated and disposed of by the department at its discretion.

To secure the effective protection of shrimp, the commissioner shall appoint wild life agents whose entire time shall be, under the direction of the commissioner, devoted to the performance of their official duty under this Sub-part. The commissioner shall fix the compensation of all agents. The commissioner may also appoint as many special or cooperative officers, to be designated special wild life agents or special agents, as he deems proper. Special agents, in the enforcement of the provisions of this Sub-part have all the rights, powers, and duties of agents, except as hereinafter mentioned. Special agents serve without expense to the state or to the department in excess of a salary of one dollar per year.

The commissioner, agents, and the various sheriffs, deputy sheriffs, constables, deputy constables, and other police officers may without warrant arrest any person committing a violation of this Sub-part in his presence or view, and may take such person in custody immediately for examination or trial before any officer or court of competent jurisdiction of this state or the United States. They may also serve and execute any warrant or other process issued by any officer or court of this state of competent jurisdiction for the enforcement of the provisions of this Sub-part.

The commissioner, and agents, may examine

records, visit or examine, with or without search warrant, any cold storage plant, warehouse, boat, store, car, conveyance, automobile, or other vehicle, airplane, basket, or other receptacle, or any place of deposit for shrimp, whenever they have probable cause to believe that any provisions of this Sub-part have been violated.

Agents may carry weapons concealed while in the performance of their duties.

The several judges of the district courts and the several justices of the peace shall within their respective jurisdiction upon proper oath or affirmation, and upon probable cause shown, issue search warrants in aid of the enforcement of the provisions of this Sub-part.

Agents shall at frequent intervals visit and inspect cold storage plants, warehouses, public restaurants, public and private markets, stores, and places where shrimp are likely to be kept and offered for sale in violation of the provisions of this Sub-part. Such visitations and inspections are lawful without search warrant. They shall take proceedings in any court of competent jurisdiction, state or federal, against any offender.

Special agents have all the rights and duties conferred or imposed upon agents, but have no authority to make any contracts for the commissioner.

4. CONFISCATION AND DESTRUCTION OF ILLEGAL TACKLE. Possession or operation of illegal, unlicensed and improperly tagged tackle is prima facie evidence that it is being used unlawfully or kept for unlawful use. Such tackle is hereby declared to be a public nuisance and shall be confiscated by the Louisiana Wild Life and Fisheries Commission through its duly authorized agents and after having been used as evidence, if necessary, in a Court of Justice of this State shall be destroyed by the Louisiana Wild Life and Fisheries Commission through its duly authorized agents.

In the destruction of the illegal, unlicensed or improperly tagged tackle, as herein provided, the Louisiana Wild Life and Fisheries Commission shall be relieved of any and all responsibility and/or liability whatsoever to any person, firm, or corporation which may have owned the same.

In cases of arrests for any violation of the provisions of this Sub-part, the arresting officer shall confiscate any or all legal tackle being illegally used which shall remain in the possession of the Louisiana Wild Life and Fisheries Commission during the pendency and disposition of trial of the person or persons so arrested and said Commission shall be relieved of any and all responsibility and/or liability whatsoever to any person, firm or corporation of said tackle while in its possession. As amended Acts 1958, No. 53.

4. DEFINING INSIDE AND OUTSIDE WATERS.

A. Solely for the purpose of this subpart, the shrimping waters of the state are divided into two classes,

inside and outside waters. The line of demarcation of the classes of water shall commence at the coastal boundary between Mississippi and Louisiana. The exact delineation of this line is presently in litigation.

B. All waters of the state shoreward of the line described in Subsection A hereof within which the tide regularly rises and falls or into which saltwater shrimp migrate are inside waters. All waters seaward of the line described in Subsection A of this section are outside waters. Acts 1956, No. 29; Acts 1958, No. 53; Acts 1962, No. 452; Acts 1971, No. 99; Acts 1972, No. 203.

5. TRAWLING VESSELS; SIZE OF TRAWLS.

A. No trawling shall be permitted in inside waters during the closed season. No vessel may trawl for shrimp pulling more than two trawls. No trawl over fifty feet in length along the cork line may be used in inside waters.

B. No vessel, during the open season, rigged for double trawls, nor any Biloxi type vessel, single or double rigged, shall trawl in inside waters, except within Breton Sound and Chandeleur Sound, in which sounds they may in open season trawl up to the outermost points of the main land mass. As amended Acts 1962, No. 452; Acts 1964, No. 490; Acts 1971, No. 179.

6. RESIDENCE REQUIREMENTS; EXCEPTION.

Any persons, firm or association operating a shrimp processing plant in this state may take salt water shrimp from the waters of this state and process them.

Any restrictions affecting non-resident persons from taking or processing salt water shrimp does not apply to the citizens of any state which grant equal privileges or licenses to the citizens of this state which said states have entered into the Gulf States Marine Fisheries Compact under 1950, R.S. 46:41, etc., as amended Acts 1952, No. 627.

7. SEASONS, BAIT SHRIMP.

A. No person shall take, have in possession, sell or offer for sale any saltwater shrimp taken from inside waters except in open seasons as herein below described:

The open seasons for all or part of the inside waters shall be fixed by the commission, including the right to open or close seasons from time to time other than during the regular seasons, and further including the right to set special shrimp seasons for all or part of the inside waters. Opening of the seasons shall be based upon the best technical data presented to the commission that marketable shrimp are available. Seasons may be opened or closed at regular meetings of the commission or after due notice to the public of a special meeting to determine the opening or closing date. Due notice shall consist of the issuance of a news release by the commission to news media seven days prior to a special meeting. Be it further provided that the commission shall fix no less than two open seasons each year for all inside waters, one of which shall commence not later than May 25 and shall remain

open a minimum of 50 days or until technical data indicates a need for closure to protect the forthcoming white shrimp population, and the other to commence on the third Monday of August and to remain open until the following December 21. It is further provided that no open season dates shall begin on a Sunday.

B. Salt water shrimp legally taken and processed within the state, may be bought and sold at any time. Salt water shrimp in their fresh state, legally taken during the open seasons in inside waters, may be possessed for five days following the last day of each open season. Bait shrimp may be taken in inside waters during the closed season, but only in cast nets, dip nets with a diameter not to exceed three feet operated only by hand without any mechanical device or pulley whatsoever, bait traps, and seines less than one hundred feet long, said seines to be manually operated on foot and may not in whole or in part be operated by any mechanical means or device whatsoever. No shrimp may be taken in inside waters during closed seasons with the use of a butterfly net, paupier, trawl, night trawl, or beam trawl, except as set forth in this Sub-part.

