South Carolina Wildlife and Marine Resources Department

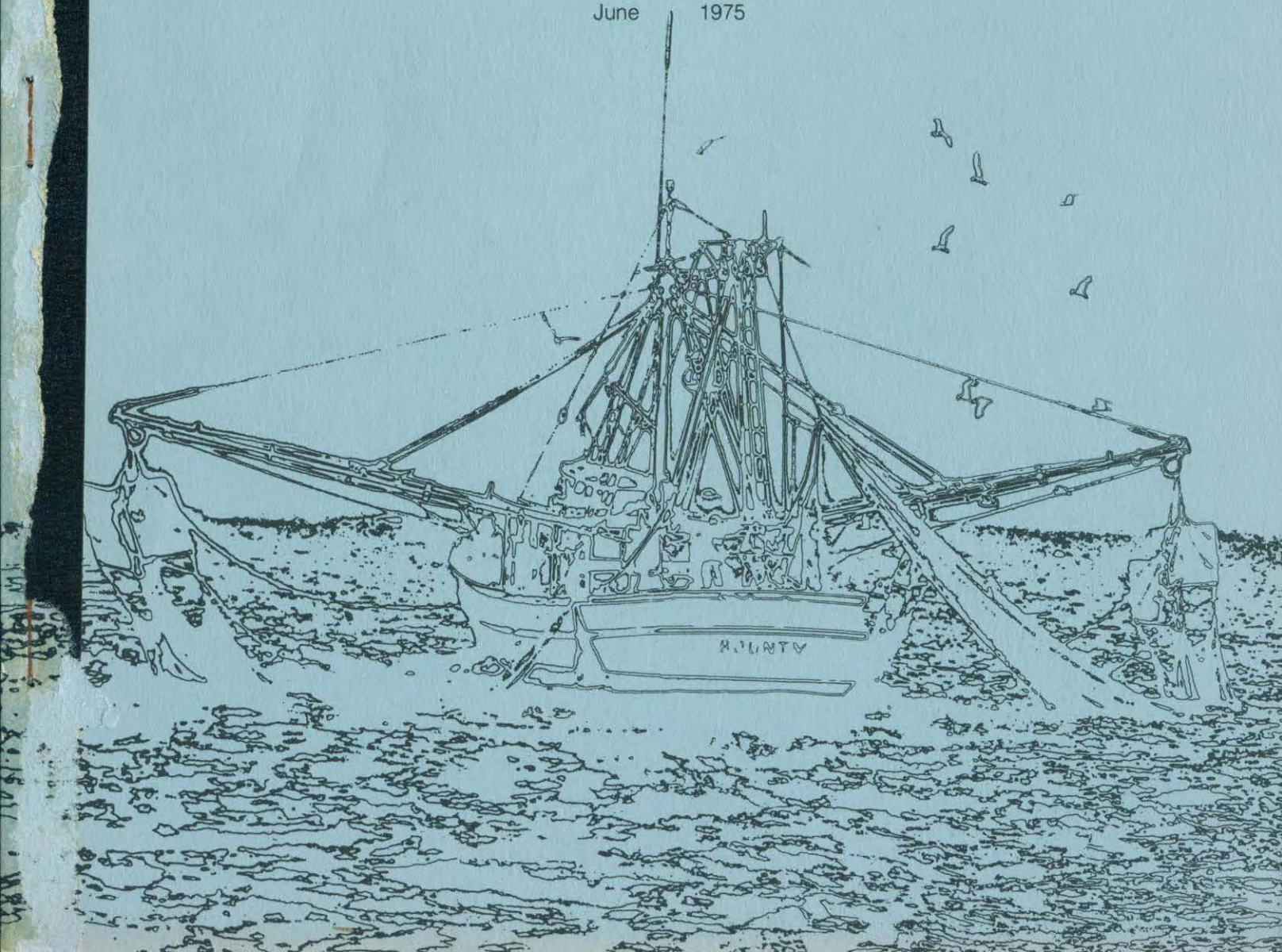
The Shrimp Fishery Of The South Atlantic United States: A Regional Management Plan

A Co-operative State-Federal Study

Edited by: Peter J. Eldridge and Steven A. Goldstein

South Carolina Marine Resources Center
Technical Report Number 8

June 1975



THE SHRIMP FISHERY OF THE SOUTH ATLANTIC UNITED STATES:

A REGIONAL MANAGEMENT PLAN

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TECHNICAL REPORT NO. 8

SOUTH CAROLINA MARINE RESOURCES CENTER

SOUTH CAROLINA WILDLIFE AND MARINE RESOURCES DEPARTMENT

CHARLESTON, SOUTH CAROLINA 29412

JUNE 1975

PREFACE

The South Atlantic Committee for Shrimp Management was established in 1973 to examine the feasibility and desirability of managing the shrimp fishery of the states of North Carolina, South Carolina, Georgia, and the Atlantic coast of Florida on a regional basis, and within the concept of a state-federal partnership. The committee is comprised of two representatives from each of the four states: Michael W. Street and Walter Godwin of the North Carolina Department of Natural and Economic Resources; Edwin B. Joseph and Charles M. Bearden of the South Carolina Wildlife and Marine Resources Department; William W. Anderson and David Gould of the Georgia Department of Natural Resources; and Clifford A. Willis and Edwin A. Joyce, Jr., Florida Department of Natural Resources. Irwin M. Alperin, Executive Director of the Atlantic States Marine Fisheries Commission, is an ex officio member of the committee.

Among the items discussed at an early committee meeting was the need for a management planning profile for the shrimp fishery of the South Atlantic region. The staff of the Marine Resources Center of the South Carolina Wildlife and Marine Resources Department agreed to prepare the profile with the assistance of committee members and personnel from the respective state management agencies. This work, which summarized the existing state of knowledge concerning the South Atlantic shrimp fishery, was completed and published in September, 1974.

The development of the management profile revealed the need for a policy plan which could serve as a guide for the implementation of a regional shrimp management program for the states in this region. For this reason the Management Committee formed a planning team and directed them to develop a regional

shrimp management plan. Work began in July, 1974 and this document represents the completed plan.

We are indebted to Irwin M. Alperin, Thomas L. Linton, Edward G. McCoy, James A. Timmerman, Harmon W. Shields, William H. Stevenson, I. B. Byrd, Johnie Crance, and Richard Schaefer for their participation in the formulation and development of this study. Particular thanks are due to Paul Leach, Robert LaFollette, Johnie Crance, Steven Goldstein, and Peter Eldridge, who as members of the planning team, were instrumental in the development of the plan and this document. Also, thanks are due to James Acheson, Dick Surdi, Jukka Kolhonen, Richard Kinoshita, Roger Hutchinson, Raymond Rhodes, and Kenneth Roberts, who provided technical assistance concerning the socio-economic aspects of the plan. Their assistance significantly improved the scope of the plan. Also, we wish to thank Dale Calder, I. B. Byrd, Johnie Crance, David Cupka and Connell Purvis for critically reviewing this document and adding significantly to its content. Mrs. Lourene Rigsbee typed the manuscript and helped to prepare figures. This study was supported by Contract No. 03-3-042-29 from the U. S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. Funds for travel were made available from the Atlantic States Marine Fisheries Commission through a grant from the National Marine Fisheries Service.

South Atlantic Shrimp Management Committee

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Chapter 1

SUMMARY

Shrimp presently constitute the most valuable commercial fishery resource of the South Atlantic States of North Carolina, South Carolina, Georgia, and Atlantic coast of Florida. During the last 20 years landings (round weight) have averaged approximately 25 million pounds with a value to fishermen of approximately 20 million dollars. In 1973, the value of the catch was almost 27 million dollars. Although the fishery has generally prospered during its 100 year history without depletion of the stocks and management of the resource has been satisfactory within states, it has not been possible to solve other problems which are regional in nature because of the lack of a regional management structure. Management of the resource has also been hindered by inadequate catch and effort statistics, limited jurisdiction in waters outside of states, key information gaps concerning the dynamics of shrimp populations, lack of socio-economic data and movement of fishermen between states. In 1974, management of the fishery was complicated by the general economic condition of the country which resulted in significantly lower prices for shrimp while the cost of fishing soared. These factors in addition to the probability of extended fisheries jurisdiction have encouraged managers to seek new institutional arrangements in order to cope with the biological and socio-economic complexities that presently confront them.

Although managers must be fully cognizant of the factors that control the stability of an exploited resource, they also must be aware of the social attributes and institutional arrangements that exist because these factors not only affect management decisions, but also the results of those decisions. A failure to recognize this has often resulted in less than satisfactory

management of fishery resources in the past. For these reasons the State-Federal Fisheries Management Program (SFFMP) has been developed to merge State and Federal capabilities and responsibilities into a partnership in order to effectively develop and implement comprehensive fishery management programs. This plan is a result of that concept and should enhance the management of the shrimp fisheries in this region.

The shrimp fishery is based primarily upon exploitation of brown and white shrimp which presently comprise about 95 percent of the catch. Pink, royal red, and rock shrimp constitute the remainder of the commercial catch.

White and brown shrimp are most abundant in South Carolina, Georgia, and the Atlantic coast of Florida; whereas, pink and brown shrimp are most abundant in North Carolina. Shrimp can be considered as an annual crop due to their short life span.

Although annual catches of shrimp vary considerably in some states, the combined commercial catch of shrimp has not varied appreciably in the past 20 years in the region. This suggests that fishing has not adversely affected the abundance of shrimp during this time.

Most shrimp are taken commercially by otter trawls although some are taken by a variety of other gear such as cast nets, haul seines, and channel nets.

Shrimp are caught primarily between May and December in coastal waters. During this time bays and sounds may be open to commercial fishing for varying time intervals. Recreational fishing also occurs for shrimp between May and December and is concentrated in bays and sounds. A recent survey indicated that 10 to 15 percent of the total shrimp catch in the region may be taken by recreational fishermen. Bait fishing, which is most important in Florida, is also primarily restricted to creeks, rivers, bays, and sounds.

Chapter 2 presents an overview of shrimp resources and their associated fisheries.

Chapter 3 describes the present management system that is basically one in which states manage shrimp in their waters independently of other agencies, state or federal. Chapter 3 also identifies the problems of the present management system and the reader is referred to that section for more details.

Chapter 4 lists the goal and objectives of the regional shrimp management plan.

Chapter 5 describes the proposed regional shrimp management plan. Key areas of the plan given in this chapter are: (1) a conceptual overview of the plan; (2) plan objectives; (3) plan advantages and disadvantages; (4) models illustrating interactions of managing brown and white shrimp and managing brown and pink shrimp; (5) management structure options; (6) capabilities of present as well as proposed management systems; and (7) statistical information options.

Chapter 6 presents recommendations which will enable the plan to be implemented. Recommendations are ranked in order of priority; namely, high, medium or low with a short note of explanation beneath each recommendation. A total of 33 recommendations are presented with 25 ranked as high, four ranked as medium, and four ranked as low priority.

The two recommendations which the Council feels are most important deal with the formation and composition of a Regional Fisheries Management Council and the development and use of a Regional Catch and Effort Statistics System. The Committee has recommended that the Regional Fisheries Management Council be composed of the Regional Director of NMFS and those fishery administrators appointed to the ASMFC from each state. The recommendation

concerning the Catch and Effort Statistics system calls for the system to be implemented by the four states and supported by state and federal funds. This particular recommendation is of particular importance because the system eventually will include all commercial fishery statistics in this region.

Chapter 7 is a Management Action Program Summary. This is presented in chart form and shows time horizons, estimated funds needed, potential funding sources, and suggested responsibilities for activities which will be undertaken to begin implementation of the regional shrimp management plan.

Appendices present a glossary of words and terms which may be unfamiliar to the general reader of this document, and a summary of the planning chronology and methodology which went into the preparation of this plan. Also included is a section on plan implementation and evaluation.

