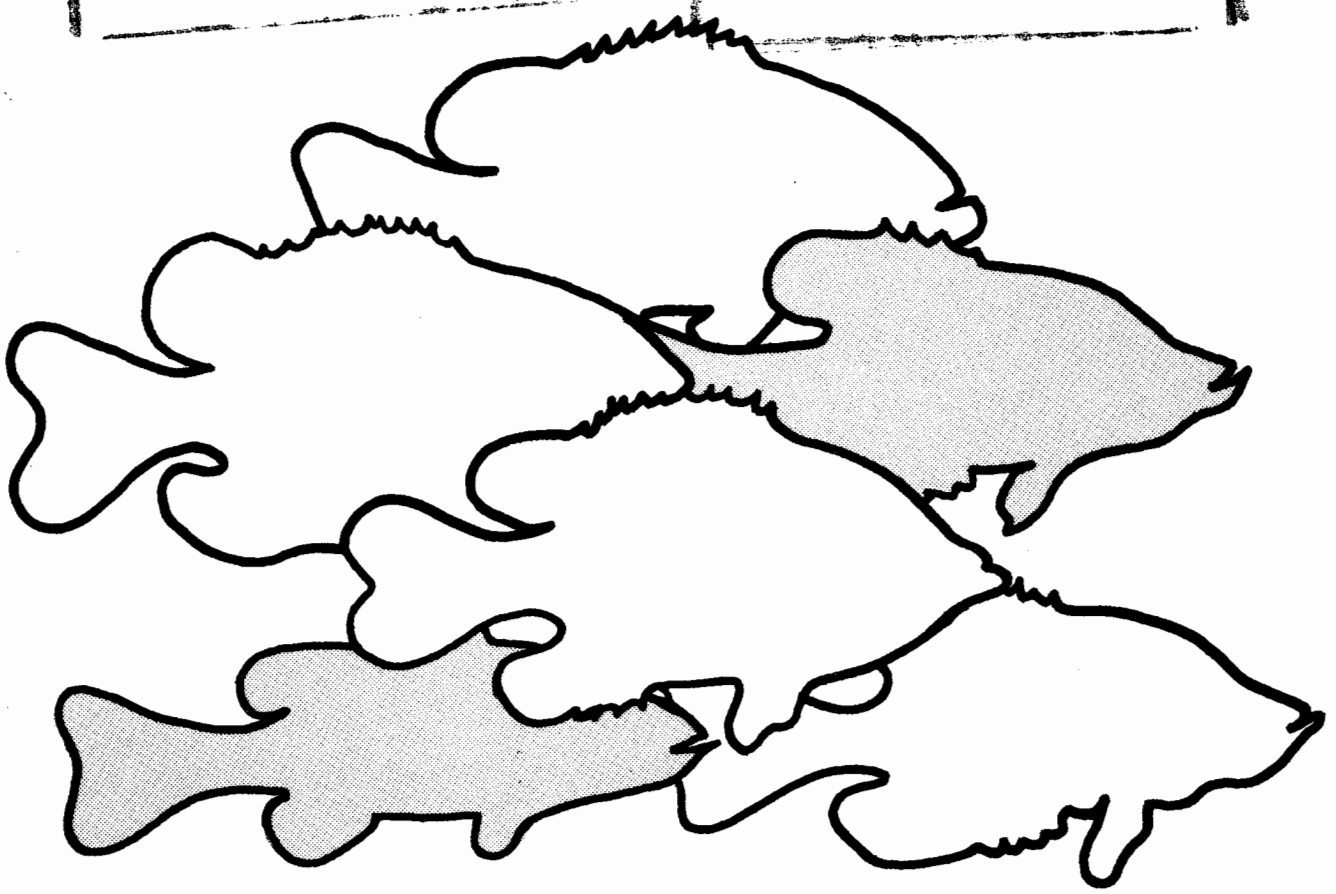
AMERICAN FISHERIES SOCIETY

PROCEEDINGS

ANNUAL MEETING
MISSISSIPPI CHAPTER



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PREFACE

The annual meeting of the Mississippi Chapter of the American Fisheries Society was held February 15, 1979 on the campus of the University of Southern Mississippi, Hattiesburg, Mississippi. The purposes of an annual meeting are to exchange information pertinent to fisheries in Mississippi and to provide opportunity for fishery biologists in Mississippi to meet and discuss accomplishments and problems at least once a year.