As amended Acts 1954, No. 348, Acts 1958, No. 53; Acts 1962, No. 452; Acts 1964, No. 490; Acts 1966, No. 54; Acts 1968 Special Session, No. 53; Acts 1969, No. 60; Acts 1970, No. 504; Acts 1974, No. 490.

8. SIZE LIMIT. No person shall take or have in possession any salt water shrimp which average more than 68 specimens to a pound except during the spring open season defined in R.S. 56:497(A) when there shall be no limitation as to count, and from November 15 to December 20 when there shall be no limitation as to count on the brown, or Brazilian-type shrimp (*Penaeus* (sic) *aztecus*). This restriction does not apply to "Sea bobs" (*Xiphopeneus kroyeri*), also called "six barbes" which may be taken or sold through commercial channels in any season only in outside waters. There shall be no size limit on bait shrimp taken in the manner prescribed in R.S. 56:497 (B) and R.S. 56:500. As amended Acts 1950, No. 544; Acts 1958; No. 53; Acts 1962, No. 452.

9. SEINES, TRAWLS, BEAM TRAWLS AND BUTTERFLY NETS; SIZE OF MESH; LENGTH; DIAMETER OF BUTTERFLY NETS; NAVIGATION LIGHTS.

A. No persons shall take salt water shrimp with any seine or trawl with a mesh size less than three-fourths of an inch "bar" or one and one-half inch stretched, or any beam trawl or butterfly net with a mesh less than five-eighths of an inch "bar" or one and one-fourths inch stretched. No trawl, beam trawl or butterfly net may be used in closed waters. No person shall use a seine over three thousand feet in length, provided that in closed waters no seine may be used except as specified for the taking of bait in R.S. 56:497. No person shall use a double beam trawl or butterfly net having individual nets more than twelve feet in diameter each or a single beam trawl or butterfly net greater than twenty-two

feet in diameter. Operation of beam trawl and butterfly nets shall in no way impede or restrict normal navigation, and each net shall be equipped with not less than two navigation lights when used between the hours of one-half hour after sunset to one-half hour before sunrise.

B. For the purpose of licensing, beam trawls and butterfly nets shall be considered as trawls and Section 500 of Title 56 shall apply. As amended Acts 1950, No. 544; Acts 1958, No. 53; Acts 1966, No. 421.

10. LENGTH OF TRAWLS IN VERMILION BAY, EAST COTE BLANCHE BAY AND WEST COTE BLANCHE BAY; USE OF TRAWLS IN CALCASIEU LAKE.

A. No person shall use a trawl more than fifty feet in length in the waters of Vermilion Bay, East Cote Blanche Bay or West Cote Blanche Bay.

B. No person shall use a trawl for the taking of shrimp at night in Calcasieu Lake, Calcasieu River, and Calcasieu Ship Channel, all in Cameron Parish, in the day time and in night time, during open season.

C. Any person who violates the provisions of this Section shall be fined in the amount of fifty dollars, together with the mandatory seizure and destruction of the trawl, for each offense. As amended Acts 1954, No. 251; Acts 1962, No. 452; Acts 1966, No. 190.

11. BUTTERFLY AND BOTTOM NETS; LAKE PONTCHARTRAIN AND INTRACOASTAL WATERWAY. Notwithstanding the provisions of R.S. 56:499 to the contrary, in that area of Lake Pontchartrain south and east of the Interstate Highway 10 Bridge, south and eastward to include the waters of Lake St. Catherine and its passes, the Rigolets, Unknown Pass, and Chef Menteur Pass and south and eastward to Lake Borgne and that portion of the Mississippi River Gulf outlet and the Intracoastal Waterway from the Industrial Canal eastward to Lake Borgne, shrimp may be taken with butterfly nets and bottom nets. Acts 1972, No. 558.

12. LICENSE FEE; SEINES OR TRAWLS; SEVERANCE TAXES; NON-RESIDENTS, APPLICATIONS AND AFFIDAVITS. No person shall use a shrimp seine or trawl unless an annual license fee has been paid thereon to the Louisiana Wild Life and Fisheries Commission as follows: on each separate salt water shrimp seine or other webbing less than one hundred feet in length, ten dollars; on each separate salt water shrimp seine or other webbing one hundred feet or more, but less than five hundred feet in length, fifteen dollars; on each separate seine or other webbing five hundred feet or more, but less than two thousand feet in length, twenty-five dollars; on each separate seine two thousand feet or more but not to exceed three thousand feet in length, thirty dollars; on each separate trawl in operation sixteen feet or less, ten dollars; on each separate trawl in operation more than sixteen feet, but less than forty feet,

fifteen dollars; on each separate trawl forty feet or over, twenty dollars. Commercial vessels may use a test trawl not exceeding sixteen feet without additional license provided that a license fee has been paid on one or more larger trawls. Any person selling his catch shall be considered as a commercial fisherman and must have all necessary licenses. The holder of a shrimp seine or trawl license may sell any fish or crustaceans other than shrimp that happen to be caught in the shrimp seine or trawl and the holder of a trawl license may sell fish taken with pole and line or cast net without the payment of additional license or licenses. Any sports fisherman may in open waters in open seasons use a trawl not to exceed sixteen feet without payment of license, provided the shrimp taken with such trawl are used for bait or for his own consumption and are not sold, traded, or otherwise permitted to enter into commerce and shall not exceed one hundred (100) pounds in the aggregate at one time per day to each boat irrespective of the number of persons thereon. No vessel shall engage or be used in commercial salt water shrimp fishing in Louisiana waters until a license therefor according to its linear feet length shall be procured as follows: Not more than forty feet, five dollars; more than forty feet, ten dollars. No license shall be required of any vessel used exclusively for sports fishing and for no other purpose. As a condition of the application for the granting of the license, all shrimp caught or transported by the vessel while the license is outstanding are deemed to have been taken in the waters of Louisiana, and subject to severance tax thereon. Nothing to the contrary shall be claimed.

No vessel, licensed or not, shall engage or be used in transporting shrimp taken in Louisiana waters to points out of the state unless severance taxes have been paid thereon, or unless due arrangement has been made for payment with the Commission under regulations made by the Commission at the port of exit established as provided in R.S. 56:506. If convenience or necessity requires a place beyond the boundary of this state, such place may be established as a port of exit.

Vessels operating in buying, freighting, or transporting salt water shrimp as permitted by R.S. 56:502, whether operated for or by wholesalers or not, shall have license therefor on the same basis as those issued for fishing vessels with respect to shrimp transported by them to points outside of the state; their rights and obligations shall be the same as vessels taking shrimp from the waters. Any boat licensed hereunder for shrimp fishing may also engage in commercial fishing without the payment of an additional boat license.

