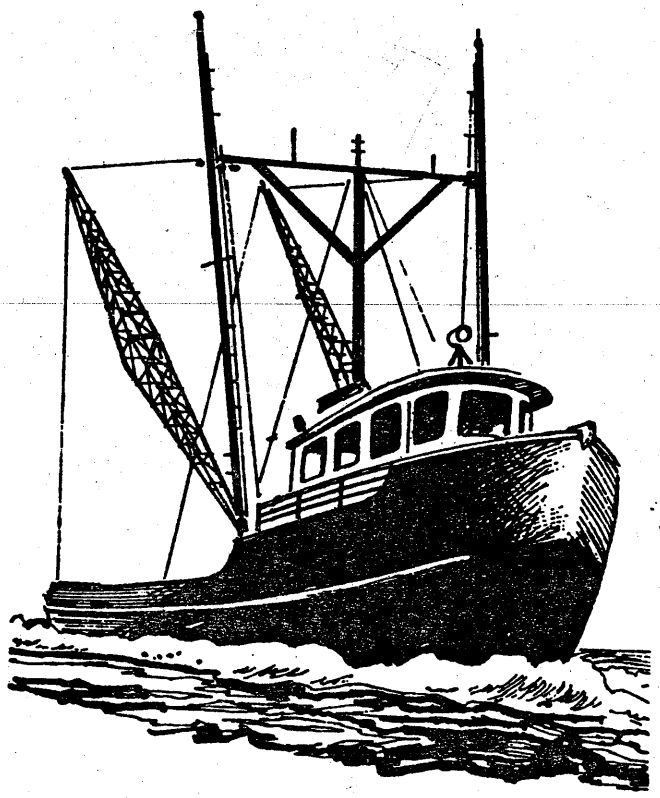
Office Copy

# A Management Plan

For

# Mississippi's Marine Fisheries



Charles H. Lyles, Director

MISSISSIPPI MARINE CONSERVATION COMMISSION

1201 East Bayview Avenue

Biloxi, Mississippi

JUNE, 1976

One of the most frequent criticisms concerning management and wise utilization of the marine fisheries of the U. S. is that no document exists which sets forth direction of fishery policy, strategy to be employed in managing the fishery, goals and priorities of research, and funding required to achieve these objectives. This document purports to do this for the state of Mississippi. Since organizational structure of the agency charged with management responsibilities is a vital link in the management system, that subject is also dealt with in some depth.

File No. _____

# MISSISSIPPI MARINE CONSERVATION COMMISSION

1201 EAST BAYVIEW BILOXI, MISS. 39530

PHONE 432-8769



To: The Governor, Members of the Legislature and Members of the Marine Conservation Commission

Subject: "A Management Plan for Mississippi's Marine Fisheries"

Transmitted herewith is a plan for management of Mississippi's marine fisheries. This state has not previously had the benefit of such a document. While the preparation of this document was my work, it has been reviewed by persons with education and experience in fisheries management at a state, national and international level. Their comments have been included in the final report. Problem areas are identified and research programs are suggested to solve specific problems. Priorities are placed on needed research, since there will never be sufficient funds for all needed projects.

This Commission has had little help or cooperation in pragmatic research. I have been Director of this organization for 28 months and the only overture I have had regarding help in such research as would solve management problems came from Dr. David Veal of the Sea Grant Advisory Service. The only other funds available to this Commission for research comes from a Federal grant under PL 88-309 amounting to $110,000. Almost all of this is required in a monitoring and assessment program which is vitally important in establishing opening season dates on certain species.

Fisheries management is a complicated science, as complicated as space technology and in some ways more expensive. The number of variables with which the fishery scientist must deal is perhaps greater than those of another scientist. Funds available for solution to these problems have been extremely limited.

To manage fisheries intelligently, there are some broad basic requirements. These are:

1. Adequate implementing legislation.
2. A strategy document.
3. A data base.
4. Adequate funding.
5. Adequate staffing.

The Mississippi Marine Conservation Commission has only one of these requirements and that is a strategy document or management plan. No data base for management exists. The implementing legislation is not workable. There is inadequate funding and staffing and no table of organization can be drawn since the implementing legislation is vague in establishing lines of authority and delegating responsibilities.

The Marine Conservation Commission is the second most important agency in the state, the Department of Agriculture being, in my opinion, first in importance. More than 5,000 jobs in the coastal counties of this state are dependent on a sustaining yield of the marine fisheries and these resources contribute approximately $70 million annually to the economy of this state and the nation. The sea must play an important role in supplying the needs of a hungry world and in providing employment and recreation. This can only be done through intelligent, scientific management of these resources. Failure to recognize and act on this is a derelict of duty.

Very truly yours,

Charles H. Lyles,
Director

CHL:gb

MISSISSIPPI MARINE CONSERVATION COMMISSION
1201 East Bayview Avenue
Biloxi, MS 39530


CHARLES H. LYLES
Director

The author wishes to express appreciation to Mr. William H. Stevenson, Regional Director and the staff of National Marine Fisheries Service, Southeast Region, including biological personnel, to Mr. Jim Cagle and Charles Roithmayr of the Pascagoula Laboratory and Mr. Tom Vanselous, NASA Test Facility, Bay St. Louis, for special assistance in preparation of the document; to Dr. Joe Angelovic and staff of the Galveston Laboratory; Mr. Wayne Swingle, Director of the Marine Division, Alabama Department of Conservation; Mr. Ed Joyce, Florida Department of Natural Resources; Mr. Terrance Leary, Texas Parks and Wildlife; Dr. Robert Edwards, Director, Woods Hole Laboratory, National Marine Fisheries Service; and Mr. Benard E. Skud, Director, International North Pacific Halibut Commission for their critical and helpful review of the manuscript.

The statistical tables are the courtesy of National Marine Fisheries Service for whose help in preparation I am indebted to Miss Thelma Bell and Mr. Don Fitzgibbons of that agency.

Fishing gear sketches are from publications of the Bureau of Commercial Fisheries.

The typing and proof-reading was done by Mrs. Gail Byrd and Mrs. Patricia Daughdrill. The errors are mine.

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# SUMMARY OF REQUIREMENTS

I. Overall--Highest Priority.

1. Basic catch and effort statistics in both commercial and recreational fishery.

2. Basic stock assessment--sometimes called monitoring and assessment.

3. Environmental data--temperature, salinity, $O_2$ content, etc. Cost will be about $145,000.

4. Additional office space to provide adequate privacy.

Monitoring and assessment program is being presently supported by PL 88-309 funds. An additional $45,000 will be needed for statistics program. Both programs will be on an annual recurring basis.

II. Net Fishery--For Coastal Species.

1. Life history, stock identification and predation interrelationship for the following species: (1) Spotted sea trout, (2) Red drum (redfish), (3) White trout, and (4) Flounder.

This is a one-time job. It will not recur and the cost will be approximately $175,000.

III. The Menhaden Fishery.

1. A statistical system is in operation as a result of action by this commission. Reports are received twice monthly and are on file in this office. The method of calculating the catch per unit of effort is questionable. This should be reviewed in order to determine accuracy. Increased stock assessment is needed but must be coordinated with work being done by National Marine Fisheries Service. No increase in funds is recommended for this fishery.

A problem solving mechanism must be established within the Mississippi Marine Conservation Commission for resolving conflicts relative to this fishery. This is provided for in the overall plan.

IV. The Shrimp Fishery.

1. An in-depth economic study of the Mississippi-Alabama shrimp fishery designed to identify economic problem areas and suggest possible solutions.

2. Limited entry legislation.

3. Research designed to identify the factors that control migratory patterns of shrimp in Mississippi Sound. This is necessary to determine length of time these animals remain in the Sound once they leave the bays. Experiment should include determination of approximate quantities that enter the Mississippi Sound from Louisiana marshes.

V. The Crab Fishery.

The fishery only requires cautious monitoring. No further research of high priority seems needed at present.

VI. The Oyster Fishery.

1. Mississippi has an abundance of oysters, perhaps enough to supply all her needs. However, the most productive areas are closed. Samples taken in the summers of 1965 and 1966 indicate that approximately 125,000 barrels of oysters can be removed from these closed areas annually without damage to the reefs. An efficient method of moving oysters has now been washed out so that one vessel can move almost 3,000 barrels per week. Therefore, a separate division should be established in the Marine Conservation Commission under the supervision of an individual immediately reponsible to the Director. The present "Barge" and "Conservationist" should be used to transfer oysters from closed areas to open areas. The cost is $1.47 per barrel at present. In order to compensate for this the taxes on oysters should be increased to partially pay for the operation. Such a will doubtless reduce the enforcement load now present.

2. Study to determine whether or not suitable areas exist in Mississippi Sound for building new oyster reefs. If such areas can be found, reefs should be established there.

VII. The Pet Food Fishery.

Since National Marine Fisheries Service is presently studying the fishery very little work is recommended. Resource assessment work in Mississippi Sound is coordinated with National Marine Fisheries Service, other than a review board meeting periodically, to include all scientific personnel involved in the fishery, the industry and recreational interests, to review data and make recommendations. No further action is needed at present.

No funding is recommended at this time.

VIII. The Red Snapper-Grouper Fishery.

1. Biology of the species taken to determine:
   (a) Growth rates
   (b) Reproductive cycle
   (c) Stock identification

Cost will be approximately $45,000.

IX. Recreational Fishing.

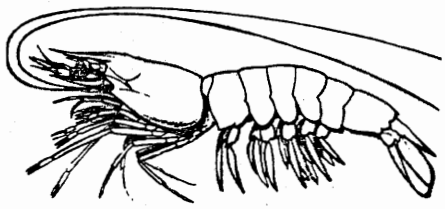
1. Biology of important species (covered under net fishery costs).
2. A marine sport fishing license.
3. An advisory board of recreational interests to assist in developing programs.
4. Advertise recreational possibilities through pamphlets and circulars.

Cost will be approximately $15,000 annually.

X. Implementing Legislation.

The legislature is composed of some very fine attorneys and some very dedicated men but there are no fishery experts among their number. There are few good attorneys among the fishery administrators. Consequently, to write meaningful fishery legislation there is a need to have the legislator and the fishery administrator sit down together with each supplying his particular skill in framing the needed meaningful legislation.

Each has a skill the other should use if quality legislation is to be achieved. All of the implementing legislation governing the commission must be rewritten if the state is to have an organization for administering its marine fisheries. No organization exists at present.



# INTRODUCTION

Evaluation of fish, fisheries and fishing must be based on man's needs and his environment. At the beginning of written history there were fewer people on this planet than reside in New York today. A hundred years ago world population was 1.4 billion and today there are almost 4 billion human beings residing on this planet. Such rapid population growth has placed a severe strain on food production, environmental conditions and recreational facilities. Millions of hungry and starving individuals present a menace to the stability of all governments and should trouble the conscience of all men. Wise utilization of our fishery resources demands that we manage for a sustaining yield in order to meet this world food crisis. We cannot afford to do otherwise. Mississippi can no longer hide its head in the sands of inaction and lethargy. Nothing less than positive action will suffice.

Mississippi occupies a favorable position with regard to its marine fishery resources. With the shortest coastline of any of the five Gulf states, it has achieved the number two position among the five Gulf states and sixth position in the entire nation in production of fish and shellfish. While there have been year to year fluctuations in landings, the demand for fishery products produced in this state has continued steadily upward over the past three decades. However, some serious problems are beginning to surface and the need to give these matters immediate attention makes preparation of this document imperative. The goal of this management plan must be to assure this state and the nation that the flow of high quality protein from these waters will continue to be assured and that the 5,000 jobs thus created in the coastal counties through utilization of these resources is safeguarded. Furthermore, that recreational optimization is fully achieved through carefully planned and scientifically oriented management.

The coastal counties are the fastest growing areas in Mississippi as far as population is concerned. This influx of people will doubtless cause severe strain on the environment which in turn may affect the stability of fish populations and in turn the food and recreation of thousands of people. Careful and thoughtful planning to maintain quality environmental conditions as well as allowable harvests will be necessary to insure that food and recreation resources from the sea are sustained at a high level. This document has as its main objective a planning strategy in each fishery to insure a sustaining yield for each of the species harvested. Since the State of Mississippi has historically given no thought to scientific management of its fisheries, this document is somewhat limited in scope. It has, as its basic design, the beginning of charting a course. It does, however, address itself very clearly to the basics in fish management. A review of the strategy in two to three years is a necessity.

The case for fisheries management rests on the knowledge that when animal populations are exploited by man, they compensate for this increased mortality by increasing their survival and growth rates. Most marine fish and shellfish possess a tremendous resilience; that is, man may remove large quantities yet not impair the capacity of the resource to reproduce itself. But beyond a certain point, the reproductive success is affected and additional harvests result in a reduction in future abundance. A primary goal of fishery research is to determine the level of fishing effort that produces an optimum catch, and to formulate methods to maintain this balance.

The determination of optimum catch limits involves not only the biological knowledge of the resource, but also includes economic, statistical and sociological considerations.

Basic data requirements for a fishery management system are the total numbers removed by fishing and by natural causes, rates of growth, environmental factors (habitat, food and life support), and fishing effort expended in making the catch. Without definite knowledge of these data, effective fishery management cannot be instituted.

## PUBLIC POLICY FOR FISHERY MANAGEMENT

The public policy of the State of Mississippi is to provide for the protection, propagation and conservation of its living marine resources. Living marine resources provide major economic, social and aesthetic values to the state and its people, and are a renewable asset that is the property of the state until legally acquired through individual or corporate effort. The state shall provide legislation and an organizational entity to manage and control this resource for the benefit of all the people. All marine fish, shellfish, mollusks and marine mammals existing or living in the territorial waters of the State of Mississippi shall be and will remain the property of the state until title thereto shall be legally divested in such manner as may be authorized and approved by statute, rules or regulations established by the legislature or the Mississippi Marine Conservation Commission.

## FISHERY MANAGEMENT OBJECTIVES

This document consists of a series of small fishery plans (a plan for each fishery), which drawn together, constitutes the overall strategy for managing the marine fishery resources of the state. It is, therefore, referred to as "The Fishery Management Plan". It has as its objective the optimization of these resources; that is, providing a sustaining supply of fishery products for food and industrial purposes, a climate conducive to full employment in harvesting and wise utilization of these resources and full optimization of recreational facilities. Where conflicts exist in harvesting segments a mechanism must be established to minimize these conflicts before they damage the economic life of the community and the state.

Through implementation of this policy, the state can be assured of continued optimization of its living marine resources, and the citizens of Mississippi shall have a continued return from their asset through increased food supply, employment, revenue and recreational pursuits. Over a period of time the benefits will far surpass the initial investment.

## MEANS OF OBTAINING OBJECTIVES IN THE MANAGEMENT OF MISSISSIPPI'S MARINE FISHERIES

*Develop and maintain a data base of statistical, biological, economic and sociological information to identify and substantiate state positions relative to the protection, propagation and conservation of its living marine resources.

*Identify and implement the activities required to provide for viable recreational and commercial fisheries in the state.

*Establish and implement regulations and enforcement mechanisms to insure wise utilization of the state's living marine resources and to provide a satisfactory environment for the resources' continued viability.

## RATIONALE FOR FISHERY MANAGEMENT

Since 1954, the annual catch rate of commercial fisheries of Mississippi

has fluctuated from a low of 116.7 million pounds in 1954 to a high of 397.0 million pounds in 1971 (fig. 1). Data are unavailable for the recreational catch. While there has been some rather severe fluctuations in certain species, the overall trend has been steadily upward. Causes of some of these fluctuations is not known. The fluctuations have caused severe economic hardship within some segments of the coastal communities and the inability to fully explain these fluctuations is a constant embarrassment to this agency.

While we as managers can do little or nothing about the quantity of larval or post larval offsprings produced by nature each year, we can, through organized scientific managment, create an environment and provide sufficient breeding stock to assure continued viability of the resource. Without effective management the stocks may be overfished and ultimately become depleted, at least in commercial quantities.

To develop an equitable management plan, it is necessary to determine the annual yield or productivity of the fish stocks and to determine how much yield is necessary or desirable. Yield means the portion of the fish populations available to commercial and recreational fishermen plus the renewable breeding stock required to sustain the population over a given time span. Research to determine the annual yield is necessary to identify the amount of stock that can be harvested and still leave a sufficient breeding reserve. Knowledge of the annual yield of living marine resources is just as important for fisheries management as determining tree growth is in forestry, measuring crop production in agriculture, or knowledge of turnover in business. Without the capability for scientific assessment of the resource, rational management is not possible, and without management, the protection and wise use of Mississippi's marine resources is impossible.

The Mississippi Marine Conservation Commission must have the data necessary for management purposes if the state's fishery resources are to be conserved and wisely utilized for the good of all its citizens. When these data are available, we can allocate to each user group, when and if allocation becomes necessary, an amount consistent with their needs and safely reserve the necessary breeding stock. For example, the commercial fishermen may be permitted to take their allocation with the most efficient gear consistent with sound conservation principles, in the shortest possible time; then, if necessary, cease fishing or move to another species or location. While at the same time the recreational fisherman's daily needs can be prorated or adjusted to the limits of the fishery stock. Such a management program would insure wise utilization of the people's resources and assure their continued availability.

This document was developed to serve as a tool for management of Mississippi's living marine resources. The management program is intended to provide the greatest resource utilization by the largest number of people, to improve the quality of life for Mississippi residents, and to serve the economic good of the state.

The building block of any management system--a data base (statistics)--is discussed on the following pages, followed by the identification of basic requirements for each of the proposed fisheries and species to be managed. Organization and plan implementation are discussed in the concluding pages.

## STATISTICS

The foundation of any management system is an adequate and sound data base. Large corporations insulate themselves against poor decisions by developing adequate data management systems and employing trained personnel

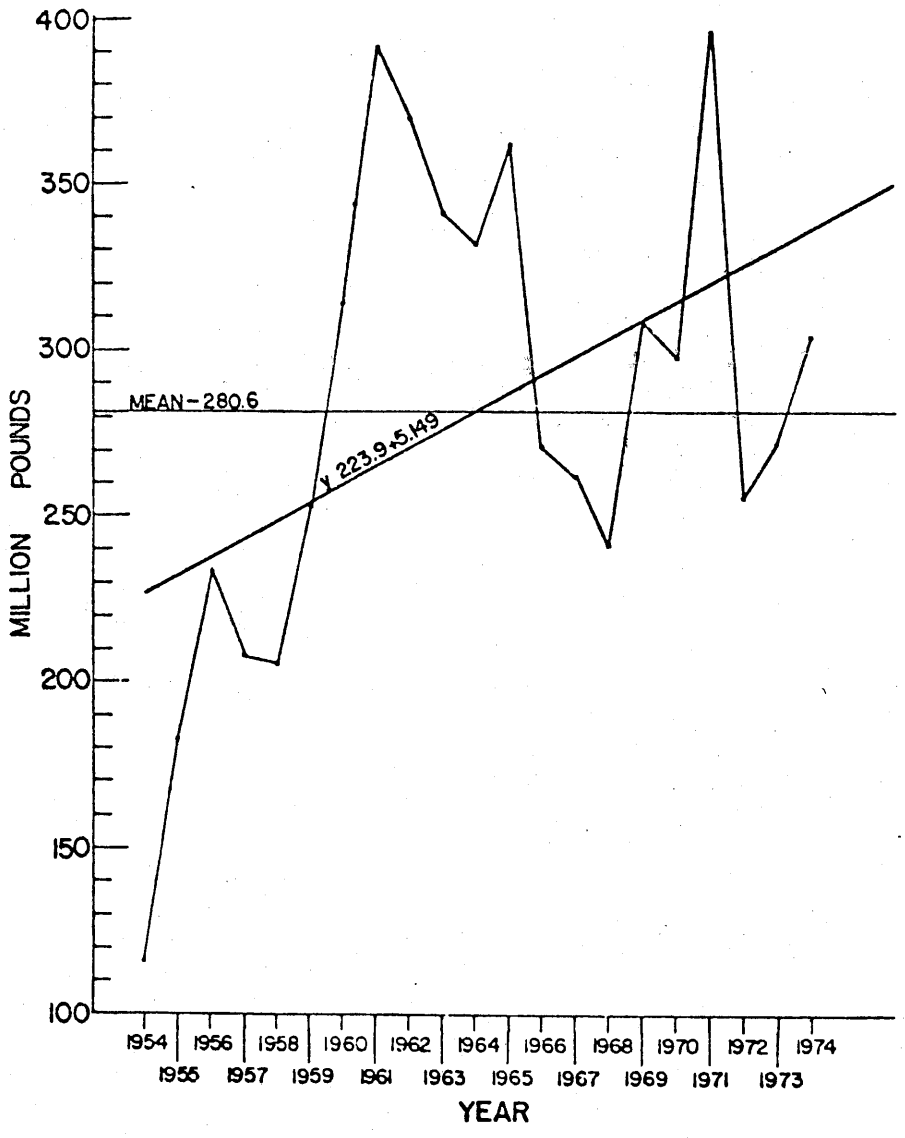



Figure 1

Landings of Fish and Shellfish at Mississippi Ports, 1954-1974
With Calculated Mean and Trend Lines

to interpret the data. Whether it is a corporation engaged in the production of oil or building automobiles, vast amounts of data are required and must be carefully analyzed to insure that management makes decisions that are in the best interest of the stockholder and the general public. Fisheries management is no less important and its data requirements are greater and infinitely more complicated than that required by most corporations. Because numerous natural phenomena plus man-induced occurrences affect the resources being managed, there is need for catch and effort data, biological data on life histories of the fishes, environmental data (such as salinity and temperature) over the ranges of the animal, and data on the effect of the environmental and habitat changes. There must also be a data base on sociological and economic factors in each fishery. The data must be tested in accordance with accepted methods, and evaluations completed prior to decision-making. The following quotation by a well known fishery management biologist emphasizes this. Dr. George A. Rounsefell in his testbook, Fishery Science, says, "Modern research is no longer haphazard groping. It is orderly production of knowledge by subjection of measurable entities to quantitive statistical analysis. Unless you understand the use of statistical methods, you cannot adequately evaluate the complex relationships that may exist between the various factors in the problem."

A basic statistical system involving catch, economic value, area of capture, size of the animal and the effort required to make the catch is the first requirement of a data base for a fishery management system. This is often referred to by fishery scientists as "catch statistics". This system must be established prior to any other kind of research project. For example, when pounds and value of any harvested species is known, it serves as a guide for allocating funds and establishing priorities, since there will never be sufficient funds for all the research requirements. Within the basic data of a statistical system is the information to determine whether or not a species is being overfished. In severe or emergency situations the necessary information to close off an area to heavy fishing pressure can be determined from data on the area of capture and effort. On the other hand, it can aid in opening up an area to more intense fishing when effort data so indicates, thus permitting greater harvest and income to the state from use of these resources. Since a resource not fully utilized is wasted, a good statistical program is of the highest priority. If funding for this cannot be obtained, there is no need for a conservation commission and it would be my strong recommendation that the commission be abolished and all enforcement and research activities in marine fish cease for the simple reason that without the first requirement of a management system we are wasting the taxpayer's money and the time of people. Without an adequate data base any fishery management program is impossible.

The following is a listing of some of the elements in a data base (statistical and biological) required to manage a fishery.

EXAMPLES OF THE KNOWLEDGE REQUIRED TO MANAGE A FISHERY

Basic catch statistics: reported by species.

Total catch and value: Economic conditions often control fishing and fishing effort and are an important factor in evaluating the condition of the fishery. Thus, the need for value of the catch. Total volume by species of both recreational and commercial fishing is essential in order to guage the biological matter being withdrawn.

Catch by area: Among the many reasons why area of capture is important is that the area in which the fish are taken may be the area in which they spawn, resulting in possible damage to the spawning stock. Fishermen may be required to move to other areas during spawning season if it appears the population is being damaged by fishing. It is one of the basic requirements in setting regulations.

Size of fish taken: Data on length, weight, sex and sexual development must be recorded; a sample is sufficient. When the size of fish harvested gets smaller each year, it may be a sign of overfishing.

Numbers of fishermen and quantity of gear: Numbers of boats or vessels and quantity of gear for both sport and commercial and numbers of fishermen are required. Normally termed the "operating units", this gives some indication of how to make allocations where controversy arises. Furthermore, it is an index of the importance of the operation to the local economy.

Food habits: We must know what each species feeds on at each season of the year. Knowledge of predation interrelationship is necessary.

Catch per unit of effort: While effort is difficult to define in precise mathematical formula, it generally means the quantity of fish, in pounds, caught in a given number of hours or number of days of fishing in a given time period, usually one month, twelve months of the year. Several years of data are needed before beginning to treat the data biometrically. It must be related to size of fish harvested.

Size of fish at maturity: Often, because of heavy fishing pressure, it is necessary to allow the maximum number of fish to spawn at least once. This is true when it has been established that a relationship exists between numbers of the spawners and the resulting population. If this is the case, then a size limit of the animal must be imposed that is large enough to allow the maximum number of fish spawn at least once.

Spawning season: Often times fish congregate in the spawning areas during spawning season. Maximum protection may be necessary in these areas during spawning if the population appears to be damaged by overfishing. It may be necessary to close an area during the spawning season.

Spawning areas: Knowledge of the spawning areas is important as it may be necessary to close these areas during spawning season. This is particularly true if fish congregate there in large numbers, and are vulnerable to harvest during the spawning period.

Nursery grounds: This is a term used to describe the area where small fish feed and grow, and it may be, and often is, necessary to close these areas permanently. Identification of the areas is most important.

Water temperature and salinity: These and other environmental factors affect movement, food supply and survival. The data are necessary when evaluating year class data.

Year class size and survival: Constant assessment and monitoring gives some indication of the extent of survival of each year class and what to expect in the way of management requirements for the next year. It is through this means that an index of abundance of the animal is developed.

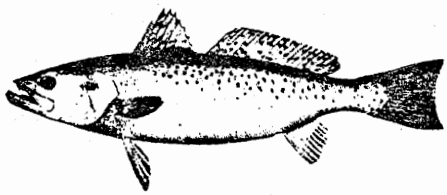
Stock identification: It is necessary to know whether or not more than one stock of fish exists within a fishery. For example, in the spotted sea trout fishery in Mississippi we need to know whether the fish that make up the total population are comprised of three stocks, one off Pascagoula, one off Biloxi and one off Bay St. Louis, or whether the population is a single stock. Management decisions rest on this type of information.

Economic data: Ills in a fishery are quite often related to earning capacity. To properly identify these factors and to suggest enlightened legislation, periodic economic studies should be made of each fishery along with comparisons in other states. Some of the more important economic data needed are:

1. Fuel costs--gallons used and cost
2. Ice--tons and cost
3. Food--cost
4. Vessel repairs--cost (including engine replacement)
5. Haul outs--number and cost
6. Nets, including doors and towing warps--number and cost
7. Investment in equipment
8. Interest, taxes, etc.
9. Vessel cost and monthly mortgage payments--bait and lures in both sport and commercial
10. Sociological data such as kinds of persons participating in the harvest (part time, full time, etc.)

A fleet sample scientifically designed to accomodate all classes of operating units is sufficient.

Table 1, which follows, lists the status of knowledge for management purposes of fishery data of Mississippi fisheries. The table is not intended as a statement of what is needed before any management is possible. It serves as a guide to the paucity of information available, and certainly implies that a beginning must be made now. While it is true that some of the research has been done in other states, that does not satisfy the needs in Mississippi because there are interrelations in conditions here that must be dealt with on a local basis. The table serves as a guide to where we are so that we may clearly state where we are going and how we intend to get there.



SEA TROUT OR WEAKFISH, SPOTTED

Table 1
STATUS OF KNOWLEDGE FOR MANAGEMENT OF
MISSISSIPPI FISHERIES

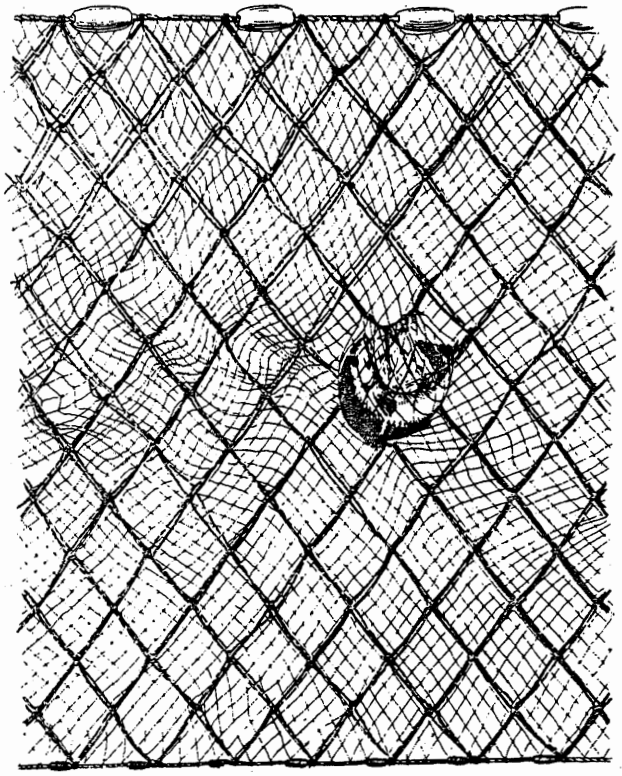
| Identifying No. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FISH: | | | | | | | | | | | | | | | |
| Blackfish | I | N | I | N | I | I | I | N | N | I | N | N | | I | N |
| Bluefish | I | I | N | N | N | N | N | N | N | N | N | N | | I | N |
| Croaker | I | I | I | A | A | I | I | I | I | I | N | I | | I | N |
| Drum: | | | | | | | | | | | | | | | |
| Black | I | N | I | I | N | I | I | A | N | N | N | N | | I | N |
| Red | I | N | I | I | N | I | I | I | N | N | N | N | | I | N |
| Flounder | I | N | I | I | N | I | I | I | N | N | N | N | | I | N |
| Grouper | I | N | I | N | N | N | I | I | N | N | N | N | | I | N |
| King whiting | I | N | I | I | I | I | I | I | N | N | N | N | | I | N |
| Lemonfish | I | N | I | N | I | I | N | N | I | I | I | N | | I | N |
| Mackerel: | | | | | | | | | | | | | | | |
| King | I | N | I | N | N | N | I | N | N | N | N | N | | I | N |
| Spanish | I | N | I | N | N | N | I | N | N | N | N | N | | I | N |
| Menhaden | A | I | A | A | A | A | A | A | N | I | I | A | | A | N |
| Mullet | I | N | N | N | N | A | I | I | N | N | N | N | | I | N |
| Pompano | I | N | I | N | I | I | N | N | I | I | N | N | | I | N |
| Sea trout: | | | | | | | | | | | | | | | |
| Spotted | I | N | N | N | N | I | I | I | N | N | N | N | | I | N |
| White | I | N | N | N | N | I | I | I | N | N | N | N | | I | N |
| Sharks | I | N | I | N | N | I | N | N | N | I | I | N | | I | N |
| Sheepshead | I | N | N | N | N | N | I | I | N | N | N | N | | I | N |
| Snapper, red | I | N | N | N | N | N | I | N | N | N | N | N | | I | N |
| Overall | I | I | I | I | N | I | I | I | N | N | N | I | I | I | N |
| SHELLFISH: | | | | | | | | | | | | | | | |
| Crabs, blue | I | I | A | A | A | A | A | A | N | I | A | A | | I | N |
| Shrimp: | | | | | | | | | | | | | | | |
| Brown | I | I | A | I | A | I | I | A | N | I | I | I | | I | N |
| Pink | I | I | A | I | A | I | I | A | N | I | I | I | | I | N |
| White | I | I | A | I | A | I | I | A | N | I | I | I | | I | N |
| Oysters | I | - | - | - | - | - | A | I | - | - | - | - | | - | - |
| Overall | I | I | A | A | A | A | A | A | N | I | A | I | | I | N |

A = Adequate
I = Inadequate
N = None
- = Not applicable

1. Catch statistics--sport and commercial.
2. Effort data.
3. Area of capture.
4. Size of fish in commercial and sport catch.
5. Spawning area.
6. Spawning season.
7. Spawning size.
8. Nursery grounds.
9. Growth rates.
10. Year class survival--monitoring and assessment.
11. Food habits--stomach analysis.
12. Stock identification--tagging program.
13. Relationship of spawners to resulting population.
14. Temperature & salinity data over sound & bays.
15. Economic data base.

## TRAMMEL NET

This type of fishing gear has three panels of netting which are suspended from a common cork line and attached to a single bottom or lead line. The two outside webs or walls of netting are of a larger mesh than the inside webbing. The inside net has a greater depth and hangs loosely between the outer panels of webbing. A fish striking from either side passes through the large-mesh outer webbing and hits the small-mesh netting, which is carried through one of the openings of the other large-mesh webbing, forming a sack or pocket in which the fish is entrapped. A trammel net is usually fished by drifting or fastened to poles.