This is the third Proceedings held by the Chapter. Since publication procedures have not yet been determined by the Chapter, the papers presented herein have been reproduced in the same form in which they were received. No editorial corrections have been made.

Cost for publication of the Proceedings has been met by the Mississippi Department of Wildlife Conservation. This publication was compiled by Terry Heaton and Wendell Lorio.

Much appreciation to the speakers for their contribution to the Annual Meeting and this Proceedings. The local arrangements committee with Dr. Steve Ross as Chairman is to be commended on a job well done.

Mississippi Chapter
American Fisheries Society
November, 1979

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THE D-J FEDERAL AID PROGRAM IN MISSISSIPPI

by

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The Federal Aid in Fish and Wildlife Restoration program is an important phase of the Mississippi Game and Fish Commission's efforts to benefit the fish and wildlife resources and the sportsmen of the State.

The Federal Aid in Fish and Wildlife Restoration program represents the culmination of concerted efforts by conservation interests throughout the United States to provide for management of wildlife and fish of recreational value. The Program encompasses wild mammal and bird restoration and hunter safety under the Federal Aid in Wildlife Restoration Act (Pittman O. Robertson Act, 1937) and sport fish restoration through the Federal Aid in Fish Restoration Act (Dingell-Johnson Act, 1950). A summary of the major programs is presented in Figure 1.

The Federal Aid in Sport Fish Restoration Program, better known as the Dingell-Johnson or D-J program, was passed in 1950 as P.L. 81-681 and was initiated in the fiscal year 1951. The source of funds was the 10% Manufacturers' excise tax on rods, reels, creels, and artificial baits, lures and flies and is administered by the Federal Aid Division of the Fish and Wildlife Service. Those eligible to receive these funds are fish and wildlife agencies of all states and Guam, Puerto Rico, the Virgin Islands, and American Samoa. The basis of apportionment is a statutory formula based on area

of the state and number of paid sport fishing license holders, with not less than 1% or more than 5% to any state.

The maximum share borne by Federal Funds is 75 percent and Mississippi's apportionment for FY 1977 was $344,656.00 of the $24,850,000.00 available to the states. The apportionments are given to the states as a preliminary apportionment, which has been from 70 to 80 percent of the final apportionment, and a final apportionment after the total excise tax is known for the fiscal year. Mississippi's preliminary apportionment for FY 1979 is $246,584.10 of the $17,850,000.00 available to the states.

To adapt the Federal Aid program to fit the wide variety of state fish and wildlife agencies and organization structure, the Federal Aid programs may be managed under one or more of the following options: Individual projects, single agency combination projects, joint federal cooperative projects, multi-state cooperative projects, planning projects and statewide comprehensive fish and wildlife management plan.

The first use of D-J funds by the Mississippi Game and Fish Commission was land acquisition. In December, 1952, the Commission purchased for $5,000.00, six (6) acres of land on the shoreline of Moon Lake in Coahoma County to provide public access to the lake.

The next project submitted and approved was for the construction of Lake Mary (Crawford) in Lawrence County at an estimated cost of $68,084. Following that was a development project on the Commission's new Moon Lake Access Area in which a boat launching ramp, restrooms, deep well and well house were to be constructed. However, prior to the start of

the work, the Commission saw that the D-J program would be an expanding program and recognized there was a need for a coordination project. The development of the Moon Lake Access Area project was terminated so that funds would be available immediately for the establishment of the Fish Management Coordination Project.

Following the approval of the Coordination project, the development of the Moon Lake Access Area was resubmitted and approved.

With the initiation of the Fish Management Coordination project, technical planning and guidance for the D-J program was provided. This Coordination project has continued since July 1, 1954 and been under the direction of Barry Freeman since November 11, 1955.

In the early years of the D-J program, project proposals were submitted to the Federal Aid Division of the Fish and Wildlife Service under one of the following categories: Land acquisition, Development and Management, and Research and Surveys.