Vessels owned or operated by bona fide citizens of a state which has heretofore entered into a reciprocal agreement with Louisiana under the authority of Act 10 of the First Extraordinary Session of the Louisiana

Legislature of 1940 may be licensed under this Sub-part to engage in such shrimp fishing and freighting operations in the same waters in which Louisiana citizens are licensed and permitted to operate.

Citizens of such reciprocating states, and boats owned by such bona fide citizens, may catch or take and transport shrimp from those waters of Louisiana described, upon payment of the same licenses and taxes as levied upon citizens of Louisiana and upon boats owned by them.

However, no person, nor any vessel owned in whole or part by any person, firm or corporation shall be licensed to catch or transport shrimp in the described waters of Louisiana under such reciprocal agreement, unless the person, and the individuals composing the partnership, association or corporation are citizens of such reciprocating state and have actually resided in such state at least two years next preceding the application for a license under this Sub-part. Each application for a license under the reciprocal agreement shall be accompanied by an affidavit giving full details regarding the domicile and residence of the applicant and of the ownership of the vessel.

All applications and affidavits required under this Sub-part shall be filed with the Commission and preserved, and be subject to public inspection as in the case of other public records.

Any material misstatement of fact regarding the domicile or residence of the applicant, or of the ownership of the vessel for which application is made, supported by false affidavits, subjects the person making such affidavit to prosecution and subjects the vessel to forfeiture as provided for forfeiture of vessels and equipment in this Sub-part.

Any person convicted of making false affidavit to any application required under this Sub-part shall be fined not less than five hundred dollars nor more than one thousand dollars and imprisoned for not less than ninety days nor more than six months.

The fine and jail sentence herein provided shall be mandatory and shall not be suspended for any cause or reason whatsoever, nor shall any diminution of any sentence be granted or allowed for good behavior or otherwise. As amended, Acts 1952. No. 627; Acts 1958, No. 53.

13. LICENSE; PROCESSORS AND WHOLESALERS. No person shall buy and sell or process shrimp in Louisiana without having first obtained from the commissioner an annual license.

Each shrimp factory, platform, or other processing plant, and each resident person buying or handling shrimp for resale to others than consumers, whether on a commission basis or otherwise, and each resident person shipping salt water shrimp out of the state is a wholesale

dealer and shall pay an annual license of fifty dollars. Each processor or wholesaler shall submit to the commissioner the names and addresses of all buyers, agents, and freight or ice boats solely in his employ, whether on a salary or other basis.

The privileges of a wholesaler include the privileges of a retailer and of dealers of fish and oysters without additional license. Wholesalers' licenses shall be issued only to persons who have been bona fide residents of Louisiana for at least two years.

All shrimp processing plants and wholesale dealers shall keep, in the English language, records of the date, quantity, and point of origin of each lot of shrimp received, from whom purchased and to whom sold. These records shall be maintained intact for three years, and shall be open to inspection by the commissioner.

14. LICENSE; WHOLESALER'S AGENT; MANIFEST OF CARGO OF VESSEL CARRYING SHRIMP. Each person engaged in the buying of salt water shrimp as a wholesaler's agent, whether on a commission or salary basis or otherwise, and not selling in the open market, including the owner or operator of any vessel buying, freighting, or transporting salt water shrimp, shall pay an annual license of ten dollars and is responsible for any illegal transactions ensuing between the time he purchases from the fisherman and the time they are accepted by the wholesaler for whom he is operating. A person engaged in the buying of salt water shrimp for more than one wholesaler, and any owner or operator of any vessel buying, freighting, or transporting salt water shrimp for more than one wholesaler, shall purchase a wholesaler's license.

All vessels transporting shrimp shall keep in writing a manifest of their cargo, a copy of which shall be filed on each trip with the dealer or processor to which delivery is made and a copy sent to the department. Statements giving the date, quantity, and point of origin of each lot, and from whom purchased and to whom delivered, shall be sent to the department on forms furnished for the purpose, not later than the tenth of the month following date of delivery.

15. RETAILER'S LICENSE. Each resident person buying and selling salt water shrimp for retail sale, including the sale of bait, to the consumer, shall purchase from the Commission a five (5) dollar annual license. The privileges of a retailer entitle him to retail fish, crabs and oysters without additional license. Retailers shall buy direct only from licensed producers or licensed commercial fishermen and said retailers shall pay the severance tax provided herein, and shall file with the Commission between April first and April tenth; July first and July tenth; October first and October tenth; and January first and January tenth a complete sworn report on printed forms furnished by the Commission of the amount of

shrimp which they have so purchased, complete with the name and license number of each party from whom shrimp were purchased, and shall pay the tax due at the time of the filing of the report. Failure to make the sworn report or the failure to pay the tax subjects the retailer dealer to the full penalties of this Sub-part and the immediate revocation of his license by the Commission. A license shall not be issued to any such retail dealer who has not made a report and paid a tax for the preceding year and until said report has been filed and severance tax paid on same. As amended Acts 1958, No. 53.

16. **ISSUANCE OF LICENSE; POSSESSION.** Licenses shall be issued by the commissioner. Each person required to purchase a license under this Sub-part shall have that license in his possession when shrimping or operating his shrimp business. The license shall be shown on demand to any duly authorized agent of the commissioner. License tags shall be attached to nets, tackle, or boats in a conspicuous and acceptable place.

License fees are due on the first of January of each year and are payable in advance. For failure to secure a license before operating a penalty of ten percent of the license shall be charged for any delay not exceeding thirty days; a penalty of twenty-five percent for any delay exceeding thirty days but not exceeding sixty days; and a penalty of fifty percent for any delay exceeding sixty days but not exceeding one hundred twenty days, the commissioner may refuse to issue license for the balance of the year.

16. **SEVERANCE TAX; DEFAULT IN PAYMENT; PENALTY.** There is levied a severance tax on all salt water shrimp taken from the waters of this state of \$0.15 per barrel of two hundred and ten pounds. Out of state shipments other than by common carrier shall be registered and certified as provided in R.S. 56:506 and shall be taxed \$0.50 per barrel of two hundred and ten pounds.

The severance tax on shrimp is to be computed when in the fresh state as delivery to the first purchaser and shall be paid by him; provided that processors operating boats as producers shall pay as required by the first purchaser. Processors or any other first purchaser may pay the tax at the end of each month, or before the tenth of the following month. A statement of the quantity of shrimp purchased, vessels and owners thereof, and other dealers from whom purchased or received shall be made under oath on blanks furnished by the department and shall accompany each payment. All wholesalers, processors, and first purchasers shall at the time and in the same report make a full statement of the disposition thereof, including sales and persons to whom made.