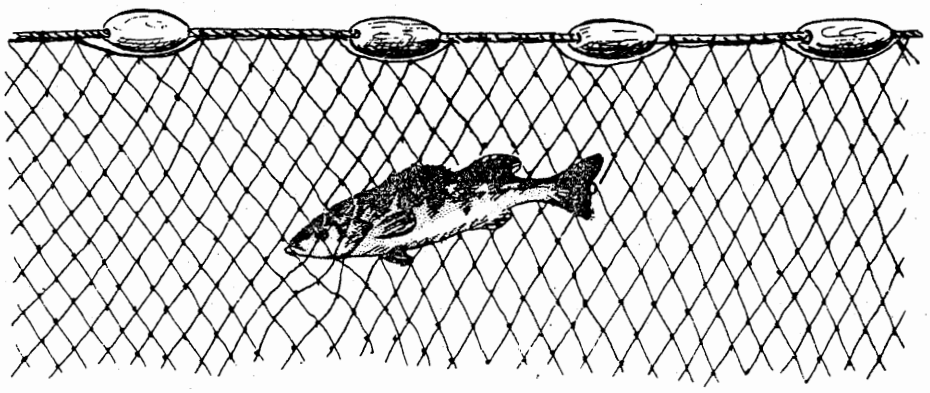


Trammel net

Figure 2

## GILL NET

A gill net is an upright fence of netting in which the fish are caught in the meshes of the net. Fish, of a size for which the net is designed, swimming into the net can pass only part way through a single mesh. When it struggles to free itself, the twine slips back of the gill cover and prevents the fish from escaping. The fish is thus "gilled" and can neither go forward nor back. Various sizes of mesh are used depending on the species and size of the fish to be caught. Gill nets can be suspended at the surface, in midwater, or close to the bottom by controlling the number of buoy lines and the size and number of floats on the top or cork line and weights on the lead line. The net may be operated as stationary or movable gear.



Gill net

Figure 3

## THE MISSISSIPPI NET FISHERY
## (For Coastal Species)

Mississippi has a relatively small net fishery (215 gill and trammel nets in 1975) operating in the territorial waters of this state and in areas of Louisiana open to net fishing. The principal species taken in this fishery are black and red drum, spotted and white sea trout, Spanish mackerel and mullet. The commercial value of the catch at ex-vessel level is about $160,000 annually (table 2, 3 and 4). The value to the nation's economy is about 1.2 million dollars. Some of the nets are used for owners home use while others are used to harvest for market purpose. The Mississippi Marine Conservation Commission has not designated a commercial license apart from those that fish for home use. The commission's implementing legislation is so vague that enforcement of the net regulations would be difficult if the law were challenged. The nets are, like those used in other states and throughout the world, of synthetic material, many of them monofilament gill nets. They are believed to be very efficient fish harvesting gear which has led to considerable controversy in recent years over the use of monofilament webbing. Accusations have been made that the nets are "too efficient" in that they catch too many fish. Furthermore, in some areas the charge has been made that the nets are set and left untended which results in harvesting fish that are lost through spoilage and predation by other marine organisms. Recreational fishermen also charge that commercial netters set their nets around the area being fished by recreational interests, making it impossible to catch fish.

The net fishery for littoral species has, like most fisheries, undergone phenomenal changes since World War II. Webbing used in most fish nets at that time was natural fibers and was subject to rapid deterioration resulting from rot and wear. It was also heavy when wet, which made fish harvesting very difficult and tiresome. The development of synthetic fibers resulted in longer lasting and more efficient nets. It also meant more webbing could be handled by fewer fishermen. In Mississippi the gill nets are monofilament of 3 3/8 to 3 1/2 inches stretched mesh and are about 1200 to 1800 feet in length and from 65 to 100 meshes deep. The present cost of the nets is about $1.00 per foot.

The boats used in this fishery generally are about 24 to 48 feet in length with the majority in the 30 to 38 feet range. Some are equipped with a flying bridge which permits stationing a man in a position to serve as a look-out for schools of fish. The operation is similar to the menhaden operation of a quarter of a century back. When the fishermen are seeking spotted sea trout, they fish mostly in the daytime. However, when fishing for Spanish mackerel they will fish both day and night but the principal fishery takes place in dark nights. The mackerel are located principally by their actions at the surface stirring up phosphorescent light in the water. They are also located in daylight hours by the action of sea gulls feeding on smaller fish driven to the surface by mackerel feeding on them.

When the fisherman arrives at a selected place where he anticipates making a catch, the net is paid out from the stern of the boat. If the net is being set on a school of fish which has been sighted, the usual procedure is to surround the school, fasten the ends of the net together and haul in so that the fish, compressed into a small area, gill themselves. When paying out the net, one end is anchored while circling the school. On completing the encircle-

ment the fisherman returns to the same end to tie the two together before beginning to haul in. In this way the fisherman is able to completely encircle the school and make the maximum catch. Sets of this type generally occur on a falling tide when the fish have a tendency to back away from the beach and school up.

The Spanish mackerel season usually runs from late April to early November while the spotted sea trout fishery is principally carried on from November to February. The boats carry anywhere from 600 pounds to a ton of ice, depending on the size of the boat and the length of the trip and time of year. The sets made along the beach in a hook-like fashion are generally made in the winter since in warmer months there is a tendency to circle the school, gill the fish and haul them in quickly since nets are left for extended periods of time offer the possibility of some of the catch spoiling before being removed.

A controversy rages continuously among sport and commercial fishermen because of competition near the Barrier Islands. The commercial fishermen charge the sport fishermen with running through their nets with motorboats which become entangled and, of course, tear and do considerable damage to the webbing. On the other hand, the sport fishermen charge that commercial fishermen will, in many instances, completely encircle them with a set so that there is no possibility of getting out except going through the nets. It is competition for the resource in its rawest form. Efforts must be made to get the two groups together.

There are two types of nets operated in this fishery--the trammel net and the gill net. A trammel net is a device in which there is a center web of rather small mesh with larger mesh on either side. The three sets of webbing are hung from a single cork line and are attached to a single lead line. The fish are caught when they come in contact with the small mesh and attempt to push their way through the larger mesh, creating a pocket-type situation in which the fish are entrapped (see figure 2 ). The small mesh in the trammel net is about three inches, stretched. This fishery has not changed, materially, in the past twenty-five years.

The fishery is operated by the use of a carrier boat, generally ranging up to about 30 to 40 feet and two net skiffs about 14 to 16 feet in length. On reaching the fishing grounds and when a school of fish is sighted, the net is paid out from the skiffs in such a manner that the fish are encircled. Generally, the trammel nets are operated in the same fashion as the gill nets; that is, they have a tendency either to circle a school of fish which they have sighted or they set from the beach in a hook-shaped manner. Fishing is carried on in the same months and in the same manner as with the gill net fishery. The trammel net fishery, at the present time, is concentrated in the Orange Beach--Pecan and in Pass Christian--Bay St. Louis areas and by a relatively few fishermen. One of the problems in this fishery is that the taking of mullet is restricted to the use of gill and trammel nets. A more efficient method would be to permit certain sizes of purse seines to take mullet. Thus the cost of harvesting would be less and the fishermen could probably market the catch at a profit, whereas they encounter difficulty at present, using trammel and gill nets. The time required to make a set on mullet, haul in the net and to remove the fish from either the gill nets or trammel nets, makes the operation extremely costly and time-consuming. Not only has the quality of the fish deteriorated, but the fishermen cannot produce enough of these fish to make the operation profitable. What is needed in this fishery is sufficient research to indicate what stocks will bear in the way of harvesting each year and permit a more efficient gear to be utilized by the

commercial fishermen so that they can earn a living in this fishery. The mullet is an excellent table fish and more of them should be harvested. The outlawing of purse seines, for example, in the taking of food fish is another way of trying to promote conservation through legislating in favor of inefficient harvesting methods. This not only places the commercial fishermen in a lower grade of our society, but prevents full utilization of our resources. It is an example of the most ignorant mismanagement of our renewable resources. I can think of no other operation in government regulations in which the emphasis is placed on the requirement for inefficient harvesting methods rather than in promoting efficiency and in conserving and fully utilizing the resources.

Regulation of the net fishery for littoral species by the Mississippi Marine Conservation Commission has historically not been formulated from a data base. Those regulations now in effect are largely the result of emotional appeals and convenient accomodations. This Commission just does not have the data base to (1) determine what regulations are necessary, (2) formulate these regulations, (3) verify the accuracy intended of the regulation, (4) or the implementing legislation necessary to carry out a net fishery regulation. The charges against netting is based in part on fact and part on a total ignorance of the principles of sound fishery management. Nets are left untended and it is said they continue to fish, even though the catch is not regularly removed. This is a valid complaint. Any resource that is not harvested is wasted and by the same method of evaluation, a resource that is harvested and destroyed without use is also waste. The latter is perhaps the worst misuse. The charge that monofilament is too efficient and is, therefore, damaging the stocks is hardly a valid argument. The objective of fishery management should be to establish, through research, the quantity of any species that may be removed without damaging the population and permit the commercial harvester to harvest with the most efficient gear. When he has removed the tonnage quota, shut him down or require that he move to another species or location. Recreational fishermen, on the other hand, should be given a daily allowance or catch limit consistent with their needs and should be permitted to fish the entire year. The stocks must be maintained at a sustainable yield.

Life history, migratory pattern and food habits are important areas for high priority research on the species prosecuted in the net fishery.

The Mississippi Marine Conservation Commission prohibits setting nets within 1500 feet of a pier, harbor entrance or in the bays and rivers emptying into Mississippi Sound. There is no data base to justify keeping a netter 1500 feet from a pier. It is simply a sociological regulation designed to keep resource competitors separated. It may be justified, however, on the basis of keeping resource users separated. On the other hand, the closure at the mouth of bays and bayous could have some biological management significance, provided there is a data base to support and justify its enactment and prove its effectiveness.

The fish taken in the littoral net fishery are almost all used in Mississippi since the production is hardly adequate to supply the needs of the local population. Further curtailment will doubtless eliminate this fishery since the fishermen hardly earn a livelihood under present arrangements.

The species sought by the net fishermen are some of the ones sought by recreational fishermen, thus causing some of the most heated controversies. Since fishing is basically an emotional issue, very serious problems arise and in the charged atmosphere equitable solutions are difficult, if not impossible. The fishery administrator is often forced into taking sides in the argument, which in many instances render him useless. Under conditions

of this kind both sides lose. Since the fish are the property of all the people it is mandatory that the manager or administrator find equitable solutions, not just solutions. If he, for example, submits to pressure to close off an area or a species to fishing for any purpose without justification to sustain the fish population, then he is as guilty of a crime of robbing an individual of his income as though he had held a gun to the man's back and robbed him of his earnings. True, there is a difference in the degree of sophistication--but the net result is the same--the loser has been deprived of his earnings. This controversy has been going far too long with little being done to educate either group. If this fire is left untended, it can destroy the fishing industry through unfounded accusations and a valuable resource will be wasted each year.

Successful management must anticipate user conflicts and must develop equitable dispute settlement mechanisms which require rigorous but fair enforcement. Penalties must be sufficiently stiff to discourage violations.

Fishery conflicts are caused by a basic animal behavioral instinct, aggressive self-assertion for complete territorial and tribal control, rather than mutual beneficial cooperation and compromise. Each must recognize the other has a right to exist, if solutions are to be equated.

Problems of the fishery are: (1) Lack of a data base on the fishery and species harvested on which to formulate regulations or to verify their effectiveness once they are enacted. This includes catch statistics as well as life histories, migratory pattern, stock identification, environmental data, food habits and monitoring and assessment of each year class. (2) Controversy between sport and commercial fishermen relative to ownership of the stocks of fish. (3) Lack of meaningful data on the economic wealth generated by the various user groups.

Suggested solution: (1) Obtain data base including biological and statistical research on species harvested by this gear. Life history stock identification and food habits of spotted sea trout, red fish and Spanish mackerel in Mississippi are critical and of very high priority. Catch and effort statistics must be obtained and should include: 1. catch and value of commercial catch by species, 2. area of capture, 3. effort-- (a) size of net, (b) number of sets, (c) time net is fishing, (d) mesh size, 4. catch of recreational fishermen, area caught and time spent fishing, 5. catch and effort data on net catches made primarily for home use. (2) Develop economic data on wealth generated by each user group to aid in allocation of resource if allocation becomes necessary. (3) Communicate with recreational and commercial fishermen the principles of management and what benefits accrue. Bring both groups together for eyeball meeting to discuss the mutual problem of fish shortage.

How the plan works for this fishery: Establish an advisory board in this fishery composed of the following members: 1. Director, MMCC, 2. Four commercial netters, 3. Four recreational fishermen, 4. Two persons representing the consumers (this may be from the public at large and must not be a commercial or recreational fisherman but may be a restaurant operator).

The board meets periodically to review catch and effort data, monitoring and assessment reports and to make recommendations to Mississippi Marine Conservation Commission relative to action to be taken in this fishery.

Table 2
COMMERCIAL LANDINGS OF TRAMMEL NET-CAUGHT FISH
Mississippi, 1960-1972
(Various Years)

| Species | 1960 Pounds | 1960 Value | 1970 Pounds | 1970 Value | 1972 Pounds | 1972 Value |
|---|---|---|---|---|---|---|
| Bluefish | 2,800 | $ 280 | 900 | $ 73 | 2,000 | $ 200 |
| Crevalle | 600 | 36 | | | | |
| Croaker | 400 | 22 | 1,200 | 170 | 2,100 | 288 |
| Drum: black | 13,900 | 835 | 19,800 | 1,217 | 4,900 | 291 |
| red | 36,800 | 5,521 | 43,600 | 6,421 | 12,800 | 1,912 |
| Flounders, unclassified | | | | | 100 | 8 |
| King whiting or "kingfish" | 200 | 12 | 400 | 24 | 500 | 40 |
| Mullet, black (lisa) | 392,300 | 19,775 | 153,900 | 8,736 | 91,200 | 5,367 |
| Pompano | 300 | 75 | | | | |
| Sea Catfish | 2,000 | 100 | | | 300 | 14 |
| Sea trout or weakfish: | | | | | | |
| spotted | 102,800 | 25,700 | 165,900 | 41,030 | 61,400 | 16,016 |
| white | | | 500 | 75 | 2,000 | 160 |
| Sheepshead, saltwater | 45,800 | 3,668 | 23,800 | 1,924 | 12,500 | 996 |
| Spanish mackerel | | | 600 | 60 | 6,000 | 720 |
| Tripletail (blackfish) | 300 | 30 | | | | |
| Spot | | | 1,800 | 119 | | |
| TOTALS | 598,200 | $56,054 | 412,400 | $59,849 | 195,800 | $26,012 |

Sea Trout

Table 3
COMMERCIAL LANDINGS OF GILL NET-CAUGHT FISH
(Anchor, Set or Stake)
Mississippi, 1960-1972
(Various Years)

| Species | 1960 Pounds | 1960 Value | 1970 Pounds | 1970 Value | 1972 Pounds | 1972 Value |
|---|---|---|---|---|---|---|
| Bluefish | | | 3,500 | $ 390 | 11,700 | $ 1,190 |
| Croaker | | | 47,000 | 8,800 | 67,500 | 10,278 |
| Drum: black | | | 4,900 | 350 | 16,300 | 1,038 |
| red | | | 3,300 | 495 | 8,500 | 1,275 |
| Spanish mackerel | | | 41,000 | 4,920 | 472,900 | 56,248 |
| Mullet, black (lisa) | | | 1,000 | 70 | 10,700 | 642 |
| Sea trout: spotted | | | 21,000 | 5,700 | 113,500 | 30,550 |
| white | | | 1,400 | 198 | 63,500 | 5,810 |
| Sheepshead, saltwater | | | 2,100 | 198 | 8,500 | 680 |
| TOTALS | | | 125,200 | $21,121 | 773,100 | $107,711 |

Red Drum

Table 4
COMMERCIAL LANDINGS OF GILL NET CAUGHT FISH (RUNAROUND)
Mississippi, 1960-1972
(Various Years)

| Species | 1960 | | 1970 | | 1972 | |
|---|---|---|---|---|---|---|
| | Pounds | Value | Pounds | Value | Pounds | Value |
| Bluefish | 1,000 | $ 100 | | $ | | $ |
| Croaker | | | | | 1,800 | 158 |
| Sea trout or weakfish: | | | | | | |
| spotted | 8,000 | 2,000 | 67,900 | 16,517 | 77,200 | 20,794 |
| white | | | | | 1,200 | 112 |
| Spanish mackerel | 7,500 | 750 | | | | |
| Drum: black | | | 1,400 | 84 | 1,000 | 57 |
| red | | | 3,200 | 438 | 17,500 | 2,602 |
| Mullet, black (lisa) | | | 7,000 | 350 | 59,100 | 3,546 |
| Sheepshead, saltwater | | | 1,900 | 152 | 6,200 | 496 |
| Pompano | | | | | 600 | 375 |
| TOTALS | 16,500 | $2,850 | 81,400 | $17,541 | 164,600 | $28,140 |

Bluefish

## THE MISSISSIPPI MENHADEN FISHERY

The menhaden fishery is one of the oldest fisheries in the United States, having been established on Long Island, New York, before the Civil War. It spread to New Jersey, Chesapeake Bay, North and South Carolina and Florida's east coast where it continues to prosper today. It is, however, a comparatively newcomer to Mississippi having been established in Jackson County in 1939. Wallace M. Quinn built the first plant for producing fish meal and oil from menhaden on the west bank of the Pascagoula River just north of the present highway 90 bridge. The plant was subsequently relocated on Sioux Bayou where it remained until it closed. Other plants were later established in the Moss Point area. The business thrived so well that the Moss Point-Pascagoula area has, for more than a decade, been among the nation's leading fishery ports in both volume and value. Menhaden accounts for a majority of the volume and value. A healthy business climate in Jackson County and a stable resource contributed much to the growth of this important industry.

Menhaden constitute about 40 per cent of the total of all fish and shellfish landings in the U. S., about 79 per cent of the total landed in the Gulf states, and 71 per cent of all landings in Mississippi (Fisheries of the U. S., 1974, National Marine Fisheries Service).

The fishery in Mississippi is supported largely by a single species--Brevoortia patronus (Goode). The life history of this species has been fairly well worked out in Mississippi. Data thus far collected indicates that adult menhaden spawn offshore south of Horn Island (Christmas and Waller, 1975). Suttkus assumed spawning began in October and ceased in February (Early Life History of the Gulf Menhaden, Brevoortia patronus, in Louisiana, Royal D. Suttkus, 1956). Small fish move inshore to bays and river systems where the salinity is much reduced. In that environment they feed and grow and by fall are moving offshore to winter in the deep water. These fish re-enter the coastal waters the following spring to feed and grow. They pass into the sound in enormous, thickly packed schools that lend themselves to an efficient mass production harvesting method known as "purse seining".

Once in the sound the schools migrate, usually in some pattern indicative of being subjected to forces not yet fully understood. For example, in some years the fish seem to congregate in the eastern end of Mississippi Sound while in other years they are more to the west. With the advent of cooler weather in October these fish, now sexually mature, move through the passes and offshore to deeper water where spawning takes place. The fishery, for the most part, is made up of one and two year old fish, although there is a small mixture of other year classes in each year's harvest. The greatest part of the Mississippi catch is taken in low salinity water in Mississippi Sound, Chandeleur and Breton Sound. Very little catch is made south of Horn Island. National Marine Fisheries Service data show that of a total of two billion pounds landed in the U. S. in 1974, 1.8 billion or 90 per cent was taken within three miles of the shoreline. The size of the fish taken in Mississippi waters varies but the average is about ¼ pound each.

Fishing in Mississippi begins in April and extends to the second Tuesday in October, but the seasons and the volume harvested seems to be governed more by the weather and economic conditions that by legislation. (Statute 49-15-15)

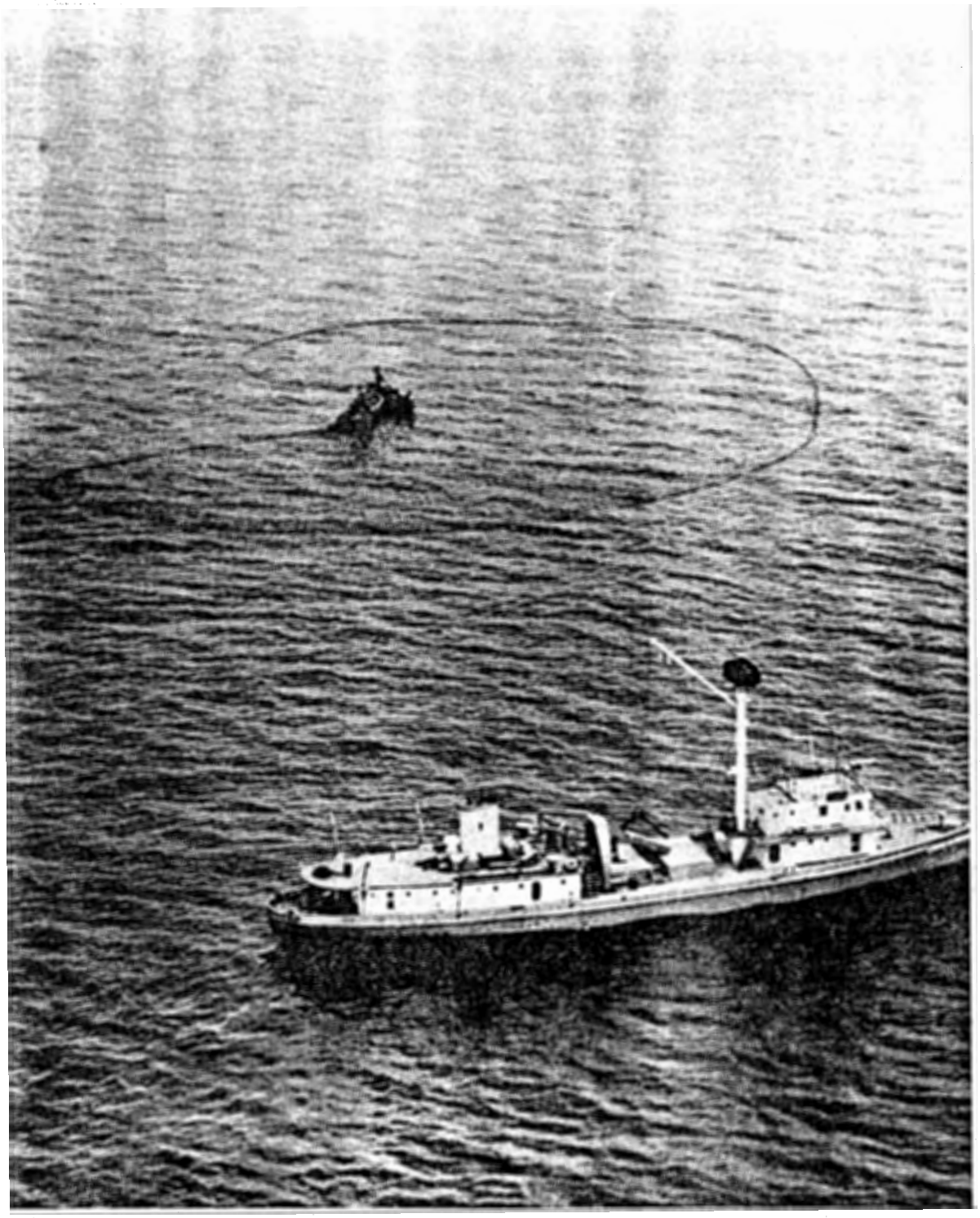


Figure 4

Note the carrier vessel in the foreground. Purse boats beyond have surrounded a school of menhaden. Note the concentration of fish to the lower right of the purse boats.

Photo courtesy of
Zapata-Haynie

meal without reducing operating costs. Since the fishery consists of one and two year old fish the danger of overfishing the resource is very real and could be very damaging to the economy of this state. There is constant pressure to further reduce the area of operation by outlawing purse seines near the shoreline or to outlaw them entirely forcing the menhaden industry out of Mississippi. The menhaden companies have failed to mount a good public relations program which would show the importance of this industry to the welfare of the public in general and specifically to the aged and those of lower income. While menhaden fishing has not been proven to damage other fisheries they have failed to convince the public of this fact. There is much ignorance and enormous prejudice concerning menhaden fishing which must be overcome. There is an emotionally charged atmosphere surrounding this fishery which makes enlightened decision making very difficult.

The controversy over menhaden fishing and the accusations that large quantities of other fish are taken are not new. It has raged for almost a hundred years by recorded history and if the accusation were true menhaden would have already been overfished and the fleet would doubtless have destroyed most of the other species sought by other fishermen. The controversy is largely engendered by the uninformed and reduced to its simplest form is in reality an emotional issue. Scientists who have worked on the biology of the animal see no real menace in a well regulated menhaden fishery. To the contrary, there are many capable scientists who believe that harvesting menhaden is an asset to the environment for this reason; fish that are not harvested are wasted since they die and their fertility sinks to the ocean bottom. The harvesting of menhaden returns much of the fertility to the farm where, after it has been used for animal food, what remains leaches again to the estuary and provides fertility at the base of the food chain. Since the menhaden is a plankton feeder, obtaining its food at the base of the food chain, it takes the plankton thus produced from leachings of fertile soil and returns it to animal protein, again to be recycled through the system, simultaneously providing needed protein for man.

However, to deal with the contention that other fishes are taken by purse seines set on menhaden, let us examine what occurs in other fisheries and what competent scientists have found. Although we know that predators are quite often near or in schooling fish, comparatively few are ever taken. This not only holds true for menhaden but also, for example, in Alaska herring (the menhaden is related to the herrings). Salmon surely prey on herring but purse seining for herring results in the capture of almost no salmon. Dr. George A. Rounsefell tells me that in years of biological work on Alaska herring he has never seen a salmon taken in the herring purse seines, and even though these predators are nearby they somehow do not get caught in these nets (personal communication with Dr. Rounsefell).

J. L. Baughman, Director of the Marine Laboratory of the Texas Game, Fish and Oyster Commission made rather extensive studies of this problem in Texas in 1949. Mr. Baughman assigned Mr. J. P. Breuer to observe the menhaden vessel, "H. C. Dashiell", for a period of 62 days beginning June 14 and ending August 14, during which time he remained with the vessel during all its fishing operations. Mr. Breuer noted that the vessel made 59 sets during this period and took 2.5 million menhaden. During the same period they took 2,174 other fish of which 1,500 or 69 per cent were herring-like fishes and could not be classed as so-called game fish (table five). You will note that all of the fish other than menhaden amount to far less than one per cent of the catch (see table 5). Gunter, Christmas, and Whatley made a study of fishes taken in the menhaden fishery of Alabama, Mississippi and eastern Louisiana. The work covered the 1958-1959 seasons. Christmas et al found

that in numbers of fish more than 97 per cent of the sampled catch were menhaden. The following ten species, given in order of their abundance, made up over 90 per cent of the other fishes caught: Mugil cephalus, Micropogon undulatus, Leiostomus xanthurus, Dorosoma petenense, Bagre marina, Arius felis, Cynoscion arenarius, Poronotus triacanthus, Cynoscion nothus, and Lagodon rhomboides. From the data collected Gunter and Christmas estimate that about 15 million pounds of fish of all species other than menhaden are taken in the purse seines. Though the figure appears large to the average man, one must keep in mind that it has been estimated rather reliably by scientists that the catch of other fish by shrimp trawlers in the process of catching shrimp is somewhere between 750 million and 1.2 billion pounds each year. Almost all of this is discarded at sea. Has this affected recreational fishing? To answer this, we know that removal of large volumes of fish by shrimpers may be beneficial or deleterious or both. We just don't know and the data base to answer these questions just does not exist. Some of the methods of determining the status of a stock of fish is the volume of the catch, the effort expended, and the size of individual fish harvested. When the volume remains stable and the average size landed is no smaller the chance of overfishing is reduced. Hardly a year goes by but that records of both total pounds of fish taken and the size of individual species are broken at local fish rodeos. As long as records are broken, it is doubtful that the population is being overfished.

Retracing our steps in history to near the end of the 19th century we find that Dr. Hugh M. Smith, that distinguished scientist who headed the United States Fish Commission in 1896, was concerned over the then clamor that purse seines took other fish and might thereby damage other fisheries. Accordingly, he dispatched capable scientists to observe the catches of these vessels and report their findings to the commission. The following is taken from the Bulletin, U. S. Bureau of Fisheries 15:297: "The observations of this commission's agents proved that, as a general thing, not enough desirable food fish are taken by the menhaden steamers to keep the vessel's crews regularly supplied with fresh fish". While this generally gives a pretty good picture from the last century to date and should put to rest any fears that exist, one should not take the word of others. Any good biological library will contain extensive bibliographies on the subject and one may read for himself the findings of the scientists who have worked on this species and published reports. That is the best source of information and permits the individual to examine facts and evaluate for himself.

It is interesting to note that the controversy has been raised and continued by persons without professional fishery training or experience and by those who generally need a whipping boy to support an otherwise defenceless position. As far as I know, no scientist who has worked on the menhaden fishery has come up with an indictment of the industry. Furthermore, those who foster and continue the controversy refuse to go aboard menhaden vessels or visit the vessels unloading at the processing plants to see first hand what catches are made.

There is really little need for controversy between sport and commercial fishermen in any well regulated fishery. What is really sought in all fisheries is an optimum or maximum sustained yield. This should, but may not, always provide the greatest good for the greatest number of people. To insure that all fisheries in Mississippi are maintained at their highest level, there is a desperate need for catch and effort data on sport, commercial, and on subsistence fishing. There are no complete data on sport catches in Mississippi and effort and area of capture data for commercial species of finfish is either non-existent or woefully inadequate and is desperately needed to insure that

the fishery is carefully watched. Menhaden, on the other hand, is the one fishery where size and age of fish as well as effort data are available.

There is no way that restricting menhaden fishing will aid in better recreational fishing. Biological data such as spawning areas, spawning time, size of fish at first spawn, are needed on all of our littoral fishes for adequate management and to provide information which will aid the recreational fishermen to make better catches and to manage for a sustained yield. Monthly data on area of capture and effort along with water temperature, salinity and a program for systematically monitoring the year class survival will aid in improving all fishing. Fishing is excellent on the Mississippi Gulf Coast and data can be obtained which clearly shows this. It can be used to advertise Mississippi's bountiful recreational resources and to increase recreational fishing success, a factor which could improve the economy of the area. It could do much to reduce the friction between sport and commercial fishermen. Accusations that large quantities of other fish are taken by menhaden purse seines are fostered by a comparatively few but they have been remarkably successful in getting a large part of the population to believe them.

A little known fact but of immense importance is that menhaden processing companies do not want other species of fish since the economy of the industry is based on the yield of meal (about 18 per cent of the weight of raw fish) and oil. The processing of non-oily fish results in a financial loss to the company. Therefore, fishes other than menhaden are avoided. Furthermore, the machinery is constructed to move a specific size and species; namely, menhaden, and other species just do not move through the processing easily.

Finally, there is the question of whether or not menhaden form the basis of food for other fishes in the area. Certainly many fishes are carnivorous and will not only feed on other fishes that are present in the area but will also devour their own fellows when opportunity presents itself. However, to be preyed upon the two animals must meet at the right place and at the right time. John Pearson first observed the food of the spotted sea trout (Cynoscion nebulosus) and redfish (Sciaenops ocellata) while studying the life history and conservation of these fishes in Texas during 1926-1927. There was no menhaden fishery in Texas at that time so that the population of these fish could have been at the highest level possible, consistent with environmental conditions since the population had not been reduced by fishing pressure. Pearson found the following in his Texas study:

A. Food Habits of the Redfish (red drum)

1. The food of the redfish along the Texas coast is made up primarily of crustaceans such as shrimp and crabs. The commercial shrimp (Penaeus) appeared to be the favorite food. The common blue crab (Callinectes), when small or in molting condition, ranks second in abundance.

2. Fish are eaten to some extent with the mullet, gobies, and Menidia species showing in the greatest abundance among the food fragments.

3. Curious incidental food is at times found in the stomachs of this species. These include a marsh rat, squid, and annelid worms.

B. Food Habits of the Spotted Trout (Cynoscion nebulosus)

1. The food of the spotted trout, which ranged in size from 3-24 inches, is composed largely of various species of marine shrimp and fish.

2. Of the fish examined for stomach contents, 61 per cent had been feeding on shrimp exclusively (usually penaeus), 24 per cent had eaten fish, one per cent crabs, and 14 per cent mixed organisms. The mixed food usually was composed of shrimp and fish.