The first project submitted by the Commission in the category of Research and Surveys was the "Fisheries Investigation on Flood Control Reservoirs." It was approved by Federal Aid, started in June, 1955 and continued under that title until June, 1967. During the eleven years of field data collecting, the following project jobs were investigated with the number of years for each shown in parentheses: Life history (11); fish populations (11); age and growth (11); food habits (8); tagging and distribution (3); chemical, biological and physical data collections (3); creel census (8); evaluation of auto-body shelters (2); experimental shocking of white bass (2); catch of game fish in commercial gear

(2); and evaluation of macrobenthos recovery on dewatered flats with relation to vegetative types (2).

In June, 1957, a survey project entitled "State-wide Lake and Stream Survey" was initiated that was to continue through December, 1966. During this period, 181 lakes, rivers and creeks were investigated with 68 rotenone fish population studies conducted and basic water quality data collected from nearly all of the 181 bodies of water. A number of the larger oxbow lakes in the Delta were mapped with depth transects.

In May, 1959, a pollution study project entitled "Detection of Sources of Stream Pollution and Its Effects Upon Bottom Organism, Fish and Chemical Quality of the Water", was initiated on the Pearl River System and in the next 12 years all of the major and a few of the minor river systems of the State, except the mainstem of the Mississippi River, were investigated.

These first three major fisheries research and survey projects fairly well indicate the direction the D-J program was to take for a number of years.

In March, 1963, a project was initiated to investigate the fishery resources of Pearl River Reservoir, later changed to the Ross R. Barnett Reservoir. This reservoir has been under continuous investigation since that date, not only by the Commission's D-J projects, but by other State agencies, Federal agencies and most of the colleges and universities of the State. The first successful stocking and survival of the striped bass fry from South Carolina and the development of a

fishery was a result of the Commission's project on this reservoir.

In January, 1967, the D-J program entered into a new field of research with the initiation of a project entitled "Comparative Study of Two Oxbow Lakes". The project objectives were to determine the level of pesticides found in the bottom muds, waters, and fish of two oxbow lakes and the chemical characteristics of the water; to determine the types and quantity of bottom organisms in the two lakes and the plankton; and to determine the utilization of food items by the major fish species". The same objectives were in the second year of the project and a fourth job was added: "to determine the tolerance level of fish in Wolf and Mossy Lakes to certain pesticides that have been used in those areas in past years (toxaphene, endrin, DDT and methyl parathion)." The Mississippi Game and Fish Commission was one of the first state fish and wildlife agencies in the nation to try to measure the extent and magnitude of pesticide pollution with the initiation of a project in January, 1969 entitled "A Survey of Insecticide Levels & Chemical Quality of Twenty Randomly Selected Delta Lakes."

As a result of the data collected on the various pesticide projects, the Commission closed Mossy Lake and Wolf Lake to commercial fishing effective July 8, 1971 and issued a warning to sport fishermen that eating excessive amounts of fish from these waters could be hazardous to their health. Effective August 17, 1973, Lake Washington was closed to commercial fishing and a warning issued on eating of fish from the lake. As various projects on pesticides continued, it was found that the levels of pesticides had decreased below those estalbished by the

FDA as safe levels in Mossy Lake and Lake Washington; therefore, the Commission repealed the ban on commercial fishing effecitve April 20, 1978.

In May, 1968, a statewide river basin survey was started to determine the effects of drainage programs on watersheds, with 16 projects investigated through June, 1973. From July, 1968 through June, 1971, studies were made to determine the walleye population and related parameters in the Tombigbee River System in Mississippi. With the use of aerial applications of the fire ant bait, Mirex, over large areas of Mississippi, the Commission undertook a survey of Mirex residues in fish and wildlife from two areas in the State. Both the aquatic and the wildlife environment were sampled and analyzed. This project started in February, 1971.

As was noted earlier, reservoir investigations were continuing on Arkabutla, Sardis, Enid, Grenada and Sardis Reservoirs, and in March, 1971, studies were initiated on Okatibbee Reservoir near Meridian. The investigations were modeled after those conducted on the above-mentioned reservoirs.

Reservoirs were receiving a lot of attention over the Southeast from both the fishermen and the fisheries biologists in the 1960's and early 1970's. The Reservoir Committee of the Southern Division of the American Fisheries Society was an active group of biologists and greatly influenced the direction of reservoir research and surveys in member states.

In January, 1972, a project was started that was designed to evaluate predatory fish introductions that had been made in Sardis, Enid and Grenada Reservoirs.