No first purchaser, processor, wholesaler, or other

dealer required under this Sub-part to pay the severance tax, or who in any way deals in buying, selling, or handling salt water shrimp, shall violate any provision of this Sub-part. Whoever violates this Section shall be fined not less than two hundred and fifty dollars nor more than five hundred dollars for the first offense; for the second offense his license shall be revoked and not reissued to him or anyone associated with him for two years.

A barrel of shrimp or any part thereof on which this tax has been paid shall not again be taxable. The monthly official report and pertinent records of the department shall be prima facie evidence of the payment or non-payment of severance taxes.

Shrimp severance taxes shall be payable to the department on or before the tenth day of the month following the date of sale. Upon failure to pay severance taxes when due, a penalty of ten percent per month, not exceeding thirty percent in the aggregate, calculated upon the severance tax due, shall be levied and collected by the department in addition to the tax due. If there is a delinquency in the filing of reports and in the payment of taxes due as required above, demand for payment shall be made by the department as soon thereafter as possible, coupled with the warning that the license of the delinquent shall be revoked unless report is made and taxes paid. After demand for payment and warning, the department may seize any shrimp or parts of products thereof in the possession of a person liable for taxes and penalties due and sell them for payment of the tax and penalties. Any surplus from the proceeds of sale, after deducting all costs and charges, taxes and penalties due, shall be paid to the owner of the shrimp or parts or products thereof seized. At any time after demand for payment and warning the license of any person who fails to make monthly reports and to pay severance taxes due shall be revoked by the department, and shall so remain until all reports are made and all taxes due are paid with accrued penalties. Any person who refused or fails to pay the severance taxes due or to make monthly reports as aforesaid, and whose license has been revoked, is hereby prohibited from buying and selling or otherwise engaging in the disposition of shrimp or parts or products thereof and other sea-foods under the jurisdiction of this department. As amended Acts 1950, No. 544, No. 1.

17. **SHIPMENT; TAGS; CERTIFICATE OF EXPORT; SALE IN ORIGINAL PACKAGE.** All shipments containing salt water shrimp shall be plainly marked. The tags or certificates shall show the names of the consignor and consignee, with an itemized statement of the number of pounds of salt water shrimp and the names of each kind contained therein. All bills of lading issued by common carrier for such shipments shall state the number of packages which contain salt water shrimp. All shipments

of salt water shrimp made to points outside the state other than by common carrier, shall be registered by the owner or his agent at some port of exit established by the department before they can be legally transported to points outside the state.

When fresh shrimp are marketed in original packages so that the entire contents are not readily inspectable by the purchaser, each package shall be tagged or identified with the name, address, and license number of the packer.

Failure to tag and identify the package constitutes a violation of this Sub-part. No person shall purchase, acquire, or accept such a package unless tagged and identified.

18. PENALTY FOR VIOLATIONS OF SUB-PART.

Whoever violates any provisions of this Sub-part, including but not restricted to commercial fishermen, processors, wholesalers and retail dealers, where fine or imprisonment has not been otherwise specifically provided, shall be mandatorily fined not less than two hundred (\$200) dollars nor more than five hundred (\$500) dollars or sentenced to serve not less than fifteen nor more than thirty days in jail or both, for the first offense; not less than five hundred (\$500) dollars nor more than one thousand (\$1000) dollars and not less than sixty nor more than ninety days in jail for the second offense. For the third and all subsequent offenses, the fine shall be not less than seven hundred fifty (\$750) dollars nor more than one thousand (\$1000) dollars and not less than ninety days nor more than one hundred twenty days in jail, and in addition, the license under which operations are being conducted shall be revoked and shall not be reinstated at any time during the period for which it has been issued and for one year thereafter. The jail sentence herein provided shall be mandatory, except for the first offense which shall be at the discretion of the court, and no sentence or fine shall be suspended for any cause or reason whatsoever, nor shall any diminution of any sentence be granted or allowed for good behavior or otherwise. In addition thereto, and in the same proceedings, the seines, trawls, other devices or equipment, tackle, etc., used in the violation shall be forfeited by order of the Court imposing the fine and sentence to the Louisiana Wild Life and Fisheries Commission for such disposition as in its discretion it may see fit to make. As amended Acts 1950, No. 544; Acts 1958, No. 53.

19. SEIZURE AND FORFEITURE OF VESSELS OR EQUIPMENT USED ILLEGALLY; RELEASE.

A. Vessels, airplanes, vehicles, or other forms of transport used in the illegal taking or transportation of salt water shrimp shall be seized and taken into possession by the department. The department shall release the seizure upon the owner or person in charge thereof furnishing a bond with security, of not more than twenty-five

hundred dollars, as fixed and approved by the judge of the district court having jurisdiction.

B. The vessel, airplane, vehicle, or other thing, all hereinafter designated "the thing", is liable to forfeiture upon proceedings instituted to that end by the district attorney having jurisdiction or the department through its authorized attorney. The district court may decree the forfeiture of the thing, which shall be sold at public auction by the sheriff, without the necessity of appraisal, but after notice of seizure and advertisement as prescribed by law for the sale of movable property seized under a writ of fieri facias. The proceeds of the sale, less the cost of seizure, keeping, and sale, shall be paid into the state treasury to the credit of the department.

C. Whenever a charge of illegal taking or transportation of salt water shrimp shall be nolle prosequed by the district attorney for the parish in which the violation is alleged, or shall be dismissed by the district court on the basis of a preliminary hearing or other preliminary proceedings, or when an accused fisherman is acquitted following a trial in the district court of the parish in which the violation is alleged to have occurred, then, any and all vessels, airplanes, vehicles, other forms of transport, shrimp, nets and any and all other equipment and paraphernalia seized in the arrest, shall be returned to the individual accused of said violation immediately without the necessity of any further proceedings or rules to show cause, or otherwise. Where the possibility of further prosecution exists, as in cases of a nolle prosequi by the district attorney, or as in case of dismissal before trial by the court, the district attorney and/or the Wildlife and Fisheries Commission shall leave the authority to photograph the vessels, airplanes, vehicles, or other paraphernalia, for preservation as evidence, provided that said photographs are made immediately and do not cause a delay in the return of said items to the accused fisherman. Amended by Acts 1970, No. 544.