3. The various species of fish captured and consumed by the spotted trout include principally the juvenile of croaker, spot and mullet, besides the young adult Menidia and anchovia. Small grass dwelling fishes such as gobies are also eaten.

Another study was made by Dr. Gordon Gunter, then a biologist with the Texas Game and Fish Commission. This research covered the years 1941-1942. Dr. Gunter's findings were as follows:

A. Food Habits of the Redfish

1. Crustaceans were found to be the most important food items. The blue crab was found most often in the stomach of the redfish, followed closely by peneid shrimp. Other crustaceans eaten by redfish include such organisms as grass shrimp, mud crabs, amphipods and snapping shrimp.

2. Gunter found the more numerous occurrences of fish in redfish stomachs as follows: mullet, gobies, minnows, pipefish, anchovies, catfish, spots, and tongue fish.

B. Food Habits of the Spotted Sea Trout--Gunter found the following:

1. During warmer months the food of the spotted trout was found to be largely shrimp. During the winter months when shrimp were scarce, fish was the more important food item, followed by shrimp. Mullet was found to have been the fish most frequently eaten. However, such fish as silversides, minnow, menhaden, pinfish, and pigfish were found in lesser quantities.

Neither of these published scientific studies show menhaden as a major forage fish. Pearson's work, however, makes no mention of menhaden as a food item (Pearson was an extremely keen and observant scientist and had he noted menhaden as food for these fish it doubtless would have been mentioned). Both these studies were conducted at a time when no menhaden fishing occurred in Texas so there was no external pressure to obtain any specific answer. Thus the reports must be considered of the highest academic quality.

In 1948-49, Mr. J. S. Baughman, Director, Marine Laboratory, Texas Game, Fish and Oyster Commission, Rockport, Texas, directed the efforts of a group of scientists who examined stomachs from fish taken by beach seine, charter boats, hook and line-caught littoral fishes, and from fish passing through Cedar Bayou to and from the gulf. These scientists examined the stomachs from 26,005 fish of which more than half were spotted sea trout, 3,137 redfish, 3,428 Spanish mackerel, 2,237 king mackerel, 26 sailfish, 28 jacks, and 3,861 other fish. A total of only 581 menhaden were found in the stomachs of the 26,000 samples taken. This amounts to about 2.15 per cent by numbers. On the other hand, 67 per cent of the littoral species had eaten shrimp, a fact already known to sport fishermen since they prefer live shrimp as bait. Mr. Kemp, one of the researchers working under Baughman, found that menhaden constituted 5.5 per cent of the food of king mackerel. However, he also noted that squid made up 35.7 per cent of their diet and he concluded that squid was the preferred diet of the king mackerel.

This brief summary of the literature brings out some of the facts about menhaden fishing and other fish populations, and that menhaden is a valuable renewable resource that should be fully utilized. However, it is suggested that those who would know the truth visit any good marine library and there read first hand of the work of men who have made a systematic study of this species and the fishery to get the truth concerning the problem.

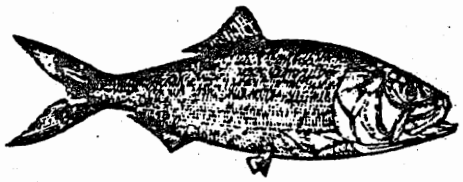
Problems in the menhaden fishery:

1. Review of effort data and if present effort data not adequate, determine the type of effort data necessary to evaluate the effect of fishing on stocks of fish. Highest priority.
2. Controversy between recreational and menhaden interests. Solution must be found. Very critical and high priority.
3. Positive stock identification.
4. Limited entry legislation--highest priority.
5. Improve resource assessment.

The plan:

Objective--to maintain maximum sustainable yield in terms of volume.

Formation of advisory group consisting of one member from each of the menhaden companies, two recreational fishermen and one consumer. The Director of the Mississippi Marine Conservation Commission will be the chairman and voting member. This advisory group will meet once each year to review the status of the fishery and recommend action in the form of regulation or additional research. The recommendation to be forwarded to the Mississippi Marine Conservation Commission for its action.



Menhaden

Table 5
A COMPARISON OF THE NUMBERS OF FISH TAKEN IN MENHADEN PURSE SEINES AND THOSE TAKEN BY SHRIMP TRAWLS 1/

| | "H. C. Dashiell" | Shrimp Trawls | Along Waterfront |
|---|---|---|---|
| Fishing Time | June 14-Aug. 14 or 62 days | 313 hrs. extended over a period of 2 yrs. | Oct. 1-31 (209 fishermen) |
| No. shrimp hauls | | 313 (1 hr. ea.) | |
| No. seine hauls | 59 | | |
| No. menhaden taken | 2,500,000 | 4,415 | - |
| Fish taken other than menhaden: | | | |
| BLOWFISH | | | |
| Spheroides spp. | 2 | 242 | - |
| BLUEFISH | | | |
| Pomatomus saltatrix | 42 | 0 | - |
| CRABS | 26 | - | - |
| CROAKERS | | | |
| Micropogon undulatus | 39 | 64,903 | - |
| DRUM | | | |
| Pogonias cromis | 3 | 0 | 54 |
| FLOUNDER | | | |
| Paralichthys spp. | 7 | 227 | 16 |
| GAFF-TOPSAIL | | | |
| Bagre marina | 3 | 1,431 | 14 |
| HARDHEAD CATFISH | | | |
| Galeichthys felis | 3 | 4,717 | - |
| HARVEST FISH | | | |
| Paprilus paru | 117 | 19 | - |
| HERRING-LIKE FISH* | 1,500 | - | - |
| POMPANO | | | |
| Trachinotus carolinus | 8 | 20 | 3 |
| REDFISH | | | |
| Sciaenops ocellatus | 1 | 0 | 734 |
| RIBBONFISH | | | |
| Trachiurus lepturus | 72 | 3,623 | - |
| SAND TROUT | | | |
| Cynoscion nothus and | | | |
| Cynoscion arenarius | 77 | 8,706 | 7 |
| SHARKS | 63 | - | 3 |
| SHRIMP | | | |
| Penaeus spp. | 34 | - | - |
| SPANISH MACKEREL | | | |
| Scombermorus maculatus | 107 | 21 | - |
| SPOTS | | | |
| Leiostomus xanthurus | 50 | 2,604 | - |
| SPECKLED TROUT | | | |
| Cynoscion nebulosus | 2 | 816 | 3,420 (25%-35% less than 12 in.) |

cont.

| | "H. C. Dashiell" | Shrimp Trawls | Along Waterfront |
|---|---|---|---|
| STING RAYS | 13 | 56 | - |
| TARPON | | | |
| Tarpon atlanticus | 5 | 0 | - |
| SQUID | 1 | - | - |
| WHITING | | | |
| Menticirrhus spp. | 7 | 1,278 | - |
| SPADEFISH | | | |
| Chaetodipterus faber | 0 | 223 | - |
| SHEEPSHEAD | | | |
| Archosargus probatocephalus | 0 | 3 | 0 |
| JACKFISH | | | |
| Caranx hippos | 0 | 48 | - |
| FRINGED FLOUNDER | | | |
| Etropus crossotus | 0 | 1,191 | - |
| WHIFF | | | |
| Citharichthys spilopterus | 0 | 801 | - |
| HOG CHOKER & STRIPED SOLE | | | |
| Achiurus faber & Archiurus lineatus | 0 | 2,639 | - |

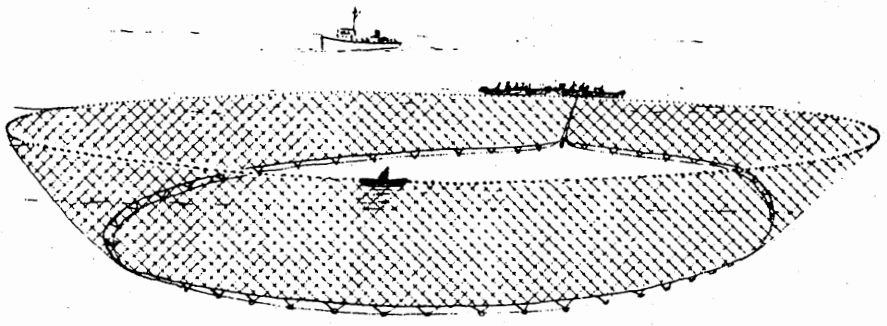
1/ This table was taken from the annual report of the Texas Game, Fish and Oyster Commission - 1949.

Table 6
MISSISSIPPI MENHADEN FISHERY
OPERATING UNITS, 1960-1973

| Year | No. Fishermen | No. Vessels | Gross Tons | Av. Gross Tons |
|---|---|---|---|---|
| 1960 | 378 | 19 | 5,909 | 311.0 |
| 1961 | 381 | 18 | 5,376 | 298.66 |
| 1962 | 905 | 45 | 10,738 | 238.62 |
| 1963 | 282 | 16 | 4,998 | 312.37 |
| 1964 | 372 | 21 | 6,048 | 288.0 |
| 1965 | 335 | 18 | 5,646 | 313.66 |
| 1966 | 471 | 26 | 7,503 | 288.57 |
| 1967 | 385 | 21 | 6,046 | 287.90 |
| 1968 | 328 | 18 | 5,652 | 314.0 |
| 1969 | 256 | 15 | 4,887 | 325.8 |
| 1970 | 295 | 17 | 5,197 | 305.7 |
| 1971 | 343 | 20 | 6,098 | 304.9 |
| 1972 | 319 | 18 | 6,261 | 347.83 |
| 1973 | 175 | 10 | 3,419 | 341.9 |

## PURSE SEINE

The net is actually a long wall of webbing without a prominent bunt or bag. The top edge is floated by a series of corks (the cork line) and the bottom edge is weighted with a number of leads (the lead line). The essential feature of this net is the pursing by closing the draw string which is threaded through a series of rings along the bottom of the net below the lead line. Capture is affected by surrounding the school, pursing the bottom line so that the lead line is bunched or puckered, and concentrating the catch in the landing piece or small bag.



Menhaden purse seine

Figure 7

Table 7

Gulf of Mexico Menhaden Fishery - 1950-1974[1/]

(Thousands of Pounds and Thousands of Dollars)

| Year | Florida West Coast Quantity | Florida West Coast Value | Mississippi Quantity | Mississippi Value | Louisiana Quantity | Louisiana Value | Texas Quantity | Texas Year | Total Quantity | Total Total |
|---|---|---|---|---|---|---|---|---|---|---|
| 1950 | 1,534 | $ 15 | 69,550 | $ 828 | 207,755 | $2,327 | 47,191 | $ 463 | 326,030 | $3,633 |
| 1951 | 3,375 | 35 | 114,895 | 1,424 | 209,574 | 2,892 | 30,121 | 521 | 357,965 | 4,872 |
| 1952 | 10,737 | 81 | 112,890 | 1,252 | 283,373 | 2,765 | 52,984 | 498 | 459,984 | 4,596 |
| 1953 | 4,031 | 40 | 58,933 | 619 | 307,492 | 3,690 | 66,589 | 840 | 437,045 | 5,189 |
| 1954 | 2 | (2) | 79,445 | 890 | 270,094 | 3,727 | 51,702 | 693 | 401,243 | 5,310 |
| 1955 | 1,935 | 19 | 128,123 | 1,960 | 298,309 | 4,594 | 52,625 | 716 | 480,992 | 7,289 |
| 1956 | 32 | 1 | 172,592 | 2,589 | 320,521 | 4,840 | 66,691 | 974 | 559,836 | 8,404 |
| 1957 | 7 | (2) | 142,124 | 2,146 | 162,817 | 2,459 | 57,585 | 835 | 362,533 | 5,440 |
| 1958 | 9,108 | 140 | 123,346 | 1,887 | 241,813 | 3,627 | 68,559 | 1,104 | 442,826 | 6,758 |
| 1959 | 17,590 | 204 | 174,802 | 2,193 | 442,740 | 5,977 | 117,424 | 1,527 | 751,836 | 9,901 |
| 1960 | 6,580 | 60 | 218,644 | 2,198 | 470,108 | 5,139 | 145,575 | 1,497 | 840,907 | 8,894 |
| 1961 | 3,375 | 32 | 301,271 | 3,404 | 581,682 | 6,748 | 134,105 | 1,408 | 1,020,433 | 11,592 |
| 1962 | 20 | 1 | 263,574 | 2,917 | 689,157 | 7,994 | 103,874 | 1,137 | 1,050,625 | 12,049 |
| 1963 | 44 | 2 | 250,429 | 3,276 | 633,484 | 7,862 | 83,736 | 1,034 | 967,693 | 12,174 |
| 1964 | 84 | 2 | 237,833 | 3,131 | 599,538 | 9,046 | 66,686 | 822 | 904,141 | 13,001 |
| 1965 | 432 | 17 | 278,104 | 3,973 | 682,435 | 11,790 | 61,866 | 1,122 | 1,022,837 | 16,902 |
| 1966 | 7,302 | 128 | 190,654 | 3,465 | 555,852 | 9,558 | 38,863 | 773 | 792,671 | 13,924 |
| 1967 | 127 | 4 | 166,527 | 2,145 | 510,414 | 6,134 | 23,020 | 262 | 700,088 | 8,545 |
| 1968 | 457 | 13 | 149,535 | 2,038 | 622,291 | 7,740 | 51,073 | 674 | 823,356 | 10,465 |
| 1969 | 382 | 13 | 225,377 | 3,306 | 856,251 | 12,764 | 73,193 | 1,233 | 1,155,203 | 17,316 |
| 1970 | 617 | 22 | 205,980 | 3,888 | 959,810 | 18,931 | 43,060 | 903 | 1,209,467 | 23,744 |
| 1971 | 807 | 30 | 308,351 | 4,823 | 1,237,093 | 20,015 | 62,931 | 1,050 | 1,609,182 | 25,918 |
| 1972 | 644 | 20 | 178,273 | 2,915 | 928,252 | 15,279 | - | - | 1,107,169 | 18,214 |
| 1973 | 983 | 36 | 177,856 | 8,789 | 894,930 | 37,221 | - | - | 1,073,769 | 46,046 |
| 1974 | 900 | 45 | 215,674 | 8,743 | 1,079,304 | 39,539 | - | - | 1,295,878 | 48,327 |

1/ There were no landings of menhaden in Alabama during the period covered by this report.

(2) Less than 500 lbs or 500 dollars.

Table 8
MISSISSIPPI MENHADEN PRODUCTS, 1950-1972

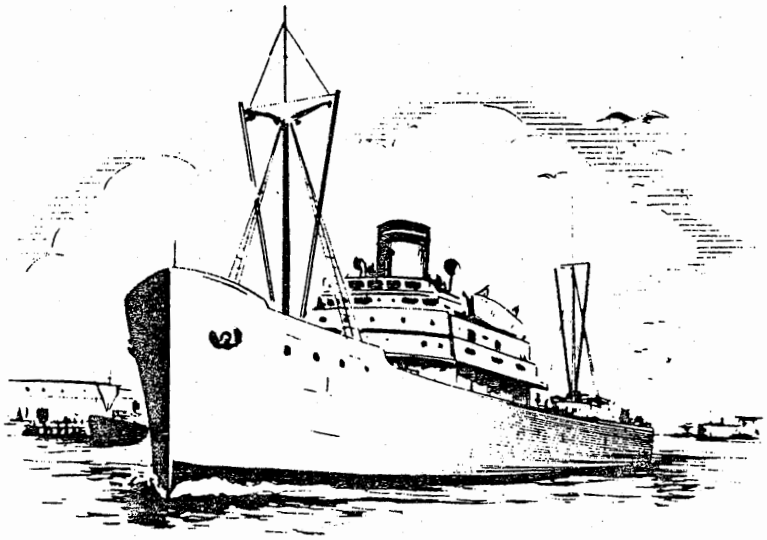
| Year | Meal | | * Oil | | Solubles | | Total Value |
|---|---|---|---|---|---|---|---|
| | Tons | Value | ~~Gals.~~ | Value | Tons | Value | |
| 1950 | 6,845 | 967,424 | 8,615 | 567,783 | - | - | 1,535,207 |
| 1951 | 11,170 | 1,321,899 | 15,739 | 1,325,844 | - | - | 2,647,743 |
| 1952 | 11,873 | 1,510,530 | 13,312 | 824,707 | - | - | 2,335,237 |
| 1953 | 5,084 | 646,838 | 5,064 | 312,336 | 1,506 | 120,391 | 1,079,565 |
| 1954 | 6,790 | 892,052 | 5,008 | 313,650 | 2,760 | 278,698 | 1,484,400 |
| 1955 | 12,559 | 1,594,993 | 15,437 | 1,294,037 | 5,112 | 383,063 | 3,272,093 |
| 1956 | 16,243 | 2,133,600 | 20,062 | 1,681,900 | 6,587 | 498,900 | 4,314,400 |
| 1957 | 13,556 | 1,762,280 | 14,959 | 1,254,614 | 6,256 | 563,027 | 3,579,921 |
| 1958 | 12,145 | 1,578,850 | 14,601 | 1,035,852 | 6,055 | 544,955 | 3,159,657 |
| 1959 | 16,831 | 2,103,875 | 14,456 | 1,016,571 | 8,670 | 606,922 | 3,727,368 |
| 1960 | 21,037 | 1,893,340 | 22,168 | 1,432,600 | 8,420 | 336,820 | 3,662,760 |
| 1961 | 29,550 | 3,062,224 | 37,253 | 2,162,649 | 11,392 | 455,672 | 5,680,545 |
| 1962 | 25,344 | 2,969,402 | 30,700 | 1,377,785 | 10,302 | 520,197 | 4,867,384 |
| 1963 | 25,121 | 3,027,079 | 29,578 | 1,705,634 | 12,055 | 727,646 | 5,460,359 |
| 1964 | 24,231 | 2,956,182 | 22,184 | 1,574,343 | 11,777 | 706,632 | 5,237,157 |
| 1965 | 29,501 | 4,157,346 | 20,703 | 1,658,213 | 13,375 | 805,727 | 6,621,286 |
| 1966 | 19,612 | 3,179,244 | 22,548 | 1,949,278 | 9,929 | 647,201 | 5,775,723 |
| 1967 | 19,214 | 2,519,571 | 17,671 | 893,369 | 9,798 | 602,765 | 4,015,705 |
| 1968 | 16,083 | 2,248,460 | 18,745 | 690,720 | 7,996 | 457,160 | 3,396,340 |
| 1969 | 23,458 | 3,720,851 | 20,747 | 1,204,646 | 11,567 | 577,843 | 5,503,340 |
| 1970 | 21,195 | 3,834,380 | 24,995 | 2,234,734 | 10,716 | 445,428 | 6,514,542 |
| 1971 | 31,722 | 5,169,825 | 34,010 | 2,691,264 | 14,302 | 572,040 | 8,433,129 |
| 1972 | 18,862 | 3,437,435 | 14,808 | 998,236 | 11,284 | 424,132 | 4,859,803 |

* Thousands of Pounds

Menhaden

Table 9
EXPORTS OF DOMESTIC FISH OILS - 1950-1974
(Thousands of pounds - Thousands of dollars)

| YEAR | QUANTITY | VALUE |
|---|---|---|
| 1950 | 75,974 | $ 7,137 |
| 1951 | 49,840 | 6,705 |
| 1952 | 43,961 | 3,536 |
| 1953 | 108,467 | 7,764 |
| 1954 | 141,633 | 11,055 |
| 1955 | 142,671 | 11,852 |
| 1956 | 140,804 | 12,883 |
| 1957 | 114,940 | 10,760 |
| 1958 | 94,043 | 7,761 |
| 1959 | 144,481 | 11,902 |
| 1960 | 143,659 | 10,688 |
| 1961 | 122,486 | 8,908 |
| 1962 | 123,050 | 6,047 |
| 1963 | 262,342 | 15,636 |
| 1964 | 151,469 | 13,096 |
| 1965 | 103,807 | 9,208 |
| 1966 | 77,255 | 7,401 |
| 1967 | 76,816 | 4,674 |
| 1968 | 65,129 | 2,700 |
| 1969 | 196,073 | 11,048 |
| 1970 | 158,787 | 15,699 |
| 1971 | 229,898 | 19,312 |
| 1972 | 193,198 | 15,276 |
| 1973 | 247,793 | 33,945 |
| 1974 | 199,122 | 39,595 |



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## THE MISSISSIPPI SHRIMP FISHERY

The shrimp fishery is among the more valuable fisheries in the State of Mississippi. Between 1500 and 1800 fishermen are employed annually in catching shrimp worth more than 5 million dollars at ex-vessel price and about 30 million to the economy of the state and nation. Several hundred people are employed in processing and marketing. Vessel construction, repair and maintenance are all supported from this basic income. Shrimp trawlers constructed in Mississippi now ply the waters of the Caribbean and coastal South America, as well as the Gulf of Mexico and a few are working in Alaska and in the Persian Gulf. Biloxi net making, which now supplies a world market, was originally supported and developed by Biloxi shrimpers. Ice, fuel, oil and groceries used on the vessels are all more or less supported from this basic income. Shrimp fishing has had far more impact on the economy of the coastal communities than the value of the landings imply. The availability of bait shrimp to tourists has greatly boosted recreational activities along the coast and far outweighs the value of the few shrimp produced and sold.

Mississippi's commercially important shrimp are the brown shrimp (Penaeus aztecus), the pink shrimp or hopper (Penaeus duorarum) and the white shrimp (Penaeus setiferus). A few sea bobs (Xiphopenaeus kroyeri) are occasionally taken south of Pascagoula River and off the mouth of the Mississippi River and red sea bobs or (Trachypenaeus similis) occurs in the same area, sometime quite plentiful during December, January and February. These are not commercially important. Trachypenaeus species should be exploited as they are a valuable source of food and could also be used as bait shrimp by recreational fishermen.

Shrimp are harvested in Mississippi by the use of the shrimp trawl, a conical shaped net held open by means of doors or otter boards. The net is towed through the water at a speed of about four knots per hour by a motor powered boat or vessel. The length of tow varies from about 30 minutes to one hour for the very small boats to approximately three hours for the larger vessels. When the tow is completed, the trawl is pulled aboard the vessel by use of a winch and the catch emptied by releasing the trip line on the cod end or bag. The catch is sorted, placed in the hold of the vessel and iced down. Sorting is accomplished on some of the larger vessels by the use of a brine solution in a tank aboard the vessel, commonly called a salt box. Portions of the catch are dumped in the brine solution where the most of the fish float to the surface. They are skimmed off with a dip net while the shrimp sink and are, subsequently, dipped out. Some further sorting to remove fish and crabs is almost always necessary. It has been shown that from three to twenty pounds of fish are discarded for every pound of shrimp landed.

The life history of the three commercial shrimp is quite similar and is well documented in literature. Adult shrimp move offshore to deeper, more saline waters and spawn. In Mississippi all spawning takes place south of the Barrier Islands. The eggs hatch after a few hours and the nauplii drift in the water at the mercy of ocean currents. After several protozeal and mysis stages, the young shrimp begin to enter the bays and sounds as postlarval shrimp. Kutkuhn concluded the time lag from hatching to postlarval to be within three to six weeks. Once in the bays, the small animals are subjected to many forces of nature but temperature and salinity are believed to be extremely critical during early life history of brown shrimp. They grow in the inland waters and as they mature sexually they begin their migration to the offshore areas. Growth rates are dependent on food and environmental factors.

## SHRIMP TRAWLER

**Medium**

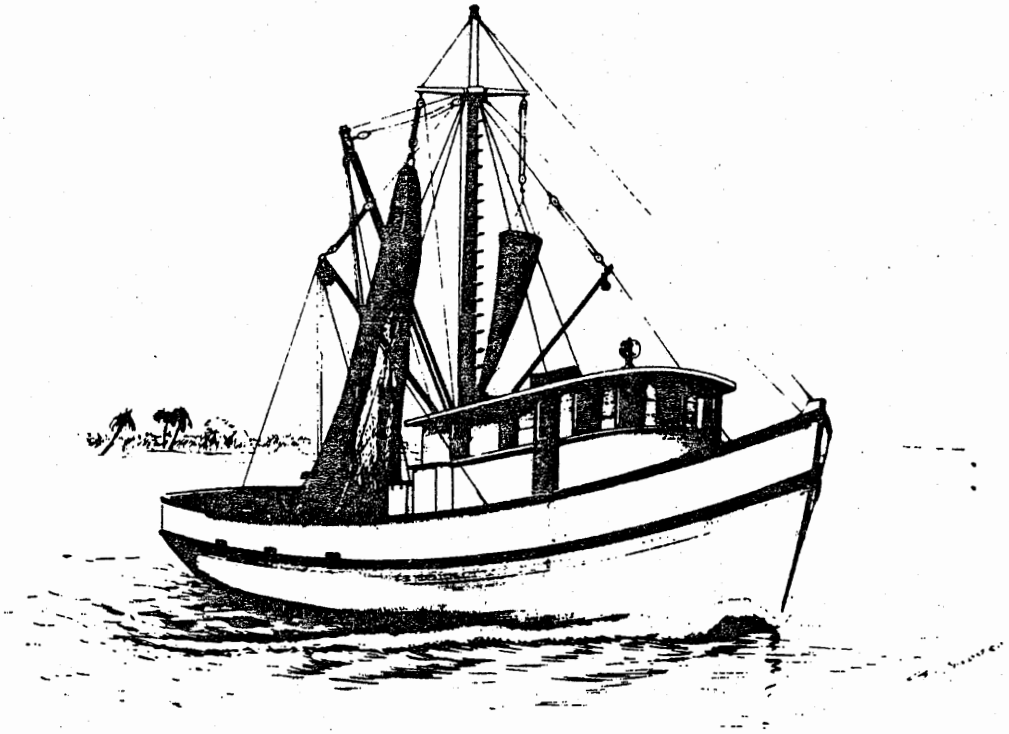


Figure 8

## SHRIMP TRAWL

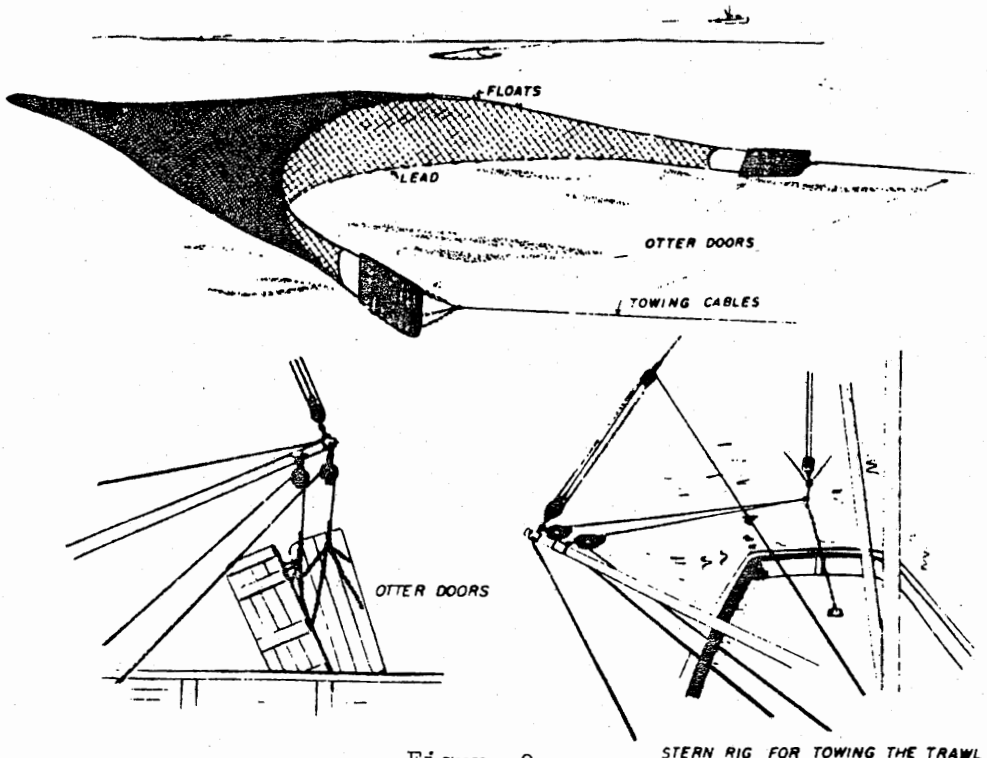



Figure 9

There are no distant water shrimp vessels operating from Mississippi ports as there are in Florida and Texas. Mississippi fishermen have largely fished the resource that is almost on their doorsteps. Traditionally, they fish in Mississippi Sound, Chandeleur Sound, Lake Borgne, Breton Sound, with an occasional trip to the west side of the Mississippi River. In the years prior to World War II the fishermen suffered many hardships in making the catch. They left home in mid August, the opening of the season, and many of them saw home only occasionally until the season closed in mid December. The fishery was almost 100 per cent a white shrimp fishery. The catching fleet was supplied by freight boats that in turn received the catch of shrimp, iced it down and transported it to the canning plants in Biloxi. Very little fishing was done by freight boats. The freight vessels have disappeared and each vessel now brings its own catch to the plant.

Prior to 1950 very little fishing was carried on in the open gulf. A fishery for white shrimp was carried on south of Horn Island fairly close to the shore but there was no offshore brown shrimp fishery at any time of the year. In July of 1950, a trawler from Florida bound for Texas tried fishing south of Horn Island, resulting in phenomenal catches of large brown shrimp. The result was a convergence on the area by out of state vessels. As is the case in most virgin fisheries, initial catches were good and as new vessels arrived they found landing facilities better in Mississippi than elsewhere and they were closer to the grounds. Thus, the state shared liberally in the early exploitation of sub area 011.0, as the area south of Horn Island and east of Chandeleur is now commonly known.

The shrimp fishery began expanding over the entire gulf in the early fifties and this expansion subsequently had an effect on the viability of Mississippi's shrimp fishery for shrimp was then becoming a world commodity. Remaining viable meant keeping up with changing conditions. Per capita consumption of shrimp began to rise but the demand was mostly for medium to large size. Early in 1950 the Tortugas fishery got under way and though it was kept a closely guarded secret for many months, it's vastness gradually leaked and full production became a reality. The Bureau of Commercial Fisheries established a station at Pascagoula and located the vessel "Oregon" there to do exploratory work in the gulf. Within a short time the vessel operations revealed large concentration of adult brown shrimp slightly southwest of the mouth of the Mississippi River. On the Texas coast the fleet expanded its operation south along the Mexican coast as far as the Campeche area, while at the same time delineating some very productive grounds from Freeport to Aransas Pass. All were in the offshore areas. The bays and sounds yielded no more shrimp than they previously had and in some instances probably not as much but the decrease could not be traced to increased fishing pressure. The market demand was for the larger sizes in the fresh or frozen state and the demand continued to grow. Canned shrimp reached a plateau and leveled off while the dried product, produced only in Louisiana, began a steady decline. Since the latter two commodities were produced from small shrimp, the trend became clear--<u>larger vessels for offshore work</u>, and it was in this direction that the growth occurred. With the rapid growth some communities provided unloading facilities to promote economic growth of the community. The port of Brownsville, Texas is a classic example of well planned facilities for a shrimp processing operation. Tampa, Florida, Aransas Pass, Texas and Bayou LaBatre, Alabama all constructed or made available excellent unloading facilities resulting in a concentration of the sea going vessels at those ports. Landings in these areas naturally increased. Landings in Mississippi, however, have not followed the general pattern in other Gulf states. With the single exception of Mississippi, all Gulf states have shown a remarkable increase since 1950 (see table 12).

As previously stated, Mississippi catches come almost exclusively from waters lying west of 88° and east of 91°. The most important areas are Mississippi Sound and an area lying offshore just south of Horn Island, referred to in this report as sub area 011.0. These numbers are assigned to the statistical grid areas by National Marine Fisheries Service for the purpose of identifying the area of capture of shrimp landed at the various ports along the gulf. Mississippi shrimpers compete with vessels from Alabama, Florida and Louisiana on these grounds and in this competition they have not fared so well. The causative factors behind Mississippi's decline are not fully understood by the fishermen and it is this fact that has given rise to considerable controversy. One of the purposes of this report is to point to some of these causes in order that the matter may be dealt with in a more enlightened manner and in addition to better aid in managing the fishery. In the period from 1956 to 1971, sub area 011.0 has been fished predominantly by vessels landing in either Alabama or Mississippi (90 per cent or more). Many of these vessels are transient vessels looking for good port facilities and caring little in what state they are located. During this period (1956-1971) the catch increased from 12.9 million pounds (heads on) in 1956 to 18.8 million pounds in 1971 with severe fluctuations in some years. In 1958, the catch dropped to almost half that of the previous year but more than doubled the following year, 1959. Again, in 1961 the catch dropped to 4.9 million pounds, a mere 1/3 of 1956 totals. These fluctuations and the general decline in Mississippi position in no way reflects a declining resource. Rather, they are believed to have been related to weather conditions, principally rainfall and temperature and to certain economic factors not fully understood.