Chapter 2

AN OVERVIEW OF THE RESOURCE AND FISHERY

The Resource

Presently white shrimp, Penaeus setiferus, and brown shrimp, Penaeus aztecus, comprise about 95 percent of commercial landings of shrimp in the South Atlantic United States. Pink shrimp, Penaeus duorarum, provide a significant part of the catch in North Carolina, but only 1 or 2 percent in the rest of the region. Recently, landings of rock shrimp. Sicyonia brevirostris, have increased significantly in Florida.

The white shrimp is the most abundant shrimp in Georgia, South Carolina, and along the east coast of Florida; whereas, the brown shrimp is most abundant in North Carolina.

White, pink, and brown shrimp utilize estuaries as nursery grounds for postlarval and juvenile stages. All species are exploited in bays, sounds, and nearshore waters. Although adult white shrimp are almost always vulnerable to capture (except during closed seasons), adult pink and brown shrimp migrate to offshore waters where they are "lost" to the fishery. These migrations occur before spawning, and spawning grounds within this region for both species are poorly known. In contrast, white shrimp normally spawn slightly offshore in depths from 20 to 80 feet.

Pink, brown, and white shrimp grow rapidly and most are caught before attaining 1 year of age. Because it is not possible to age shrimp precisely, their maximum age remains unknown. However, some individuals apparently can live for 18 or 24 months.

The major concentration of pink shrimp along this coast is located in North Carolina, and for management purposes they can be treated as one stock.

It is not known definitely whether there are one or several stocks of brown shrimp along the South Atlantic coast; however, catch statistics (Calder, Eldridge, and Shealy 1974) suggest that there may be only one. Although the definition of white shrimp stocks is poorly understood, catch statistics suggest that there may be several stocklets in this region (Calder, Eldridge, and Shealy 1974). Stock definition of white shrimp is particularly difficult because larger shrimp generally migrate to the south, whereas many smaller whites overwinter in estuaries in North Carolina, South Carolina, Georgia, and the more saline waters of the east coast of Florida.

Abundance of shrimp varies greatly from year to year in sectors of the fishery. However, the combined commercial catch of shrimp has not varied appreciably in the past 20 years, although 3 to 5 year trends in abundance of white shrimp have occurred during this period. This suggests that fishing has not adversely affected the abundance of shrimp during this time. In fact, the greatest threat to shrimp currently appears to be the alteration of the coastal environment by man. Effective coastal zone management policies will, hopefully, insure the preservation of esturaries in quantity and quality that will sustain the shrimp resource at an acceptable level.

Important information gaps concerning the shrimp resource are: (1) lack of knowledge concerning "loss" rates such as natural mortality, fishing mortality, and emigration; (2) the inability to adequately define growth rates; (3) the lack of adequate knowledge concerning spawner-recruitment relationships; and (4) lack of knowledge concerning the effects of intermediate to long term environmental variations on shrimp populations.

All four factors inhibit development of harvesting strategies because of inadequate estimates of growth and "loss" rates. The first and third factors may also reduce yields by causing managers to become too conservative

in establishing policies such as when to open the spring season for white shrimp. Finally, lack of knowledge concerning effects of environmental variation upon shrimp abundance could cause severe economic perturbations if those variations led to significant declines in catches.

The Fishery

Fishermen have exploited shrimp at least since 1817, although commercial catch statistics were not collected and published until 1880. Initially, dipnets, haul seines, and cast nets were the principal gears used. However, between 1912 and 1915 fishermen began to use otter trawls. The otter trawl became the standard gear by 1917, and by the 1930's accounted for approximately 90 percent of the catch. The remaining 10 percent was taken by cast nets and seines.

Initially, early fishing craft were small, open skiffs powered with gasoline engines. During the 1920's and 1930's vessels were decked over, engines placed forward with a pilot house added, and the diesel engine was introduced. Since then shrimp vessels and boats in the South Atlantic have been strongly influenced by vessels designed to fish along Florida and in the Gulf of Mexico. At the present time most vessels are double-rigged for towing two nets simultaneously. An exception to this is smaller boats that fish in the bays and sounds of North and South Carolina. These boats are usually equipped with power winches, rope towlines, and rigged for towing a single trawl from the stern.

Most commercial trawlers use a flat or two-seam balloon net to fish for brown shrimp; whereas, four-seam semi-balloon nets are often preferred for white shrimp (Rhodes 1974). White shrimp are generally caught during daylight. In contrast, brown and pink shrimp are sought mainly at night.

Most fishing trips last 1 or 2 days and most fishing grounds are locat-

ed within 6 miles of shore. There is no significant offshore fishery comparable to that in the Gulf of Mexico.

Although the otter trawl is the dominant commercial gear, some shrimp are taken by haul seines, cast, butterfly, drop, push, and channel nets. Channel nets are effective for harvesting pink shrimp in North Carolina and white shrimp in South Carolina. However, channel nets are strongly opposed by trawl fishermen in South Carolina and their use in that state is restricted to certain areas and seasons.

Pink shrimp are taken in the spring between April and June and the fall between September and November. Brown shrimp are most abundant from mid-June to mid-August. There is a spring fishery for white "roe" shrimp in May and June, and their progeny form the basis of the fall fishery which occurs primarily from September through December when seasons generally close.

The major fishing area in North Carolina is Pamlico Sound where about 50 percent of the annual catch is taken. Core and Bogue Sounds as well as White Oak, New, Cape Fear and the mouths of the Neuse and Newport Rivers are also good shrimping grounds. Recently a significant shrimp fishery has developed in the ocean off the southern coast of North Carolina.

St. Helena, Port Royal, and Calibogue Sounds as well as Bulls Bay are the most productive inshore shrimping grounds in South Carolina. Offshore waters within 6 miles of the beach are most productive from Bulls Bay to Tybee Roads.

Wassaw, Ossabaw, Sapelo, St. Simons, St. Andrews, and Cumberland Sounds are the most productive inshore areas in Georgia. Offshore waters from near shore out to 5 to 7 miles are quite productive.

Waters off Fernandina, the mouth of the St. John's River, St. Augus-

tine, New Smyrna, and Cape Canaveral are the most productive in Florida.

Generally, trawlers fishing primarily in one area deal with only one or two shrimp wholesale dealers, who not only buy shrimp but also provide services such as heading and packing, ice, and occasionally fuel. Larger vessels may fish in several states; hence, they deal with several dealers during a season. Most dealers assume responsponsibility for shrimp purchased from vessels; some, however, may act as brokers.

Shrimp fishermen engage in a number of other fisheries during the off season. In North Carolina, a number of shrimp vessels participate in the winter ground-fishery for species such as black sea bass, butterfish, flounder and porgy. In South Carolina and Georgia, vessels may fish with pots for black sea bass or trawl for blue crabs. Others may fish demersal species such as snapper, grouper, grunts, porgy, and black sea bass. In Florida, many vessels are now taking rock shrimp.

Bait shrimping is conducted throughout the region, but is probably most important in Florida and is based upon both live and dead shrimp.

Recreational shrimp fishing is widespread and probably accounts for 10 to 15 percent of the total catch of shrimp in the region. However, because of the lack of recreational catch statistics, it is very difficult to document either the catch or the value of this fishery. Nonetheless, a recent survey of this recreational fishery indicated that over 300,000 angler days were spent annually in this region in pursuit of shrimp (Eldridge, Rhodes, and Cupka 1974).

Information gaps include lack of catch and effort and socio-economic data.

Chapter 3

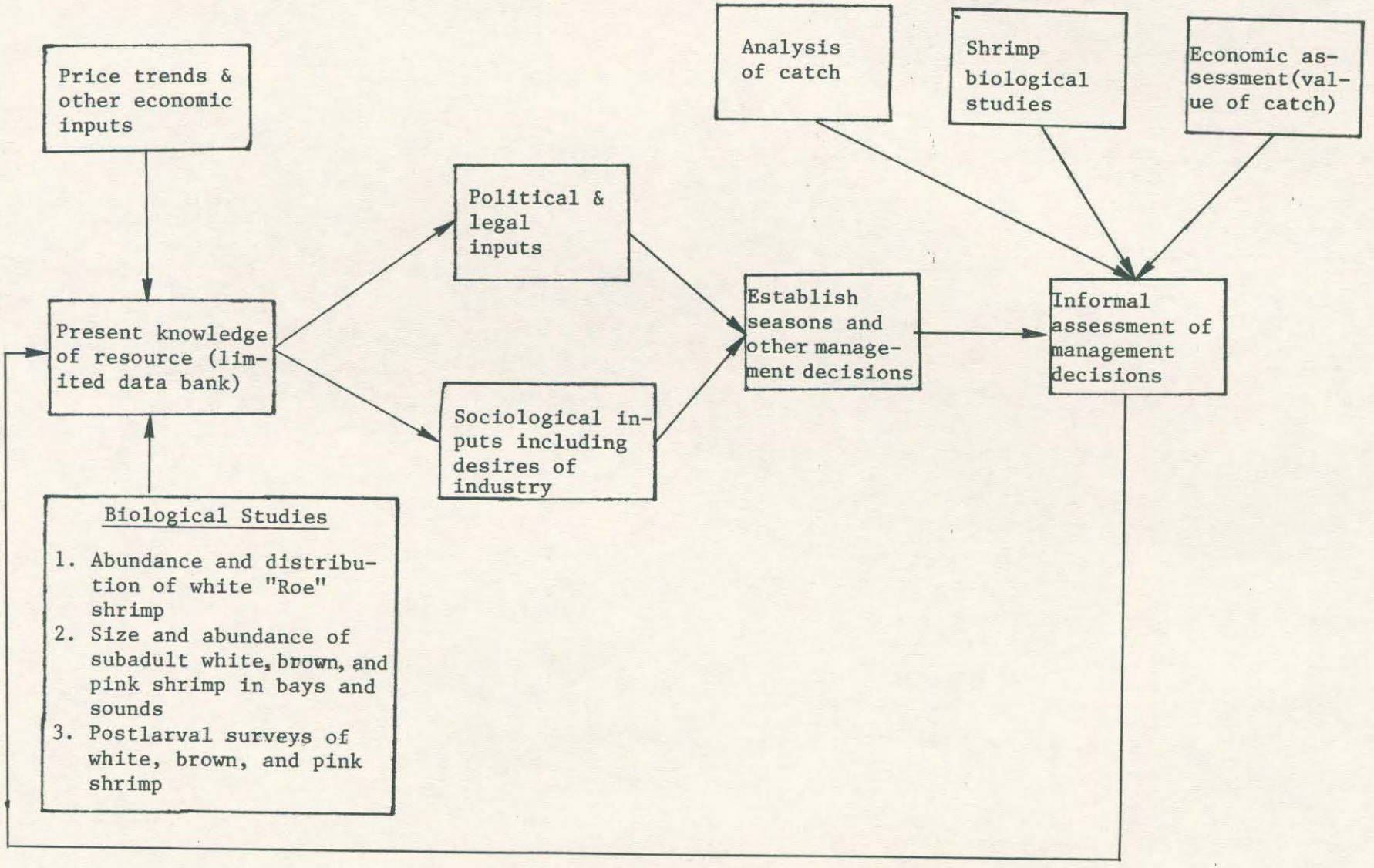
PRESENT MANAGEMENT SYSTEM AND ASSOCIATED PROBELMS

Present System

The present shrimp management system has evolved over approximately 50 years and is based largely on biological knowledge, experience, and intuition gained over that period (See Figure 1). In fact, a major limitation of the present system is the lack of methodology to fully evaluate management decisions. Another characteristic is insufficient ability to predict accurately either the well being of the resource or the welfare of the industry as a whole, particularly its economic health. Moreover, the catch reporting system presently used is inadequate to document either trends in the fishery or to determine economic parameters such as the cost of harvesting. Despite these handicaps managers have been able to protect the health of the resource and the industry apparently has done reasonably well economically prior to recent increases in energy costs and lower prices for shrimp. Finally, certain segments of the industry appear to influence key state legislators, who may in turn exert influence upon fishery managers with varying degrees of success. This phenomenon appears to occur most frequently in those instances where significant gaps in biological information exist.