20. PETITION BY COMMISSIONER FOR SUSPENSION RATHER THAN FORFEITURE; RELEASE UNDER BOND BETWEEN SEASONS. Where forfeiture shall, in the judgment of the commissioner or court, exceed justice, the commissioner may petition for a suspension of the operation of the thing. If guilt is established the court shall impose a suspension of the operation for not less than thirty days nor more than ninety days. Where suspension is ordered, the thing shall be kept in the custody of the department at the cost and risk of the thing, its owner, or operator and not released until all cost and charges are paid. The owner or operator may name a keeper at his own expense, the thing to be deemed to continue in the custody of the department, notwithstanding. The days of suspension provided for means for a vessel, days of open season. If the term of suspension has not expired before the current season is

closed, the vessel may be released at the end of the season on giving bond, with security, approved by the commission, conditioned on its return to the custody of the department at the beginning of the next season. The vessel under no condition shall operate in the fisheries in which it had been engaged when seized, until its term of suspension has been served during the days of open season.

21. FORFEITURE OR SUSPENSION WHERE OWNER OR LESSEE IS WITHOUT KNOWLEDGE OR CONSENT; PUNISHMENT OF PERSON IN CHARGE OR COMMAND AT TIME OF OFFENSE. Where forfeiture or suspension is decreed by the District Court having jurisdiction, and where the owner or lessee of the thing proves that the offense was committed without his knowledge or consent, the captain, pilot, or person in charge or command of the thing at the time of the offense shall by order of court be enjoined and suspended from engaging in shrimp fishing or other operations having to do with shrimp for not less than sixty days nor more than six months. In addition, he shall be subjected to the fines and penalties provided in R.S. 56:507. As amended Acts 1958, No. 53.

22. REGULATION OF IN REM PROCEEDINGS. Proceedings shall be in rem insofar as not inconsistent with the provisions of R.S. 56:508 through 56:512. The in rem proceedings provided for in R.S. 34:801 through 34:817 shall be followed when not inconsistent with the foregoing. Notice shall be given by the Commission as provided in R.S. 34:806. Persons interested may file answers as provided in R.S. 34:808. If the claimant fails to answer plaintiff's petition, default may be taken as provided in R.S. 34:809. The plaintiff may, at its option, join a suit in personam against the vessel owner or the operator. As amended Acts 1950, No. 316; Acts 1958, No. 53.

23. JURISDICTION OF COURTS. For the purposes of this Sub-part the jurisdiction of the District Courts of any parish extends to the limits of the state's sovereignty over tidal waters and the bottoms thereof. Proceedings may be brought in the parish where the offense occurs or at the home port of any vessel. No person charged, or owner, operator, or other person in interest, shall except to the jurisdiction of any court proceeding under this Section, unless at the time he discloses the jurisdiction within which the thing was operating at the time and place charged with violation. If the operator or owner professes ignorance of the jurisdiction, there shall be no change of venue from the place where the proceeding was begun. As amended Acts 1958, No. 53.

24. COMPROMISE BY COMMISSION; PROCEDURE. Upon seizure of the thing and either before or after proceedings have been filed in the District Court, the Commission may, as party plaintiff, enter into a compromise with parties defendant, and file a pleading setting

forth the seizure and cause thereof and the agreement. The case shall be docketed and with the approval of the Court shall be the basis of a final civil judgment entitled to full authority, faith and credit, binding on all parties thereto, upon which orders and decrees of the court may issue directed to proper parties with the force and effect of a thing adjudged. No compromise shall be affected where the actual suspension of the thing shall be ordered and decreed for less than ten days. If it be shown that the owner or lessee is without guilty knowledge, the guilty parties shall be fined and imprisoned as provided in R.S. 56:507. As amended Acts 1958, No. 53.

25. JURISDICTION WHERE OFFENSE COMMITTED IN RIVER BETWEEN TWO PARISHES. If any offense is alleged to have been committed in a river dividing two parishes, any court in either parish has territorial jurisdiction if otherwise competent as provided in this Sub-part. If committed in any lake, bay, inlet, or other body of water bounded by more than one parish, any court in any parish bordering on such waters has territorial jurisdiction if otherwise competent as provided in this Sub-part.

26. JURISDICTION WHERE OFFENSE COMMITTED IN GULF OF MEXICO. If an offense is alleged to have been committed in the Gulf of Mexico within the waters of Louisiana, any court in any parish bordering on the Gulf has territorial jurisdiction if otherwise competent as provided in the Sub-part.

27. DEFINITIONS; FORFEITURES FOR FRAUD. No person shall be construed to be a bona fide resident of the state unless the individual or the individuals composing the partnership or association, or in the case of a corporation, the officers and owners of all of the corporate stock, are bona fide residents of the state and have actually resided herein more than two years next preceding the date of the application for a license under this Sub-part. Non-residents who have owned stock in a corporation more than two years next preceding July 31, 1946 are not affected hereby. Where the proof shows that a license as a resident has been obtained by fraud or subterfuge, the vessels and equipment used under that license shall be forfeited by proceedings maintained as provided for the forfeiture of vessels in this Sub-part.

28. LICENSE REQUIRED FOR SHIPMENT INTO OR OUT OF STATE OF SHRIMP OR OYSTERS FOR PAY, SALE, BARTER, OR EXCHANGE. No non-resident commercial fisherman shall bring into this state or carry out of this state any shrimp or oysters on any boat for pay, or for the purpose of sale, barter, or exchange, without first having produced a non-resident commercial fisherman's license.

No person shall bring into this state or carry or take out of this state in any non-resident commercial fishing boat any shrimp or oysters for pay, or for the purpose of sale, barter, or exchange, without first having

procured a non-resident commercial fishing boat license.

Note: This section has been declared unconstitutional although never repealed.

29. **PENALTY FOR VIOLATION OF SUB-PART; SEIZURES AUTHORIZED.** Whoever fails to comply with or violates any provision of this Sub-part, shall be fined not less than one hundred dollars nor more than one thousand dollars, or imprisoned for not less than one month nor more than one year, or both. The department or its authorized agent may seize and hold boats, nets, seines, trawls or other tackle until after trial of the defendant without being maintained against the department or its authorized agents therefor.

30. **BOATS MAINTAINED FOR ENFORCEMENT.** The department shall keep and maintain suitable boats for the purpose of enforcing the provisions of this Sub-part.

31. **DISPOSITION OF MONEYS RECEIVED.** All moneys collected under the provisions of this Sub-part from fines paid for violation of the provisions of this Sub-part shall be remitted to the department not later than the tenth of the month following collection and shall be deposited by the department in the state treasury to the credit of the department's fund.

32. **ENFORCEMENT OF PENALTIES BY CIVIL PROCEEDINGS.** All penalties provided in this Sub-part shall be enforced against corporations by civil proceedings instituted by the proper enforcement officers of this state.