Water temperature and salinity data for Mississippi Sound are not available for a sufficient unbroken time span to conclusively prove the effect of these factors on the larval and post larval shrimp in this area. Air temperature data was available only in averages and did not seem to be useable for a study. In lieu of better data, and because of the need to understand the environmental factors affecting the fishery, the water discharge (in cubic feet per second) of the Pearl and Pascagoula Rivers was chosen and two manipulations were performed with the data. The total catch in sub area 011.0 was graphically plotted against the total river discharge. There appeared to be a definite relationship between river discharge and the resulting catch in this area. In addition, the graph also pointed to the possibility that the length of time of high discharge also affected the subsequent catch. This could be caused by the destruction of greater quantities of post larval due to the length of time these animals were subjected to environmental stress. While it is true that the trend line of catches in sub area 011.0 is up, this upward drift is the result of increased effort.

A coefficient of correlation between shrimp catch and river discharge was computed and found to be statistically significant. This follows a general pattern of findings elsewhere. St. Amant and Ford have shown a relationship between temperature, salinity and the resulting shrimp crop in Louisiana. Barrett and Gillespie have shown a relationship between Mississippi River discharge and subsequent shrimp catches in Louisiana. These researchers, however, did have temperature and salinity data for much of the area studied. While it was not available for Mississippi Sound, it is reasonable to assume that salinity in Mississippi Sound was lowered considerably by the increased discharge of these rivers. Since it appeared that weather conditions were a probable cause of the fluctuation, it was decided to test the effort data in sub area 011.0 to determine if the appreciable increase in effort from 1956 to 1971 had resulted in a tendency to deplete the stocks. Since the shrimp is, broadly speaking, an annual animal, the catch by size shows little in the

way of depletion of stocks. A regression was plotted of the days fished, of interviewed craft in sub area 011.0 against the resulting catch. The result was an indication the greater the effort the greater the catch. Therefore, from the available data it does not appear that fishing has had anywhere near the effect on the stocks of shrimp as environmental factors for the following reasons: (1) High river discharges in some years doubtless reduct salinity and result in heavy mortality of postlarval. This is reflected in reduced catches. (2) Despite fishing pressure and natural disasters there appears to be enough spawners that escape into areas not fished to repopulate the stocks. (3) From the regression, it appears the more effort applied, the greater the catch. The shrimp resource, therefore, does not appear biologically to be overfished. What is more likely is the increase in numbers of vessels and fishermen in Mississippi Sound and sub area 011.0 has resulted in a smaller catch per vessel despite the overall total increase.

Competition for the resource on Mississippi's traditional fishing grounds and for suitable landings facilities has become more intense with each passing year. In 1962, the first year data was available on species and area of capture for each state, vessels landing in Mississippi took 61 per cent of the shrimp caught in sub area 011.0. Vessels landing in Alabama took 37 per cent with the remaining two per cent being landed in other states. A decline in the take in this area by shrimpers landing their catches in Mississippi has been rather steady since 1962. In 1971, they took only 21.5 per cent. On the other hand, vessels landing in Alabama that took 37 per cent in 1962 increased their take to 68.6 per cent by 1971 (see table 16).

Some possible clues to the reasons Mississippi is getting a smaller portion of the catch in sub area 011.0 can be found in an examination of the catch and operating unit data. Since vessels landing in Alabama steadily increased their take in this area, it is reasonable to look at their producing units and landings for a clue to the causes. From data on the landings by species and size in Alabama and Mississippi the average prices for each size and species were computed. It was found that ex-vessel prices paid for shrimp landed in Alabama for specific size groups was slightly higher in 1956 than in Mississippi and the overall average price paid in Alabama was also slightly higher than in Mississippi. The average price in Louisiana was also found to be higher for the same period. The difference was near three cents per pound (see table 10). This price difference, plus the fact that Alabama has built a completely new port facility at Bayou LaBatre during the past 15 years providing more inducement to transient vessels has doubtless placed Alabama in a more favored position with regard to transient vessels landing their catches in that state. In 1973 and 1974 the price structure improved at Mississippi ports and it remains to be seen if the improved price structure will lure the out of state vessels to land at Mississippi ports again as they did in the early fifties.

These are not the only factors affecting Alabama's increase take of this offshore fishery. There has been an enormous growth in the number and size of the Alabama fleet since 1956--far outstripping their Mississippi competitors. For example, there were 148 vessels landing shrimp at Alabama ports in 1956. By 1970 the number had increased to 448, more than tripling in fourteen years. Mississippi, on the other hand, had 488 vessels landing shrimp in 1956 but the number had declined to 452 in 1970.

Table 10
AVERAGE PRICE PER POUND PAID FISHERMEN FOR 21-25 HEADS OFF BROWN SHRIMP IN ALABAMA, MISSISSIPPI, AND LOUISIANA, 1956-1974 1/

| Year | Louisiana | Alabama | Mississippi |
|---|---|---|---|
| 1956 | $ 0.64 | $ 0.63 | $ 0.57 |
| 1957 | 0.75 | 0.72 | 0.61 |
| 1958 | 0.76 | 0.77 | 0.71 |
| 1959 | 0.61 | 0.55 | 0.53 |
| 1960 | 0.59 | 0.57 | 0.55 |
| 1961 | 0.67 | 0.71 | 0.67 |
| 1962 | 0.93 | 0.92 | 0.91 |
| 1963 | 0.73 | 0.72 | 0.68 |
| 1964 | 0.71 | 0.70 | 0.67 |
| 1965 | 0.77 | 0.78 | 0.77 |
| 1966 | 1.00 | 0.96 | 0.92 |
| 1967 | 0.84 | 0.85 | 0.84 |
| 1968 | 1.13 | 1.16 | 1.14 |
| 1969 | 1.18 | 1.20 | 1.20 |
| 1970 | 1.12 | 1.09 | 1.06 |
| 1971 | 1.53 | 1.54 | 0.51 |
| 1972 | 1.64 | 1.63 | 1.63 |
| 1973 | 2.14 | 2.23 | 2.31 |
| 1974 | 1.81 | 1.92 | 2.10 |

1/ Source: Shrimp Landings--National Marine Fisheries Service

Numbers of vessels alone, however, does not tell the entire story. An examination of the age and structure of these vessels is much more revealing. Data on the age of vessels was not available for any time sequence prior to 1961. For the 447 vessels fishing shrimp in Mississippi in that year the data revealed that 50 per cent were 15 years or older, and that 50 per cent of the tonnage of the fleet was 12 years or older. In other words, half of the fleet had been built prior to 1948 (three vessels, for example, were found to have been built in 1901) and half of the tonnage weight had been built prior to 1952. In the same year (1961) an examination of the Alabama data revealed there were 186 vessels fishing shrimp and that 50 per cent of the number had been built prior to 1949--or they averaged 14 years of age. Seventy-eight of these vessels constituted one half of the total gross tons and all had been built since 1952; that is, they were nine years or less of age. Considering average age, only about one year separated the age of the two fleets but by tonnage weight, half of the Alabama fleet was three years newer than the Mississippi fleet.

Five years later, in 1966, there were 410 vessels fishing shrimp in Mississippi, a decline of 37 vessels in five years. Of the total, 50 per cent had been built prior to 1953, or they were 15 or more years old. On the other hand, 50 per cent of the tonnage of the fleet had been built since 1955 or they were 12 years or less of age. By number of vessels and by tonnage weight, the age of the Mississippi fleet remained unchanged during the five year interval from 1961 to 1966. Alabama, on the other hand, was experiencing a phenomenal growth. There were 366 vessels fishing shrimp in 1966 and

landing in Alabama--179 more than in 1961. The fleet had almost doubled in number in five years. Of the total, half were 11 years or less of age. However, of the total 366 vessels, 126 made up half of the gross tons and these had been constructed in the past eight years or less, four years newer than the same grouping of Mississippi vessels. The Alabama fleet, on the whole, was of more recent construction than had been the case five years earlier.

In 1971, only 282 vessels were fishing shrimp in Mississippi--128 less than five years earlier and 50 per cent of the number were 17 years or older--two years older than in 1966. Eighty-three vessels made up 50 per cent of the gross tons in the fleet and all these had been built within the past six years. The data indicates that the older Mississippi vessels are slowly being weeded out. The new craft will doubtless be more competitive, though fewer in number. In 1971, Alabama had 451 vessels fishing shrimp--264 more than in 1961, and half of the total had been built within the past eight years or less, half the age of the Mississippi fleet. One hundred sixty-three of the vessels accounted for 50 per cent of the gross tonnage of the fleet, indicating that more of the fleet had been built in recent years and that all were pretty near the same gross tonnage. It takes very little evaluating of these data to see that Alabama has outbuilt Mississippi in both number and size. This increased tonnage is doubtless one of the reasons for their increased productiveness.

The rapid increase in the size of vessels landing shrimp in Alabama is demonstrated in table 14. The data show that not only has Alabama outstripped Mississippi in size of vessels but surpasses every other Gulf state.

The producing units of the two states have differing needs and objectives. Quite a large number of Mississippi vessels were originally constructed as combination shrimp and oyster vessels. They are, in fact, a modification of the old Biloxi schooner, designed for oyster and inshore shrimp work but with motor power replacing the sail. The decks sweep low toward the water line to facilitate oyster dredges being hauled over the side and the construction is such as to permit operation in shallow water where some of the best oyster reefs are located. They are not as seaworthy as the newer Alabama vessels and in heavy seas, when Alabama craft continue to work, the older combination vessels of the Mississippi fleet must seek shelter. Therefore, the Mississippi craft gets fewer working days on the offshore shrimp grounds. Furthermore, they spend more time fishing inside the sound, a fact which results in a higher percentage of over 40 count shrimp than is the case in Alabama and consequently get less for their catch (see tables 18, 19, 20 and 21). The question then arises, why does not Mississippi vessel owners build new larger vessels to compete with the modern craft of other states, particularly the offshore fleets of Alabama and Louisiana. This is rightfully a question that can only be answered by an economic study and there is a dire need for an in depth economic study of Mississippi's fisheries, particularly shrimp. Legislation intended to revitalize Mississippi's shrimp fisheries can hardly be successful unless and until answers are obtained to questions of this type.

There are a few clues, however, to the present situation. Most of the seafood firms in Mississippi are old established firms with long time investments. Many of them are combination fresh, frozen and canned shrimp producers and some also market fresh as well as canned oysters. There is a definite need for the combination oyster and shrimp vessel to supply the multiple production needs of the processors. If they use specialized craft, two will be required where one is now used and the cost is almost doubled. In the second place, many of these older combination vessels have been amortized off the books and despite the fact that their book life has been depleted,

they are capable of making several thousand dollars a year for the owner. Therefore, the owner might just reasonably think this old debt free vessel offers more return than a $150,000 mortgage on a new vessel and perhaps this type thinking is justified. In years of an abundant shrimp crop resulting in declining prices and stabilized costs the heavy capitalization of the shrimp industry in some neighboring states can result in severe economic hardships.

The production of shrimp in Mississippi is geared to the processing needs. As pointed out above, Mississippi fleet is composed of many combination vessels. Much of their time is spent fishing shrimp in the sounds and bays from the Pascagoula to the mouth of the Mississippi River. As a result of much of this inshore type fishing, Mississippi gets a larger share of its catch in the smaller sizes (see tables 18, 19, 20, 21, showing per cent of take of four sizes of shrimp in Mississippi and Alabama). The complaint is often heard that taking the small shrimp reduces the value of the industry in the state. There are two sides to this argument and both should be investigated before valid conclusions can be drawn. First of all, some thinning of the shrimp population in certain years when there is a strong year class is desirable and necessary and doubtless does not reduce the offshore catch materially nor damage the resource. It may also accelerate the growth rate of the remaining stocks. Management of the resource in Mississippi has provided sufficient stocks for the offshore fishery if in fact the stocks in sub area 011.0 are Mississippi shrimp. Second, taking small shrimp for canning adds employment since labor is required to process and can the shrimp, which would not be true where shrimp are boxed as headless frozen and shipped out. Mississippi's canned shrimp production is worth more than five million dollars at producing level (see table 22). In addition, several hundred people find gainful employment in these factories.

The shrimp canning industry is, however, facing a severe test in the requirement that it cease to discharge solid matter waste into navigatable waterways. The equipment to dispose of this material is quite costly to install and the day to day operation is expensive. Furthermore, shrimp canners face some serious problems in meeting requirements of the Food and Drug Administration in labeling their product. Adding these costly requirements to the production of a food item already burdened with production costs will doubtless create insurmountable obstacles. Small canners with limited financial resources may find operations more difficult. Now is an opportune time for the industry to shift to production of peeled shrimp and breaded shrimp, a shift that could be made easier by a management program designed to provide larger shrimp.

Mississippi's shrimp industry was largely founded on canning since freezing had not developed sufficiently during the early years of the industry to permit marketing the product in that form. Shortly after Mr. Dunbar perfected the canning of shrimp in Louisiana, canneries sprang up on the Mississippi Gulf Coast and have continued to be a substantial part of the shrimp industry in this state. At one time or another, canneries have been located in all three coastal counties. In 1950, there were 19 shrimp canneries in Mississippi whose total production was roughly 26 per cent of the total U. S. pack of canned shrimp. Louisiana accounted for another 66 per cent of the U. S. total so that 92 per cent of all the shrimp canned in the U. S. was canned in the two states.

Mississippi has historically followed Louisiana's opening of the brown shrimp season by about two weeks. As a result, Mississippi finds itself in competition with Louisiana both on a production and price basis because of the size of the shrimp. Since Mississippi has a very small area for nursery

grounds, its production is only a fraction of Louisiana production. The result is that prices set in Louisiana are carried over to Mississippi since the canners here can pay no more than Louisiana and still be competitive. A more profitable management system would be to delay the season opening until the shrimp are larger and not so much in competition with the smaller sizes in Louisiana, thus gaining much greater value and perhaps a larger volume. Such a program will leave Mississippi largely free of competition since Texas' outside waters do not open until early July, and the tortugas season has ended.

While there is no data available on imports of canned shrimp prior to 1963, it is the opinion of those in the industry that in 1950 imports of canned shrimp were negligible. Since data on imports became available in 1963 this item does not appear to have been a problem, in that for the ten year period imports have not dramatically increased and have averaged only about 2.8 million pounds annually, or less than eight per cent of our total supply. Exports of canned shrimp have risen steadily during the past twenty years. In 1950, the U. S. exported only about 1.1 million pounds whereas in 1973 we exported 9.9 million pounds, a record for the 24 year period. Canada, Great Britain, France and Switzerland account for approximately 90 per cent of our exports. The rise in exports has been greater than the rise in U. S. production indicating what industry representatives have always said--that given a choice European nations will always choose U. S. shrimp.

Table 11
THE SHRIMP FISHERY, 1950-1974
TOTAL U. S. EXPORTS OF DOMESTIC CANNED SHRIMP
(Thousands of Pounds and Thousands of Dollars)

| Year | Quantity | Value |
|---|---|---|
| 1950 | 1085 | $ 850 |
| 1951 | 1550 | 1162 |
| 1952 | 1685 | 1405 |
| 1953 | 1729 | 1795 |
| 1954 | 1973 | 1661 |
| 1955 | 2832 | 2456 |
| 1956 | 2451 | 2650 |
| 1957 | 2296 | 2410 |
| 1958 | 2161 | 2548 |
| 1959 | 2876 | 2898 |
| 1960 | 3482 | 3383 |
| 1961 | 2503 | 2487 |
| 1962 | 2212 | 2572 |
| 1963 | 3199 | 3054 |
| 1964 | 3692 | 3664 |
| 1965 | 4510 | 4809 |
| 1966 | 4479 | 5192 |
| 1967 | 5255 | 5585 |
| 1968 | 4467 | 4758 |
| 1969 | 5682 | 5753 |
| 1970 | 6076 | 6652 |
| 1971 | 8334 | 9278 |
| 1972 | 8450 | 10729 |
| 1973 | 9949 | 14472 |
| 1974 | 6885 | 11830 |

While data on per capita consumption of canned shrimp are not available, the consumption of all canned shellfish has stabilized at about ½ pound per person.

Shrimp are frozen in one to five pound boxes by many Mississippi plants. Since preparation of the product is quite simple very little labor is required beyond removing the heads. There has been little change in the volume marketed in this manner during the past twenty years. Breading shrimp has never been an important industry on the Mississippi Coast. Only one firm is presently engaged in preparing shrimp in this manner. It would appear that with the trend of use of this product on a steady increase and with the old well established firms having marketing channels that production of this item might offer possibilities to diversify.

Considerable controversy has evolved around the bait shrimp fishery in Mississippi. A few remarks regarding this fishery are necessary to set the record straight. Bait shrimpers are often the target of much criticism for taking small shrimp in waters closed to other shrimpers. There are about thirty bait operators in the State of Mississippi at present and while we do not have any long statistical series on catch, the indications are that the annual average total for all bait operators will probably be near 150,000 pounds or less. The contribution of these few individuals to the recreational facilities along the Mississippi Coast is far greater than the small economic renumeration they receive for their services.

There are some serious problems in this fishery. No regulation can be designed to limit the number of bait harvesters without limited entry legislation either at state or national level. Unscrupulous individuals do enter the bait business, harvest and sell as market shrimp the catch taken in the nursery grounds. This results in numerous charges by commercial and sport fishermen that the bait harvesters have a license to steal. Limited entry legislation for this industry is a must.

## CONCLUSIONS

Data on the brown shrimp fishery reveals that the resource is not in real danger from biological overfishing to the point of damaging the stock. The problems are: (1) A constant increase in numbers, size and cost of producing units so that each unit gets a smaller share despite an overall increase in production--his unit cost is higher and his catch smaller, resulting in smaller returns to the fishermen. (2) The Mississippi fleet, in general, is of a type of construction and age that has not permitted gainful competition in the offshore fishery (This is a general indictment. There are some excellent vessels in Mississippi). (3) Alabama shore plants pay a little higher ex-vessel price than those in Mississippi and therefore have outbid Mississippi in the market place, thus getting the catches of transient vessels fishing in sub area 011.0. These factors point to a need for an economic study to determine the causes and suggest remedies to improve the economy of this industry.

No treatment of the problems in the shrimp fishery is complete without a discussion of the white shrimp fishery. The decline in this fishery has been a source of concern and controversy among fishery scientists since the decline began about 1946. Since little detailed statistical data are available on the fishery for that time and biological research was somewhat limited, about all that can be done is to summarize in a general way from the knowledge and observation of those who were connected with the industry at that time. Linder

and Anderson have estimated that the brown shrimp catch prior to the development of this fishery in 1946 was about three per cent of the total shrimp catch. If one considers the fishery over its principal commercial range from North Carolina to Brownsville, Texas, this probably is correct. However, if one considers the upper central gulf as the principal fishing area for this species, which at that time was the principal white shrimp area, then the three per cent figure is doubtless low. Using the monthly tax reports of the state of Louisiana and the statistics of the U. S. Bureau of Fisheries, one finds that the dried shrimp industry produced near 18 million pounds of heads-on shrimp for drying purposes in certain years prior to World War II. Most of this production for drying occurred in the months of May, June, and July with small quantities being produced in other months. There were few white shrimp available in the estuaries, bays, and areas available to shrimping for the drying platforms during the spring and early summer. White shrimp of larger sizes were just outside along the beaches and were used in the headless trade. Drying, which took place during those months, was made up of the small brown shrimp that were growing in the bays and would be or were migrating outside. The drying production was about the only regular prosecution of this fishery although there were occasional cargoes of brown shrimp sold in regular market channels. These sales were of minor importance and constituted no real basis of expansion of the fishery.

Mississippi produced no dried shrimp and, as a result, Mississippi was not exploiting its spring brown shrimp crop. The Mississippi white shrimp fishery was prosecuted largely along the beaches in Harrison, Jackson and Hancock counties (heaviest landings were made in Harrison County) with heaviest production in Jackson County (Reference here is the area of production. There were substantial landings from catches made in the Louisiana marshes by Mississippi vessels). Since the Mississippi season usually opened around the middle of August each year, as did Louisiana's white shrimp season, the majority of the Mississippi catch in those days came from the Louisiana marshes with lesser quantities taken in Mississippi. The vessels proceeded to the marshes at the opening of the season, prepared to remain there for some time. Freight vessels carried ice, purchased shrimp from catcher vessels and freighted the catch back to Mississippi processing plants. As an observer of the fishery in the early days aboard vessels and at unloading docks, I do not recall having seen any quantities of brown shrimp in the catch of white shrimp. Processing plants refused to take brown shrimp primarily because they had a limited market for shrimp and the white shrimp were considered more saleable because of their color. The coloration of the brown shrimp made them appear to be in a spoiling condition and persons not familiar with the technology of the animal judged the brownish color to be an indication of spoilage. This just about ruled out the brown shrimp as a product of the fresh and frozen trade. The Morgan City, Louisiana, fishery was prosecuted exclusively for white shrimp and almost all of the catches were made along the beaches or on Ship and Trinity Shoal, slightly offshore from the mouth of the Atchafalaya River.

In 1946, the white shrimp fishery appeared to decline over its entire range. Shore establishments closed, boats and vessels refused to leave the dock because catches were not sufficient to pay expenses. The industry was in a chaotic condition. An enterprising wholesaler in Aransas Pass, Texas, agreed to take brown shrimp which could be caught in considerable quantities at night and to attempt to market them. He agreed that if he could market the browns, he would pay the boats a specific price, usually somewhat below the going price for the same size white shrimp. Because of the disasterous year and a growing demand for shrimp, the scheme worked and very soon rather

large quantities of brown shrimp were flowing into market thus developing the brown shrimp fishery. The brown shrimp operations expanded to the remaining states along the gulf. The white shrimp fishery never reached its former abundance except in Texas, where the total landings of white shrimp today are approximately the same as they were in previous years. The stability of the white shrimp fishery in Texas and the regulations which have been used to regulate the fishery is the basis for some rather interesting observations. The question of what has produced this decline elsewhere in white shrimp defies scientific explanation.

Since there are few clues to the causes of the decline, developing a research program to solve unknown problems is somewhat difficult. There are, however, some possibilities that might offer a clue and should be investigated as a prelude to research on this species. First, there should be a thorough search of the literature and statistics of this fishery for any clues to the causes of this decline. There is always the possibility that observations made by scientists doing research on this or other species would lead to the answers or the causes for this decline. It might be well to look at the growth of the pesticide industry and its effect on the white shrimp fishery. For example, a giant petrochemical industry has grown up along the Mississippi River. Most of the white shrimp produced in Mississippi and Louisiana in the years before World War II were produced in the marshes, bays and estuaries of the State of Louisiana. With the development and use of DDT and other pesticides during and following World War II, the use could have had a rather substantial effect on this fishery. In this connection, it should be borne in mind that since the white shrimp post larval begin to enter the bays and marshes of the upper gulf in late June of each year, there is the possibility that these tiny animals run head-on into the period of greatest use of pesticides. The use of pesticides on the lawns and on the agricultural crops coincides with the summer months and with the runoff from summer showers. The possibility exists that this could have some effect on larval white shrimp survival.

The brown shrimp post larval grow to juvenile and adult stages and pass out of the bays before the use of pesticide reaches its annual peak. They are thus not as susceptible as young white shrimp which are then entering the bays and which generally do not start to migrate until the early fall when the water temperatures cool.

Chinn and Inglis, working at the Galveston Laboratory, Bureau of Fisheries, determined that spraying for mosquitoes with airplanes in the Galveston area had a tendency to kill all of the live bait shrimp being held in the bait tanks of commercial bait operators. Research into this important area might provide clues to the white shrimp decline.

There is an additional clue that might provide some light on the matter. J. Y. Christmas observed that given one hundred brown post larval shrimp and a hundred white post larval shrimp, there is indication that more of the brown shrimp will reach adulthood and migrate to theoutside than is the case with the white shrimp. The causes are not understood (personal communication with Christmas).

There are also some other areas that possibly might offer a clue. Normally, we think there is no relationship between the number of spawners and the resulting crop in the shrimp fishery. This is based primarily on the fact that after disasterous years in the shrimp fishery, there is

oftentimes a quick recovery so that the fishery reaches its former abundance within a year or two. If the number of spawners was insufficient, the crop would be materially reduced in years following a disaster. This does not seem to be the case. However, an examination of the effects of fishing on the stocks of white shrimp should be checked thoroughly. In addition, a rather thorough review of all of the regulations in effect at the present time in the various states and the catches resulting from the regulations should be reviewed in order to determine, if possible, what effect regulation is having on this fishery.

The suggestion has been offered that the brown shrimp were not as abundant in former years as now and that man's predation and the competition between the two species has contributed to a condition which favored a brown shrimp take over a white shrimp decline. Perhaps it should be explored.

We should not close the discussion of the shrimp fishery without mentioning the third species of commercial importance found in Mississippi waters--Penaeus duorarum, known in Florida as pink shrimp and in Mississippi as the hopper. The fishery is primarily prosecuted near the Barrier Islands in the early spring months, usually late March, April and early May. It is the least important species. In some years it may amount to as much as a couple of hundred thousand pounds. While there has been no positive stock identification, at least a substantial portion of pink shrimp, or hoppers, are found mixed in with the white shrimp along the beaches in the early fall. They undoubtedly overwinter and form the basis for the crop harvested near Horn Island in the spring months. It is part of the reason for continuing the ban on fishing within the half-mile limit. Because of the bottom conditions in the State of Mississippi and because of differing environmental requirements for this species, the fishery will probably never be very large. It is, however, of sufficient economic importance to continue to receive attention of the Commission. It comes at a time of year when most everything is slack and offers some employment for people that might otherwise be out of work.

In summary, the pink or hopper fishery begins in April and runs into early May. It is followed in June or, in some years, July by the development of the brown shrimp fishery and finally in August, by the white shrimp fishery. The complicated science necessary to manage a fishery of this complexity with the three species certainly overlapping to some extent will require an extensive data base and serious deliberation if this commission is to provide answers to these complex management problems and provide the maximum return from this public wealth.

I should hasten to warn that fishery science is not an exact science that can always produce precise answers. We cannot, for instance, calculate decisions as one can measure the distance between two points. There are many unknowns, an excellent example of which is the pilchard fishery of the Pacific Coast. At one time the largest fishery in terms of volume in the United States, it declined in the late forties and early fifties to the point that it completely disappeared as a commercial fishery. It has not reappeared. Many scientists do not believe this fishery was overfished to the point of depletion. If that had been the cause, the pilchard doubtless would have returned to its former abundance when the fleet ceased operating. There are fluctuations in other fisheries that defy explanation. We do know, however, that fishing effort has had some effect on the stocks of

fish in the North Sea and in the northwest Atlantic. Fishery scientists have been able to measure, with some degree of accuracy, the effects of trawling on the stocks of these fish and efforts have been made to conserve them and to maintain the stocks at a sustainable yield. The Pacific halibut fishery is a classic example of a fishery that has been restored by scientific management. We must work toward this goal in Mississippi's fisheries.

Problems in economics of the shrimp fishery are: (1) Industry geared to use of small shrimp, (2) Harbor facilities not as good as some in adjoining states, (3) Prices paid in Mississippi slightly lower, (4) Lack of data to indicate most economical size of vessel for Mississippi, (5) Increasing numbers of harvesters in resource with decrease in catch per vessel, and (6) Inability to control bait shrimp fishery because of inability to limit numbers of harvesters.

Suggested economic solutions: (1) Economic study of Mississippi-Alabama shrimp industry designed to identify economic problem areas in the fishery, and (2) Limited entry legislation or refuse to permit special privileges to bait catchers.

Problems in biology of the shrimp fishery: (1) Lack of knowledge of factors, environmental and physiological, that control migratory patterns and of time shrimp spend in Mississippi Sound before migrating to outside waters, (2) Stock identification in sub area 011.0 (the area south of Horn Island) and in Mississippi Sound, (3) Dynamics of the penaeid shrimp population - this includes determining the optimum harvest size both from the standpoint of economics and biology, (4) Location of overwintering area of white shrimp, and (5) Effects of pesticides on larval shrimp.

Suggested biological solutions: (1) Research and tagging program to solve biologist's knowledge gap (no. 1), and (2) Work with other Gulf states to try to induce National Marine Fisheries Service to identify stocks and study shrimp population dynamics (no. 2 and 3), since the salary cost of professionals in this field is too high for the state to provide support research.