The objectives of the present system of shrimp management have been to: (1) protect the resource; (2) maximize catch; and (3) maximize gross economic yield. The first of these objectives has been achieved by regulating the harvest and by regulating the alteration of the coastal zone. The second and third objectives have been more difficult. However, managers have attempted to attain these goals by regulating the size of shrimp harvested. This procedure may have been successful, but because losses due to natural

Figure 1. Schematic diagram of typical state management system.



mortality and emigration are not known precisely, it has not been possible to evaluate fully the success of this strategy.

The present system is operating under a number of constraints including biological information gaps, inadequate catch and effort statistics, insufficient social and economic data, lack of jurisdiction in waters outside of State control, and enforcement and legal problems.

Continuing management problems are the inability to regulate and administer the fishery on a regional basis, and the inability to fully evaluate the effects of management decisions.

Identification of Problems

One of the first steps in the development of a fisheries management plan is the assessment of existing and potential problems within the fishery. This was accomplished at least in part by the development of a regional shrimp management planning profile (Calder, Eldridge and Joseph 1974), and that material with some changes is presented here. Additional work dealing with socio-economic attitudes and problems was identified in a separate study conducted by State and NMFS personnel for the Management Committee. The reader should refer to this document for further details (Acheson MS).

Biological Problems

1. Improving Catch and Effort Statistics

Adequate catch and effort statistics are needed to monitor biological and economic trends in the fishery, document changes in the efficiency of vessels and gear, estimate fishing and natural mortality rates, evaluate management decisions such as the opening of bays and sounds, estimate the abundance of white roe shrimp, and evaluate forecasts derived from biological sampling of postlarvae, juveniles, and overwintering stocks of shrimp.

2. Protection of Spawning Stocks

Because pink and brown shrimp spawning grounds are largely unknown along the South Atlantic Coast, these species are not presently fished during their spawning seasons. Since such grounds are located offshore, state management agencies do not have jurisdiction to protect spawning stocks, should this be necessary. Such stocks could be protected through an appropriate State-Federal Fisheries Management Program assuming some form of extended jurisdiction is achieved.

Spawning populations of white shrimp are currently harvested. The fishery on these stocks within the 3-mile limit is presently controlled by state regulations.

3. Protection of Juvenile Stages

Protection of juveniles is partly a function of proper coastal zone management. Juveniles are protected in bays and sounds by opening and closing of seasons based on size of shrimp present and by prohibiting most types of commercial fishing activities in certain areas known to be important nursery grounds. An exception to this is that limited bait fisheries do operate in some nursery grounds in some states. While attempts are made to protect juveniles in nursery grounds, the success of these efforts is uncertain largely because of insufficient information on growth and mortality rates. However, the industry generally supports such efforts as good conservation policy. Injudicious use of pesticides and other chemicals could be a management problem, particularly when applied directly in the coastal zone. Channelization and other flood control projects can also adversely affect shrimp production. This has occurred in North Carolina.

4. Exploitation of mixed penaeid populations

In some areas the fishery for one species has an adverse effect on

juveniles of another. In North Carolina management officials are faced with the problem of deciding when to prohibit fishing for pink shrimp to protect juvenile brown shrimp. Seasons for pink shrimp in some years are closed temporarily in the hope of increasing the economic yield of brown shrimp. Also, night fishing for brown shrimp may need to be regulated in order to protect juvenile pinks. A similar situation exists in some bays and sounds in South Carolina during July and August when juvenile white shrimp enter areas inhabited by larger brown shrimp. In June, 1974, the opposite situation occurred when large numbers of juvenile brown shrimp entered fishing grounds inhabited by adult white shrimp. In this case the shrimp fishing season was temporarily closed in South Carolina to protect the smaller brown shrimp. However, in this instance as well as in other cases it is very difficult to document the benefits of such a decision.

5. Definition of adequate parental stock size

Adequate parental stock size for brown and pink shrimp cannot be defined until the spawning grounds of these species are located. Since we do not understand the parent-progeny relationship for white shrimp, which are exploited while spawning, and because it is not known how environmental factors may affect this relationship, problems exist in deciding when to open the spring season for white shrimp and how to evaluate the effect of that decision upon the subsequent fall crop of white shrimp.

6. Natural and Fishing Mortality Rates of Commercial Shrimp

A major problem for any fishery is determining the rate of fishing that will maximize yield. Because neither natural nor fishing mortality rates for shrimp along this coast are well established, managers must subjectively select those sizes of shrimp to be exploited.

7. Age and Growth Determination

Methods of aging shrimp with acceptable accuracy are presently lacking although a size-age conversion for pink shrimp has been developed. Also, reasonable growth rates have been developed for brown, pink and white shrimp based on tagging experiments. However, until age can be more precisely determined, various estimates of growth remain approximations. Insufficient information concerning growth is a definite problem in yield-per-recruit analysis. Similarly, lack of knowledge concerning survival rates of post-larvae and juveniles also makes it difficult for managers to predict supply, thus increasing the risk for industry.

8. Characterization of Overwintering Patterns

Annual assessments of distribution, movement, and relative abundance of overwintering populations of white shrimp in North Carolina, South Carolina, Georgia, and Florida would enable managers to make better forecasts concerning the potential resource available to the spring fishery. The absence of such information makes it difficult to decide when the fishing season should be opened. Moreover, the absence of a forecast makes it more difficult for members of industry to plan their fishing activities.

Overwintering patterns of pink shrimp in North Carolina are documented. Brown shrimp overwinter somewhere offshore and it would be both difficult and expensive to determine their overwintering patterns.

9. Spawning Grounds of White, Brown, and Pink Shrimp

Spawning grounds of brown and pink shrimp are not known, but both species probably spawn mainly beyond the 3-mile limit. State and federal agencies have limited jurisdiction to control fishing on such offshore grounds.

White shrimp spawning grounds are generally known, and exploitation of spawners can be partially controlled within existing jurisdictional limits

of each state.

10. Emigration

A knowledge of emigration rates of adult brown and pink shrimp from fishing to non-fishing grounds (offshore areas) is needed before satisfactory estimates of fishing and natural mortality rates can be obtained for these species. This is also true for white shrimp which migrate north and south and may also move offshore. This entire problem is exacerbated by the lack of adequate catch and effort statistics making it more difficult to estimate rates of fishing mortality.

Emigration of pre-adults into fishing areas, particularly in response to environmental factors such as heavy rains, may result in the harvesting of a majority of the population before the individuals reach optimal size.

11. Distribution and recruitment Patterns of Larvae and Postlarvae

Although recruitment patterns of larvae and postlarvae might be inferred if better oceanographic data including current patterns were available, it would be very difficult to locate where these stages originated because specimens from different areas could not be discriminated.

12. Habitat Alteration and Loss

Alteration and loss of habitat has been considerable in the past 50 years and may continue. Such activities could significantly reduce production of shrimp.

13. Mass Mortalities

Environmental factors and actions by man can cause mass mortalities. This problem directly affects biological supply and the economics of the industry.

14. Diseases

Diseases may either reduce shrimp supplies through mortality or reduce their acceptability to the consumer.

15. Environmental Factors

Such factors present problems over which management agencies have little control, unless they are man-induced. Rates of survival in nursery grounds are probably highly variable and depend to a large extent upon weather and hydrological conditions. Natural phenomena can be studied to determine their possible influences on shrimp. For example, a relationship has been noted in Florida between incidence of red tide one year and abundance of shrimp and blue crabs in the following year.

16. Incidental Catch of Juvenile Loggerhead Turtles

Juvenile loggerhead turtles are sometines caught by shrimp trawlers in this region. If the loggerhead turtle is designated a threatened species, appropriate measures and enforcement practices must be instituted in order to minimize the number injured or killed by shrimp trawlers.

Economic Problems

1. Commercial vs. Commercial

Such problems involve competition among shrimpers utilizing different harvesting techniques. For example, in South Carolina there is a controversy between users of fixed gear (channel or set nets) and moving gear (trawlers). Friction has also arisen between bait and commercial shrimpers. In addition to competition among shrimp fishermen, there may be competition between shrimpers and other fishermen such as crabbers.

2. Commercial vs. Recreational

This is largely an allocation of resource problem; some commercial fishermen view the recreational fishery as detrimental to their livelihood. With the possible exception of the St. Johns River, Florida, and the sounds of North Carolina, where large numbers of shrimp licenses are sold, actual gear and space competition between commercial and recreational shrimping does not

appear to be a major problem at this time.

3. Bait Shrimp Fishery

Commercial fishermen in some areas oppose bait shrimp fishing because: (1) they oppose the harvesting of large numbers of small shrimp for bait; (2) destruction of nursery ground habitat has been alleged in some cases; (3) bait shrimp are occasionally sold for human consumption; and (4) they feel that such activity will lead to widespread illegal trawling because of difficulty of law enforcement. Despite these criticisms, bait shrimp are particularly valuable to recreational fishermen and command a good price for bait dealers.

4. Availability of Shoreside Facilities

From an economic viewpoint it is essential to have adequate dock space and supply facilities in areas within reasonable distance of the fishing grounds. Dock and supply facilities as well as storage space and adequacy of local processing appear to be rather limited in most areas of the South Atlantic United States.

5. Utilization or Elimination of Incidental Catch

The occurrence of species other than shrimp in the catch is generally regarded as a problem because of the time and effort necessary to sort the catch. Disposal of dead fish, crabs, jellyfish, etc., may be a problem, particularly near beaches or in harbors. Some methods should be devised to utilize the incidental catch for the good of the industry. Fish, including large numbers of sciaenids, are taken by the gear presently in use. Some Japanese and United States firms are currently interested in exploring the passibility of using these fish for food.

6. Waste Disposal

This is a problem for vessels and especially for dockside dealers. A

number of state, local and federal agenices are currently establishing standards relating to waste disposal; industry will be required to comply with these.

7. Product Inspection

This is an industry problem; prices to the fishermen are not related to the price incentive system except at the extremes of good vs. poor quality.

8. Entry to and Exit from Industry

At present the productivity of each vessel is quite low, predominantly due to the large number of units in the fishery. Nichols and Griffin (1975) reported that catch per unit effort (CPUE) declined 50 percent in the Gulf of Mexico shrimp fishery between 1967 and 1973 and suggest that high prices were the only factor that allowed vessels to operate profitably. They also concluded that high prices had attracted additional effort into the Gulf fishery and that the recent decline in shrimp prices had created economic hardship for owners and operators. This situation also holds for the South Atlantic region. This problem is aggravated because capital invested in the industry has low salvage value and as a result is relatively fixed.

9. Effective Market Utilization

There is a need, particularly in North and South Carolina, to identify and effectively utilize alternative markets, and to improve existing markets.

10. General Lack of Economic Information

There is a paucity of information and data on the economics of the South Atlantic shrimp fishery. Such information is particularly lacking for the market above the harvester level.

11. Fluctuations in Supply and Prices

Fluctuations in the supply of shrimp occur seasonally and from year to

year. Immediate problems arise for the primary harvesters, the dock dealers, and others whose income depends upon a native supply of shrimp. Fluctuation in biological production is largely an uncontrollable variable, although management agencies or extension personnel can advise the industry of predicted catches and their potential impact on prices. The price structure is also significantly influenced by imports and exports of shrimp, which also vary.

12. Rate of Return on Investment

This is a problem closely tied to entry and the economy.

13. Labor Market

Low wages and seasonal employment result in a shortage of labor, particularly of strikers. Frequent personnel changes also decrease the operating efficiency of a crew.