33. **DEFINITION OF NON-RESIDENT COMMERCIAL FISHERMAN.** "Non-resident commercial fisherman" means any person who is a citizen of any other state, or any person who has not continually been a bona fide inhabitant of this state for two years. "Person" includes partnerships, associations, and corporations who have not continually had a bona fide place of business in this state for the same period of time and who take or assist in taking or catching shrimp or oysters from the tidal waters of this state for pay or for purpose of sale, barter, or exchange.

34. **DEFINITION OF NON-RESIDENT COMMERCIAL FISHING BOAT.** "Non-resident commercial fishing boat" means any boat or vessel registered in any other state, or which has not continually been registered in this state for a period of more than twelve months, or which is not owned by any person which has had a bona fide residence or place of business in this state for two years, and which is used for the purpose of taking or assisting in taking or catching shrimp or oysters from the tidal salt waters of this state for pay or for the purpose of sale, barter, or exchange.

Regulations

1. **LENGTH OF TRAWL.** Netting along cork line—

50' maximum inside waters.

2. **INSIDE WATERS.** All waters of the state shoreward of a line commencing from the mouth of Sabine Pass in an easterly direction following the offshore beaches to South Point on Marsh Isle, thence in a direct line to Eugene I. Lighthouse; then continuing in an easterly direction along the beaches to the west end of Isle Dernieres and then easterly along the beaches of Isle Dernieres, Wine Isle and Timbalier Islands to the mouth of Bayou LaFourche; then eastward along the beaches of the main land mass including Grand Isle and Grand Terre to the Mississippi Delta; then along the shores of the Mississippi Delta, excluding the passes of the River to Bird Island; thence in a northeasterly direction to and along the beaches of the Breton Island and Chandeleur Island complex to the Mississippi line.

3. **OPEN SEASON.**

a. **Spring Season.** No less than two seasons each year, not later than May 25 extending for a period of not less than 50 consecutive days or until technical data indicates a need for closure to protect the forthcoming white shrimp population.

b. **Fall Season.** Third Monday in August until December 21.

4. **DURING CLOSED SEASON**

a. There shall be no closed season in outside waters.

b. All trawls prohibited from inside waters.

c. Butterfly Nets prohibited from inside waters.

d. Cast Nets, Dip Nets, Bait Traps or Shrimp Seines less than 100 feet may be used if operated manually.

5. **SIZE COUNT**

a. Spring Season — No Count

b. Fall Season — 68 Count

c. Closed Season — No Count

d. Exception:

1. Sea Bobs — No Count

2. Brown (Brazilian) — No Count Nov. 15, Dec. 20.

3. Bait Shrimp — No count during Open or Closed Seasons if taken with Cast Net, Dip Net, Bait Traps or manually operated Seines 100 feet or less.

6. **GENERAL TRAWL & SEINE REGULATIONS.**

1. Only one (1) trawl may be used at a time in inside waters except that double rigs may be used within Breton and Chandeleur Sounds. A license is required for each trawl in use except that licensed commercial trawlers may use one 16' test trawl without paying additional license fee for test trawl.

2. Maximum trawl length—50 feet in inside waters.

3. Mesh—3/4" square or 1 1/2" stretched.

4. Trawls prohibited in inside waters during closed seasons.
5. Trawls prohibited in closed waters.
6. Maximum length Seine—3,000 feet.
7. Trawl or seine license plus vessel license required for Commercial use.
8. No trawl or vessel license required for sportsmen using trawls 16' or less for own bait purposes and own consumption only.

TEXAS

Laws

Licenses

1. **COMMERCIAL GULF SHRIMP BOAT** — is registered boat used for catching shrimp or other edible aquatic products for pay or sale from the Gulf or "Outside Waters" or unloading products caught outside of Texas. License fee, \$50.00. License expires August 31.
2. **COMMERCIAL BAY SHRIMP BOAT** — is registered boat used for taking for pay or sale shrimp from the "Inside" or "Bay Waters." License fee, \$40.00. License may be purchased only in January and February and expires March 1 of the following year.
3. **COMMERCIAL BAIT SHRIMP BOAT** — is registered boat used in the "Inside" or "Bay Waters" for taking bait shrimp or other aquatic products for sale or pay. Boat must be inspected for adequate live holding facilities before license is issued. License fee, \$40.00. Expires August 31.
4. **COMMERCIAL FISHERMAN'S LICENSE** — is required of the captain and each paid member of the crew of all commercial shrimp boats. License fee is \$10.00.
5. **SHRIMP HOUSE OPERATOR** — is any person, except Wholesale Fish Dealer, who operates shrimp house for pay or profit to unload and handle shrimp and other aquatic products from commercial Gulf and bay shrimp boats. A shrimp house operator may not also be licensed as a bait shrimp dealer. License fee, \$150.00. License expires August.
6. **BAIT SHRIMP DEALER** — is any person, except Wholesale Fish Dealer, who operates establishment in any coastal county for purpose of handling bait shrimp and other fish bait. Grocery stores not unloading or purchasing from bait shrimp boats do not need this license. License fee, \$40.00. License expires August 31.
7. **INDIVIDUAL BAIT-SHRIMP TRAWL** — any trawl, net, or rig used for catching shrimp for one's own personal use. License fee, \$5.00. Expires August 31.
8. **SPORT FISHING LICENSE** — is required of any person taking shrimp for personal use except those persons under 17 or over 67 years of age.
9. **SPECIAL PROVISIONS** — When any licensed

commercial shrimp boat is sold and the original license is surrendered an application can be filed by the new owner requesting a duplicate license showing the new ownership. This duplicate license will be issued without charge.

Waters Defined

1. **INSIDE WATERS** — mean all bays, passes, river, or other bodies of water landward from the Gulf and in which the tide rises and falls.
2. **MAJOR BAYS** — include Sabine Lake, Trinity, Galveston, East Galveston, West Galveston, Matagorda including Keller and East Matagorda, Tres Palacios, Espiritu Santo, Lavaca from the Causeway seaward, San Antonio, Ayres, Aransas, Mosquite, and Corpus Christi Bays, all exclusive of tributary bays and inlets.

That portion of West Galveston Bay in Brazoria County north of the Gulf Intracoastal Waterway is closed except to bait shrimping.

3. **OUTSIDE WATERS** — are defined in part as that portion of the Gulf of Mexico extending from the shoreline seaward and within the jurisdiction of the State of Texas.

4. **CONTIGUOUS ZONE** — is defined as that area of the Gulf of Mexico, where shrimp are found, adjacent to and offshore from the jurisdiction of the State of Texas.