Table 12
Shrimp Landings, Gulf States, 1950 - 1974
(Thousands of Pounds and Thousands of Dollars)

| Year | Florida West Coast | | Alabama | | Mississippi | | Louisiana | | Texas | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Quantity | Value | Quantity | Value | Quantity | Value | Quantity | Value | Quantity | Value | Quantity | Value |
| 1950 | 13,639 | 3,692 | 5,007 | 1,107 | 16,665 | 3,713 | 70,630 | 14,696 | 45,812 | 9,904 | 151,753 | 33,112 |
| 1951 | 29,756 | 8,009 | 6,356 | 1,268 | 15,029 | 2,906 | 78,164 | 17,587 | 64,346 | 14,366 | 193,651 | 44,136 |
| 1952 | 37,130 | 11,812 | 6,208 | 1,521 | 14,050 | 3,330 | 75,854 | 15,722 | 65,026 | 15,785 | 198,268 | 48,170 |
| 1953 | 52,804 | 19,009 | 5,806 | 1,800 | 13,869 | 3,746 | 81,589 | 16,427 | 70,435 | 25,354 | 224,503 | 66,336 |
| 1954 | 45,800 | 13,164 | 6,226 | 1,039 | 14,160 | 2,596 | 77,709 | 15,451 | 93,258 | 21,402 | 237,153 | 53,652 |
| 1955 | 48,598 | 14,324 | 6,676 | 1,349 | 16,625 | 3,076 | 68,986 | 13,745 | 71,517 | 21,971 | 212,402 | 54,465 |
| 1956 | 49,115 | 17,581 | 7,668 | 2,223 | 14,818 | 3,729 | 56,886 | 15,316 | 65,134 | 23,650 | 193,621 | 62,499 |
| 1957 | 41,921 | 16,460 | 6,035 | 1,871 | 11,755 | 3,190 | 31,917 | 9,660 | 76,825 | 32,107 | 168,453 | 63,288 |
| 1958 | 45,606 | 16,312 | 5,308 | 1,984 | 7,724 | 2,830 | 39,760 | 13,080 | 74,956 | 29,665 | 173,354 | 63,871 |
| 1959 | 32,252 | 9,752 | 8,018 | 1,991 | 12,636 | 2,609 | 56,036 | 12,803 | 84,561 | 23,193 | 193,503 | 50,348 |
| 1960 | 44,464 | 12,155 | 7,169 | 2,090 | 11,031 | 2,899 | 61,758 | 15,881 | 81,303 | 24,606 | 205,725 | 57,631 |
| 1961 | 36,069 | 11,094 | 3,525 | 1,154 | 4,408 | 1,281 | 31,027 | 8,913 | 58,766 | 21,208 | 133,795 | 43,650 |
| 1962 | 32,146 | 14,556 | 3,748 | 1,647 | 6,104 | 2,220 | 43,585 | 14,985 | 56,143 | 27,149 | 141,726 | 60,557 |
| 1963 | 34,941 | 12,256 | 7,760 | 2,419 | 9,375 | 2,484 | 80,809 | 19,789 | 70,231 | 26,591 | 203,116 | 63,539 |
| 1964 | 39,966 | 13,322 | 7,215 | 2,630 | 6,416 | 1,805 | 59,382 | 18,794 | 66,053 | 26,144 | 179,032 | 62,695 |
| 1965 | 37,759 | 13,905 | 9,624 | 3,654 | 8,233 | 2,523 | 62,593 | 19,584 | 77,028 | 31,241 | 195,237 | 70,907 |
| 1966 | 28,879 | 12,427 | 10,608 | 4,920 | 7,560 | 2,751 | 62,269 | 24,388 | 69,907 | 38,485 | 179,223 | 82,971 |
| 1967 | 23,449 | 10,476 | 14,456 | 6,049 | 9,625 | 3,122 | 75,317 | 24,573 | 102,876 | 46,355 | 225,723 | 90,575 |
| 1968 | 27,277 | 12,695 | 15,450 | 7,964 | 10,193 | 3,677 | 67,768 | 25,623 | 83,336 | 45,870 | 204,024 | 95,829 |
| 1969 | 22,964 | 12,021 | 14,976 | 8,788 | 8,906 | 4,011 | 82,881 | 33,356 | 70,695 | 42,884 | 200,422 | 101,060 |
| 1970 | 26,564 | 13,108 | 15,031 | 8,040 | 9,604 | 3,810 | 90,939 | 34,612 | 88,327 | 48,614 | 230,465 | 108,184 |
| 1971 | 21,688 | 12,985 | 16,713 | 11,451 | 9,589 | 4,362 | 92,476 | 43,284 | 86,905 | 64,191 | 227,371 | 136,273 |
| 1972 | 22,828 | 17,309 | 17,549 | 14,661 | 7,951 | 4,966 | 83,035 | 47,066 | 97,578 | 80,099 | 228,938 | 164,099 |
| 1973 | 26,137 | 22,598 | 12,019 | 14,165 | 3,681 | 3,698 | 58,653 | 44,512 | 80,969 | 86,003 | 181,459 | 170,976 |
| 1974 | 28,237 | 21,132 | 13,922 | 13,205 | 5,313 | 3,020 | 59,536 | 32,144 | 78,673 | 67,671 | 185,681 | 137,172 |

Table 13

Boats and Vessels Engaged in Gulf of Mexico Shrimp Fishery, 1954-1972

| Year | Florida West Coast | | Alabama | | Mississippi | | Louisiana | | Texas | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Boats | Vessels | Boats | Vessels | Boats | Vessels | Boats | Vessels | Boats | Vessels |
| 1954 | 82 | 784 | 170 | 115 | 379 | 249 | 1,408 | 763 | 1,107 | 967 |
| 1955 | 65 | 868 | 151 | 130 | 377 | 280 | 1,570 | 752 | 806 | 832 |
| 1956 | 54 | 868 | 224 | 148 | 375 | 488 | 1,516 | 856 | 891 | 938 |
| 1957 | 77 | 967 | 209 | 166 | 375 | 473 | 1,442 | 771 | 378 | 1,251 |
| 1958 | 127 | 1,019 | 210 | 194 | 347 | 461 | 1,488 | 1,001 | 422 | 1,632 |
| 1959 | 104 | 1,079 | 201 | 222 | 368 | 479 | 1,623 | 1,188 | 487 | 1,564 |
| 1960 | 90 | 869 | 206 | 222 | 385 | 435 | 1,999 | 1,235 | 421 | 1,521 |
| 1961 | 104 | 875 | 192 | 187 | 346 | 447 | 1,920 | 962 | 429 | 1,541 |
| 1962 | 111 | 823 | 231 | 168 | 356 | 451 | 2,443 | 905 | 803 | 1,275 |
| 1963 | 127 | 847 | 247 | 247 | 357 | 432 | 2,867 | 1,262 | 919 | 1,356 |
| 1964 | 107 | 901 | 231 | 230 | 360 | 405 | 2,967 | 1,343 | 695 | 1,387 |
| 1965 | 114 | 845 | 206 | 295 | 396 | 409 | 3,236 | 1,299 | 845 | 1,371 |
| 1966 | 98 | 886 | 203 | 366 | 380 | 410 | 3,261 | 1,342 | 861 | 1,409 |
| 1967 | 95 | 891 | 174 | 397 | 594 | 351 | 3,402 | 1,421 | 724 | 1,675 |
| 1968 | 84 | 988 | 139 | 467 | 634 | 486 | 3,471 | 1,447 | 781 | 1,815 |
| 1969 | 76 | 932 | 129 | 506 | 615 | 464 | 3,452 | 1,502 | 545 | 1,806 |
| 1970 | 76 | 813 | 149 | 448 | 600 | 452 | 3,250 | 1,693 | 420 | 1,723 |
| 1971 | 70 | 756 | 169 | 456 | 618 | 344 | 3,465 | 1,517 | 506 | 1,931 |
| 1972 | 66 | 849 | 179 | 451 | 540 | 310 | 3,625 | 1,624 | 438 | 1,900 |

Table 14

GULF OF MEXICO SHRIMP FISHERY 1960 - 1973

TOTAL GROSS TONS AND AVERAGE OF SHRIMP VESSELS BY STATE

| | Florida West Coast Gross Tons | | Alabama Gross Tons | | Mississippi Gross Tons | | Louisiana Gross Tons | | Texas Gross Tons | |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | Total | Average | Total | Average | Total | Average | Total | Average | Total | Average |
| 1960 | 41959 | 48.28 | 6737 | 30.44 | 13345 | 30.67 | 46133 | 37.35 | 76060 | 50.00 |
| 1961 | 41250 | 47.14 | 6081 | 32.51 | 15142 | 33.87 | 35352 | 36.74 | 49044 | 51.29 |
| 1962 | 38582 | 46.87 | 5212 | 31.02 | 15100 | 33.48 | 31290 | 34.57 | 63901 | 50.11 |
| 1963 | 39887 | 47.09 | 8977 | 36.34 | 15025 | 34.78 | 47599 | 37.71 | 67327 | 49.65 |
| 1964 | 42659 | 47.34 | 8225 | 35.76 | 14405 | 35.56 | 53617 | 39.92 | 70572 | 50.88 |
| 1965 | 41410 | 49.00 | 9547 | 32.36 | 14997 | 36.66 | 53065 | 40.85 | 68673 | 50.08 |
| 1966 | 43682 | 49.30 | 14050 | 38.38 | 16835 | 41.06 | 59007 | 43.96 | 77348 | 54.89 |
| 1967 | 46370 | 52.04 | 17413 | 43.86 | 14497 | 41.30 | 66830 | 46.99 | 100707 | 60.12 |
| 1968 | 53440 | 54.08 | 23718 | 50.78 | 21844 | 44.94 | 74573 | 51.53 | 115643 | 63.71 |
| 1969 | 54287 | 58.24 | 27487 | 54.32 | 21874 | 47.14 | 81511 | 54.26 | 114535 | 63.41 |
| 1970 | 48323 | 59.43 | 24904 | 55.58 | 19965 | 44.17 | 94173 | 55.62 | 112102 | 65.06 |
| 1971 | 46979 | 62.14 | 26434 | 57.96 | 15997 | 46.50 | 94590 | 62.35 | 128446 | 66.51 |
| 1972 | 55624 | 65.52 | 28647 | 63.52 | 13673 | 44.11 | 94266 | 58.05 | 136412 | 71.80 |
| 1973 | 69997 | 66.41 | 36793 | 66.90 | 16751 | 45.89 | 114586 | 60.06 | 164510 | 71.71 |

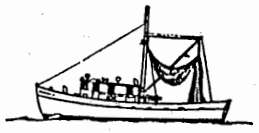


Table 15
LANDINGS OF SHRIMP FROM SUB AREA 011.0, 1956-1974
(Heads-On)

| Year | Brown Pounds | Pink Pounds | White Pounds | Sea Bobs Pounds | Royal Reds Pounds | Total Pounds |
|---|---|---|---|---|---|---|
| 1956 | 11,080,708 | 509,502 | 1,262,289 | - | - | 12,852,499 |
| 1957 | 9,883,220 | 652,066 | 589,307 | - | - | 11,124,593 |
| 1958 | 5,025,256 | 148,674 | 1,031,035 | - | - | 6,353,639 |
| 1959 | 11,966,467 | 211,341 | 1,158,734 | - | - | 13,336,542 |
| 1960 | 10,414,245 | 72,269 | 847,522 | 4,904 | - | 11,338,940 |
| 1961 | 4,442,489 | 223,758 | 245,462 | - | - | 4,911,709 |
| 1962 | 4,557,778 | 8,938 | 1,264,548 | 85,383 | 2,133 | 5,918,780 |
| 1963 | 8,503,756 | 281,742 | 1,568,310 | 2,306 | 3,596 | 10,359,710 |
| 1964 | 7,249,416 | 90,629 | 2,559,448 | 468 | 4,676 | 9,904,637 |
| 1965 | 11,685,180 | 52,453 | 1,931,100 | 497 | 15,075 | 13,668,733 |
| 1966 | 11,680,841 | 70,451 | 1,110,424 | - | - | 12,861,716 |
| 1967 | 12,717,338 | 238,350 | 1,308,743 | - | 9,068 | 14,273,499 |
| 1968 | 15,254,671 | 279,190 | 1,189,488 | 1,591 | 86,992 | 16,811,932 |
| 1969 | 13,322,054 | 595,416 | 3,788,368 | - | 58,642 | 17,764,480 |
| 1970 | 13,112,019 | 296,570 | 3,279,997 | - | 6,665 | 16,695,251 |
| 1971 | 15,706,878 | 283,557 | 2,851,971 | - | 7,380 | 18,849,786 |
| 1972 | 11,247,837 | 199,917 | 1,665,416 | 32,256 | - | 13,145,426 |
| 1973 | 4,710,095 | 230,534 | 897,235 | 59,400 | 170,095 | 6,067,359 |
| 1974 | 6,019,916 | 106,699 | 1,369,159 | 76 | 203,661 | 7,699,511 |

Table 16
MISSISSIPPI AND ALABAMA LANDINGS OF SHRIMP FROM AREA 011.0
Pounds, Heads-On, 1962-74

| Year | Mississippi Heads On Pounds | Per Cent Of Area Total | Alabama Heads On Pounds | Per Cent Of Area Total | Other States Per Cent |
|---|---|---|---|---|---|
| 1962 | 3,562,200 | 61.0% | 2,190,000 | 37.0% | 02.0% |
| 1963 | 4,977,700 | 48.0% | 3,921,400 | 37.0% | 15.0% |
| 1964 | 3,870,100 | 39.0% | 4,487,000 | 45.3% | 16.7% |
| 1965 | 4,326,100 | 31.6% | 6,825,900 | 49.9% | 19.5% |
| 1966 | 4,030,300 | 31.3% | 7,031,900 | 54.6% | 14.1% |
| 1967 | 3,478,400 | 24.3% | 9,566,800 | 67.0% | 08.7% |
| 1968 | 4,530,900 | 26.9% | 10,442,700 | 62.1% | 11.0% |
| 1969 | 3,825,400 | 21.5% | 11,281,900 | 63.5% | 15.0% |
| 1970 | 4,121,700 | 24.6% | 10,338,300 | 58.1% | 17.3% |
| 1971 | 4,054,200 | 21.5% | 12,938,900 | 68.6% | 09.9% |
| 1972 | 2,788,445 | 21.0% | 9,520,154 | 72.0% | 06.0% |
| 1973 | 1,113,150 | 18.8% | 4,512,790 | 76.5% | 04.7% |
| 1974 | 1,831,380 | 24.7% | 5,154,550 | 69.5% | 05.8% |

Table 17
MISSISSIPPI SHRIMP FISHERY 1950-1974
PRODUCTION OF FROZEN HEADLESS
(Thousands of Pounds and Thousands of Dollars)

| Year | Quantity | Value |
|---|---|---|
| 1950 | 5,169 | 2,928 |
| 1951 | 1/ | 1/ |
| 1952 | 4,824 | 2,925 |
| 1953 | 2,714 | 1,696 |
| 1954 | 3,540 | 1,596 |
| 1955 | 3,670 | 2,019 |
| 1956 | 46 | 34 |
| 1957 | 4,594 | 3,047 |
| 1958 | 1,303 | 988 |
| 1959 | 1,824 | 1,058 |
| 1960 | 2,191 | 1,534 |
| 1961 | 1,092 | 821 |
| 1962 | 1,091 | 909 |
| 1963 | 1/ | 1/ |
| 1964 | 1/ | 1/ |
| 1965 | 1/ | 1/ |
| 1966 | 2,848 | 2,628 |
| 1967 | 3,361 | 3,501 |
| 1968 | 3,636 | 4,286 |
| 1969 | 5,880 | 6,938 |
| 1970 | 4,585 | 5,302 |
| 1971 | 5,562 | 7,415 |
| 1972 | 5,057 | 7,570 |
| 1973 | 4,805 | 10,923 |
| 1974 | 5,725 | 9,814 |

1/ Data not available

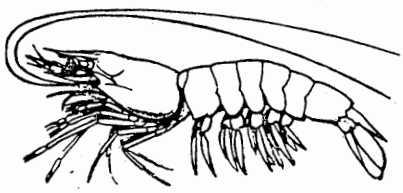


Table 18
MISSISSIPPI SHRIMP FISHERIES
PERCENT OF CERTAIN SIZE GROUPS OF BROWN SHRIMP
TO TOTAL BROWN LANDINGS 1956-1974

| Size Groups | 1956 Percent | 1957 Percent | 1958 Percent | 1959 Percent | 1960 Percent | 1961 Percent | 1962 Percent | 1963 Percent | 1964 Percent | 1965 Percent |
|---|---|---|---|---|---|---|---|---|---|---|
| Under 40 | 32.2 | 28.2 | 42.5 | 17.5 | 37.2 | 35.0 | 23.4 | 42.9 | 23.8 | 17.3 |
| 41-50 | 16.8 | 13.1 | 20.9 | 16.5 | 22.7 | 14.1 | 12.6 | 26.6 | 16.5 | 14.8 |
| 51-67 | 32.8 | 28.7 | 33.2 | 27.1 | 29.9 | 33.8 | 32.0 | 22.5 | 33.2 | 49.2 |
| 68-over | 18.2 | 30.0 | 03.4 | 38.9 | 10.2 | 17.1 | 32.0 | 08.0 | 26.5 | 18.7 |

| | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 |
|---|---|---|---|---|---|---|---|---|---|
| Under 40 | 15.5 | 27.0 | 20.3 | 16.0 | 26.2 | 19.5 | 22.9 | 41.7 | 18.2 |
| 41-50 | 09.9 | 16.9 | 15.0 | 15.6 | 08.3 | 14.8 | 11.5 | 16.2 | 07.6 |
| 51-67 | 26.3 | 36.7 | 32.4 | 46.3 | 27.3 | 27.3 | 19.5 | 19.8 | 27.3 |
| 68-over | 48.3 | 19.4 | 32.3 | 22.1 | 38.2 | 38.4 | 46.1 | 22.3 | 46.9 |

Table 19
MISSISSIPPI SHRIMP FISHERIES
PERCENT OF CERTAIN SIZE GROUPS OF WHITE SHRIMP
TO TOTAL WHITE LANDINGS 1956-1974

| Size Groups | 1956 Percent | 1957 Percent | 1958 Percent | 1959 Percent | 1960 Percent | 1961 Percent | 1962 Percent | 1963 Percent | 1964 Percent | 1965 Percent |
|---|---|---|---|---|---|---|---|---|---|---|
| Under 40 | 66.8 | 66.0 | 65.3 | 73.7 | 77.8 | 75.8 | 54.1 | 52.4 | 76.2 | 54.4 |
| 41-50 | 15.4 | 12.2 | 11.6 | 10.7 | 08.9 | 13.5 | 15.7 | 12.9 | 07.2 | 20.8 |
| 51-67 | 11.3 | 15.7 | 14.6 | 11.0 | 09.0 | 09.3 | 14.7 | 12.9 | 08.3 | 17.9 |
| 68-over | 06.5 | 06.1 | 08.5 | 04.6 | 04.3 | 01.4 | 15.5 | 21.8 | 08.3 | 06.9 |

| | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 |
|---|---|---|---|---|---|---|---|---|---|
| Under 40 | 43.5 | 79.7 | 87.1 | 81.0 | 75.5 | 54.3 | 66.7 | 73.2 | 45.6 |
| 41-50 | 08.2 | 08.2 | 06.6 | 04.5 | 06.5 | 07.7 | 08.2 | 11.9 | 07.8 |
| 51-67 | 12.8 | 09.4 | 04.5 | 07.8 | 06.0 | 17.7 | 11.3 | 08.3 | 13.6 |
| 68-over | 35.5 | 02.7 | 01.8 | 06.7 | 12.0 | 20.3 | 13.6 | 06.6 | 33.0 |

Table 20
ALABAMA SHRIMP FISHERIES
PERCENT OF CERTAIN SIZE GROUPS OF BROWN SHRIMP
TOTAL BROWN SHRIMP LANDINGS, 1956-1974

| Size Groups | 1956 Percent | 1957 Percent | 1958 Percent | 1959 Percent | 1960 Percent | 1961 Percent | 1962 Percent | 1963 Percent | 1964 Percent | 1965 Percent |
|---|---|---|---|---|---|---|---|---|---|---|
| Under 40 | 49.8 | 43.6 | 49.2 | 48.2 | 62.0 | 55.0 | 46.6 | 46.7 | 43.9 | 49.7 |
| 41-50 | 08.1 | 09.0 | 09.8 | 12.4 | 13.5 | 10.5 | 11.4 | 17.8 | 13.3 | 13.5 |
| 51-67 | 27.9 | 19.5 | 24.1 | 15.8 | 17.9 | 14.0 | 20.1 | 28.0 | 18.5 | 23.1 |
| 68-over | 14.2 | 27.9 | 16.9 | 23.6 | 06.6 | 20.5 | 21.9 | 07.5 | 24.3 | 13.7 |

| | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 |
|---|---|---|---|---|---|---|---|---|---|
| Under 40 | 47.6 | 53.8 | 52.9 | 54.9 | 58.3 | 57.3 | 51.1 | 70.4 | 67.5 |
| 41-50 | 10.4 | 12.3 | 10.9 | 12.2 | 09.4 | 14.5 | 08.5 | 12.6 | 09.7 |
| 51-67 | 14.6 | 21.3 | 18.8 | 23.8 | 16.5 | 11.3 | 09.7 | 12.8 | 13.4 |
| 68-over | 27.4 | 12.6 | 17.4 | 09.1 | 15.8 | 16.9 | 16.2 | 04.2 | 09.4 |

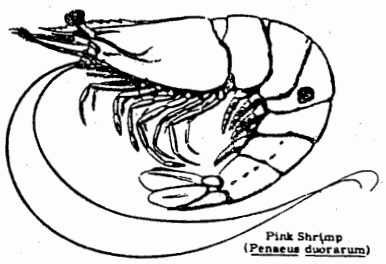
Table 21
ALABAMA SHRIMP FISHERIES
PERCENT OF CERTAIN SIZE GROUPS OF WHITE SHRIMP
TO TOTAL WHITE LANDINGS, 1956-1974

| Size Groups | 1956 Percent | 1957 Percent | 1958 Percent | 1959 Percent | 1960 Percent | 1961 Percent | 1962 Percent | 1963 Percent | 1964 Percent | 1965 Percent |
|---|---|---|---|---|---|---|---|---|---|---|
| Under 40 | 48.8 | 65.7 | 70.7 | 70.4 | 68.2 | 79.4 | 69.1 | 69.6 | 88.4 | 70.8 |
| 41-50 | 14.0 | 08.7 | 10.6 | 08.4 | 10.8 | 08.6 | 11.0 | 17.1 | 06.1 | 15.3 |
| 51-67 | 27.9 | 13.7 | 12.5 | 14.2 | 11.4 | 04.5 | 12.3 | 10.5 | 04.4 | 10.6 |
| 68-over | 09.3 | 11.9 | 06.2 | 07.0 | 09.6 | 07.5 | 07.6 | 02.8 | 01.1 | 03.3 |

| | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974 |
|---|---|---|---|---|---|---|---|---|---|
| Under 40 | 68.2 | 89.0 | 88.7 | 83.6 | 90.7 | 75.0 | 88.1 | 76.5 | 77.9 |
| 41-50 | 08.8 | 05.8 | 05.8 | 08.4 | 04.4 | 15.5 | 05.2 | 12.6 | 08.7 |
| 51-67 | 09.7 | 03.6 | 04.4 | 06.0 | 02.9 | 07.7 | 05.3 | 08.8 | 10.4 |
| 68-over | 13.3 | 01.6 | 01.1 | 02.0 | 02.0 | 01.8 | 01.4 | 02.1 | 03.0 |

Table 22
MISSISSIPPI AND UNITED STATES PRODUCTION
OF CANNED SHRIMP, 1950-1974

| Year | Mississippi No. Firms | Mississippi Standard Cases | Mississippi Value | U. S. No. Firms | U. S. Standard Cases | U. S. Value |
|---|---|---|---|---|---|---|
| 1950 | 19 | 448,902 | 3,417,345 | 50 | 1,747,224 | 12,773,346 |
| 1951 | 16 | 405,273 | 2,738,787 | 45 | 1,935,936 | 12,187,049 |
| 1952 | 16 | 431,447 | 2,968,068 | 43 | 1,817,578 | 12,998,814 |
| 1953 | 16 | 454,811 | 4,116,067 | 43 | 2,257,258 | 18,935,122 |
| 1954 | 16 | 442,651 | 3,269,306 | 43 | 2,077,158 | 13,691,253 |
| 1955 | 11 | 422,567 | 3,239,758 | 36 | 2,022,307 | 13,562,310 |
| 1956 | 11 | 487,080 | 4,111,383 | 36 | 2,020,138 | 16,421,433 |
| 1957 | 13 | 405,462 | 4,535,285 | 46 | 1,351,113 | 13,135,880 |
| 1958 | 13 | 398,227 | 4,768,461 | 51 | 2,119,731 | 20,790,602 |
| 1959 | 9 | 430,747 | 3,873,529 | 46 | 2,049,222 | 16,948,470 |
| 1960 | 12 | 517,431 | 4,781,318 | 45 | 2,113,820 | 17,232,593 |
| 1961 | 11 | 185,453 | 1,943,895 | 44 | 1,375,418 | 11,741,826 |
| 1962 | 11 | 308,962 | 3,345,361 | 46 | 1,962,840 | 18,973,182 |
| 1963 | 10 | 443,331 | 4,069,341 | 40 | 2,356,216 | 19,531,170 |
| 1964 | 9 | 182,118 | 1,747,108 | 33 | 1,442,960 | 12,985,850 |
| 1965 | 9 | 445,708 | 4,462,907 | 36 | 2,315,448 | 20,654,847 |
| 1966 | 9 | 396,800 | 4,071,536 | 34 | 2,103,925 | 21,973,348 |
| 1967 | 10 | 458,618 | 4,854,015 | 36 | 2,496,427 | 24,332,213 |
| 1968 | 10 | 537,072 | 5,767,371 | 39 | 2,809,965 | 29,443,519 |
| 1969 | 10 | 300,786 | 3,546,663 | 38 | 3,071,021 | 27,730,096 |
| 1970 | 9 | 490,334 | 6,366,088 | 36 | 3,722,253 | 37,276,782 |
| 1971 | 10 | 401,160 | 5,286,292 | 32 | 3,310,385 | 33,647,503 |
| 1972 | 9 | 340,976 | 5,807,996 | 30 | 3,525,186 | 41,839,852 |
| 1973 | 9 | 223,811 | 4,814,268 | 32 | 3,737,424 | 55,233,936 |
| 1974 | 8 | 338,643 | 6,613,695 | 31 | 3,277,192 | 44,370,402 |


Pink Shrimp
(Penaeus duorarum)

## THE MISSISSIPPI CRAB FISHERY

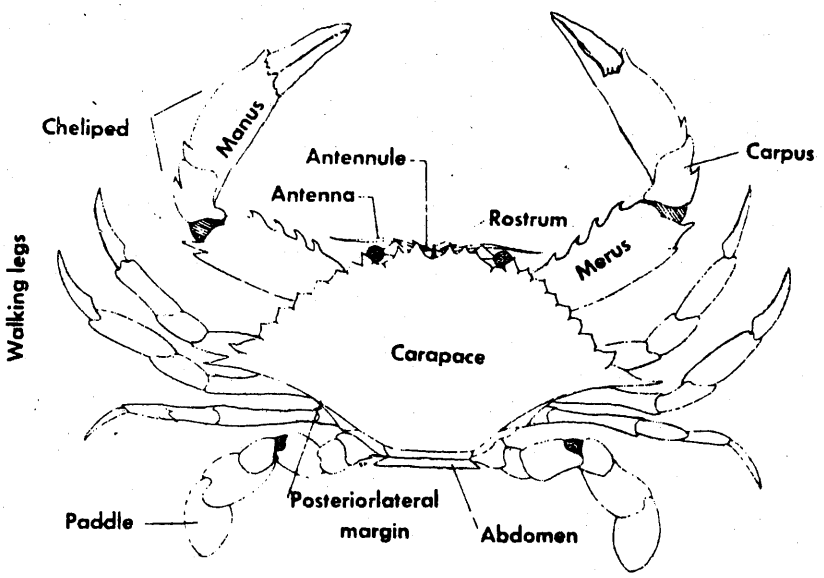
Long before most people have awakened, the Mississippi crab fisherman has loaded his daily supply of bait, refueled his boat and set out for the area where his crab traps are located. He selects the area for a number of reasons, but the more important are available supply of crabs and the least, chance of having the traps robbed by thievery, dragged away by a shrimp or menhaden fisherman. On arrival at his trap line, he locates the trap by means of a buoy which is attached to the trap with about ¼ inch rope about ten feet in length. Buoys are anything from a plastic jug to a plastic net float or cork. As he approaches the trap he catches the buoy with a gaff type device and lifts the trap aboard the boat. As he does this, he sets the steering of the boat in a circular motion so that the craft circles the spot where the trap was raised. The crabber then opens the top of the trap, which is secured by rubber bands and a small hook which fastens into one of the mesh of the trap, turns the trap upside down and dumps the crawling, pinching crustaceans into a container, closes the trap, turns it over, and places the bait in the trap's bait box. His bait is usually mullet, sea cats or other fish he can obtain at a reasonable price. Trap and buoy are then thrown overboard in about the same place from which it was removed. The crabber then steers the boat in the direction of the next trap and the operation is repeated until he has raised all his traps or until he has completed the limit of crabs he has been allotted for the day. During the summer months when catches are large and the market becomes saturated with crab meat, crabbers are often placed on a limit of the number of pounds of live crabs the processing plant will buy in any 24-hour period.

Upon completion of his rounds, he returns to the dock where he unloads the crabs, which may be at the processing plant or at a wharf where his truck is parked. In the latter case, he transports the crabs to the processing plant where they will be cooked and the meat removed. He usually tries to reach the plant before noon since the heat of the summer sun will cause heavy mortality in the animals.

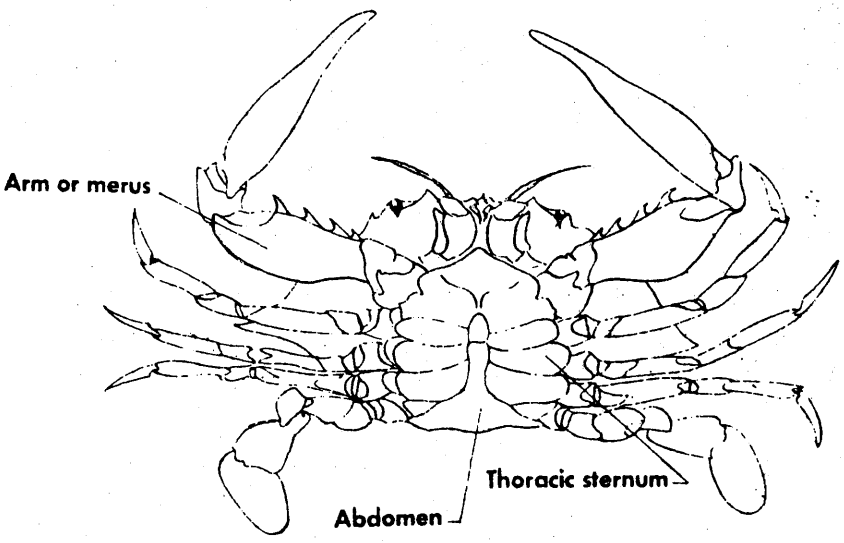
The commercial crab fishery of Mississippi is one of the state's lesser fisheries. Only twice in the past twenty years has the catch exceeded three million pounds. In only one year during that period has the value of landings reached 200 thousand dollars. The catch is largely limited by the quantity of meat that can be marketed. Fluctuations in the catch appear to be governed more by economic conditions than a scarcity of crabs, and while the available catch and effort data is biased because of limits placed on crabbers, it is doubtful that the commercial crabbing fleet is large enough to damage the stocks. Therefore, fluctuations in the catch could be the result of either natural disasters or economic conditions or, what is more likely, a combination of both. A more complete data base must be obtained before a comprehensive analysis can be undertaken. The average number of commercial crabbers in this state is fewer than 75. There is, however, a substantial recreational fishery for crabs. Subsistence [1/] crab fishing for home use is believed to be growing, but probably has little or no effect on the stocks of crabs.

The fishery is restricted to a single species, Callinectes sapidus Rathbun--the common blue crab of the Atlantic and Gulf Coasts. Its preferred habitat is muddy bottom near the shoreline and since a large part of the Mississippi Coastal area generally fits this description, the blue crab flourishes in its coastal waters. The life history of the blue crab is well documented in literature. Churchill, Hay and others have substantiated that female crabs spawn from

# PARTS OF A CRAB




DORSAL VIEW




VENTRAL VIEW

Figure 10

Courtesy of Sandra P. Leary
Texas Parks and Wildlife

700,000 to two million eggs in the more saline waters. The Mississippi Barrier Islands; Cat, Ship, Horn and Petit Bois, appear to be the principal spawning area. Perry [2/] found peak numbers of megalops and zoeae of the blue crab in Dog Key Pass between Horn and Ship Islands. The newly hatched crabs work inland toward the estuarine area where in a favorable environment of reduced salinity and adequate food supply they grow to adulthood. Since the crab is a crustacean, the animal must shed its shell in order to grow. As they approach adulthood, the freshly shed crabs (soft-shells) are sought as a delicacy. The female mates shortly after the last moult, or shedding, while still in the soft shell state and only once. Thereafter she begins to make her way back to a more saline area where spawning takes place. The most favorable area in Mississippi is around the Barrier Islands. Two to nine months may elapse between time of mating and egg laying. Female crabs may spawn twice and occasionally three times before dying, thus each adult female is capable of producing between 1.4 and 4.0 million eggs in her lifespan. Upon completion of the last spawn the female dies. Every year one can observe windrows of spent dead and dying female crabs on the shores of the Barrier Islands in Mississippi whose numbers would doubtless run into the millions. A similar condition occurs along certain Barrier Islands in Louisiana and Texas.

Researchers have found little relationship between spawning stocks and subsequent commercial catches. Therefore, extensive regulation is not believed necessary; however, Perry's studies of the blue crab in Mississippi indicated that seasonal protection of sponge crabs in some areas might be beneficial. Since there are heavy concentrations of spawning females along the Barrier Islands and in fairly shallow water the Marine Conservation Commission, acting in the interest of conservation, created a sanctuary around the Barrier Islands in 1975 (Ordinance 69, Section 2). This action should insure protection for adequate spawning stock for the forseeable future.

It is desperately important that the general public understand the enormous fecundity of the crab and the impact of certain forces of nature on the newly hatched crabs in order to minimize the demand for useless and unnecessary regulation of this fishery.

By way of simple arithmetic we can understand the reproductive capability of this creature. Using Churchill's figure of 700,000 to two million eggs at a single spawning and each female spawning twice, we may assume each female will produce nearly two million eggs in her lifetime. If all crabs reached maturity and at an average of 0.4 pounds per crab, four female crabs could produce all poundage needed in the commercial catch of Mississippi in one year. Of course everyone knows that few of the hatched crabs reach maturity for any of a number of causes. Starvation from lack of food, predation, natural mortality and the effects of environmental factors, specifically rainfall and temperature, on these tiny animals, are a few of the reasons. These factors are more devastating than the effects of fishing.

The Mississippi fishery is prosecuted almost exclusively by the use of pots or traps--a complete change of a quarter of a century back when the traditional line with baits was the chief method of harvesting. The crab trap or pot is a cubical shaped trap with an opening on two sides to permit crabs to enter. A bait box is constructed in the center with an opening at the bottom. The fishery is prosecuted by the use of boats or small craft from 16 to 26 feet. Very few are larger and all are motor powered. Very little regulation is exercised over the crab fishery by the Mississippi Marine Conservation Commission, and that in the form of a license fee of $2.25 for a commercial crab license and an ordinance prohibiting the taking of sponge crabs within one mile of the Barrier Islands. There is no closed season on

taking of crabs in Mississippi nor does one seem necessary.

As previously stated, the available catch and effort data is very limited and contains a bias because of the limits placed on crabbers during the peak abundance of summer months. Therefore, an analysis of the fishery is all but impossible. Because crabbers are usually placed on a limit during the summer months when crabs are most plentiful, effort data must, of necessity, be a function of research and should periodically be done to insure stability in the resource. However, from the data available the resource does not apear to be in danger of overfishing. In fact, there is evidence the fishery could withstand more pressure than is currently exerted. Historical statistics tend to confirm this.

Crabs are marketed mostly as fresh crab meat which has been removed from the cooked crab by hand. Crabs are usually boiled about ten minutes in a brine solution, removed and allowed to cool. The claws and legs are then broken off, the backs removed and the eviscera washed out so that the body of the crab is cleaned and ready for the picker to remove the meat. Pickers are paid by the amount of meat removed; the present rate being fifty cents per pound for lump and claw and forty-five cents for white and fingers. One hundred pounds of crabs will yield from twelve to seventeen pounds of meat, depending on the picker and condition of the crabs.