14. Cost and Availability of Insurance

The availability and cost of insurance is a definite problem for shrimp fishermen. The major problem relating to hull insurance is obtaining coverage on a used boat at a reasonable premium, particularly for an older vessel. Property and idemnity insurance is so expensive that a large percentage of owners cannot afford to carry it.

15. Seasonal Aspects of the Fishery

This adversely affects (1) the rate of return on investment because capital is tied up in idle equipment for a portion of the year; (2) marketing, particularly of the incidental catch ; and (3) labor , since help may be unemployed for part of the year.

16. Availability and Cost of Fuel

The cost of fuel has doubled over the past year and is a major influence on the rate of return on investment; long-term availability of fuel represents a potential problem.

Institutional Problems

1. Space Competition

Dredging operations, jetty construction, shipping and artificial reefs may present space competition for shrimpers. The possible development of offshore oil rigs, deep water ports and floating nuclear power plants in offshore fishing grounds presents potential for space problems.

Captains of small shrimp boats, who traditionally fish the bays and sounds, may be disturbed by the presence of large boats when the latter move in to fish in such grounds. Space competition occasionally arises between shrimpers and crab pot fishermen in bays and sounds.

2. Out-of state Entry

Problems arising from out-of-state entry include: (1) in-state resentment against out-of-state boats; (2) competition for fuel resources; (3) crowding of dock facilities which tends to disrupt business activities and may cause problems in the public health sector by taxing local facilities for waste disposal; (4) potential law enforcement difficulties because of lack of familiarity with state laws; (5) complication of management activities when agencies do not know the number of vessels to be concentrated in an area to be opened; (6) the introduction of a source of error in catch and effort statistics when shrimp are caught in one state and landed in another; and (7) the probability of economic loss to local processors if vessels fish in one state and land in another.

3. Foreign Vessel Entry and Competition

This does not presently constitute a problem to the South Atlantic shrimp fishery. With the exception of the developing fishery for rock shrimp, shrimping on this section of the coast is confined to near-shore

waters, and under maritime law foreign vessels are prohibited from fishing within the 12-mile limit.

4. Effective Law Enforcement

Management agencies must be prepared to enforce laws and regulations necessary to carry out effective fisheries management programs. Effective law enforcement appears to be an issue in some areas. Law enforcement is a problem in part because law enforcement agencies may be understaffed and lack adequate funds. Other factors are legislative and regulatory constraints and lack of properly trained personnel.

5. Inadequate Navigational Aids and Underwater Obstructions

These constitute definite hazards to personnel and property in some areas.

6. Jurisdictional Problems

While both federal and state agencies lack adequate management authority outside the 3-mile limit, this has relatively little impact on the contemporary shrimp fishery of the South Atlantic, since it is conducted mostly in near-shore waters. States have jurisdiction over the fishery within the 3-mile limit. However, problems frequently arise because each of the four states in the region has its own set of laws and regulations. In addition, a sizable fishery for rock shrimp has developed in Florida beyond the 3-mile limit.

7. Federal, State, and Local Regulations

Differing laws and regulations at three levels of government represent a problem for both industry and management. This adds to the administrative workload on industry and especially on dealers, who sometimes must file reports to federal, state, and local agencies. Such problems tend to create poor rapport between industry and management.

8. Common Property Nature of Resource

Fishermen lack ownership rights to the shrimp resource of the South Atlantic region and entry to the fishery is unlimited. Consequently, investment in vessels and equipment may have exceeded an optimal level. Increased operating costs and lower prices for shrimp during 1974 have caused severe economic stress on the harvesting sector of the industry over the entire region.

9. Effective Industry Organization

The lack of cohesive organization weakens the influence of the shrimp industry in matters of importance. Without effective organization it is difficult for management to ascertain who speaks for the industry. Strong organization would enable industry to better recognize the causes of specific problems and facilitate resolving these problems.

10. Federal Unemployment and Other Taxes to Fishermen

This is perceived as a problem by some vessel owners and shrimp dealers who must hire labor. The federal government has jurisdiction over this area and industry must comply with existing regulations.

11. Imports of Shrimp

Shrimp imports generally have had a negative effect on the price structure of domestic shrimp, particularly within the past 2 years as demand has slackened.

12. Extension, Education, and Training Activities

American agriculture has progressed well with a strong background of extension activities leading it forward. A parallel effort is needed in the shrimp fishery of the South Atlantic United States to assist in marketing, improving product quality, developing technology, and encouraging offseason fisheries.

13. Lack of Mechanism for Managing Fishery on Regional Basis

This deficiency makes it very difficult for states to coordinate research and management programs both within and outside state waters. This problem should be largely resolved once an effective State-Federal Fisheries Management Program including a Regional Management Council is established in fact as well as on paper.

Chapter 4

GOAL AND OBJECTIVES

The goal and objectives developed by the Management Committee are shown below.

Goal

The management of the shrimp resources and fisheries of the South Atlantic United States in order to provide maximum sustained benefits for the region and the nation.

Objectives

I. To design a regional shrimp management system by June 1975 that will allow the formulation of regional management policies.

II. To sustain the resource so that the catch level of presently utilized species can be maintained at least at the established average of the 1955-1970 period until 1980.

III. To identify by 1978 the potential expansion of harvest by better utilization of existing species and exploiting underutilized species.

IV. To establish economic criteria by 1978 for evaluating and initiating management action.

V. To determine by 1978 those social parameters important as criteria for initiating and evaluating management action.

This plan was developed as a policy or strategic plan in contrast to the more common technical or tactical plan. Its purpose is to show what inputs are needed and how these inputs may be used to arrive at policies . These policies will in turn be used to develop regulations, programs and other activities which will satisfy the objectives. If the fisheries environment were static, the goal of the Management Council would be achieved

when all objectives were met. However, because biological, economic, and social conditions are constantly changing, the management system must be capable of responding in a timely manner. Thus, objectives and policies must be re-evaluated for continued relevance. For this reason the goal and objectives of this plan should be considered as guidelines for the future management of the shrimp resource and fishery in the South Atlantic States that will require adjustments from time to time.

Chapter 5

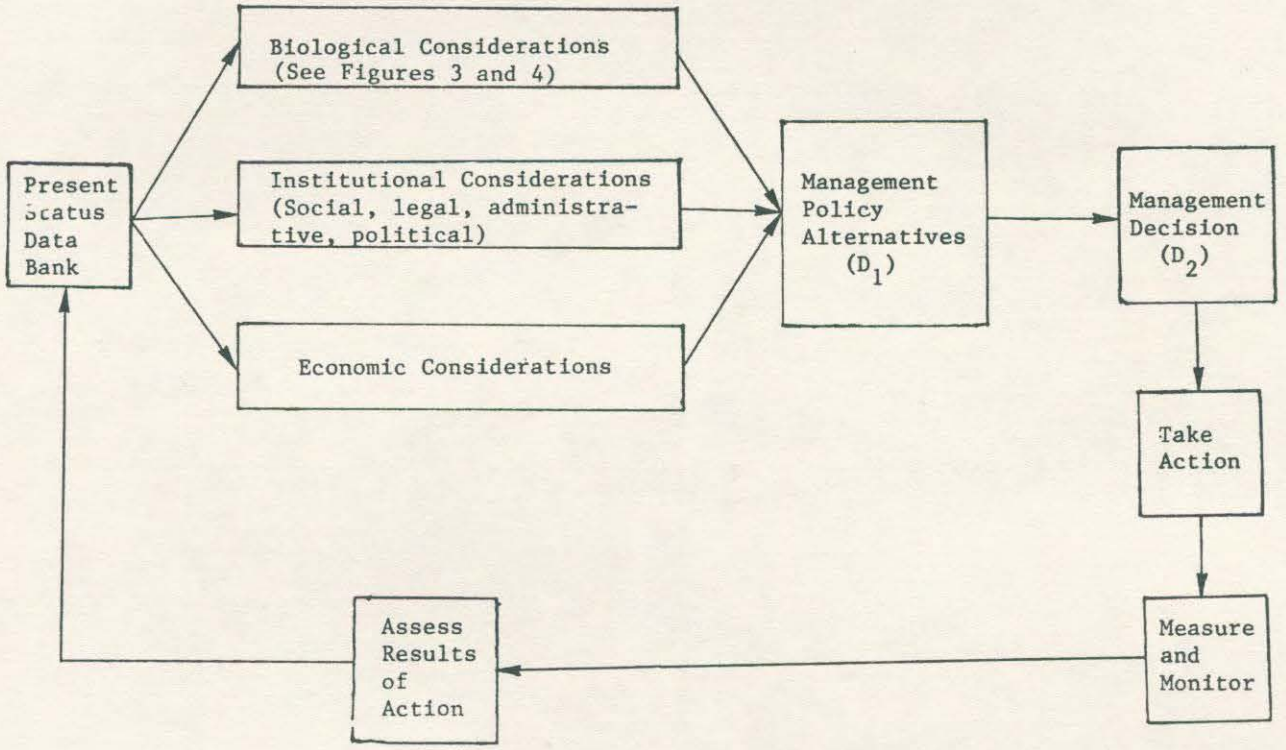
PROPOSED FUTURE SYSTEM

Under the new system States will continue to manage the shrimp fishery within their boundaries, but will cooperate in managing those regional aspects of the fishery which can not be managed under the present system. States will be assisted in this effort by appropriate federal agencies, particularly in the development and early implementation of the plan which has a time horizon of 10 years; the first 5 years will be devoted to making the plan operational, and the second 5 years will be used to evaluate and improve the plan.

The core of the suggested regional plan is a regional catch and effort statistics program which would provide for collection of economic and biological data. The statistical program developed for shrimp should have the capability of being expanded to include other fisheries when desired.

Figure 2 shows a conceptual model of the regional management plan. The system is contingent upon a regional data base which will provide information for: (1) population dynamic models; (2) development of insight into the economic structure of the industry; (3) optimal vessel and fleet configuration; (4) determination of social attributes of the fishing community; and (5) determination of those environmental parameters which can be monitored to provide continuous information concerning the status of the resource as well as the condition of the environment which supports the shrimp resource. This information in turn will be used to: (1) develop harvest prediction models; (2) develop economic criteria to allow managers to judge the health of the fishing industry and evaluate the impact of management decisions; (3) formulate social and political criteria which can be used

Figure 2. Conceptual Model of Future Management System.



EXPLANATION OF DECISIONS TO BE MADE

D_1 At this point biological, institutional and economic considerations must be taken into account to produce alternative actions which may be used to solve the problem under examination. All forms of action should be considered, ranging from the null alternative (the "do nothing" alternative) to drastic action. Those alternatives which appear to have the best chance of solving the problem, along with each options' advantages and disadvantages should be used for decisions (D_2).

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

D_2 The Fisheries Management Council will make this decision by choosing the best alternative in accordance with previously set policies.

to determine (a) the potential acceptance of management policies, and (b) the social impact of management decisions; and (4) suggest guidelines to advise members of industry and the public concerning the present status of the shrimp resource. Once these tasks are accomplished, management policies will be developed that will consider biological, economic, social and political conditions in the fishery. The next step of this process will be to decide on the proper techniques for implementing policies. After implementation, policies will be evaluated for their effectiveness and relevance to changing conditions.

The objectives of the new regional management system are to: (1) sustain the resource and to maintain a viable fishing industry; (2) establish a system that can predict the future status of the resource and industry; (3) evaluate the biological, economic and sociological effects of management policies; and (4) establish a regional management system that could serve as an example for future management of other fisheries located in the area.