Seasons

1. **BAIT SHRIMP SEASON** — "Inside Waters" open throughout the year except at night during the "Fall Open Season".
 2. **SPRING OPEN SEASON** — "Major Bays" open May 15 through July 15, days only from 30 minutes before sunrise to 30 minutes after sunset.
 3. **FALL OPEN SEASON** — "Major Bays" open August 15 through December 15, days only from 30 minutes before sunrise to 30 minutes after sunset.
 4. **GULF SEASONS** — The "Outside Waters" and "Contiguous Zone" are closed from June 1 through July 15 both days inclusive. This 45-day closed season may be extended by the Parks and Wildlife Commission to no more than 60 days by changing the opening or closing dates. The "Contiguous Zone" may be opened to Texas fishermen if the Parks & Wildlife Department finds that shrimp are being taken on a meaningful basis by vessels not subject to Texas Regulations. The closing date may be changed with a 72-hour public notice and the season may be reopened with a 24-hour public notice. White shrimp may be taken within four fathoms during this closed season by commercial Gulf shrimp boats using no more than one trawl and a try net. The trawl may not exceed 25 feet in width and must have a mesh size no smaller than 5 stretched meshes in 8 3/4 inches. The try net may not exceed 12 feet in width.
- The "Outside Waters" within seven fathoms are also closed from December 16 through February 1, both

days inclusive and this area is also closed to night shrimping (30 minutes after sunset to 30 minutes before sunrise) at all times. Seabobs may be taken in this closed season during daylight hours only by commercial shrimp boats using no smaller than 5 stretched meshes in 6 1/2 inches. The catch taken in this period may not include more than 10 percent by weight or numbers of shrimp of other species.

Shrimp Size

For shrimp taken from "Outside Waters" and from "Inside Waters" during the "Fall Open Season" the legal shrimp count is not more than 65 headless or 39 heads-on per pound. Shrimp taken during the "Spring Open Season," shrimp taken for bait, shrimp graded and landed and sea-bobs are not required to meet count requirements.

Shrimp for Personal Use

1. **LEGAL MEANS FOR TAKING** – Shrimp may be taken for personal use from all coastal waters except passes by means of a cast net, dip net, bait trap, manually operated minnow seine not exceeding 20 feet in length or "Individual Bait – Shrimp Trawl." Only one "Individual Bait-Shrimp Trawl" is permitted per boat. This trawl may not exceed 20 feet in width measured between the doors (boards), may not have a mesh size smaller than 5 stretched meshes in 8 3/4 inches, and may not have doors (boards) exceeding 15 inches by 30 inches (450 square inches) each.

In "Outside Waters" during open "Gulf Seasons" shrimp may be taken by a manually operated seine not exceeding 400 feet in length with a mesh size no smaller than 1 1/2 inches except for the bag and 50 feet on each side of the bag which may have a mesh size no smaller than 1 inch square. This seine may not be used within one mile of any pass. All marine life taken and not retained when using this seine must be returned to the waters from which taken.

2. **CATCH LIMITS** – No more than 2 quarts of shrimp per person or more than 4 quarts per boat may be in possession aboard any boat using an "Individual Bait-Shrimp Trawl" during any closed season in "Inside Waters." No shrimp for any purpose may be taken from "Outside Waters" during closed "Gulf Seasons."

100 pounds of legal size whole shrimp per day may be taken by any legal means from "Major Bays" during the "Fall Open Season" and from the "Outside Waters" during all open "Gulf Seasons."

15 pounds of any size whole shrimp may be taken by any legal means from "Major Bays" during the "Spring Open Season."

3. **SPECIAL PROVISIONS** – It is unlawful to buy or sell shrimp taken for personal use.

Commercial shrimping hours apply to individuals shrimping for personal use.

Inside Waters – Commercial Bait-Shrimp Boats.

1. **LEGAL MEANS OF TAKING** – Only one trawl not to exceed 25 feet in width and one try net not to exceed 5 feet in width are permitted. The trawl may not have a mesh size smaller than 5 stretched meshes in 6 1/2 inches.

2. **CATCH LIMIT** – No more than 150 pounds of any size whole shrimp per day may be taken or possessed on board. At least 50% of the on-board catch must be kept in a live condition and all shrimp on board must have heads attached.

3. **SPECIAL PROVISIONS** – Except in the Laguna Madre, shrimping is not permitted between sunset and sunrise during the "Fall Open Season."

Selling or unloading shrimp from a "Commercial Bait-Shrimp Boat" is not permitted except to a licensed "Bait Shrimp Dealer" or to a sport fisherman operating a boat in the "Inside Waters."

Inside Waters – Commercial Bay Shrimp Boats

1. **LEGAL MEANS OF TAKING, "SPRING OPEN SEASON"** – Only one trawl not to exceed 25 feet in width and one try net are permitted. The trawl may not have a mesh size smaller than 5 stretched meshes in 6 1/2 inches.

2. **LEGAL MEANS OF TAKING, "FALL OPEN SEASON"** – Only one trawl not to exceed 65 feet in width and one try net not to exceed 12 feet in width are permitted. The trawl may not have a mesh size smaller than 5 stretched meshes in 8 3/4 inches.

3. **CATCH LIMITS, "SPRING OPEN SEASON"** – No more than 300 pounds of any size whole shrimp per day may be taken or possessed on board. Shrimp may be taken from "Major Bays" only.

4. **CATCH LIMITS, "FALL OPEN SEASON"** – Catch and possession limits are not restricted.

5. **SPECIAL PROVISIONS** – Shrimp may be taken during the period beginning thirty (30) minutes before sunrise and ending thirty (30) minutes after sunset.

Outside Waters – Commercial Gulf Shrimp Boats.

1. **LEGAL MEANS OF TAKING** – There are no restrictions on the number or size of trawls for use in "Outside Waters" except trawls must have a mesh size no smaller than 5 stretched meshes in 8 3/4 inches and try nets may not exceed 12 feet in width. When taking white shrimp during the summer closed season and when taking seabobs during the winter closed season inside the seven fathom limit certain trawl restrictions apply as specified under the heading "Seasons" in the "Gulf Seasons" section.

2. **CATCH LIMITS, OPEN "GULF SEASONS"** – Catch and possession limits are not restricted.

Regulations

1. All widths specified for commercial trawls and try

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nets shall be measured along the corkline or headrope from hanging to hanging.

2. Mesh sizes specified for commercial trawls for use in "Inside Waters" apply to the trawl, bag and trawl liner.

3. It is unlawful to head shrimp aboard a boat in inside waters, or to dump same, except in artificial passes, canals, or basins.

4. Fresh shrimp may be held in possession only through open seasons and 5 days thereafter except that bait dealers and sport fishermen may have same throughout the year.