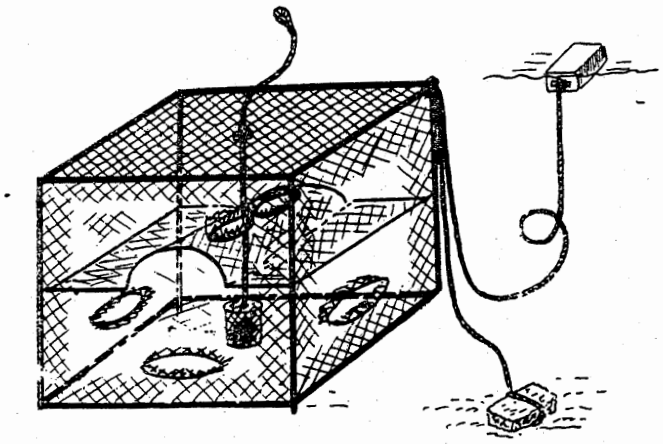
The meat is packed in one or two pound cans, placed in crushed ice and shipped to market. It is usually marketed in four grades; lump, flake, claw and cocktail fingers. The lump meat is that muscle of the crab which moves the swimming leg. It is called back fin lump in some eastern markets and demands the highest price (current market price at Fulton Fish Market, N.Y., is about $4.25-$5.75 per pound, depending on quality). Flake, regular or special is from the muscle of the walking legs of the crab and is next to back fin lump in price. The claw meat is the cheapest in price. It is obtained from the claw of the crab. Many connoisseurs claim it is the sweetest in flavor of all parts of the crab. Cocktail fingers are obtained by removing the shell from around the claw, leaving the meat and one pincer intact.

The crab industry faces some serious problems which are in no way related to resource stability and which do not lend themselves to an easy solution. They are not unique to Mississippi but are common throughout the United States blue crab fishery. The decline as shown from data in table 23 has occurred not from a scarcity of crabs but from the inability to profitably market the prepared product. Inability to retain the meat in cold storage for any extended period and thus spread utilization over the entire year is a serious problem. For example, shrimp harvested in June may not be used until the following June. Crab meat, however, does not have this kind of storage life and when the crab is caught, cooked, and the meat removed, it must be used within a week or so at the most. Pasteurization of the meat has helped some but has not proven to be the all encompassing solution to the storage life problem.

The meat of the blue crab has been canned for many years, but does not seem to have the market appeal of fresh crab meat. Because of the summer peaks in landings and the inability to store the meat in a condition acceptable to the general public, there is a condition of glut and famine in the crab meat market. Prices are lowest during the summer abundance and highest during winter scarcity. Furthermore, the pickers do not always find regular and steady employment during the winter months so that attrition slowly takes its toll in the labor force. Because of the labor problem there is a great need

for a mechanical picking machine. While much engineering skill has been applied to developing such a machine, it has not yet been perfected to such an extent that the labor problem is solved. Furthermore, the uses of crab meat in such prepared dishes as deviled crab, stuffed crab, etc., has declined considerably. The crab meat formerly used in these dishes has been replaced with fish, principally cod and hake. Thus, the crab industry has not only suffered from a labor problem but has lost some of its most profitable markets to a cheaper product. While the resource is apparently no longer in danger from overfishing, serious economic and engineering problems do confront the industry. It will require more than the resource of a single state to solve these problems. No management action is anticipated at present.

Other than establishing a data base, there are no further recommendations at this time. The fishery requires cautious watching. This is to be accomplished by monitoring the larval and juvenile crabs in each year's recruitment and by monitoring the quantity of female crabs destroyed by shrimp trawls in Mississippi Sound south of the tugboat channel.



**Hard crab pot**

1/ Subsistence fishing is defined as a level of fishing somewhat above the recreational level but a condition in which no sales are made.

2/ Perry, Harriet....."Gulf Research Report", Volume 5, No. 1, December, 1975.

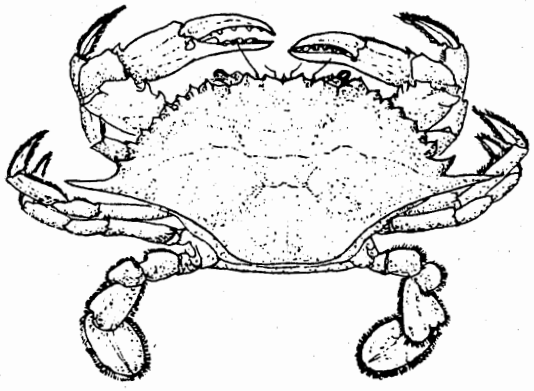
Table 23
LANDINGS OF BLUE HARD CRABS GULF STATES, 1950-1974
(Thousands of Pounds and Thousands of Dollars)

| Year | Fla. West Coast | | Alabama | | Mississippi | | Louisiana | | Texas | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Quantity | Value | Quantity | Value | Quantity | Value | Quantity | Value | Quantity | Value | Quantity | Value |
| 1950 | 684 | 27 | 599 | 26 | 4,040 | 202 | 13,106 | 599 | 387 | 30 | 18,816 | 884 |
| 1951 | 2,076 | 83 | 1,109 | 46 | 1,623 | 82 | 8,710 | 461 | 280 | 24 | 13,798 | 696 |
| 1952 | 1,984 | 89 | 655 | 39 | 1,726 | 86 | 7,334 | 314 | 338 | 24 | 12,037 | 552 |
| 1953 | 3,153 | 126 | 1,087 | 54 | 1,412 | 71 | 8,131 | 333 | 432 | 39 | 14,215 | 623 |
| 1954 | 2,903 | 145 | 972 | 49 | 1,256 | 68 | 7,085 | 294 | 379 | 26 | 12,595 | 582 |
| 1955 | 4,954 | 248 | 1,613 | 81 | 1,763 | 88 | 10,811 | 449 | 356 | 29 | 19,497 | 895 |
| 1956 | 3,728 | 180 | 725 | 36 | 1,979 | 99 | 9,402 | 433 | 195 | 20 | 16,029 | 768 |
| 1957 | 5,302 | 318 | 1,462 | 73 | 2,400 | 144 | 8,559 | 419 | 201 | 11 | 17,924 | 965 |
| 1958 | 8,693 | 461 | 1,182 | 56 | 2,124 | 123 | 9,336 | 402 | 570 | 41 | 21,905 | 1,083 |
| 1959 | 13,895 | 681 | 1,093 | 57 | 3,003 | 165 | 9,570 | 461 | 1,192 | 75 | 28,753 | 1,439 |
| 1960 | 18,648 | 895 | 499 | 26 | 2,812 | 169 | 10,050 | 497 | 2,867 | 177 | 34,876 | 1,764 |
| 1961 | 17,130 | 736 | 838 | 46 | 2,505 | 143 | 11,910 | 514 | 2,875 | 178 | 35,258 | 1,617 |
| 1962 | 10,356 | 487 | 634 | 35 | 907 | 55 | 9,523 | 463 | 4,473 | 289 | 25,893 | 1,329 |
| 1963 | 13,148 | 644 | 1,297 | 75 | 1,112 | 64 | 7,982 | 447 | 2,980 | 199 | 26,519 | 1,429 |
| 1964 | 14,068 | 843 | 1,762 | 110 | 1,286 | 82 | 5,692 | 379 | 2,484 | 175 | 25,292 | 1,589 |
| 1965 | 20,598 | 1,185 | 1,812 | 153 | 1,692 | 131 | 9,284 | 635 | 3,622 | 286 | 37,008 | 2,390 |
| 1966 | 16,547 | 912 | 2,183 | 182 | 1,457 | 105 | 7,986 | 537 | 2,778 | 228 | 30,951 | 1,964 |
| 1967 | 13,976 | 817 | 2,353 | 188 | 1,015 | 79 | 7,559 | 520 | 2,625 | 222 | 27,528 | 1,826 |
| 1968 | 9,008 | 674 | 1,980 | 159 | 1,136 | 108 | 9,551 | 807 | 4,084 | 329 | 25,759 | 2,077 |
| 1969 | 11,584 | 1,074 | 1,920 | 223 | 1,740 | 177 | 11,602 | 1,072 | 6,343 | 599 | 33,189 | 3,145 |
| 1970 | 14,786 | 1,076 | 1,407 | 144 | 2,027 | 193 | 10,254 | 928 | 5,525 | 509 | 33,999 | 2,850 |
| 1971 | 12,279 | 952 | 1,997 | 212 | 1,259 | 126 | 12,186 | 1,256 | 5,810 | 567 | 33,531 | 3,113 |
| 1972 | 10,673 | 959 | 1,613 | 195 | 1,362 | 169 | 15,083 | 1,777 | 6,464 | 653 | 35,195 | 3,753 |
| 1973 | 9,598 | 1,147 | 2,098 | 294 | 1,814 | 231 | 23,080 | 2,811 | 6,738 | 781 | 43,328 | 5,264 |
| 1974 | 9,118 | 1,185 | 1,826 | 284 | 1,667 | 227 | 20,639 | 2,701 | 6,337 | 867 | 39,587 | 5,624 |

Table 24
PRODUCTION OF MISSISSIPPI FISHERIES
FRESH AND FROZEN CRAB MEAT
1950-1974

| Year | Pounds | Value |
|---|---|---|
| 1950 | 424,294 | $ 342,200 |
| 1951 | 1/ | 1/ |
| 1952 | 157,865 | 107,077 |
| 1953 | 170,349 | 138,877 |
| 1954 | 186,577 | 149,260 |
| 1955 | 234,090 | 187,272 |
| 1956 | 262,300 | 262,300 |
| 1957 | 324,420 | 372,805 |
| 1958 | 290,190 | 288,392 |
| 1959 | 421,100 | 421,100 |
| 1960 | 365,300 | 365,300 |
| 1961 | 337,500 | 320,625 |
| 1962 | 120,600 | 120,600 |
| 1963 | 150,205 | 150,205 |
| 1964 | 185,100 | 203,770 |
| 1965 | 249,800 | 274,810 |
| 1966 | 199,300 | 229,815 |
| 1967 | 135,750 | 164,070 |
| 1968 | 192,800 | 242,242 |
| 1969 | 252,200 | 373,800 |
| 1970 | 338,100 | 535,940 |
| 1971 | 498,350 | 827,615 |
| 1972 | 492,950 | 1,019,695 |
| 1973 | 678,480 | 1,658,587 |
| 1974 | 720,700 | 1,586,320 |

1/ Data not available



Blue Crab

## THE MISSISSIPPI OYSTER FISHERY

The oyster fishery of Mississippi is one of the state's valuable marine fishery resources. The value has fluctuated between a low of 238 thousand dollars in 1970 and a high of 1.2 million dollars in 1968. In many years it affords employment to more people than any other fishery except the shrimp fishery. Since 1950 the volume landed has fluctuated between a low of 548 pounds in 1970 and a high of 4.8 million pounds of meats in 1963. The number of oyster fishermen has fluctuated between a low 265 in 1951 and a high 1,299 in 1963. In 1970 it ranked fifth in order of value of the state's fisheries. Ahead were menhaden, shrimp, industrial pet food, and red snapper, in that order. It is the subject of more regulation than any of the state's fisheries, in that two state agencies and the federal government share in regulating the resource, the processed products and its transport and marketing. The nature of the fishery and the nature of the animal make for considerable controversy.

Scientists classify the oyster as a bivalue mollusk, that is, the two sides of its shell are hinged which permits it to open and allow large quantities of water to pass through. By filtering this water the oyster obtains food. The animal is sedentary during its adult life and thereby victim of the viscissitudes of nature and increased predation because of its inability to move. Oysters would not be so much of a problem if they were not sedentary and if man did not consume the entire animal. However, because man does consume the entire animal, and sometimes raw, his filtering of water may present serious health problems if pollution is present. Since the oyster thrives near the shore where there is an optimal mixture of fresh and salt water, he is subjected to serious pollution problems from drainage of polluted land areas and serious predation from conchs, boring clams and sponges. He is also preyed upon by man, by crabs and by large fish. He is subjected to several very devastating diseases and because he cannot move, he may be destroyed by sudden influx of fresh water brought on by floods. It is no small wonder that he has survived all these and the man-made changes that have occurred in his environment.

The oyster is a very prolific spawner and in the warm climate of the Gulf Coast may produce spawn in every month of the year. As a result, there is seldom a scarcity of natural spawn. Climatic conditions, however, may result in poor survival of the spat, or the immature oysters may be killed by predators before reaching market size. If the animal survives these, it may be declared unfit for food because of pollution.

Management of the oyster fishery is the responsibility of the Mississippi Marine Conservation Commission and the State Health Department. The Federal Health, Education and Welfare Department issues approved permits for interstate shipment of shellfish based on recommendations of the State Health Department. Interstate shipment of oysters without a federal permit makes the commodity subject to federal seizure. The United States General Accounting Office has reported, in an investigation of the system of control by the Health, Education and Welfare Department, that it has not worked well in protecting the public from polluted shellfish. Considering the volume of oysters and clams shipped and the relatively few cases of illnesses that have occurred, it is doubtful that the oyster problem is any more serious than, say, canned tuna, mushrooms, string beans, or other food products that cause illnesses. Certainly it is not the health hazard that cigarettes, alcohol or dope presents since illnesses from eating shellfish is minimal compared with some 80,000

deaths annually from smoking and an equal number from the use of alcohol. However, this does not mean that some improvement could not be effected, despite its being a minor cause of illness or death.

Oysters are considered to be unfit for human consumption when bacteria E. coli, which inhabit the intestines of warm-blooded animals, are found to be present in the water where the oyster is harvested, at a rate of 70 mpn (per 100 milliliters of water). The count is based on several samples taken at differing time sequences. In Mississippi, the count is taken by the State Health Department. When the bacteria count has reached the critical point, an area is closed by the Health Department through notification to the Mississippi Marine Conservation Commission. It is then the Conservation Commission's responsibility to patrol the reef twenty-four hours a day, the entire year, to see that no oysters are removed. No reimbursement is made to the commission for this patrol work.

Oysters may be taken in Mississippi from September 1 to May 30 of each year by means of a type of gear legal for the area and in areas determined to be safe from contamination. Oysters may be taken in Mississippi in certain areas only by tongs or by hand. The areas reserved for tongers and hand harvesters are Bangs Lake, lower Bayou Cumbest, Heron Bayou, Pass Christian tonging reef, Waveland reef, and between bridges at the mouth of Bay St. Louis. Oysters may be taken in the following areas by tong or dredge: Henderson Point, St. Joe and Square Handkerchief and Pass Marianne Reefs.

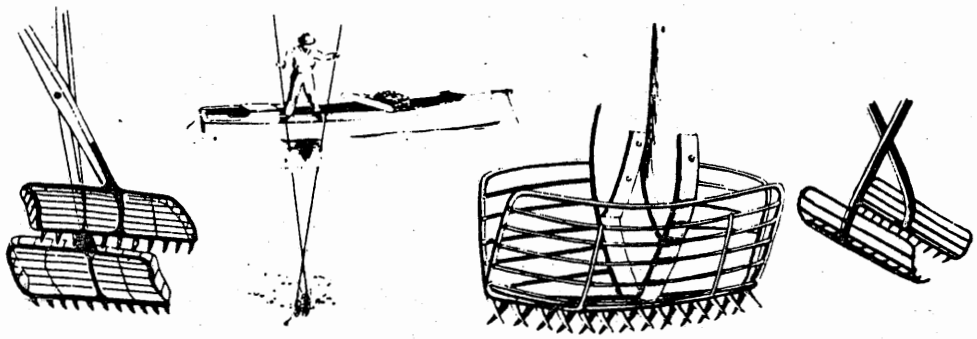
In addition to its own reefs, Mississippi obtains large quantities of oysters from the natural or wild reefs in Louisiana waters east of the Mississippi River. During the past thirty years the areas in Louisiana in which Mississippi oystermen are permitted to work have been decreasing and others have become less productive.

While some oysters are sold alive in the shell in burlap bags as sack oysters, most are processed in some form. This has not always been true as Mississippi at one time did a large sack and raw oyster business.

Oysters are processed in Mississippi for the fresh trade by removing the shells (called opening or shucking), washing the meat, packing in 12 ounce, pint or gallon containers. The oysters thus prepared are fresh and must be kept iced until sold. Oysters used for canning (placed in cans hermetically sealed and heat treated) arrive at the cannery aboard a dredge boat. The dredge boats generally fill the hold of the boat as well as the decking which has been reinforced along the sides to hold larger quantities of oysters. Upon arrival at the plant, the vessel is securely tied and the oysters are unloaded by means of a large bucket which holds about three-quarters of a barrel. This bucket is filled by one man using a coal shovel and when loaded is swung around to the conveyor by means of a boom and a winch. From here the oysters are moved by conveyor to the washing machine which is a horizontal, cylindrical device constructed of rods or perforated sheet metal to permit mud and other detritus to fall out but retain oysters. The machine is rotated by an electric motor. The washer is about 32 inches in diameter. Streams of jet-sprayed water hit the oysters and wash off most of the foreign material as they pass through the washer. It rotates and moves the oysters along to the exit. Many packers contend that the washing machine is the key to the success of the shucking machine. From the washing machine, they are conveyed by belt to the cooker. The cooker is a retort-type cooker capable of holding about thirty barrels of oysters when full. Unlike the old steam car horizontal cooker, the newer ones stand in a vertical fashion with oysters dropped at the top by a conveyor belt. Most of the packers do not fill the

# OYSTER GEAR

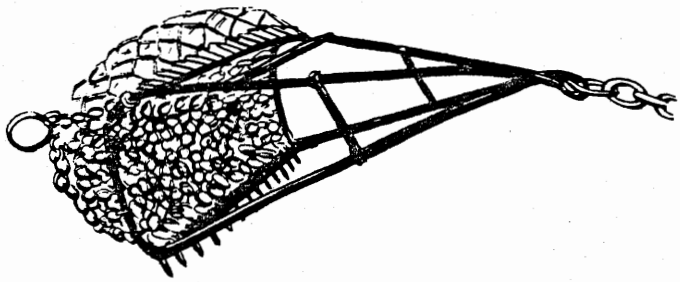
Hand tongs are actually a pair of rakes attached to the end of two long poles (up to twenty feet in length) which are fastened together like a pair of scissors, with the fulcrum near the lower end. A basketlike frame is attached to the back side of each rake in order to hold the catch.



**Hand tongs**

Figure 11

EASTERN OYSTER
*Ostrea virginica*



**Oyster dredge**

Figure 12

retort completely as it may range from half to three quarters full when closed and steam applied. The oysters are cooked under steam pressure of about twenty pounds per square inch. The cooking starts at 140-150° F. where it is held for about eight minutes. Then the steam is allowed to rise to twenty pound pressure for about 1½ minutes. When this is completed, the side of the retort is opened and some of the oysters fall out on the conveyor belt where they are carried to the shucking machine. A man stands by and sees that the conveyor belt is evenly loaded at all times and moves, as need governs, the amount of cooked oysters that will be released to the shucking machine. The shucking machine is a cylindrical device which, while it is rotating, knocks the cooked oysters open and the meat falls out between the bars and into a tray where it is removed to the packers. The shucking machine does a very efficient job during the colder months of the year but as the oysters become more milky, the machines become less efficient and have a tendency to break up the oyster meats. When the oysters have passed from the shucking machine, the shells are conveyed to the outside where they are ultimately removed and used in some commercial manner. The whole oysters are placed in cans, each containing 4 2/3 oz., sealed and moved to the retort where they are pressured for about twelve to fifteen minutes at 240 pounds. Each retort must have a recording device to insure that the temperature has remained stable throughout the cooking. Oystermen who harvest for the canneries are paid by the yield per can on each trip, usually running about twenty to twenty-five cents per can, depending on market conditions. The broken pieces are paid for at a different rate, usually about half that of the whole oysters. After the canned oysters are processed in the retort, they are allowed to cool and are removed to the warehouse where they are labeled and cased for shipment. Each case contains twenty-four cans, each can 4 2/3 oz. drained weight.

The market for canned oysters is centered in the midwestern states since the proximity to the fresh oysters in coastal areas precludes extensive marketing of the canned stock. This market was formerly supplied entirely by domestic production but in recent years imports have created serious problems for Mississippi oyster canners in that foreign produced oysters are much cheaper than domestic pack. In recent years United States packers have a tendency to pack only that which can be easily sold. Not only have imports created serious sales problems, but while United States packers have been subjected to standards as rigid for the canned pack as for the raw trade, oysters canned in foreign countries are not necessarily subjected to the same high standards. This means that United States packers are placed at a disadvantage because of the cost of meeting these standards. Much of the imported product, if canned in the United States, would be condemned by United States Food and Drug Administration. In reality the United States Government operates a double standard for canned oysters--one standard for the domestic packer, which is very high, and another standard for foreign canned pack with no enforceable standards. An example of the seriousness of the import matter is to be found in Table 29, Imports and Domestic Production of Canned Oysters. Note how imports have risen while the domestic pack declined. In 1950, the United States imported only 439 thousand pounds.

While most steam stock (oysters for canning) are taken by use of dredge and by comparatively few vessels, the raw trade oysters (those iced and sold fresh) are taken with dredge and by tongers or they are trucked in from other states. A few dredge boats work for the raw trade but the number is limited. Louisiana and Texas have, historically, been the chief source of sack osyters used in the raw trade.

The tonger is generally an independent operator with small investment and limited financial resources to fall back on in times of disaster. He supports his family in part or wholly from his earnings at sea. Therefore, when his livelihood is affected, he might reasonably be expected to be heard from, and most often is. Unfortunately, his concern is seldom directed at those who have been largely responsible for creating his problem; namely, those responsible for allowing pollution of the waters where he has historically made his living. It is extremely doubtful that most oystermen understand the source of their problem. Their wrath is most often directed to the Marine Conservation Commission, when in reality the commission had no part nor was it consulted concerning the creation of the problem. Consequently, the problem is heated up by the ignorant, the law violator and the common agitator whose ambition is economic gain despite the health hazard to the public. Legislators quite often react to this kind of pressure and not always with the wisdom which the problem demands.

The development of the coastal area of Mississippi has been very rapid in the past fifteen years. Both industrial and tourist establishments have become more numerous and home building has expanded rapidly and not always in a well planned manner. Sewer facilities have, at times, been almost non-existent and those that did exist were not always operable, as evidenced by the outbreak of hepatitis from eating oysters from polluted reefs near Pascagoula in 1961. This encroachment of sewage over some of the best oyster reefs has resulted in their condemnation and thus curtailing production. It also resulted in at least one death.

In the early years of the oyster fishery in Mississippi, that is, near the turn of the century, there were comparatively few people residing on the coast and human waste was not a serious problem. Furthermore, Mississippi's oyster fishery was then more steam stock oriented than at present. Foreign competition in canned oysters just did not exist. It was possible to obtain large quantities of oysters from the Louisiana marshes east of the Mississippi River because Louisiana's oyster industry could produce most of the oysters needed for their own use west of the river. As years passed Louisiana oystermen turned more and more to the wild reefs east of the river for seed stock, which were transplanted west of the river on leased cultivated grounds. In addition, some of the grounds east of the river were leased to private growers who farmed their own oysters, thus removing these areas from wild harvest and further curtailing Mississippi's ability to harvest oysters in Louisiana waters. After World War II, imports of canned oysters began to enter the United States in increasing quantities. In 1969, United States canners were so hard pressed by competition from imports that they planned to present their case to the Tariff Commission. Canners went to a great deal of expense and effort in preparing a case but before the hearing could be held Hurricane Camille struck the Gulf Coast in August, destroying most of the spring pack still held in the warehouses. The packers were in no financial condition, nor did they have the time to present their case, so the matter was dropped. Needless to say that, with increasing imports at lower prices, increasing costs of raw material and labor for the domestic production, packers curtailed production.

The problem of quality also gives domestic producers considerable trouble. The domestic pack must be produced from pollution-free reefs and under sanitary conditions (a group of regulations by the Food and Drug Administration called "Good Manufacturing Practice"). Not so with the foreign pack, much of which may, and often does, come from polluted areas and is produced under conditions which in the United States would be classified by the Health Department as

unsanitary and therefore unfit for human consumption.

The areas closed to oystering during the period covered by this report represents a large portion of the total oyster reefs in Mississippi. Back Bay reefs contain substantial quantities of oysters and forty years ago yielded many thousands of bushels of oysters for canning and raw trade. It was closed in the forties because of pollution and now can only be used as an area from which oysters can be taken for seed or for depuration. In 1950, the closure line was extended south of Highway 90 bridge from Ocean Springs to Biloxi, and thus additional productive acreage was lost. In 1964, an additional closure was made, this time from Grand Bayou on Deer Island to Ocean Springs Harbor. This dealt a severe blow to the reefs in the mouth of Biloxi Bay, those off the east side of Deer Island and off Ocean Springs. Again the cause was pollution from the cities of Biloxi and Ocean Springs. Continuing buildup of pollution caused the closing in 1967 of all reefs from the eastern tip of Deer Island to Marsh Point. They remain closed. The responsibility for this situation, which costs jobs and income, lies with city and county planners and elected officials that have permitted urbanization without adequate sewage treatment facilities. Furthermore, there has been little attempt to enforce the few, weak anti-dumping laws that do exist. They are so woefully unenforced that literally thousands of small dumps litter the area containing everything from disposable diapers to dead animals, the decay of which finally wash into the bays and streams from which we could take oysters.

As mentioned previously, there are substantial oyster reefs off Gautier, and at the mouth of the Pascagoula River. An outbreak of hepatitis in 1961, resulting in one death, was traced to eating oysters produced from these reefs. This resulted in the closing of all reefs in Jackson County from the mouth of Graveline Bayou east to Bayou Cassotte. Except for Bangs Lake and parts of Bayou Cumbest, legal oyster harvesting in Jackson County was then, and still is, a thing of the past. It should be pointed out that the action which caused the closing of the Pascagoula and Gautier reefs came about as a result of a breakdown in a municipal sewage disposal plant. The municipality failed to notify the Health Department of the breakdown, that raw sewage was bypassing the plant and being dumped into the river. Had this been done, the reefs would doubtless have been closed by the State Health Department and a life could have been saved. But, in any case, the reefs were lost and remain lost as a source of employment and income to the state. Probably no less than 500 jobs have been lost by the cumulative action of pollution on oyster reefs in Mississippi waters.

In the western part of the state the reefs to the seaward of Pass Christian remain open. Those north of Highway 90 bridge across Bay St. Louis are closed. The Pass Christian reef suffers severe predation by conchs in very dry years and from die offs due to low salinity in very wet years.

Hurricane Camille, which struck the coast of Mississippi in 1969, destroyed most of the oyster reefs in Mississippi. Then began the slow process of rebuilding the destroyed reefs. Oyster production dried up, jobs on the reefs and in the shucking plants disappeared. People who made their living oystering began pressuring for action. Rebuilding the reefs under conditions of this type is slow, costly, and not always successful, and before they were completed still another disaster struck--the floods of 1973.

With the use of federal funds (88-309-4b), and under the supervision of William J. Demoran, the reefs off Pass Christian were planted with clam shells in 1973. Good sets occurred during late 1973 and throughout 1974. The reefs

remained closed during 1974. In late 1975 two small keys were opened with good harvest success. The remainder of the reefs were opened in January, 1976, again with good harvesting success.

The oyster-producing fleet is generally made up of two distinctly different types of craft. The tonger usually has a skiff or small boat from which he tongs. Some of these smaller craft also pull a small dredge. These fishermen usually return to the dock each night with the days catch. The larger dredge vessel is constructed with relatively low gunwales which permit hauling the dredge over the side. These craft are designed to operate in relatively shallow water. Most are older vessels as no new ones are being built because of the evershrinking area open to harvesting and continued imports of canned oysters.

Problems of the oyster industry of Mississippi can be summed as follows: (1) Loss of the most productive reefs to pollution. Of the approximately 2,030 acres of oyster bottoms in Mississippi, over 1,000 acres are closed because of pollution (personal communication with Demoran), (2) Fluctuations in the yield of some reefs caused by damage from conchs in dry years and mortality from fresh water in wet years, and (3) Severe competition from imports of canned oysters.

Recommendations - (1) The area on both sides of Highway I-10 will doubtless experience tremendous industrialization and urbanization within the next decade. Sewage, even though treated along with industrial wastes, will doubtless render all oysters from Mississippi reefs unfit for use as human food. One alternative available is construction of a depuration plant to cleanse these shellfish for human use. Another would entail moving oysters to clean waters. In the summer of 1976, after a study conducted by Mr. Clyde McKenzie, National Marine Fisheries Service, the Mississippi Marine Conservation Commission began moving oysters from polluted reefs off Point Cadet to the Pass Christian tonging reef. One of the problems in the past has been the long delay in loading a barge with dredged oysters, getting it to the area for depuration and offloading the oysters. The method suggested by McKenzie permitted loading eight hundred barrels one day and offloading the next, so that at no time were any of the oysters out of the water more than 36 hours. Many were out less than twelve hours. During late July and August more than eight thousand barrels were moved to clean water to permit natural depuration. The cost was about $1.50 per barrel. This operation can become feasible by increasing the severance tax on oysters and financing the operation on a continuing basis by general fund appropriation. There should be a study to determine the feasibility from the standpoint of economics. If these methods cannot be made to pay, the problem becomes more serious.

(2) A study is being conducted by the Gulf Coast Research Laboratory to determine whether or not there are any areas in Mississippi Sound where oysters might be grown where they are not presently growing. If such areas can be found, reefs may be constructed and oysters may be transferred to these areas for natural depuration. However, it must be shown that this can be accomplished in a manner that is not a constant drain on the State Treasury.

(3) If transferring oysters to clean waters can be made to pay, then a program should be established to move large quantities during the closed season and allow almost complete harvesting of these oysters during the cooler months.

Table 25

OYSTER LANDINGS - GULF STATES - BY STATES - 1950-1973

(Thousands of Pounds of Meats and Thousands of Dollars)[1/]

| Year | Florida West Coast | | Alabama | | Mississippi | | Louisiana | | Texas | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Quan. | Value | Quan. | Value | Quan. | Value | Quan. | Value | Quan. | Value | Quan. | Value |
| 1950 | 873 | 392 | 2,070 | 534 | 2,188 | 623 | 7,036 | 2,416 | 125 | 45 | 12,292 | 4,010 |
| 1951 | 681 | 368 | 2,191 | 761 | 1,623 | 487 | 6,569 | 1,426 | 456 | 139 | 11,520 | 3,181 |
| 1952 | 542 | 108 | 1,842 | 573 | 2,852 | 847 | 8,573 | 2,237 | 828 | 252 | 14,637 | 4,017 |
| 1953 | 564 | 62 | 1,450 | 485 | 3,758 | 892 | 5,995 | 1,858 | 1,069 | 265 | 12,836 | 3,562 |
| 1954 | 667 | 140 | 739 | 172 | 3,339 | 683 | 5,999 | 1,867 | 699 | 193 | 11,443 | 3,055 |
| 1955 | 630 | 138 | 1,581 | 338 | 3,973 | 818 | 7,154 | 2,285 | 543 | 161 | 13,881 | 3,740 |
| 1956 | 857 | 206 | 769 | 174 | 3,781 | 778 | 7,121 | 1,633 | 985 | 286 | 13,513 | 3,077 |
| 1957 | 710 | 199 | 1,291 | 288 | 3,533 | 740 | 7,820 | 2,202 | 953 | 262 | 14,307 | 3,691 |
| 1958 | 795 | 218 | 458 | 111 | 1,857 | 391 | 6,987 | 2,158 | 311 | 119 | 10,408 | 2,997 |
| 1959 | 1,415 | 405 | 895 | 278 | 1,095 | 257 | 8,905 | 2,471 | 1,411 | 396 | 13,721 | 3,807 |
| 1960 | 1,931 | 483 | 1,169 | 317 | 2,391 | 535 | 8,311 | 2,304 | 2,296 | 655 | 16,098 | 4,294 |
| 1961 | 3,255 | 1,032 | 508 | 162 | 3,241 | 753 | 10,139 | 2,849 | 1,096 | 329 | 18,239 | 5,125 |
| 1962 | 4,952 | 1,406 | 443 | 164 | 2,074 | 538 | 10,160 | 3,317 | 1,211 | 473 | 18,840 | 5,898 |
| 1963 | 4,282 | 1,225 | 995 | 352 | 4,680 | 975 | 11,563 | 3,720 | 2,618 | 914 | 24,138 | 7,186 |
| 1964 | 2,793 | 781 | 1,005 | 324 | 4,829 | 1,099 | 11,401 | 2,976 | 3,357 | 1,093 | 23,385 | 6,273 |
| 1965 | 2,789 | 938 | 493 | 207 | 2,696 | 627 | 8,343 | 2,402 | 4,835 | 1,538 | 19,156 | 5,712 |
| 1966 | 4,157 | 1,296 | 1,304 | 607 | 2,232 | 597 | 4,764 | 2,156 | 4,725 | 1,837 | 17,182 | 6,493 |
| 1967 | 4,578 | 1,427 | 2,087 | 1,008 | 3,786 | 1,066 | 7,743 | 3,414 | 3,553 | 1,571 | 21,747 | 8,486 |
| 1968 | 5,318 | 1,754 | 1,211 | 608 | 3,786 | 1,163 | 13,122 | 5,305 | 3,302 | 1,444 | 26,739 | 10,274 |
| 1969 | 4,912 | 1,851 | 481 | 251 | 1,430 | 552 | 9,178 | 3,969 | 3,764 | 1,525 | 19,765 | 8,148 |
| 1970 | 3,573 | 1,475 | 279 | 158 | 548 | 238 | 8,639 | 3,631 | 4,675 | 2,040 | 17,714 | 7,542 |
| 1971 | 3,529 | 1,568 | 249 | 152 | 1,214 | 472 | 10,625 | 4,686 | 4,744 | 2,378 | 20,361 | 9,256 |
| 1972 | 3,231 | 1,510 | 1,069 | 701 | 1,220 | 581 | 8,805 | 4,457 | 3,935 | 2,507 | 18,260 | 9,756 |
| 1973 | 2,409 | 1,494 | 591 | 496 | 612 | 366 | 8,953 | 5,544 | 2,349 | 1,813 | 14,914 | 9,713 |

1/ Data are shown in pounds of meats:
Meat yields vary with season.