The principal advantage of the new system is that the management of the system will coincide with the geographic distribution of the resource. Other advantages are: (1) it can serve as a model for regional management of other fisheries in this area; and (2) it should lead to development of a predictive ability that (a) may reduce economic loss to the industry resulting from overinvestment which could improve the financial climate concerning investment in the fishery, (b) increase the effectiveness of management through coordinating field monitoring of the resource, (c) enable managers to evaluate the biological, economic, social-political effects of their decisions, (d) allow States to coordinate administrative, research and enforcement policies, (e) enable managers to advise industry concerning costs of fish-

ing, (f) allow managers to document biological and economic trends in the shrimp fishery, (g) provide adequate catch and effort data should it be necessary for negotiations between the federal government and other nations fishing in this area, and (h) establish for the first time a regional scientific (biological, economic and institutional) data base that can be used to eliminate information gaps which presently prevent managers from significantly improving resource management.

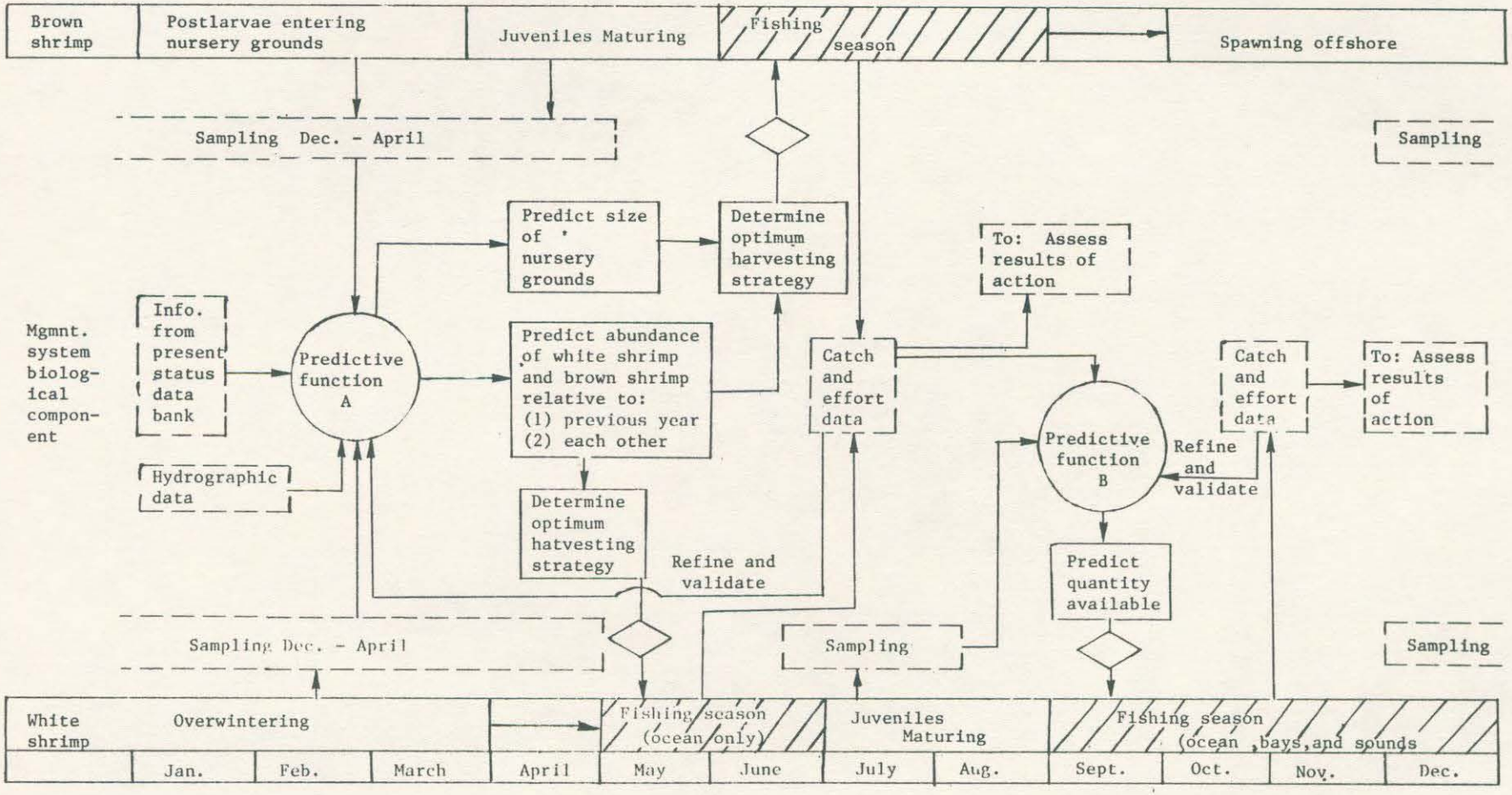
Disadvantages of the new plan include, but are not necessarily limited to, a higher initial cost particularly for a regional catch and effort statistics system. Also, the possibility that certain elements of the industry will oppose the plan on the grounds that their time is being taken up with few tangible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

Biological Shrimp Models

This section will provide a more elaborate overview of the management of the major shrimp species. The biological models that will be discussed fall under Biological Considerations in Figure 2. Similar models should be developed for other species as well as institutional and socio-economic elements in this system. However, it is not possible to construct accurate models at this time because of the lack of information.

Figure 3 shows the interactions of the management of white and brown shrimp in the region. The model represents activities for 1 year which essentially covers one generation of shrimp. Sampling begins in December to monitor and assess the abundance of overwintering white shrimp. Information derived from this activity will be used to construct a detailed model of overwintering patterns of white shrimp which can be used to predict their availability and abundance for the spring season. Managers

Figure 3. Interactions of proposed white and brown shrimp management practices in the states of North Carolina, South Carolina. Georgia and the East Coast of Florida.

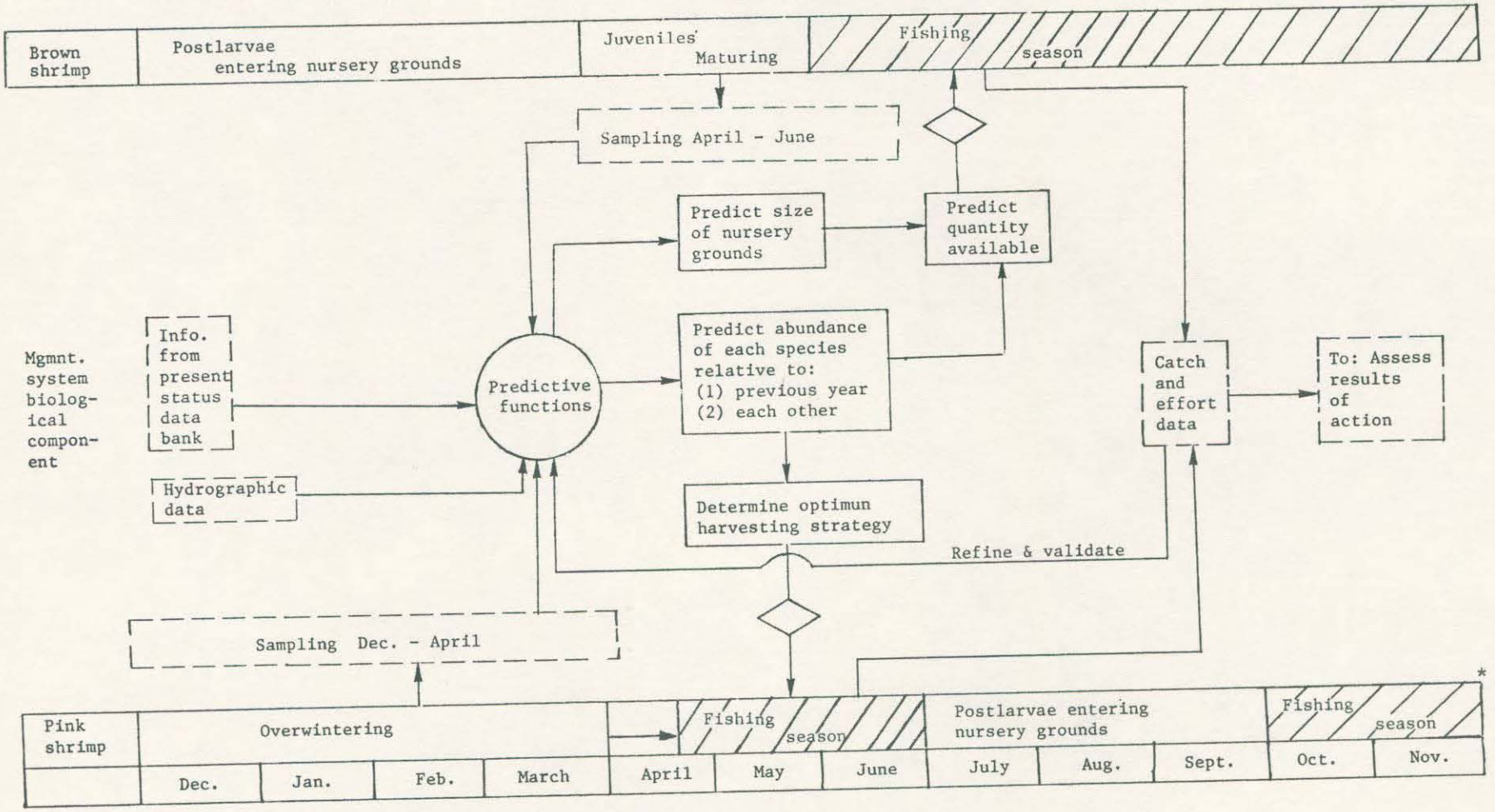


will open the spring season and estimate the potential value of the spring catch on the basis of this information. Analysis of catch and effort statistics will allow managers to evaluate and improve their spring prediction as well as permit them to make a preliminary assessment of the fall crop of white shrimp. Also, in the spring, brown shrimp juveniles enter nursery grounds and are monitored in order to obtain information to develop harvesting strategies. This becomes more important when juvenile brown shrimp enter fishing grounds for adult whites as happened in South Carolina in June, 1974. Again, as data are collected over several years predictive models will be developed for the summer fishery of brown shrimp. This information will also be used to develop decision rules for regulating seasons for bays and sounds. At the end of the summer fishery for browns, catch and effort data will be analyzed to evaluate catch predictions as well as to monitor socio-economic trends.

Monitoring activities throughout the summer will enable biologists to better estimate the fall catch of white shrimp. These activities will also provide information which will permit managers to develop criteria for regulating seasons for bays and sounds in the fall. Finally, the results of stock monitoring in addition to catch and effort data will provide useful information concerning the closure of the season in the fall. This will complete one management cycle except for the evaluation of procedures which is a continuous process.

Figure 4 shows the interactions of the management of brown and pink shrimp which represents the situation in North Carolina. In North Carolina, the overwintering patterns of pinks will be examined. Information derived from this study will be used to construct a detailed model of

Figure 4. Interactions of proposed brown and pink shrimp management practices in North Carolina.



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

overwintering patterns of pink shrimp which can be used to predict the availability and abundance of this species for the spring season. Managers will use this information to regulate the spring season. Analysis of catch and effort data will allow for evaluation of predictions. Also, in the spring, monitoring of juvenile brown shrimp on nursery grounds will provide information for development of harvesting strategies and predictions. This is particularly important for areas near inlets because brown shrimp in these areas migrate rapidly to sea where they are essentially "lost" from the fishery. Analysis of catch and effort data as well as monitoring activities will permit managers to evaluate predictions.

As previously mentioned, a problem exists when juvenile pinks enter an area occupied by adult browns. Then, managers must devise harvesting strategies to optimize yields.

Juvenile pink shrimp will be monitored in the fall and this will complete the management cycle except for the evaluation of procedures which is a constant activity.

Capabilities of Management Systems for the South Atlantic Shrimp Fishery

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

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

Table 1. Capabilities of management systems for the south Atlantic shrimp fishery.