5. It is unlawful to shrimp in any pass leading from the inside waters to the outside waters of the state.

6. For further information, please contact your local game warden or the Parks and Wildlife Department.

Appendix C. References Cited

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Appendix D. Glossary

Brown Shrimp: *Penaeus aztecus*

This species is found in commercial quantities throughout the five-State region. The peak of the brown shrimp harvest occurs during the summer.

Catch and Effort Statistics

Data describing catches of commercially important species by location of capture, size or age composition of catch, quantity captured by particular gear or vessel type, and time expended fishing. This information can be obtained by a "trip" or "weigh out" ticket which accompanies the sale of fish. (See CPUE)

CPUE: Catch Per Unit of Effort

The catch of fish, in numbers or in weight, taken by a defined unit of fishing effort.

Fishery

One or more stocks of fish which can be treated as a unit for purposes of conservation and management and which are identified on the basis of geographical, scientific, technical, recreational and economic characteristics; and any fishing for such stocks.

Fishery Conservation Zone

A zone contiguous to the territorial sea of the United States. The inner boundary of the fishery conservation zone is a line coterminous with the seaward boundary of each of the coastal States, and the other boundary of such zone is a line drawn in such a manner that each point on it is 200 nautical miles from the baseline from which the territorial sea is measured.

GMFMC: Gulf of Mexico Fishery Management Council

Consists of the States of Texas, Louisiana, Mississippi, Alabama and Florida and has authority over the fisheries in the Gulf of Mexico seaward of such States.

GS-FFMB: The Gulf State-Federal Fisheries Management Board

This Board was set up through the auspices of the Gulf States Marine Fisheries Commission to coordinate and manage (at the pleasure of the Gulf States) the marine fisheries in the Gulf of Mexico in the territorial seas.

GSMFC: The Gulf States Marine Fisheries Commission

This Commission was set up as a result of an interstate compact and is presently composed of all the Gulf States. The purpose of the Commission is to promote the better utilization of marine fisheries through the development of joint programs.

Hymenopenaeus robustus

See royal red shrimp

Mortality Rates

Mortality rates can be considered generally as two types. The first of these is natural mortality, and it can be used to describe all deaths except fishing. The second is fishing mortality, and this refers to all deaths caused by fishing.

NMFS: The National Marine Fisheries Service

The Federal agency devoted to dealing with marine fisheries problems; NMFS is a component of the National Oceanic and Atmospheric Administration (NOAA) within the United States Department of Commerce.

Nursery Area (Shrimp)

Inshore estuarine and marsh areas containing suitable habitat for growth and protection of postlarval and juvenile shrimp.

Optimum Yield

That part of a fishery that will provide "the greatest overall benefit to the Nation, with particular reference to food production and recreational opportunities—". In other words, a variety of economic, social and ecological factors are taken into account as well as biological factors.

Parent-progeny Relationship

Sometimes known as the spawner-recruitment relationship, this refers to the quantitative relationship between abundance of mature spawning adults and the number of individuals entering the harvestable stock.

Penaeus aztecus

See brown shrimp.

Penaeus duorarum

See pink shrimp.

Penaeus setiferus

See white shrimp.

Pink Shrimp: *Penaeus duorarum*

This shrimp is of commercial significance primarily in Florida. Many pink shrimp reach commercial size during the late fall and are utilized. The spring pink shrimp fishery (April–June) is dependent on overwintering survivors.

Population Dynamics

A discipline which attempts to describe and quantify basic population characteristics such as growth and mortality rates of the population rather than the individual. Also, particular emphasis is placed upon the study of the reaction of populations to perturbations, such as commercial or recreational fishing.

Recruitment Patterns (Shrimp)

This can refer to entry of postlarval and juvenile shrimp to nursery grounds in estuaries. However, it can also refer to entry of subadult shrimp into commercial fishing grounds such as bays and sounds or near shore waters. Because the regional shrimp plan applies to the entire shrimp system, both definitions are used where appropriate.

Rock Shrimp: *Sicyonia* spp.

Shrimp caught almost exclusively in the Florida fishery.

Roe Shrimp

All large white shrimp found during the spring are commonly referred to as roe shrimp. Technically, however, the term refers only to gravid (egg bearing) females found during this time.

Royal Red Shrimp: *Hymenopenaeus robustus*

A deep water shrimp which shows a potential for increased commercial importance in the future.

Salinity

High, medium and low salinity values depend on averages for an area. They may vary considerably from one area to another as, for example, between coastal marshes in Louisiana and south Texas.

Seabob: *Xiphopenaeus kroyeri*

A small shrimp caught almost exclusively in the Louisiana fishery.

***Sicyonia* spp.**

See rock shrimp.

Spawner-Recruit Relationship

See parent-progeny relationship.

S-FFMP: State-Federal Fisheries Management Program

This program within NMFS is a cooperative, inter-governmental approach to fisheries management. It establishes a partnership between one or more States and the Federal Government for the development, implementation and administration of fishery management plans with inputs from user groups.

Staging Ground

Open water areas of large bays or sounds where juvenile and adult shrimp congregate prior to migrating offshore.

Strategy

The process of deciding on objectives, or changes in

these objectives, on the resources used to attain these objectives and on the policies that are to govern the acquisition, use and disposition of the resources. This term describes a type of planning program of a broad nature which gives overall direction to the organization. The emphasis is on the pattern of basic objectives and goals and the major policies and plans for achieving them. The purpose of strategies is to determine and communicate, through a system of major objectives and policies, a picture of what kind of program is envisioned. It is not an attempt to outline how the program is to be detailed. It is a framework to guide the management authority for program development.

Strategic Planning

Involves services to be provided, basic ways to effect these services, timing and sequence of major steps, targets to be met, and must be flexible to accept changes for improvement. It will essentially consist of a systematic arrangement of inputs, with outputs being policies which could be used to develop regulations, programs and guidelines, and also used to solve identified problems. The management authority can further develop the outputs more specifically as more data are obtained and entered as inputs.

Tactical

Involving actions or means to accomplish an end. Relates to the planning and execution of small-scale actions as part of a larger purpose, and is made or carried out with only a limited or immediate end in view. (Sometimes called short-range planning, or operational planning.)

***Trachypenaeus* spp.**

Small shrimps of minor importance in the commercial fishery. A generally used common name is not available.

White Shrimp: *Penaeus setiferus*

This species is found in the five-State region. White shrimp are caught mainly during late fall and early winter.

Xiphopenaeus kroyeri

See seabob.

Yield-Per-Recruit Analysis

Mathematical techniques to determine the proper size of capture of a species given known growth, natural mortality and fishing mortality rates.

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