Size of state bushel and barrels varies.
Florida - 3214.1 cu. inches
Alabama - 2826.2 cu. inches
Texas - 2700.0 cu. inches

The following are bushel sized in Gulf states:
Mississippi - 2826.2 cu. inches
Louisiana - 2148.4 cu. inches

Table 26
MISSISSIPPI OYSTER FISHERY
Total Fishermen and Craft 1950-1973

| Year | Fishermen Number | Vessels Number | Boats Number |
|---|---|---|---|
| 1950 | 632 | 113 | 90 |
| 1951 | 265 | 28 | 64 |
| 1952 | 291 | 34 | 56 |
| 1953 | 645 | 116 | 85 |
| 1954 | 761 | 97 | 340 |
| 1955 | 801 | 116 | 320 |
| 1956 | 884 | 150 | 292 |
| 1957 | 868 | 143 | 310 |
| 1958 | 913 | 158 | 337 |
| 1959 | 794 | 103 | 385 |
| 1960 | 1,140 | 133 | 662 |
| 1961 | 1,201 | 162 | 701 |
| 1962 | 1,209 | 145 | 704 |
| 1963 | 1,299 | 196 | 663 |
| 1964 | 1,261 | 192 | 590 |
| 1965 | 1,004 | 120 | 582 |
| 1966 | 1,016 | 124 | 610 |
| 1967 | 1,203 | 191 | 583 |
| 1968 | 1,130 | 191 | 532 |
| 1969 | 804 | 81 | 514 |
| 1970 | 708 | 81 | 684 |
| 1971 | 874 | 88 | 505 |
| 1972 | 642 | 86 | 1,020 |
| 1973 | 784 | 68 | 483 |

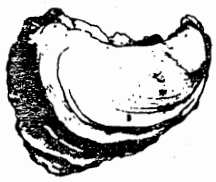


Table 27
MISSISSIPPI OYSTER FISHERY
Shucked Oyster Production 1950-1974

| Year | Gallons 1/ | Value |
|---|---|---|
| 1950 | 11,827 | 59,066 |
| 1951 | 2/ | 2/ |
| 1952 | 2,717 | 18,282 |
| 1953 | 39,182 | 215,189 |
| 1954 | 33,352 | 183,437 |
| 1955 | 65,198 | 357,621 |
| 1956 | 77,760 | 464,380 |
| 1957 | 75,170 | 457,155 |
| 1958 | 47,266 | 293,442 |
| 1959 | 42,408 | 265,283 |
| 1960 | 49,850 | 314,600 |
| 1961 | 116,300 | 726,825 |
| 1962 | 108,068 | 702,444 |
| 1963 | 101,322 | 658,592 |
| 1964 | 136,980 | 890,355 |
| 1965 | 119,080 | 833,560 |
| 1966 | 92,350 | 766,505 |
| 1967 | 89,130 | 748,780 |
| 1968 | 114,430 | 1,009,685 |
| 1969 | 130,400 | 1,106,750 |
| 1970 | 179,500 | 1,568,325 |
| 1971 | 192,750 | 1,688,825 |
| 1972 | 189,850 | 1,898,500 |
| 1973 | 150,800 | 1,804,600 |
| 1974 | 164,100 | 2,292,400 |

1/ - 1 gallon equals approximately 8.75 pounds

2/ - data not available

Table 28
Mississippi Oyster Fishery
Production of Canned Oysters, Mississippi and U.S. - 1950-1974

| Year | Mississippi No. Firms | Mississippi Standard Cases | Mississippi Value | U.S. Total No. Firms | U.S. Total Standard Cases | U.S. Total Value |
|---|---|---|---|---|---|---|
| 1950 | 18 | 148,840 | 1,179,746 | 57 | 984,780 | 7,096,235 |
| 1951 | 11 | 145,980 | 888,542 | 46 | 932,668 | 5,931,276 |
| 1952 | 16 | 306,954 | 2,079,152 | 46 | 1,058,286 | 7,047,441 |
| 1953 | 16 | 247,248 | 1,713,525 | 34 | 997,816 | 6,559,309 |
| 1954 | 14 | 211,844 | 1,450,576 | 41 | 932,168 | 5,829,378 |
| 1955 | 14 | 233,548 | 1,518,892 | 44 | 1,119,204 | 7,003,967 |
| 1956 | 14 | 196,014 | 1,317,861 | 30 | 930,256 | 6,256,581 |
| 1957 | 11 | 211,842 | 1,565,663 | 37 | 997,352 | 7,008,471 |
| 1958 | 12 | 96,402 | 735,263 | 37 | 797,102 | 5,444,713 |
| 1959 | 8 | 46,164 | 359,068 | 28 | 842,234 | 5,720,918 |
| 1960 | 9 | 127,660 | 979,279 | 31 | 821,042 | 5,640,280 |
| 1961 | 11 | 193,718 | 1,332,309 | 33 | 891,370 | 5,776,364 |
| 1962 | 10 | 99,124 | 675,811 | 26 | 643,010 | 4,556,815 |
| 1963 | 10 | 278,988 | 1,646,583 | 27 | 892,688 | 5,632,817 |
| 1964 | 10 | 217,088 | 1,424,196 | 28 | 844,522 | 5,291,680 |
| 1965 | 8 | 128,738 | (1) | 21 | 576,100 | 3,700,653 |
| 1966 | 8 | 140,783 | (1) | 20 | 400,000 | 3,201,143 |
| 1967 | 9 | 207,370 | (1) | 22 | 660,374 | 6,152,076 |
| 1968 | 9 | 185,355 | (1) | 22 | 650,962 | 5,623,645 |
| 1969 | 6 | 18,874 | (1) | 16 | 285,696 | 2,163,504 |
| 1970 | 4 | 29,263 | (1) | 12 | 271,968 | 2,101,517 |
| 1971 | 6 | 63,971 | (1) | 18 | 483,812 | 4,813,700 |
| 1972 | 7 | 63,826 | (1) | 19 | 399,679 | 4,292,030 |
| 1973 | 6 | 35,487 | 457,007 | 16 | 294,054 | 3,688,231 |
| 1974 | 6 | 20,171 | 246,574 | 14 | 282,676 | 3,265,630 |

(1) Data not available

Table 29
UNITED STATES IMPORTS OF OYSTERS, 1950-1974
(Thousands of Pounds and Thousands of Dollars)

| Year | Pounds | Value |
|---|---|---|
| 1950 | 439 | $ 263 |
| 1951 | 1,020 | 540 |
| 1952 | 613 | 358 |
| 1953 | 670 | 385 |
| 1954 | 1,128 | 618 |
| 1955 | 1,417 | 673 |
| 1956 | 1,921 | 814 |
| 1957 | 2,676 | 1,009 |
| 1958 | 5,379 | 1,578 |
| 1959 | 5,953 | 1,964 |
| 1960 | 7,025 | 2,276 |
| 1961 | 7,701 | 2,434 |
| 1962 | 7,830 | 2,810 |
| 1963 | 8,463 | 3,101 |
| 1964 | 7,969 | 2,876 |
| 1965 | 8,638 | 3,225 |
| 1966 | 12,015 | 4,494 |
| 1967 | 16,114 | 5,845 |
| 1968 | 14,499 | 5,640 |
| 1969 | 16,720 | 6,373 |
| 1970 | 14,953 | 8,140 |
| 1971 | 9,452 | 6,545 |
| 1972 | 20,848 | 13,763 |
| 1973 | 19,850 | 11,628 |
| 1974 | 16,010 | 10,130 |

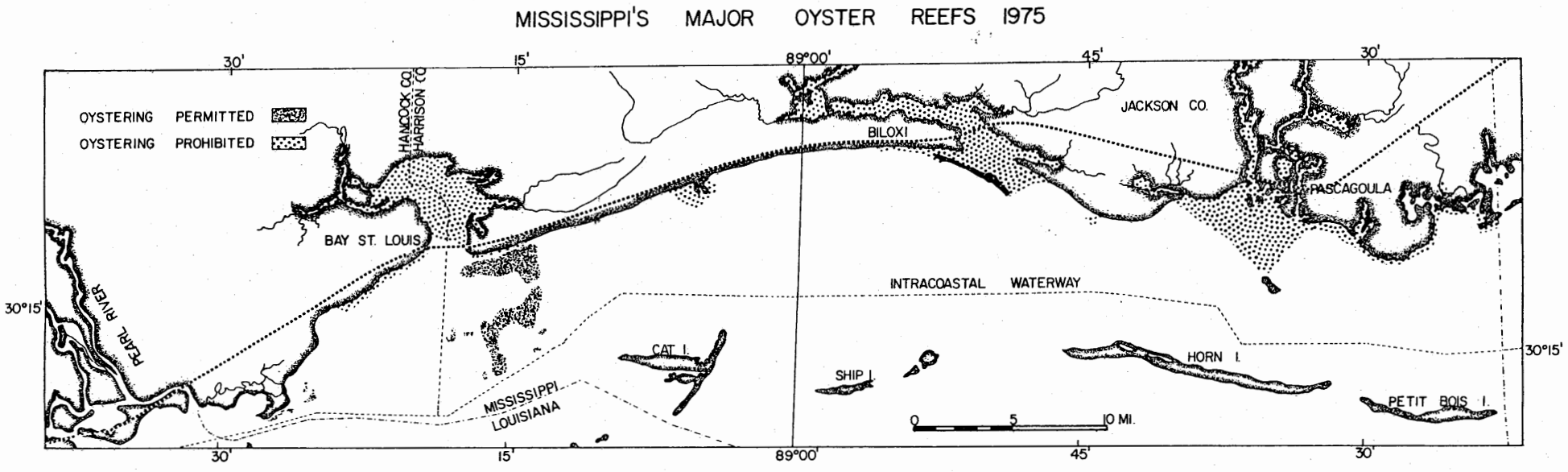

MISSISSIPPI'S MAJOR OYSTER REEFS 1975
30'
15'
89°00'
45'
30'
OYSTERING PERMITTED
OYSTERING PROHIBITED
HANCOCK CO.
HARRISON CO.
BILOXI
JACKSON CO.
PASCAGOULA
BAY ST. LOUIS
INTRACOASTAL WATERWAY
30°15'
PEARL RIVER
CAT I.
SHIP I.
HORN I.
PETIT BOIS I.
MISSISSIPPI
LOUISIANA
0 5 10 MI.

Figure 13

## THE MISSISSIPPI PET FOOD FISHERY

The use of fish discarded in harvesting the commercial catch has long been a problem of concern to fishery scientists and administrators alike. As early as the late 19th century we note mention of the problem in the report of the United States Fish Commission. The problem became more acute with the development of the shrimp fishery of the South Atlantic and Gulf and the dramatic increase of discards of unsaleable species taken in connection with this fishery. The Bureau of Fisheries established a station at Pascagoula, Mississippi in late 1949 and began exploratory fishing in the Gulf of Mexico. An employee of the agency, who had formerly worked for Quaker Oats, called attention to that company's California office the enormous quantities of fish discarded in the shrimp fishery and their suitability for use as pet food. As a result of this and overtures from elected officials of Jackson County, Quaker Oats established a plant on the east bank of the Pascagoula River in 1952. The pilot operation was designed to use the discards from shrimp catches as the basic protein in pet food.

In the initial operation there were no catcher vessels fishing solely for the pet food plant. Instead the company paid shrimp fishermen $22 per ton for fish they normally would have discarded. This proved unsatisfactory primarily for two reasons. During periods of scarcity of shrimp much of the fleet was idle and would not fish for the bottomfish for $22 per ton and during periods of great abundance of shrimp fishermen were reluctant to spend time icing down and caring for the discards at $22 per ton at the risk of not being able to care for the more profitable shrimp catch. Thus, the plant was, at times, without sufficient supplies of fish to provide for normal operations. This forced the plant to employ vessels to specifically fish for bottomfish for use in pet food.

The pet food fleet thus evolved from the shrimp fleet and was composed mostly of Florida type and Biloxi type trawlers formerly used as shrimp vessels whose owners found the year around guarantee of the saleability of the pet food catch more lucrative than the hit or miss shrimping operations. The earliest data available on physical characteristics of the fleet was for the year 1960 (Fishery Statistics of the U. S.--Power). In that year sixty-five vessels fished pet food for plants in Mississippi and they averaged 39 gross tons. They were fifty to sixty feet in length and of an average age equaling the shrimp fleet--about fourteen years. Ice was used to preserve the catch, a factor which caused some problems in trying to mechanize the unloading operation. Gradually the type of construction began to change and with the change came larger vessels and greater horsepower. By 1967 the average gross tonnage reached fifty-five and by 1973 had climbed to an average of 137 per vessel (see table 30). Horsepower of the vessels, which began at about 165, had now reached 400. The vessels which originally pulled a single trawl had almost all converted to double rigs, much the same as the shrimp fishermen. The trawls are similar in design to those used in shrimping with sufficient modification to make them efficient fish harvesters. The present pet food fleet is indeed an impressive fleet with enormous harvesting capacity. Ice is no longer used as a refrigerant, as chilled sea water has replaced it because of cost and because it facilitates mechanization of the unloading operation.

The primary fishing grounds are the comparatively shallow waters of the northern Gulf of Mexico in two to thirty fathoms, from near the mouth of Mobile Bay to Ship Shoal off the Louisiana Coast. Fishing is done only occasionally to depths greater than thirty fathoms. In the inception of the

fishery, vessels seldom ventured west of the Mississippi River but as the fishery expanded more and more trips were made west of the river. At the present time, effort and catch seems about equally divided between east and west of the river (Gutherz, Russel, Serra and Rohr, 1975). Fishermen use the sixteen foot try net similar to the one used by shrimp fishermen to locate concentrations of groundfish. It is also an indicator of the catch rate of the big trawls. As in the shrimp fishery, from whence this fishery evolved, the length of tow varies and is governed by results of the try net and what the skipper thinks his catch rate is as well as general fishing experience. If the catch rate is heavy the length of the tow will be relatively short--say five minutes, but if the catches are light it may extend four to five hours. Longer tows result in poor quality fish and quite often serious damage to the nets from sharks. Jack crevalle also damage webbing by chewing the knots while eating gilled fish in the trawl. Damage to the trawling gear from chafing, while not as serious a problem in the gulf as in New England, is nevertheless a thorny problem to the gulf bottomfish trawler. Fishing time varies with the rate of catch. If fishing is good the vessel may operate around the clock, 24 hours per day, but if fishing is poor there is a likelihood the craft will anchor for the night and begin fishing again at daylight. The length of the trip varies with the rate of catch and the distance to the fishing grounds, and while there is no hard and fast rule the processing plants prefer the trips as short as possible to maintain a high quality product. On the east delta grounds in 1976 fish were in short supply and overall effort in the fishery has nearly doubled, increasing the cost of the producers without an increase in price. The present price is $57-60 per ton.

When the vessel arrives at the processing plant it is unloaded by use of a large suction hose which removes fish and chilled brine, dumps it on a conveyor belt where the fish move inside the processing plant. The sea water is recycled into the hold of the vessel where it is again used in the removal of fish. As the fish move along the conveyor belt, employees remove the edible fish, crustaceans and undesirable species. The edible species may be sold by the crew while crustaceans and undesirable species are discarded.

In the processing plant the fish are ground, mixed with cereal products or other animal products, vitamins and minerals added, and the cooked product canned and processed. The present value of the canned pet food produced in Mississippi exceeds fifteen million dollars.

Croaker, spot and white sea trout (two species) constitute the most of the catch of the industrial pet food industry. Approximately fifty per cent of the catch landed in Mississippi (about 36 million pounds valued at more than one million dollars) is taken in sub area 011.0 or south of the Barrier Islands in depths ranging up to forty fathoms. These fish are estuarine dependent and certainly a very large share use Mississippi Sound as a nursery area. Throughout their range these fish are subjected to pressure from sport fishermen, from shrimp fishermen who discard them in their quest for shrimp, and from pet food vessels. The discards from shrimp vessels presents a very serious problem in the estimation of scientists currently studying this problem. The quantity of these fish caught by trawlers fishing shrimp vary from two to twenty pounds for every pound of shrimp taken. The use of the so-called "salt box" aboard shrimp trawlers has doubtless contributed to the increased mortality of the fish discarded in recent years. Declining catch rates for Mississippi-based pet food trawlers in 1976 indicate fishing pressure may be causing serious mortality in bottomfish stocks. As the pressure on these species increases, it is important that the data base for this important fishery be adequate to make intelligent management decisions. In this connection

the following recommendations are submitted for managing this fishery: (1) The statistical data base be initiated immediately, (2) That since National Marine Fisheries Service is doing resource assessment work, stock identification and life history, that areas of work and responsbility be clearly delineated and a set of priorities be established.

Data needed: (1) Catch and effort--number of tons per trip, per day, twenty-four hour day (specify day or night when on twelve hour shift), size of net, quantity of fish caught by trip, and area of capture, (2) Horsepower of engine, size and pitch of wheel, length of vessel, gross tons, and number of revolutions of engine on tow, and (3) Average size of fish per species (major).

Management advisory board to consist of five members as follows--each member with one vote: (1) Director, Mississippi Marine Conservation Commission, (2) One each member of processing firms, and (3) One fisherman representing harvesting segment, with the board to meet annually, review data, and make recommendations to Mississippi Marine Conservation Commission.

## OTTER TRAWL

The otter trawl is a device for catching bottom fish. It is constructed of twine webbing so that when fully assembled and rigged it will take the shape of a huge funnel while towed along the bottom of the ocean. Floats and weights are utilized in keeping the mouth of the net open. To spread the mouth so that it will cover the largest possible area, each wing is fastened to an "otter" board or trawl "door." Each door is fitted with chains for attaching to a towing cable from the trawling vessel. The resistance of the water to the forward motion of the boards, as they are towed at different angles, forces them to pull in opposite directions and thus keep the mouth of the net opened.
is used, the "otter" boards are attached

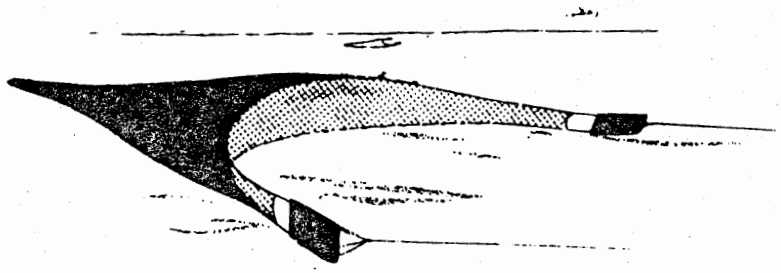


Figure 14

Table 30
MISSISSIPPI FISHERIES
OPERATING UNITS AND LANDINGS
PET FOOD FISHERY 1954-1974

| Year | Vessels, Number | Men, Number | Gross Ton | Av. Gross Ton per vessel | Landings Pounds | Landings Value |
|---|---|---|---|---|---|---|
| 1954 | 20 | 44 | 1/ | 1/ | 1/ | 1/ |
| 1955 | 20 | 43 | 1/ | 1/ | 747,400 | $ 13,080 |
| 1956 | 29 | 63 | 1/ | 1/ | 1,334,900 | 23,360 |
| 1957 | 35 | 81 | 1/ | 1/ | 50,381,000 | 881,667 |
| 1958 | 62 | 165 | 1/ | 1/ | 70,079,800 | 1,220,000 |
| 1959 | 73 | 192 | 1/ | 1/ | 61,454,000 | 1,022,950 |
| 1960 | 65 | 172 | 2,538 | 39.04 | 76,769,500 | 1,335,957 |
| 1961 | 92 | 239 | 3,757 | 40.83 | 76,857,900 | 1,306,584 |
| 1962 | 92 | 226 | 3,613 | 39.27 | 93,714,300 | 1,571,788 |
| 1963 | 82 | 194 | 3,204 | 39.07 | 72,576,600 | 1,210,320 |
| 1964 | 82 | 197 | 2,982 | 36.36 | 78,425,200 | 1,348,925 |
| 1965 | 80 | 189 | 3,331 | 41.63 | 73,820,900 | 1,289,084 |
| 1966 | 72 | 168 | 3,129 | 43.45 | 63,054,900 | 1,202,630 |
| 1967 | 54 | 139 | 2,977 | 55.12 | 74,494,100 | 1,442,257 |
| 1968 | 52 | 131 | 2,846 | 54.73 | 67,998,000 | 1,322,460 |
| 1969 | 40 | 108 | 2,668 | 66.70 | 64,014,700 | 1,259,300 |
| 1970 | 31 | 93 | 3,407 | 109.90 | 74,742,100 | 1,459,592 |
| 1971 | 37 | 111 | 4,320 | 116.75 | 71,382,600 | 1,400,334 |
| 1972 | 21 | 64 | 2,880 | 137.14 | 62,741,000 | 1,333,095 |
| 1973 | 23 | 69 | 2,905 | 126.30 | 78,942,700 | 2,066,500 |
| 1974 | 18 | 56 | 2,742 | 152.33 | 72,822,700 | 1,986,476 |

1/ Data not available

## THE MISSISSIPPI RED SNAPPER-GROUPER FISHERY

Red snappers (Lutjanus aya) have been landed in Mississippi and sold commercially since about 1918, but the fishery did not begin to take on national importance in this state until 1954, when a single vessel constituted the entire fleet. Small quantities have been landed by shrimp boats from time to time but only incidental to shrimp fishing. The United States fishery for red snappers had its beginning around Pensacola, Florida, prior to the Civil War and remained largely a Florida fishery until near the end of the 19th century when a firm began operation in Mobile, Alabama. Later, others opened in Galveston, Port Isabel and Sabine, Texas. In recent years the number of firms specializing in the production of snappers in the Gulf states has declined.

At least six species comprise most of the catch in the Mississippi red snapper fishery. Some of the more common of these are the red snapper (Lutjanus aya), the lane snapper (Lutjanus synagris), the vermillion snapper (Rhomboplites aurorubens), the mutton snapper and the yellowtail snapper. The groupers are composed mostly of Epinephelus and Mycteroperca species, which includes the jewfish. No attempt has been made to sort out the various species landed in Mississippi--they are classified only as snapper and grouper.

The fishery is an offshore fishery and none of the landings come from waters that can be construed as Mississippi waters. In 1972, the latest data available on the fleet, there were twenty-one vessels totaling 1,487 gross tons operating in Mississippi. All of these vessels have been built since 1959. No Mississippi snapper vessel was more than thirteen years old and seventeen of the craft were less than ten years old. Therefore, Mississippi's snapper fleet is comparatively new. Design of these vessels has changed considerably in the past decade. None of Mississippi's fleet is of the old two-masted schooner type vessel. Rather, they are a modification of the schooner and the deep water shrimp trawler. All are diesel powered, contrasting the old sail-driven or auxiliary power of prior fleets in other states. Most Mississippi snapper vessels are between sixty-five and eighty feet in length. They carry a crew of about eight to twelve men. All vessels use ice as a refrigerant.

Fishing is accomplished with the use of reels, stainless steel lines and jappaned hooks, which fishermen believe are more successful in hooking fish (see figure 15 hand reel). From five to fifteen hooks are attached to each line. Ladyfish (Elops saurus) and squid (Loligo sp.) are most often used as bait.

Catches on the traditional snapper banks in the Gulf of Mexico have been declining for a number of years according to old snapper fishermen. Because of this, vessels began to move into the Caribbean area a decade ago. However, with the advent of the fuel crisis, the fleet has again begun to move into the Gulf of Mexico and to fish reefs nearer home.

The recreational aspects of this fishery have grown considerably during the past few years. Not only are there hundreds of sport fishermen who frequent the oil rigs in the gulf, often times making substantial catches of snappers, but the Fishing Banks Committee of the Mississippi Gulf Coast, working through the Mississippi Marine Conservation Commission, has established fishing reefs for red snappers by sinking old liberty ships obtained from the Maritime

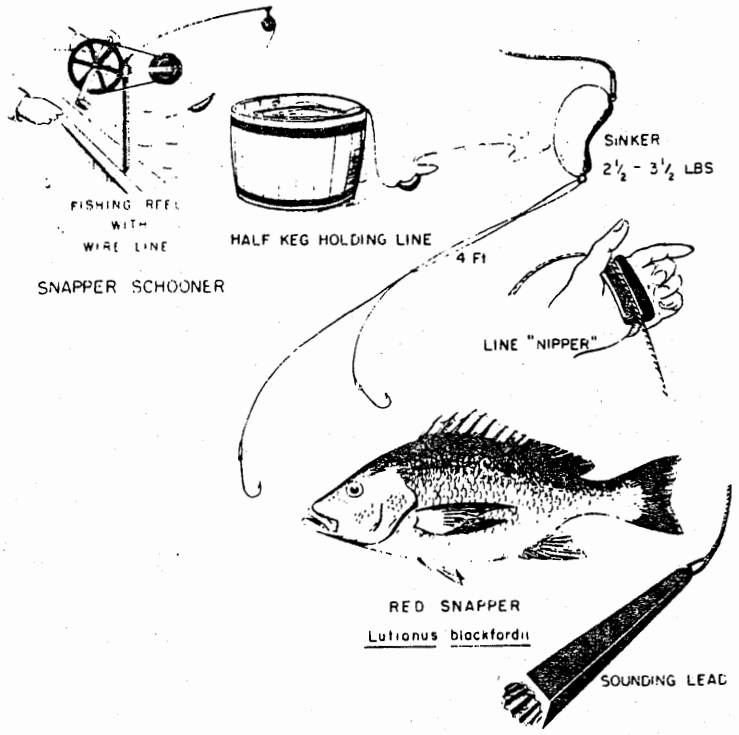

SNAPPER FISHING
FISHING REEL WITH WIRE LINE
SNAPPER SCHOONER
HALF KEG HOLDING LINE
SINKER
2½ - 3½ LBS
4 FT
LINE "NIPPER"
RED SNAPPER
Lutjanus blackfordii
SOUNDING LEAD

Figure 15

Commission. These have been sunk at locations where shrimp trawling is impractical because a wreck is already there. These ships are reported to be attracting large numbers of red snappers and will doubtless provide some relief for the expanding recreational fishery for this species.

When commercial fishermen bring fish on deck, they are allowed to accumulate only a short time before being eviscerated, iced and placed in the hold of the vessel. During the warm months the bins or boxes are reiced frequently. Attempts have been made to introduce tetracycline ice to improve the quality of the fish but was abandoned for lack of positive results. Carpenter (a Review of the Gulf of Mexico Red Snapper Fishery--James S. Carpenter, Cir. 208) believes this may have been caused by fishermen tending to rely too heavily on the antibiotic effect and not reicing frequently enough.

The company tries to stagger the landings of the vessels so that there is always a supply of fish on hand but this is not always possible. Plants maintain radio contact with the vessels for this and other managerial reasons.

When the vessel reaches port, the fish are unloaded, washed in fresh ice water, boxed in one hundred pound boxes, and usually started for market immediately. More than 95 per cent of the catch is shipped outside the state. Only a small quantity of red snapper is steaked, or cut into fillets, but a larger portion of the grouper, which is caught incidental to snapper fishing, is utilized in this fashion.

The red snapper fishery of Mississippi has received little or no service from the state for its contribution to the economy of the county and state. Almost all its sales are outside the state, which means it is a source of income to the state. This contrasts widely with, say, the oyster industry which produces no more income and yet receives many services in the form of supervision of the reefs, transplanting of shells and oysters. Little is known of why the fluctuations in snapper catches occur; whether these are caused by unsuccessful year classes or migration of the fish in search of food, water temperature or other factors yet unknown.

Problems in the fishery are: (1) The decline of the snapper population on nearby banks has made it necessary for the vessels to go farther and farther in search of adequate catches. It is not known whether this decline is due to overfishing, to a long-range natural fluctuation in the population, or to some change in migratory habits of the fish due to unknown environmental factors. The simultaneous apparent rise in effort due to recreational pressure makes overfishing a prime suspect, (2) Labor problems--the difficulty in obtaining and keeping good crews on the vessels is one of the most difficult problems in this fishery. The long periods at sea makes the job unattractive to most persons, and (3) Since Mexico has declared a 200-mile zone, further restriction may be forthcoming.

Suggested solution: (1) First, obtain a data base of sufficient depth to properly identify the problems. This includes catch, effort, area of capture and size of each species of fish being taken, (2) A biological study of sufficient magnitude to determine growth rates of the fish taken in this fishery and the reproductive cycle of the species, (3) Stock identification and migratory patterns must be known. When this is done, a pragmatic research program may be designed and, (4) Basic economic data on this fishery should also be instituted at the earliest possible date.