Problem	Item in plan document	Present system	Present system modified	Proposed system
1. Improving catch and effort statistics	B 1	-	-	+
2. Protection of spawning stock	B 2	-	-	+
3. Protection of juvenile stages	B 3	+	+	+
4. Exploitation of mixed penaeid populations	B 4	-	-	+
5. Definition of adequate parental stock size	B 5	-	-	+
6. Natural and fishing mortality rates of commercial shrimp	B 6	-	-	+
7. Age and growth determination	B 7	-	-	-
8. Characterization of overwintering patterns	B 8	-	+	+
9. Spawning grounds of white, brown, and pink shrimp	B 9	-	-	+
10. Emigration	B 10	-	-	+
11. Distribution and recruitment patterns of larvae and postlarvae	B 11	-	-	+
12. Habitat aleration and loss	B 12	+	+	+
13. Mass mortalities	B 13	A	A	A
14. Diseases	B 14	A	A	A
15. Environmental factors	B 15	A	A	A
16. Commercial vs. commercial	E 1	+	+	+
17. Commercial vs. recreational	E 2	+	+	+
18. Bait shrimp fishery	E 3	+	+	+
19. Availability of shore-side facilities	E 4	+	+	+
20. Utilization or elimination of incidental catch	E 5	-	+	+
21. Waste disposal	E 6	A	A	A
22. Product inspection	E 7	A	A	A
23. Entry to and exit from industry	E 8	-	-	+
24. Effective market utilization	E 9	-	+	+
25. General lack of economic information	E 10	-	-	+
26. Fluctions in supply and prices	E 11	-	-	A

Table 1. (continued)

Problem	Item in plan document	Present system	Present system modified	Proposed system
27. Rate of return on investment	E 12	-	-	+
28. Labor market	E 13	A	A	A
29. Cost and availability of insurance	E 14	A	A	A
30. Seasonal aspects of the fishery	E 15	-	A	A
31. Availability and cost of fuel	E 16	A	A	A
32. Space competition	I 1	A	A	A
33. Out-of-state entry	I 2	-	-	+
34. Foreign vessel entry and competition	I 3	-	-	+
35. Effective law enforcement	I 4	+	+	+
36. Inadequate navigational aids and underwater obstructions	I 5	A	A	A
37. Jurisdictional problems	I 6	-	-	+
38. Federal, state, and local regulations	I 7	-	-	+
39. Common property nature of resource	I 8	-	-	+
40. Effective industry organization	I 9	A	A	A
41. Federal unemployment taxes to fishermen	I 10	A	A	A
42. Imports of shrimp	I 11	A	A	A
43. Extension, education, and training activities	I 12	+	+	+
44. Lack of mechanism for managing fishery on regional basis	I 13	-	-	+

+ Means some management action can be taken.
- Means no management action can be taken.
A Means advisory action can be taken.
B Refers to biological problem.
E Refers to economic problem.
I Refers to institutional problem.

The final system examined is the proposed future system discussed at the beginning of this chapter.

Management Structure Composition Options

The first objective of the South Atlantic Shrimp Committee is the establishment of a regional shrimp management system that will allow formulation and implementation of regional management policies. The functions of the management system are discussed elsewhere in the plan. A discussion of the management structure follows.

The basic organization of the management structure is shown in Figure 5 which illustrates the preferred choice of the Management Committee. The basic structure is the Management Council which will set policy for regional management actions. Technical Committees with supporting groups will be appointed as necessary. The Management Council will establish appropriate procedures and policies to take all necessary actions to design, implement, and evaluate all regional management activities.

Options for the composition of the Management Council are presented below.

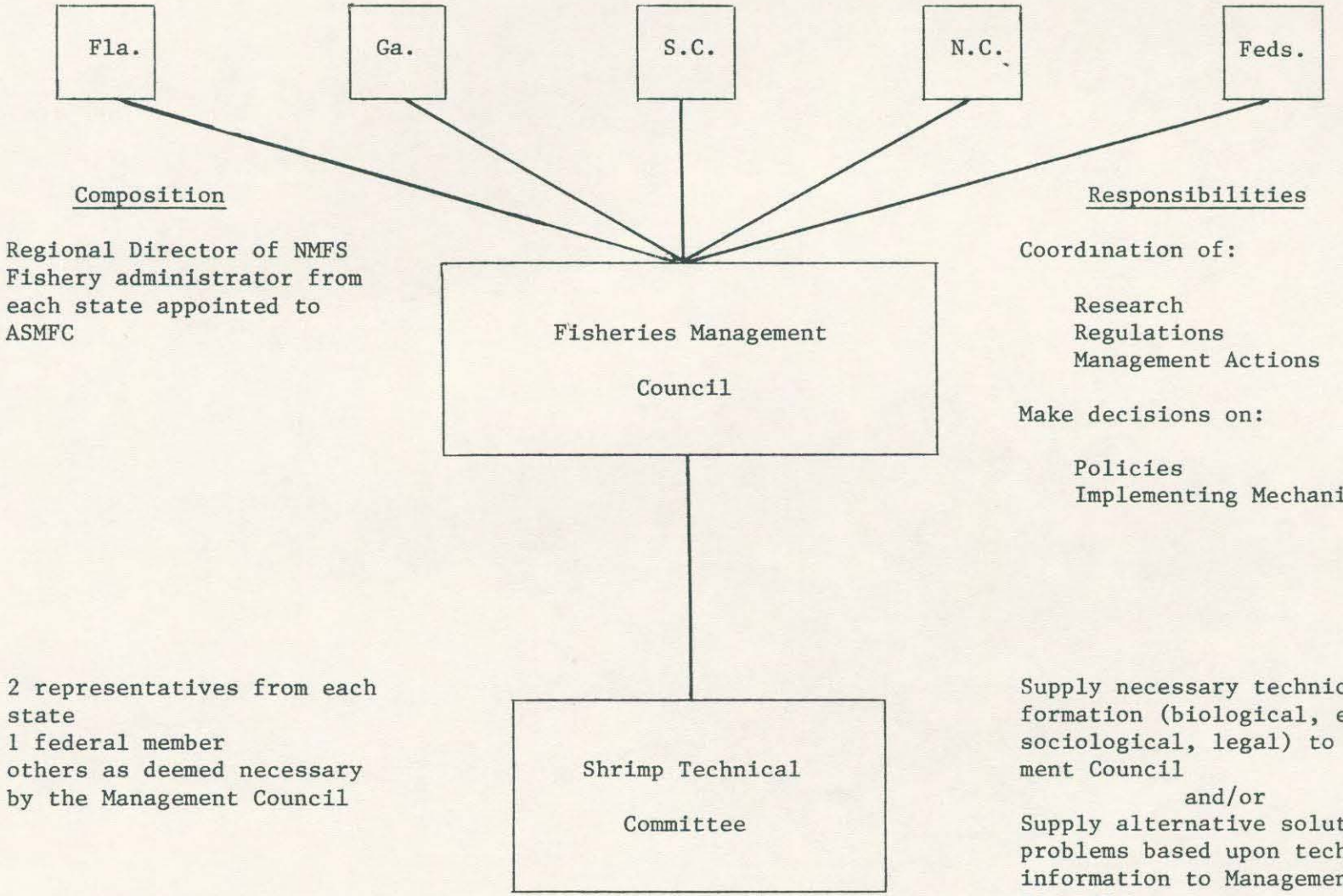
I. The Council shall be composed of:

(a). The Regional Director of the National Marine Fisheries Service.

(b). Those persons appointed by States to the Atlantic States Marine Fisheries Commission as Fishery Administrators.

The advantages of this option are that all members of the Council have knowledge of and interest in fisheries management problems and the state administrators regularly advise the heads of their departments on fisheries management problems as well as make recommendations to their legislatures.

Figure 5. Management structure recommended by the South Atlantic Shrimp Management Committee.



Also, they are familiar with the activities of the ASMFC, and therefore, can co-ordinate the activities of the Council with those of the ASMFC.

There are two disadvantages of this option. The first is that those state administrators can commit their respective agencies to a course of action only with the approval of the head of their department and through legislative or gubernatorial action. Secondly, this or any formalized regional management scheme would require legislative approval to enter into reciprocal management programs.

II. The Council shall be composed of the State Fisheries Administrator appointed to ASMFC by the four states.

Advantages of this option are that the ASMFC is already in existence with a staff and States can adopt regional regulations through the use of Amendment One of ASMFC.

Disadvantages of this option are that it lacks Federal representation, and thus problems requiring federal jurisdiction would be more difficult to solve, that it would require legislative approval, and that it may not qualify for funding under the State-Federal program.

III. The Counicl shall be composed of:

(a). The Regional Director of NMFS.

(b). The heads of each administrative agency charged with the conservation of fisheries resources.

The advantage of this option is that the heads of the appropriate state agencies will often have greater power to commit their agencies to a course of action. It must be remembered however, that legislative or gubernatorial action may still be needed in this instance.

Disadvantages of this option are that heads of agencies are extremely

busy and may be unable to devote the necessary time to the Council, they may be unfamiliar with and too far removed from actual fisheries management problems and this option will again require legislative approval.

IV. The Council shall be composed of an informal assembly of representatives from each states appropriate management agency.

The primary advantage of this option is that since it is only an informal arrangements, there is no need for legislative approval.

The disadvantages are that it will be less secure than a more formal arrangement, it may not qualify for funding under the State-Federal program, and it would probably be less responsive and effective because there would be little committment by any of the member states.

Statistical Information Options

Statistical information is necessary for a successful management program. The amount necessary is dependent on the needs of the management system, and conversely the amount of information available will be a constraint in the development and use of a management system. The following options may be considered for gathering necessary statistical information.

I. State-Federal Catch Data.

This is the present system. Its annual cost is approximately $200,000 for the four state region, most of which is paid by the Federal Government. Advantages of this system are its relatively low cost and its acceptability to industry. Its primary disadvantages are the lack of effort and economic data collected and the inability to verify the accuracy of data that are gathered. Also, a significant time period elapses between collection and publication of data.

II. States Only Catch Data

This system would cost approximately the same as the State-Federal system, $200,000 annually, but would be paid for entirely by the States at an annual cost of about $50,000 for each state. Its advantages and disadvantages are basically the same as the first option. However, States would be collecting data , while NMFS would be processing it. Thus, personnel collecting data would not be verifying it. Moreover, the increased cost per state would make it less attractive to states due to the difficulty of budgeting funds specifically for statistics.

III. State-Federal Catch and Effort Data

This system would cost about $400,000 annually, $200,000 to be paid by The Federal Government and $50,000 to be paid by each State. This system would allow managers to monitor biological and economic trends, to document changes in efficiency of vessels and gear, better estimate fishing and natural mortality rates, evaluate management decisions such as opening of bays and sounds, estimate abundance of white roe shrimp, and evaluate forecasting techniques derived from biological sampling of postlarvae, juveniles, and overwintering stocks of shrimp. Additional advantages would be improved verification of data and the quantitative experience gained by States. Disadvantages would include its increased cost, and the possibility that it might not be acceptable to some members of industry. Moreover, it would take states at least 2 years to budget their contribution.

IV. State-Federal Catch and Effort Data

This system would be essentially the same as III, but the Federal Government would pay for the entire cost of the program. This program would have the same advantages and disadvantages as III, but might be less costly

due to lower salaries for state personnel. Moreover, this system could be implemented relatively quickly by States if funds were available because of the lack of budgeting problems.

V. State-Federal Catch and Effort Data.

This system would be the same as III, but would be paid for entirely by States at an annual cost of $100,000 each. This would have the same advantages and disadvantages as III, but would be unacceptable to States because of the increased cost and the fact that Congress has specifically charged the NMFS with the collection of fishery statistics.

Chapter 6

RECOMMENDATIONS

The following recommendations have been developed by the Management Committee for the consideration of the Management Council. Recommendations are classified as high, medium or low priority. Recommendations are listed roughly in order of importance within each class.

I. High Priority

1. That a Management Committee remain in existence until the Management Council is established and functioning.

> This is necessary to maintain the program in that interval between the completion of the plan and the establishment of a Management Council or other appropriate regional arrangement.

2. That each State participate in and support a regional Management Council.

> States need a coordinating mechanism for implementing a regional management program. The Chairman of the Council will utilize the staff of his parent agency to conduct routine administrative duties of the Council:
>
> The Management Committee recommends the following composition for the Management Council.
>
> The Council shall consist of the Southeast Regional Director of the NMFS and those persons appointed by the States as Fishery Administrators to the Atlantic States Marine Fisheries Commission. Each member shall have one vote.

3. That the Management Council establish liaison with agencies such as Coastal Zone Management units, whose actions may significantly affect either the shrimp resource or the fishery.

> This is necessary to optimize shrimp management policies.

4. That the Management Council endorse and support the study presently un-

derway to design a regional catch and effort statistics system for shrimp fisheries in North Carolina, South Carolina, Georgia and the East Coast of Florida.

> This study should be completed before the Management Council sets policy concerning the regional catch and effort statistics program.

5. That each State with the assistance of NMFS institute a catch and effort statistics program compatible with the regional system presently being designed. The implementation of this program would begin after the completion of the design study and after adequate funding sources have been secured.

> Information in the system would include total pounds landed each fishing trip, species composition, size composition of catch (count), fishing area, date catch landed, port landed, dealer, length of trip, vessel identification, and total value of catch.
>
> The Management Committee recommends the following statistical systems in order of priority to accomplish this recommendation:
>
> A. State-Federal Catch and Effort Data supported entirely by Federal funds.
>
> B. State-Federal Catch and Effort Data supported by State and Federal funds.
>
> C. State-Federal Catch Data supported entirely by Federal funds.
>
> D. State-Federal Catch Data supported by State and Federal funds.

6. That the Management Council address the problem of regional licenses and reciprocity for regulation of the shrimp fishery and that this be accomplished as soon as possible.

> Because a regional license system is necessary for collecting effort data, it will be

> important to establish an efficient licensing system for the region. Such a system must also provide for distribution of revenues between states.

7. That the Fisheries Management Council review research proposals submitted for funding under the State-Federal program in order to determine their suitability to regional fisheries management programs.

> A central reviewing group will be most useful in advising researchers of those areas that need work, particularly in regard to issues of regional significance. Each state will have the final authority to approve or disapprove its own projects.

8. That the Management Council develop and recommend uniform standards and techniques for monitoring the South Atlantic shrimp resource, the environment that supports the resource, and the user groups who exploit the resource.

> Development of uniform methods and techniques would facilitate exchange of information between states and other agencies.

9. That the Management Council authorize a study to determine the overwintering patterns of white shrimp in the States of North Carolina, South Carolina, Georgia, and Florida.

> This study will develop criteria and methods to forecast the abundance of white shrimp available for the spring fishing season. The forecast will provide information which will be used to set the opening of the spring season as well as the closing of the autumn season.

10. That the Management Council authorize a study to develop optimal harvesting strategies when juveniles of one species are present in an area which is occupied by adults of a second species.

> It is suggested that North Carolina conduct this project because the mixed species pro-

blem appears most acute there, although it is present in all States.

11. That the Fisheries Management Council meet at least annually to coordinate regulatory actions for the spring fishery for white shrimp.

This action is of special importance because white shrimp are the most abundant and the spring white shrimp fishery has a high economic value. Moreover, this meeting could serve as a forum for shrimp management for the entire season.

12. That the Fisheries Management Council coordinate announcements of opening and closing of fishing grounds and seasons.

This will allow managers to plan their actions with more confidence. Such announcements will influence the movement of vessels between states as well as the economics of the industry.

13. That the Fisheries Management Council address the problem of law enforcement, uniform fines, procedures, etc.

More uniform law enforcement would contribute to a better rapport with industry as well as ease administrative duties of states.

14. That each State continue to identify appropriate user groups and brief them concerning the regional shrimp management plan and its implementation.

It is important for management agencies to maintain close liaison with user groups in order to better manage the fishery.

15. That surveys of recreational shrimp fisheries be conducted periodically to determine recreational use and value of shrimp resources.

Such studies are needed to estimate quantity and value of recreational catch.

16. That a cost and pricing study be conducted.

This study will provide information, which could be used to estimate the cost of fishing and the potential value of future catches, and

to develop economic criteria which can be used to evaluate the impact of management decisions upon the economic condition of the fishery. Sea Grant appears to be an appropriate program to conduct this type of study.

17. That a study of networks between fishing industry and associated institutions be conducted.

Such knowledge should allow managers to develop socio-economic criteria which can be used to evaluate the impact of management decisions upon various user groups. Sea Grant appears to be an appropriate program to conduct this study.

18. That a management attitudes study be conducted.

This information will enable management agencies to solve some management problems easier and to propose more effective legislation to solve more difficult problems. In the latter case it is particularly important to know which solutions are acceptable to various user groups. Such knowledge will also aid managers to develop socio-economic criteria which can be used to judge the impact of management decisions upon various user groups. Sea Grant appears to be an appropriate program to conduct this study.

19. That a migration and mobility study be conducted.

A significant number of vessels fish in more than one state. This nomadic existence may be attractive to a significant number of fishermen and this should be documented in order to permit managers to evaluate how regional management policies could affect and be affected by this nomadic sub-culture. Such knowledge will also contribute to the development of socio-economic criteria. Sea Grant appears to be an approptiate program to conduct this study.

20. That a community study be performed.

Such knowledge will help to develop socio-economic criteria which can be used to eval-

uate the potential impact of management decisions upon user groups. Sea Grant appears to be an appropriate program for this study.

21. That the Fisheries Management Council endorse and support the study presently underway to determine the distribution of Penaeus larvae off the Southeastern United States in an attempt to identify spawning grounds of the brown shrimp.

This study was designed to determine the feasibility of using the distribution of Penaeus larvae in offshore waters to help locate spawning grounds of brown shrimp in this region. Such information could prove useful in the development of management strategies should extended jurisdiction become a fact.

22. That the Management Council collect and analyze all information concerning incidental catches of the shrimp fishery in this region and summarize it in the form of a regional document.

This task will provide information to managers and user groups which will enable them to develop methods to better utilize incidental catches.

23. That a study be conducted to determine the seasonal distribution and abundance of the rock shrimp, Sicyonia brevirostris, off the coasts of North Carolina, South Carolina, Georgia, and east coast Florida.

Rock shrimp are becoming an important commercial species in Florida, and its value as a new fishery should be assessed for the rest of the region. This information will also be useful if extended jurisdiction becomes a reality. This study would be an appropriate MARMAP activity for South Carolina and the NMFS.

24. That Florida, Georgia and South Carolina adopt Amendment One to the Atlantic States Marine Fisheries Commission as well as develop legislation which will allow reciprocal management agreements between States.

Adoption of Amendment One will give states the option to use the Atlantic States Marine Fisheries Commission as a vehicle for management for this and other fisheries. North Carolina has already adopted it.

25. That the Fisheries Management Council develop models to illustrate institutional and economic elements in the system when adequate information becomes available.

II. Medium Priority

1. That a study be conducted to determine the most economical fishing craft and gear configuration.

This information would be useful to fishermen. Sea Grant or NMFS could conduct this type of study.

2. That a study be conducted to determine the effects of dredging and trawling upon survival of juvenile shrimp.

Information obtained by this study would be made available to agencies which regulate dredging and trawling.

3. That a study be conducted to locate spawning grounds of pink shrimp in this region.

Information obtained from this study could prove useful in the development of management strategies should extended jurisdiction become a reality.

4. That a study be conducted to determine potential off season utilization of shrimp fishing craft.

This would be of considerable interest to fishermen and would be an appropriate project for Sea Grant or Extension agencies.

III. Low Priority

1. That a study be undertaken to evaluate the implications of the limited

entry concept for the South Atlantic shrimp fishery.

> This study will be necessary if states wish to consider any management scheme which might limit entry.

2. That States routinely monitor incidence of disease and parasites of commercially important shrimp species.

> Information derived from the monitoring program will be used to evaluate the effects of disease and parasites on shrimp stocks. This information can also be used to predict any adverse effect on product quality, thus, allowing industry to take appropriate measures to neutralize any potential problem.

3. That a study be conducted to determine the seasonal distribution and abundance of royal red shrimp, Hymenopenaeus robustus, off the coasts of North Carolina, South Carolina, Georgia, and Florida.

> This species is of minor commercial importance now, but if large concentrations were found it would provide additional income for fishermen. Again, this information would be useful in the event of extended jurisdiction. This would be a good activity for the MARMAP program.

4. That a study be conducted to determine the extent of the whelk and other resources off the coasts of the States in this region.

> Whelks of the genus Busycon are commonly found in this region. The demand for whelks is increasing and this could be an important source of supplemental income for shrimp fishermen. Other species such as the shovel nose lobster, Scyllarides nodifer, should be surveyed for their value as a potential resource for exploitation.

Chapter 7

MANAGEMENT ACTION PROGRAM SUMMARY

This section describes the costs and time horizons of the first 5 years of the regional shrimp management plan. Costs have been estimated where possible. Costs not shown in Table 2 will be obtained once detailed proposals are prepared for specific activities. The reader should note that Table 2 only describes the first 5 years of the plan. The cost of the second 5 years, the plan evaluation period, is not shown.

The entire cost of the plan for each 5 year period in 1975 dollars will be approximately $3,000,000,or $600,000 annually. The catch and effort statistics program will be the most costly item. However, this cost will be modest until the program is fully implemented throughout the region. Potential sources of funding are:

1. State Funds
2. State-Federal Base Funds
3. Sea Grant Program
4. Coastal Plains Commission
5. U. S. Army Corp of Engineers
6. MARMAP Program
7. Grant-In-Aid Funds
8. Coastal Zone Management Funds

Table 2. Management action program summary.

Type of action	Function of task	Recommendation number	1976 Amt.	1977 Amt.	1978 Amt.	1979 Amt.	1980 Amt.	Suggested project responsibility	Priority
Administrative/ legal	Shrimp Management Committee remain in existance until Council is extablished	I-1	+						High
	Support a Regional Management Council	I-2	+						High
	Maintain liaison with Coastal Zone Management and other appropriate agencies	I-3	+	+	+	+	+		High
	Council review relevant research proposals	I-7	+						High
	Develop and institute uniform standards for monitoring	I-8	+					Georgia	High
	Coordinate spring fishery regulations	I-11	+	+	+	+	+		High
	Coordinate season and grounds openings and closings	I-12	+	+	+	+	+		High
	Make law enforcement more unifrom	I-13	+	+	+	+	+		High
	Maintain liason with user groups	I-14	+	+	+	+	+		High
	Develop institutional and economic models	I-25			+	+	+		High
	Institute regional licences	I-6	+						High
	Fla., Ga., and S. C. adopt Amendment One, ASMFC	I-24	+	+					High
	Baseline study on license moratorium	III-1			25				Low
Biological	Design a regional catch and effort system	I-4	80(+)					South Carolina	High
	Undertake a regional catch and effort system	I-5			400	400	400		High
	Determine white shrimp overwintering patterns: Pilot study	I-19	20	20				South Carolina	High

Table 2. (continued)

Type of action	Function of task	Recommendation number	1976 Amt.	1977 Amt.	1978 Amt.	1979 Amt.	1980 Amt.	Suggested project responsibility	Priority
	Develop optimal harvest strategies for mixed populations	I-10	35	35				North Carolina	High
	Determine brown shrimp spawning grounds	I-21	18(+)					South Carolina	High
	Analyze regional incidental catch	I-22	5	5					High
	Determine distribution and abundance of rock shrimp	I-23	+	+				Florida	High
	Determine effect of dredging on juveniles	II-2			20				Medium
	Locate spawning grounds of pink shrimp	II-3				30			Medium
	Monitor diseases and parasites	III-2	10	10	10	10	10		Low
	Determine distribution and abundance of royal red shrimp	III-3			50	50	50	MARMAP	Low
	Determine extent of whelk and other fishery resources	III-4		50	50	50	50	MARMAP	Low
	Recreational shrimp survey	I-15		+				Coastal Plains Comm	High
Social	Networks study	I-17		+				Sea Grant	High
	Management attitutes survey	I-18		+				Sea Grant	High
	Migration and mobility study	I-19		+				Sea Grant	High
	Community study	I-20		+				Sea Grant	High
Economic	Cost and pricing study	I-16		+				Coastal Plains Comm	High
	Optimal gear and vessel configuration study	II-1			+			NMFS	Medium
	Potential off season utilization of shrimp vessels study	II-4			25				Medium

All amounts are in thousands of dollars
+ Fiscal year in which activity will be undertaken

APPENDICES

Glossary

ASMFC: The Atlantic States Marine Fisheries Commission

This Commission was set up as a result of an interstate compact in 1940 and is presently composed of all the Atlantic States. The purpose of the Commission is to promote the better utilization of marine fisheries through the development of joint programs.