Table 31

# HISTORICAL CATCH STATISTICS—GULF OF MEXICO
# COMMERCIAL RED SNAPPER LANDINGS
## 1880-1974

(Thousands of Pounds and Thousands of Dollars)

| Year | Fla. W. C. | | Alabama | | Mississippi | | Louisiana | | Texas | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Quan. | Value | Quan. | Value | Quan. | Value | Quan. | Value | Quan. | Value | Quan. | Value |
| 1880 | 1483 | 67 | 360 | 13 | - | - | 900 | 45 | - | - | 2743 | 125 |
| 1887 | (1) | (1) | (1) | (1) | - | - | 131 | 5 | 75 | 4 | (1) | (1) |
| 1888 | 3224 | 91 | 86 | 3 | - | - | 150 | 5 | 65 | 3 | 3525 | 102 |
| 1889 | 3469 | 105 | 51 | 2 | - | - | 250 | 8 | 22 | 1 | 3792 | 116 |
| 1890 | 4173 | 124 | 62 | 2 | - | - | 240 | 7 | 5 | (2) | 4480 | 134 |
| 1897 | 5314 | 171 | 335 | 12 | - | - | - | - | 465 | 17 | 6114 | 200 |
| 1902 | 8074 | 238 | 3466 | 69 | - | - | - | - | 2068 | 103 | 13608 | 410 |
| 1908 | 7659 | 432 | 2635 | 92 | - | - | - | - | 2252 | 79 | 12546 | 603 |
| 1918 | 7230 | 455 | 799 | 49 | 98 | 7 | 60 | 4 | 1243 | 94 | 9430 | 609 |
| 1923 | 9471 | 680 | 970 | 78 | 104 | 9 | 175 | 17 | 1009 | 81 | 11729 | 865 |
| 1927 | 9313 | 740 | 1059 | 106 | 219 | 19 | 72 | 8 | 1237 | 101 | 11900 | 974 |
| 1928 | 7891 | 638 | 1301 | 118 | 97 | 8 | 48 | 7 | 1055 | 89 | 10392 | 860 |
| 1929 | 7700 | 618 | 1227 | 102 | 91 | 7 | 80 | 10 | 804 | 73 | 9902 | 810 |
| 1930 | 5002 | 424 | 848 | 68 | 189 | 16 | 76 | 6 | 930 | 75 | 7045 | 589 |
| 1931 | 4393 | 289 | 863 | 60 | 68 | 5 | 79 | 6 | 691 | 55 | 6094 | 415 |
| 1932 | 4539 | 227 | 682 | 30 | 37 | 2 | 67 | 4 | 985 | 50 | 6310 | 313 |
| 1934 | 3916 | 214 | 951 | 52 | 123 | 7 | 79 | 5 | 635 | 36 | 5704 | 314 |
| 1936 | 4804 | 298 | 1028 | 62 | 325 | 19 | 117 | 10 | 907 | 58 | 7181 | 447 |
| 1937 | 4551 | 302 | 1168 | 84 | 304 | 21 | 148 | 12 | 1141 | 80 | 7312 | 499 |
| 1938 | 5261 | 375 | 1193 | 85 | 174 | 12 | 85 | 6 | 1279 | 104 | 7992 | 582 |
| 1939 | 5494 | 413 | 1020 | 73 | 40 | 3 | 91 | 8 | 1156 | 111 | 7801 | 608 |
| 1940 | 3891 | 335 | 1255 | 112 | 26 | 3 | 104 | 9 | 1233 | 118 | 6509 | 577 |
| 1945 | 2846 | 556 | 1360 | 340 | 12 | 3 | 26 | 6 | 288 | 47 | 4532 | 952 |
| 1948 | (1) | (1) | 1852 | 442 | 143 | 32 | 52 | 14 | 1324 | 304 | (1) | (1) |
| 1949 | 5184 | 1210 | 1343 | 336 | 136 | 34 | 170 | 42 | 1055 | 242 | 7888 | 1864 |
| 1950 | 4354 | 1038 | 994 | 237 | 65 | 16 | 142 | 34 | 1233 | 318 | 6788 | 1643 |
| 1951 | 4313 | 1121 | 1229 | 284 | 2 | 1 | 9 | 2 | 1117 | 313 | 6670 | 1721 |
| 1952 | 5500 | 1265 | 1459 | 350 | - | - | 65 | 18 | 1523 | 383 | 8547 | 2016 |
| 1953 | 5136 | 1387 | 1418 | 439 | 29 | 7 | 44 | 11 | 1101 | 298 | 7728 | 2142 |
| 1954 | 5524 | 1492 | 1404 | 349 | 68 | 17 | 45 | 10 | 1345 | 306 | 8386 | 2174 |
| 1955 | 6210 | 1614 | 1173 | 289 | 147 | 35 | 71 | 15 | 1262 | 312 | 8863 | 2265 |
| 1956 | 5856 | 1457 | 1065 | 261 | 271 | 62 | 44 | 9 | 1534 | 376 | 8770 | 2165 |
| 1957 | 5587 | 1443 | 933 | 232 | 550 | 143 | 28 | 6 | 1443 | 380 | 8541 | 2204 |
| 1958 | 5844 | 1520 | 1418 | 349 | 1110 | 274 | 88 | 16 | 1399 | 373 | 9859 | 2532 |
| 1959 | 5400 | 1420 | 1819 | 452 | 1022 | 255 | 313 | 77 | 1665 | 435 | 10219 | 2639 |
| 1960 | 5447 | 1416 | 1720 | 426 | 1469 | 367 | 426 | 104 | 1153 | 293 | 10215 | 2606 |
| 1961 | 5446 | 1449 | 1784 | 470 | 2152 | 537 | 677 | 150 | 1829 | 455 | 11888 | 3061 |
| 1962 | 5375 | 1328 | 1893 | 495 | 2176 | 544 | 694 | 157 | 1742 | 444 | 11880 | 2968 |
| 1963 | 5918 | 1562 | 2315 | 663 | 1886 | 471 | 388 | 95 | 2169 | 590 | 12676 | 3381 |
| 1964 | 6532 | 2009 | 2393 | 685 | 1849 | 461 | 310 | 78 | 2250 | 631 | 13334 | 3864 |
| 1965 | 6072 | 1931 | 2495 | 707 | 2366 | 589 | 243 | 57 | 2212 | 628 | 13388 | 3912 |
| 1966 | 5190 | 1809 | 2701 | 803 | 2775 | 771 | 208 | 59 | 1653 | 512 | 12527 | 3954 |
| 1967 | 5053 | 1804 | 2288 | 690 | 2890 | 850 | 302 | 78 | 1409 | 462 | 11942 | 3884 |
| 1968 | 4308 | 1757 | 1214 | 328 | 3726 | 1118 | 277 | 73 | 1128 | 367 | 10653 | 3643 |
| 1969 | 4279 | 2279 | 1246 | 375 | 2968 | 959 | 130 | 35 | 925 | 342 | 9548 | 3990 |
| 1970 | 3864 | 2122 | 983 | 326 | 2519 | 930 | 255 | 71 | 916 | 380 | 8537 | 3829 |
| 1971 | 3878 | 2232 | 939 | 341 | 2399 | 886 | 162 | 54 | 1082 | 495 | 8460 | 4008 |
| 1972 | 3691 | 2526 | 1051 | 443 | 2266 | 944 | 259 | 97 | 1238 | 572 | 8505 | 4582 |
| 1973 | 3761 | 2790 | 960 | 422 | 2331 | 1089 | 354 | 144 | 781 | 402 | 8187 | 4847 |
| 1974 | 4611 | 3587 | 891 | 439 | 1900 | 942 | 286 | 139 | 743 | 416 | 8431 | 5523 |

(1) Data not available
(2) Less than 500 lbs. @ $500

Commissioners report for 1880 states that red snappers are never taken--that is, brought to market in Texas. Apparently the industry began between 1880 and 1887 - Silas Stearns

Source: National Marine Fisheries--Division of Statistics and Market News

## CAST NET

This is a circular net thrown by hand. The purpose of this method of fishing is to cover the fish with a cone-shaped net. When thrown on the water's surface, the leads on the outer edge of the net sink rapidly to the bottom. The leaded edge is drawn together by ropes which are attached to a recovery line, closing the net and entrapping the fish.

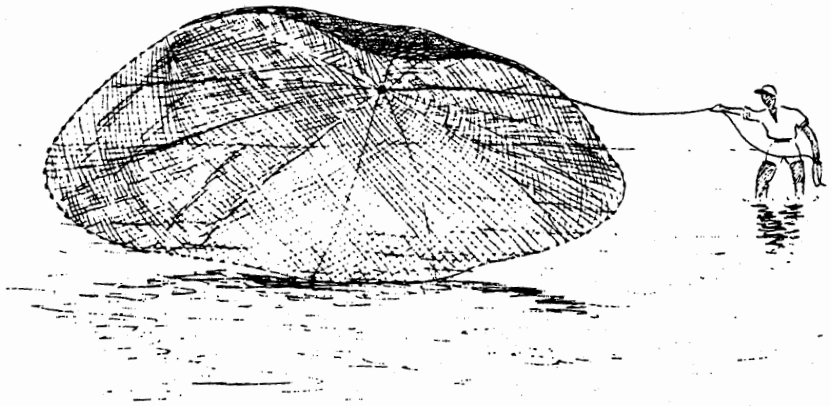


Figure 16

## RECREATIONAL FISHING

The State of Mississippi lies in the so-called fertile crescent as far as marine life is concerned. The area extending from the mouth of Mobile Bay to the Sabine River literally teems with fish life and many of the species are edible and fun to catch. Consequently, the state is blessed with some of the nation's best recreational fishing. Adding to this a mild climate and luxurious accomodations at reasonable rates and the proximity to the fishing grounds, it is no surprise that Mississippi is a favorite recreational fishing area for many. For example, there is excellent billfishing and tuna fishing southeast of the mouth of the Mississippi River. Spanish mackerel, bluefish, bonito or little tuna, king mackerel, jacks or crevalle, lemonfish and many other species are abundant near the Barrier Islands during the warmer months of the year. In Mississippi Sound, there is excellent fishing for spotted and white sea trout, redfish or red drum, croaker, flounder, black drum, sheepshead and blackfish. Each night during the spring and summer months one can see dozens of individuals with light and spear taking flounder in the shallow water near the beach. Spearing flounder is one of the major recreational fisheries on the Gulf Coast and very little equipment is needed to engage in the sport. Crabbing is also a major recreational fishery requiring little investment in gear. The sea wall or a pier, a string, a piece of fish or meat and a dip net will usually yield enough blue crabs for dinner, though some individuals will employ as many as five to ten traps. Included in the latter group are persons who give crab boils for their friends, a favorite summer pastime on the Gulf Coast.

Mississippi has excellent charter boat facilities available for fishing in the sound or offshore beyond the islands. Numerous small boat rental services are located along the coast and bait is available almost any time of the year for fishing for any of the littoral species.

Recreational fishing success is not always assured, even in Mississippi, by virtue of the size of the craft or the amount of the expenditures. Fishing success can best be understood by comparing it to rifle markmanship. One may purchase the best of equipment in the form of a fine rifle and scope but his success in competitive markmanship is largely the result of understanding the principles of shooting a rifle plus a certain amount of inert skill and practice. Without attention to these elements, he will have little success. Much the same with fishing. An expensive boat, adequate bait, excellent tackle and the time to fish just simply will not insure catching fish. What is required is knowledge of the fish's habits, where it may be caught, the kind of bait to be used, the best seasons and the relationship of tides, temperature, food supply and sexual activity to the availability of the animal. It is for this reason that, when fishing in strange territory or for species not normally sought, it is best to obtain local expertise before undertaking the venture. Furthermore, the local sport fisherman often has only one or two days each week to devote to fishing and if conditions are poor, catches often are poor or worse and like all of us he blames someone else. Quite often it is the commercial fishermen. This creates problems for the fisheries administrator who is charged with managing a resource that is property of the state or as is often termed "common property resource". When the recreational fisherman fails to catch fish, his most common clamor is to demand that all netting be outlawed in the area he is accustomed to fish, or that certain types of netting be outlawed entirely. This presents some rather knotty problems concerning management, ownership and rights in a common property resource such as a fishery.

Fish are the property of all the people and all persons participate in the harvest of the resource on an equal basis and as a privilege granted by the state and in accordance with the rules established for that fishery. To outlaw commercial harvesting is to deny this form of nutritious food to an individual who does not or cannot fish for himself. Furthermore, to deny an individual the right to make a living through commercial fishing, when curtailing his right to this labor is not substantiated by scientific facts, is morally wrong.

To arrive at an equitable solution to the problem of controversy, it is necessary to determine the annual yield or productivity of the fish stocks as part of a fisheries management plan. By yield is meant the rate at which the breeding stock produces a harvestable crop for commercial and recreational fishermen. Knowledge of the annual yield is just as important in fisheries management as is determining tree growth in forestry, measuring crop production in agriculture, or knowledge of turnover in business. Without scientific assessment of the resource very little in the way of management is possible. Without management, wise use of Mississippi's marine resources is impossible.

Recreational fishing is promoted quite well through the numerous fishing rodeos staged each year along the Gulf Coast. There are more than half a dozen of these occurring at different times during spring and summer. The best known and oldest is the Deep Sea Fishing Rodeo at Gulfport which is staged around the fourth of July each year. Almost each year records are broken on number, size and total poundage of fish caught.

Additional promotional work could be done in the form of brochures advertising Mississippi fishing. Sea Grant Advisory Service has provided a number of well planned, attractive and informative brochures which they distribute to interested persons. They need additional support in this endeavor.

Mississippi's recreational fishery potential is enormous and is a source of potential income to this state that is not currently being fully exploited.

Problems are: (1) No salt water sport fishing license, (2) Lack of catch data on recreational fisheries, (3) Lack of data on the amount of income generated by recreational fishing, particularly that which comes from outside the coastal area, (4) Controversy with commercial interests, (5) Lack of same data base as in commercial species since most of them are sought by both recreational and commercial interests, and (6) Lack of management authority on recreational fishing.

Solution: (1) Begin to acquire a data base on which valid decisions can be made when controversy arises (see section on statistics and biology), (2) Try to communicate plans to sport fishermen in effort to obtain support and cooperation and establish a problem solving mechanism for conflicts among user groups, (3) Other proposals under suggested reorganization of the commission activities, (4) Advertise recreational fishing opportunities in Mississippi, and (5) Formation of an advisory group consisting of the diversified recreational groups or interests, not more than eight members, and the Director, who will periodically meet to review fishery data and make recommendations to the commission.

## LEGISLATIVE REQUIREMENTS

### Reorganization

Implementing legislation is the cornerstone of the functioning of a state fishery management agency. The commission-type organization is the most effective way to govern or manage fishery resources as compared with the legislative process. Legislative acts setting up the commission should be sufficiently inclusive to give the commission full authority for all regulation of fisheries matters except the area of setting penalties and levying taxes. This authority should remain with the duly elected representatives of the people--the legislators. The reasons for delegating all management authority to the commission are clear. Since fishery resources are the property of the state, held in trust for the people, management of this resource is the same as managing other state property--but more sophisticated techniques are applied and considerably more skill and knowledge are required. Furthermore, management of fisheries must be organized so that emergency situations can be taken care of by emergency actions of a commission with the speed and attention to detail that could not be accomplished by a legislative body.

The following legislative changes, which were a part of the 1974-1975 annual report, are necessary to make the Mississippi Marine Conservation Commission more responsive to the needs of all resource user groups:

(1) The word "seafood" in all sections dealing with marine conservation should be replaced by "marine fish, shellfish and mollusks". sp 49-15-1, 49-15-3, 49-15-5, etc.

Webster defines seafood as "food prepared from marine fish". We are not dealing with processed food but with the management of living marine organisms.

(2) The Marine Conservation Commission should be added to the list of agencies permitted to purchase passenger carrying vehicles, Section 25-1-85.

(3) The term "inspector" should be replaced by the word, "law enforcement officer". The Marine Conservation Commission is engaged in law enforcement--not in inspection.

(4) The Chief Law Enforcement Officer, as well as all personnel of this commission, should be placed under the supervision and direction of the Director. He should be employed by the Director through a program of progressive training and promotion which stresses career development. He should be selected from the professional staff for his ability, training and devotion to duty. He should be subject to dismissal by the Director for any of the causes set forth in the personnel manual. This is a must if the statutes are to be fully implemented. The personnel manual, which required considerable time to prepare, is useless until this portion of Section 49-15-21 is implemented permitting the establishment of a personnel management system. The present arrangement is sheer chaos and a hopeless and wanton waste of the taxpayer's dollars.

(5) Section 49-15-29 should be amended to provide for a penalty for failure to pay taxes due the State of Mississippi. The commission can, at present, do little more than request the taxes be paid. If they are not paid by the end of the year, the commission can refuse to issue a license

to operate the following year. Specific dates must be set for payment and penalties levied for non-payment or delinquent payment--minimum fine $500.

(6) In order to reduce the harvesting and sale of oysters from polluted reefs the commission needs two types of oyster licenses. They should be classified as: (1) a certified commercial harvester--unlimited quantity, and (2) certified home use harvester--not permitted to sell any of his catch, and his catch limited to quantity one family can use in about one to two days, or about one bushel or one gallon or a combination not to exceed this; for example, one-half bushel and one-half gallon opened oysters. Enforcement officers of this commission may, with search warrant, enter private premises to determine quantity of oysters and type of license in possession of the individual. Individuals selling oysters must have valid commercial harvester license or receipt for purchase. Implementing legislation is necessary.

Penalty for purchase of oysters from anyone not holding certified commercial harvester license and/or certified shucking house license--$1,500 for first offense, plus six months prison term, plus confiscation of all plant and equipment, and $2,500 for second offense, plus one year prison term and confiscation of equipment and/or plant. Penalty for offering for sale without commercial harvester license--$1,500 for first offense and $2,500 for second offense and confiscation of all equipment. The commission may require such trip tickets for commercial harvesters as necessary to meet the requirements of this act.

(7) The legislature should examine all license and tax scales with the view of determining whether they are equitable and adequate. The harvesting of fish is no different from leasing mineral rights on state property and mining the resource. Therefore, the state should have a fair price for these resources. This includes a marine sport fishing license.

(8) Section 49-15-29--food establishments that already have a license to sell food products may, without purchasing a seafood dealers license, buy any quantity of fish or shellfish from the fisherman for resale. This if often done at present and we are not getting the taxes because we do not know who, or when the transaction occurs. Furthermore, this is unfair to the wholesale dealer who has paid his license and constructed an establishment to do business. This commission needs, not only the tax, but also the statistical data on catches since no management is possible without a valid statistical base. Amend section 49-15-29, paragraph g, to require all persons or firms who purchase fish, shellfish, or mollusks for resale to pay a wholesale license and report to the commission and pay taxes when due.

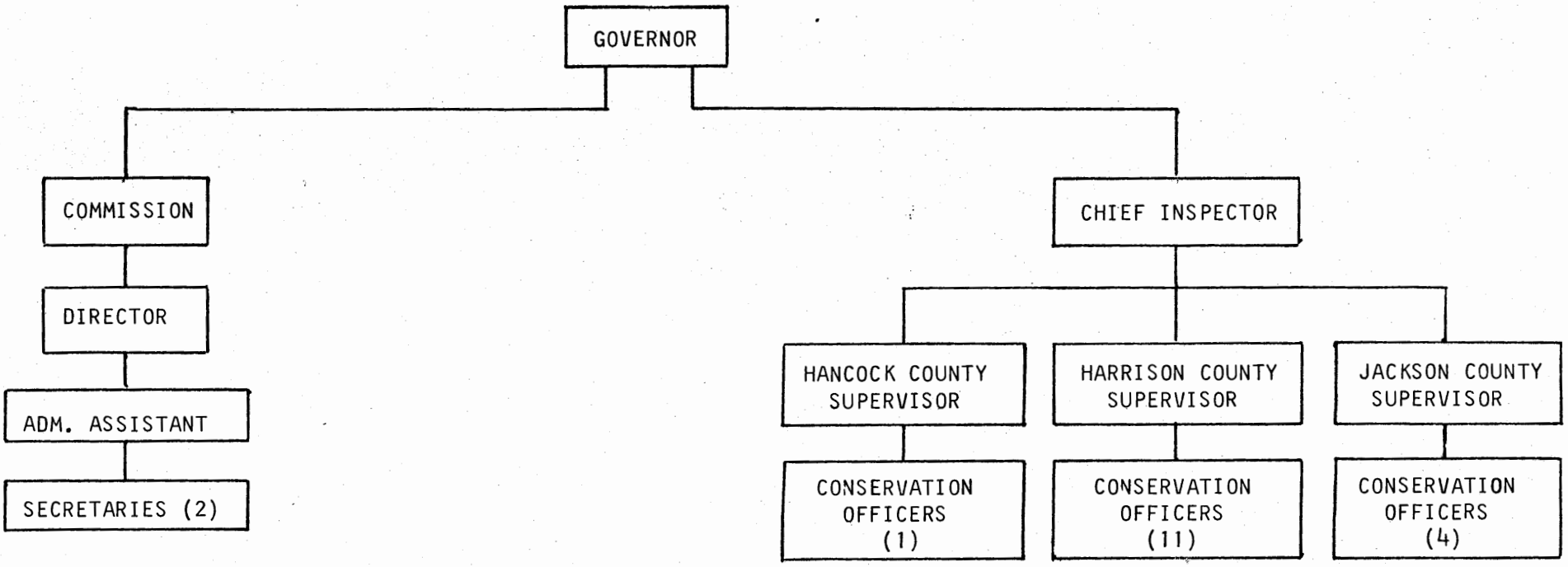
(9) Increase the membership of the commission by three members--two shall be recreational fishermen and one shall represent the public or consumers group.

(10) The minimum fine for first violation of any ordinance, regulation or statute of this commission should be $500 for first offense, $1,000 for second offense, plus confiscation of equipment. This is necessary for good management of the resource and to reduce the cost of law enforcement.

(11) Conviction of taking oysters on polluted reefs by commercial harvester should carry a mandatory fine of $1,500 plus six months for first offense, plus confiscation of all equipment. Second offense should be a mandatory $2,500 plus one year prison term, plus confiscation of all equipment, plus five year denial of any commercial fishing license.

(12) Section 49-15-15, paragraph b, limits the commission to regulating fish taken for commercial purposes. No fish population can be managed just for commercial or just for recreation. The population must be regulated for a sustained yield. Therefore, the words "taken for commercial purposes" must be deleted and paragraph b should then read: "shall open, close and regulate fishing seasons for the taking of all marine fish, shellfish, and mollusks. All regulations promulgated by the Mississippi Marine Conservation Commission must be based on scientific data obtained in an organized research program by competent scientists".

(13) The acts covering the establishment of the commission must be so rewritten that function and responsibilities of the commission and the legislature are clearly sorted out. For example, all regulating authority must be delegated to the commission while all taxes, licenses, penalties, etc., are reserved for the legislature.




PRESENT

TABLE OF ORGANIZATION

BY STATE LAW

OF THE

MISSISSIPPI MARINE CONSERVATION COMMISSION

Figure 17

## Existing Organization

Section 49-15-1 of the State Code created the Mississippi Marine Conservation Commission and Section 49-15-21 provides for the Chief Inspector. The two elements are discrete entities (figure 17) without a defined relationship or set of interactions. In order to bear legal sanction of the courts official communications must proceed through the Governor's office to achieve any degree of implementation.

The Commission has full authority to manage, control, supervise and direct any matters pertaining to all salt water aquatic life, but only commercial fish are specified. In carrying out this authority, the commission enacts regulations or recommends legislation based upon data generated by researchers over which they have no authority. They must rely on the good will of the Chief Inspector for enforcement of these pronouncements since the commission is without authority to require compliance.

The Mississippi Marine Conservation Commission has been subjected to criticism for the alleged failure to perform its duty in the field of marine conservation. Some of the criticism is based on the alleged conflict of interests of the commission members since many of them are employed in some aspect of the fishing industry. While it may be possible to select a commission whose members have no fishing interest, it is impractical; the commission must have a basic knowledge of the resource for which it is responsible. Any alleged failure must be traced back to the inability to exert complete control over the resource as well as inability to operate as a coordinated organization.

The management of the state's marine fishery resources, then, is limited to commercial fish (all recreational fish are excluded by omission) and relies on several non-related organizational elements to achieve the implementation of the public policy. As a result, both management and implementation are fragmented and incomplete. If the commission is to achieve its objective it must have control of the elements necessary to produce a desired result.

## Proposed Organization

The proposed organization (figure 18) would place the entire realm of fishery management under the direct control of the Mississippi Marine Conservation Commission. To encompass the entire spectrum of fisheries the commission's authority should be redefined to include all living marine resources. This would provide the necessary authority to manage the total fish population, not just the commercial segment.

Under the control of the Director, three operating divisions would facilitate the implementation of total fishery management. The Director is administratively and technically responsible to the commission for the management, supervision, direction and control of all matters pertaining to Mississippi's living marine resources. In addition, he serves as the focal point for the state in dealing with other states, the federal government and regional councils for matters related to living marine resources.

The Division of Biological Research and Product Development would provide for the directed research and development required to identify commission alternatives relative to a fishery, establish definitive positions and assure effective implementation. This division would also supply

PROPOSED

TABLE OF ORGANIZATION

OF THE

MISSISSIPPI MARINE CONSERVATION COMMISSION

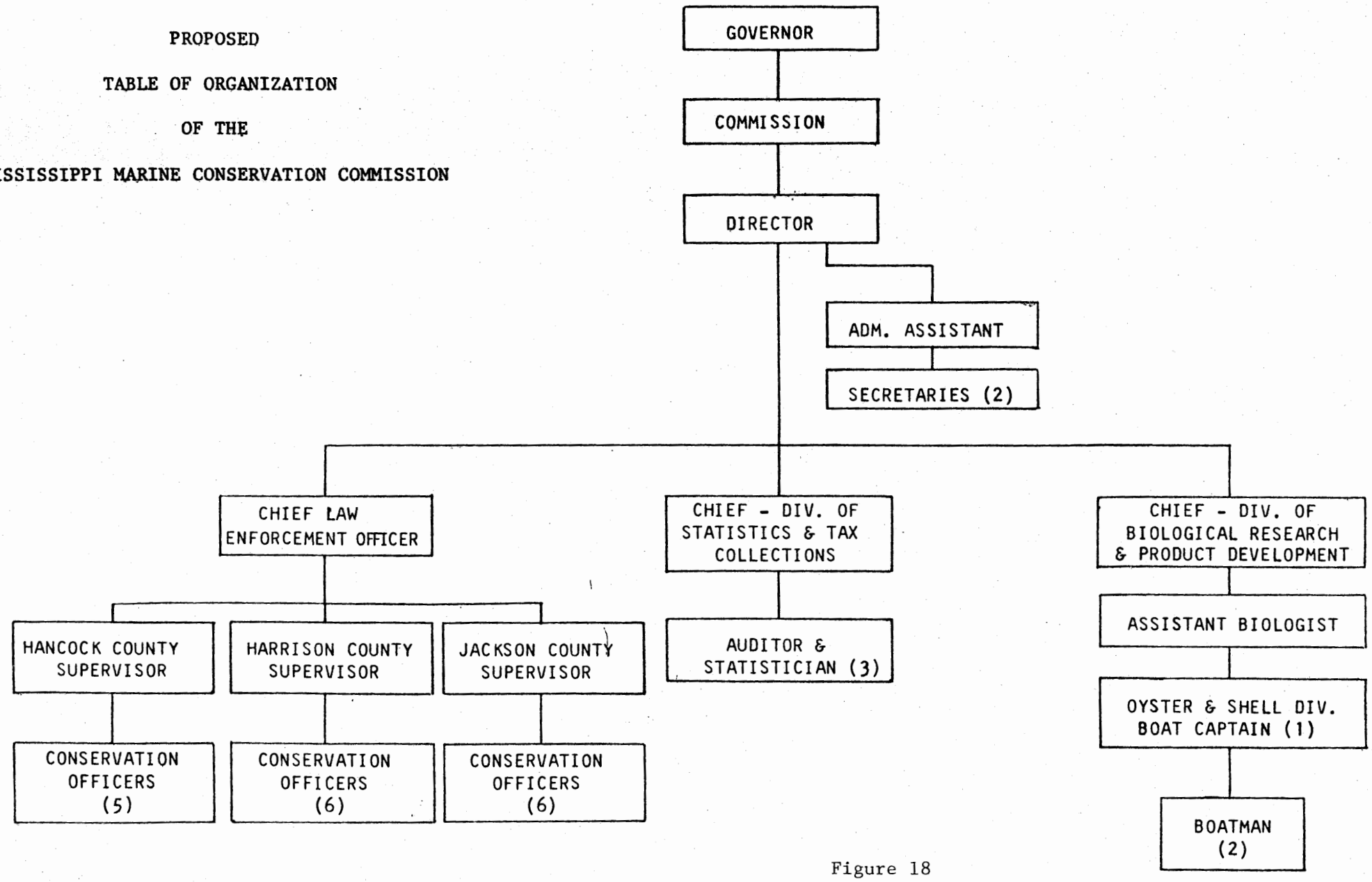



Figure 18

information to enable development or expansion of fisheries that will lead to increased revenue for the state.

The Division of Statistics and Tax Collections would acquire basic data relative to active commercial and recreational fisheries. These data will supplement and support research data, and will provide insight into stock status and fishing pressure. Collection will occur through port sampling, industry reporting and on-site inspection. Also within this division is the function of tax collection including revenue derived from fishing licenses and permits, landing fees and processing taxes. This function can be easily handled in conjunction with statistical gathering, and is in fact a set of statistics itself.

The Chief Law Enforcement Officer would become the enforcement arm of the commission. Being within the same organization will enable the officer to actively participate in the development of fishery regulations and provide inputs in the determination of required fishery research and statistical application. He must be a professional capable of understanding the fundamentals of good administration through record keeping and evaluating people and conditions. This office would close the management loop by providing the control mechanism through the application and enforcement of commission regulations and legislative enactments.

Plan implementation

A strong state fishery management policy must be supported with adequate staffing, money and legislative support on a continuing basis. Because its living marine resources are a public asset of the state, the state has an offsetting public liability to the people to maintain the viability of the asset. Implementation of this plan is the second step; the first being the recognition of the above statement.

The contents of this plan do not represent a total management system. They provide for a workable organization to ultimately implement a total system and establish a dynamic data file on which to base management decisions. The final part of the total system, the decision making process, can only be effectively accomplished when adequate scientific and statistical knowledge has been acquired.

This plan does represent the cost of a total management system, but it must be recognized that it is a continuing cost, not a one-time appropriation. As the directed research is completed on one species, another will be initiated. Efforts related to statistical gathering, tax collections and enforcement will be continuing activities, and as revenue producing regulations are promulgated these activities should approach a self-supporting position.

After approval of this plan, implementation can proceed in an orderly progression. First, the reorganization which will provide the framework for implementation of the total management system. Then, concurrently; the selection of the most critical fisheries (from an economic, biological and sociological standpoint) for initial directed research, the implementation of commercial and recreational statistical gathering, and the evaluation of existing fishery regulations and legislation based on available data and the identification of corrective action or additional information as required.

Tax collections are an on-going activity. As data becomes available, management criteria can be established for specific species, and new directed research can be initiated. Enforcement activities will continue and be supplemented as new management controls are instituted and as the need arises.

FLOW CHART FOR

FISHERY MANAGEMENT

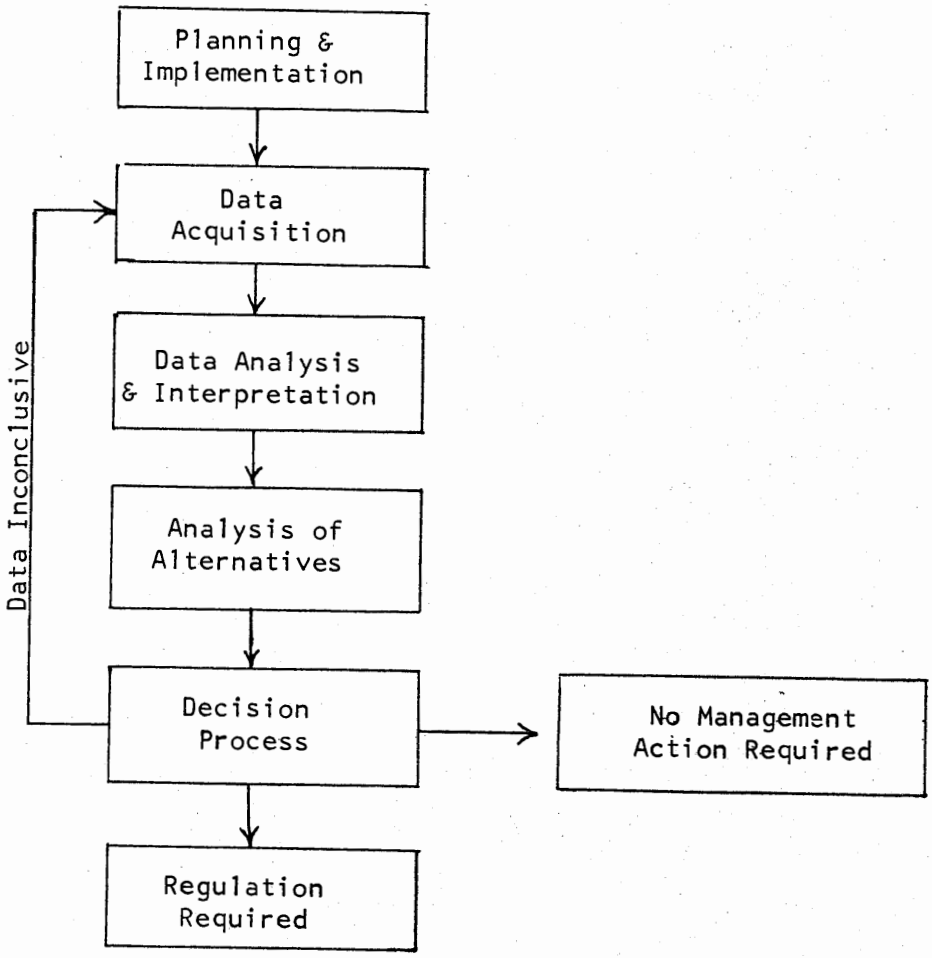



Figure 19

A systematic approach, as outlined, will yield effective and equitable fishery management control without undue hardship on the commercial or recreational communities. It will provide state authority over its resource and obviate the alternative--federal government control.

How the Plan Works

Before any decisions are made, a data acquisition plan must be implemented (see figure 19). When sufficient data has been acquired, analysis begins. As problems are identified, solutions and alternatives are analyzed. This is followed by decision. At this point, one of several directions may be followed. If the data are inconclusive it may be necessary to obtain more data. This is accomplished by: (1) altering the data gathering, (2) additional programs to provide the necessary data, or (3) continuing the program in progress until sufficient data are obtained.

The second alternative may be that no management action is necessary. In this case, a watchful status quo is to be maintained.

Finally, if it has been determined that some regulation is necessary, and after all the alternatives have been carefully studied, the Director will prepare recommendations. At this point, public hearings are announced for all interested parties. These are open to the public and all parties are urged to make their views known.

Since it is an impossibility to obtain agreement, because of user competition in the resource, some compromise will usually be necessary. The Director must be prepared with certain trade offs that will give up as little of the objective as possible.

Upon completion of the hearings the Director writes his report and recommendations to the commission. The commission then takes what action is deemed desirable.

Once the regulation is implemented, data must be obtained to verify its success. If verification cannot be made, a reevaluation is necessary.