Brown shrimp: Penaeus aztecus

This species predominates in the North Carolina fishery and is found in commercial quantities throughout the four state region. The peak of the brown shrimp harvest occurs during the summer.

Catch and Effort Statistics

Data describing catches of commercially important species by location of capture, size or age composition of catch, quantity captured by particular gear or vessel type, and time expended fishing. This information can be obtained by a "trip" or "weigh out" ticket which accompanies the sale of fish. (See CPUE)

CPUE: Catch Per Unit of Effort

The catch of fish, in numbers or in weight, taken by a defined unit of fishing effort (Ricker 1958).

Extended Jurisdiction

The extension of the fishery rights of the United States beyond the presently accepted 12 mile limit. Also included in this concept is the authority to manage the exploitation of fishery resources between the present outer limit of state waters (3 miles) and the outermost limit of

jurisdiction.

Mortality rates

Mortality rates can be considered generally as two types. The first of these is natural mortality, and it can be used to describe all deaths except fishing. The second is fishing mortality, and this refers to all deaths caused by fishing.

NMFS: The National Marine Fisheries Service

The federal agency devoted to dealing with marine fisheries problems, NMFS is a component of the National Oceanic and Atmospheric Administration (NOAA) within the United States Department of Commerce.

Parent-progeny relationship

Sometimes known as the spawner-recruitment relationship, this refers to the quantitative relationship between abundance of mature spawning adults and the number of fish entering the harvestable stock.

Penaeus aztecus: See brown shrimp.

Penaeus duorarum: See pink shrimp.

Penaeus setiferus: See white shrimp.

Pink shrimp: Penaeus duorarum

This shrimp is of major commercial significance along the Atlantic coast only in North Carolina, where it accounts for about one fourth of the total shrimp landings. Many pink shrimp reach commercial size during the late fall and are utilized. The spring pink shrimp fishery (April-June) is dependent on overwintering survivors.

Population dynamics

A discipline which attempts to describe and quantify basic population characteristics such as growth and mortality rates of the population

rather than the individual. Also, particular emphasis is placed upon the study of the reaction of populations to perturbations, such as commercial or recreational fishing.

Recruitment Patterns (Shrimp)

This can refer to entry of postlarval and juvenile shrimp to nursery grounds in estuaties. However, it can also refer to entry of subadult shrimp into commercial fishing grounds such as bays and sounds or near shore waters. Because the regional shrimp plan applies to the entire shrimp system, both definitions are used where appropriate.

Roe shrimp

All large white shrimp found during the spring are commonly referred to as roe shrimp. Technically, however, the term refers only to gravid (egg bearing) females found during this time.

Spawner recruit relationship: See parent progeny relationship.

SFFMP: State Federal Fisheries Management Program

This program within NMFS is a cooperative, intergovernmental approach to fisheries management. It establishes a partnership between one or more States and the Federal Government for the development, implementation and administration of fishery management plans with inputs from user groups.

Stocklet

A subportion of a fishery stock

Striker

A crewman on a shrimp vessel or boat, who sorts the shrimp catch.

White shrimp: Penaeus setiferus

This species is found throughout the four state region. It accounts

for the bulk of landings in South Carolina, Georgia and the east coast of Florida. White shrimp are caught mainly along the southern coast of North Carolina, but of the three species taken there it accounts for the smallest proportion of the catch.

Yield-per-recruit Analysis

Mathematical techniques to determine the proper size of capture of a species given known growth, natural mortality and fishing mortality rates.

Plan Implementation and Evaluation

A plan designed to manage the regional aspects of the shrimp fishery of the South Atlantic United States has been presented. A suggested method of plan implementation and evaluation follows.

Plan implementation will begin after the Management Committee and Council have approved the plan. The Management Committee will administer the plan until a Regional Fisheries Management Council is established and functioning. At that time the Council will become the administrative mechanism for the plan.

The first steps in implementation will consist of those recommendations given the highest priority. Specifically, these consist of such activities as the design of a regional catch and effort statistics program, a study of exploitation of mixed penaeid shrimp populations, a study of overwintering patterns of white shrimp, and adoption of uniform monitoring techniques. All funding sources listed in the plan will be considered for these and other projects.

Certain projects such as reviewing research proposals for applicability to the state-federal program and making law enforcement more uniform will be performed on a continuing basis by the Council.

The Management Council will evaluate results obtained by actions taken to satisfy recommendations. The project evaluation process will allow the Council not only to judge the success of individual projects concerning their impact on regional management, but also to re-adjust priorities of other projects should this be appropriate. Also, the Management Council at appropriate intervals will evaluate the effectiveness of the entire regional management system,particularly concerning solution of problems

identified in the planning profile. In short, the evaluation process must operate at two levels; namely, the project and the management system level.

One way of evaluating and ascertaining the success of projects and the plan is to develop a work breakdown structure for each objective of the plan. (For an example of the use of the work breakdown structure see Phenicie and Lyons 1973).

The Management Council can use the technique of work breakdown structures to co-ordinate projects, to judge their success concerning their contribution to satisfying plan objectives, and their relevance to solution of problems confronting the shrimp fishery.

Planning Methodology and Chronology

One of the advantages of the plan presented is that it may be helpful to other managers as plans are developed for other fisheries. Therefore, a brief review of the methodology used, and the chronology of activities in the development of this plan is presented.

Before the methodology and chronology is discussed, however, a number of points concerning general planning activities must be addressed. The first of these is that planning is an iterative process. This means that during the actual planning process the plan must be revised constantly. This then leads to the second point, namely, the planner must be in constant communication with those individuals who will implement the plan. In this case the implementors are those fishery administrators who form the South Atlantic Shrimp Management Committee. Only those personnel had the necessary knowledge to advise the planning team regarding plan revisions. Finally it must be realized that planning is a dynamic process. This means that even after a plan is developed and adopted, it must be constantly evaluated in order to assure its relevance in the light of changing political, economic and social climates, as well as increased biological knowledge.

This plan is an outgrowth of a previous study, "The Shrimp Fishery of the Southeastern United States: A Management Planning Profile" (Calder, Eldridge, and Joseph 1974). That document was a summary of knowledge concerning the shrimp resource and fishery of the region, with a list of actual and potential problems. The South Atlantic Technical Committee for Shrimp Management, whose name has since been changed to the South Atlantic Shrimp Management Committee, then decided that a plan should be developed to solve those problems.

The first committee meeting specifically devoted to the development of the shrimp management plan was held in Charleston, South Carolina, on October 31 and November 1, 1974. A preliminary goal and set of objectives were drawn up at this time and it was decided that a Management by Objectives technique would be used to meet the objectives. It was also decided that the plan would be the responsibility of the South Carolina Wildlife and Marine Resources Department, Marine Resources Division, because this agency had a biologist and a planner who would be able to work full time on the project. In addition to these two individuals, it was decided that there would be two federal planners and a federal fisheries administrator on the planning team. This administrative organization proved to be quite successful because there was only one agency responsible for the development of the plan, and the two individuals working for the South Carolina Marine Resources Division were able to work closely with Dr. Edwin B. Joseph, the Chairman of the Committee.

The planning team met next on November 19, 20, 21, 1974. This planning workshop was used to redefine the previous objectives set by the Management Committee. The planning team felt that such a redefinition was necessary in order to clarify and set time horizons for objectives. At this time the need for socio-economic data was also discussed.

The Management Committee met the next day and at this meeting new objectives were presented to and accepted by the Committee. The need for socio-economic data was also discussed and it was decided that the need for such data should be further investigated.

In December, 1974 two members of the planning team went to Washington, D. C. to confer with NMFS personnel, who had worked with socio-economic

aspects of other fisheries. These personnel expressed interest in the project and agreed to conduct a survey to define the socio-economic data that would be most relevant to the plan.

The next meeting of the Management Committee was on January 7 and 8, 1975. The proposed survey designed by Dr. Acheson and others was discussed and it was decided that Dr. Acheson should perform the study. This study was conducted throughout the region during the latter half of January and the first week in February. The survey allowed Dr. Acheson to prepare a report indicating the types of socio-economic information needed and a proposed list of studies that would allow managers to obtain this information.[1] It was also decided at this meeting that the planning team should begin to prepare the plan and further meetings of the Management Committee would be used to review the developing plan.

The Management Committee met next on February 6 and 7. A first draft of the plan was presented at this time. This draft consisted chiefly of steps necessary to solve each problem identified in the profile. That is, for each problem a number of possible actions were identified. The Committee rejected this draft because although it addressed individual problems it did not adequately define a management approach that could view the fishery system as an entity which is necessary to prevent suboptimization. The remainder of this meeting was spent discussing what the plan should accomplish. The planning team was directed to prepare another plan utilizing a different approach.

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[1] This report is presently being prepared for distribution.

The first draft presented was a "straw man". Its purpose was to elicit criticism and greater input from the Committee. The concept and use of a "straw man" is very important because decision makers, although aware of the need for a plan, usually do not have enough formal planning experience to direct the planning team without having an example to criticize. A "straw man" plan will usually be required as a first draft unless decision makers are accustomed to planning methodology.

The planning team met next on February 10 and 11. At this time, using the input given by the Committee in response to the first draft, the planning team developed the framework for a second plan. It was decided that the second plan should be developed as a system, in contrast to the first plan which consisted of a number of relatively independent actions. The next month was spent developing the new plan. The plan consisted of a systematic arrangement of inputs. Outputs of the system were policies which could be used to develop regulations, programs, and guidelines. Outputs were selected to solve problems identified in the Planning Profile. Although specific outputs were not developed in the plan, the Management Council can use the system to develop outputs as greater information is obtained and entered as inputs.[2]

The Management Committee met next on March 18 and 19. At this time the second draft of the plan was presented and the framework of the plan was approved. The Committee directed the planning team to further refine

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[2] This is a strategic rather than a tactical plan. The reader can refer to Phenicie and Lyons (1973) for a description of tactical planning.

and edit the plan.

On April 21 and 22 the Committee met again and was presented with the third draft of the plan. The plan was accepted and the Committee directed the planning team to re-edit the plan for typographical and other minor errors.

During the first week of May, 1975 the fourth draft of the plan was distributed to the Committee. After all members of the Committee had reviewed the plan it was approved for publication.

It is important to remember that the development of this plan required the input of each member of the Management Committee as well as the planning expertise of the Planning Team. Although many of the concepts were developed by the Planning Team, the members of the Management Committee determined the suitability and feasability of those concepts.[3]

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[3] Most planning exercises are conducted and directed by an intact management structure. However, in this case, because of the lack of a regional management structure, the plan also includes a recommended management structure which can act regionally.

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