Mercury pollution was brought to the attention of the general public and, as a result, a survey of mercury and pesticide residues in fish at locations outside of the Delta area in Mississippi was initiated in February, 1972.

The Pascagoula River Bottom in George, Jackson and adjacent counties contained many oxbow lakes that were unknown to many of the fishermen of the State. In November, 1972, a project was undertaken to determine the location of these oxbow lakes, to determine the fish populations and survey the recreational facilities on the Pascagoula River. At the completion of the project in March, 1974, a development project was initiated to improve the fishery resources. As a result of this development project, it became known that the Pascagoula Hardwood Company was willing to sell most of their land. After several years of effort, in September, 1976 the State of Mississippi purchased 32,000 acres of hardwood bottomland. The development project was rewritten and approved to cover other areas of development that were not approvable before ownership.

The Game and Fish Commission's owned or leased lakes were receiving much fishing pressure and the Fisheries Division wanted these lakes to have the best fishing possible. In February, 1973, the first of several projects was started to measure various parameters of the State lakes

fishery resources and to prepare lake by lake management plans. The earlier studies involved water quality, plankton, pesticides, fish population studies, spawning checks and dates, age and growth, mark and recapture and creel census. Later studies involved some management evaluations such as types of materials and construction for fish shelters, gravel spawning beds, fertilization (including formulations, quantities, schedules and lime), and the introduction of additional forage species such as freshwater shrimp, Asiatic clams and Mississippi silversides.

In some of the earlier work in the Pascagoula River system, it was noted that there was a need for investigation of the status of freshwater fish of the brackish waters; therefore, in June, 1976 a study was initiated to look at the situation in the Pascagoula River in the Jackson County area.

Fishermen were questioning "why the poor fishing conditions in the Jourdan River?." In an earlier study (1964-65), it was found that low pH's were prevalent in the system and the probable cause of low productivity. In August, 1976, a study was undertaken to look deeper into the factors that affect the fishery resources of the Jourdan River system. This study was the first D-J project contracted with one of the State Colleges or Universities (Mississippi State Research Station at Bay Saint Louis).

With the completion of 12 experimental ponds totaling 10 acres, near the W.H. Turcotte Research Laboratory on the Barnett Reservoir, a project was set up in January, 1978 that would investigate the

spawning techniques of the striped bass, the spotted bass, freshwater shrimp and Mississippi silversides. Other work involved determination of the depuration rate in bluegill, determination of inhibiting mechanism of pesticides in largemouth bass, evaluation of the polyculture of striped bass and freshwater shrimp.

Earlier work had been done with the walleye in the Tombigbee River and, with the construction work on the new Tennessee-Tombigbee Waterway well under way, it was determined that additional data would be desirable for later evaluations. In January, 1978, fisheries personnel in the northern part of the State shifted attention from the four flood control reservoirs to the Tombigbee River and got involved in the review of the construction plans, conducting fish population studies, inventorying the macroinvertebrates and evaluating water quality. The project leader has been working closely with Fish and Wildlife Service personnel on the review portion of the project.

Fish population studies on the Barnett Reservoir indicated there was an alarming increase in the poundage of freshwater drum and this situation needed investigating. In February, 1978, a cooperative agreement was entered into with the University of Mississippi to investigate the spawning, food habits of drum larvae, and physico-chemical parameters during the spawning season. Later, the food habits studies were expanded to cover the juveniles and adults and to take a closer look at the plankton and benthos populations in the reservoir.

With the acquisition of the Pascagoula Wildlife Management Area, the Commission acquired land to manage on both sides of Red Creek.

Red Creek is a beautiful stream and very similar to Black Creek, which has been used extensively as a canoe and float stream. In February, 1978, the Commission submitted a project to determine details necessary for formulating a float trip, collect water quality as background data and examine the fish population of the creek.

In August, 1979, the Commission entered into another agreement with the Mississippi State Research Station in Bay Saint Louis to conduct a life history study of the largemouth bass found in coastal waters of Hancock, Harrison and Jackson Counties.

Most of the research and survey projects have a minimum duration of one year and may be for two or three and even up to five years; however, a five-year project is rare.

Each year it appears that more and more supportive documentation is necessary in project proposals to receive approval from Region IV, Federal Aid in Atlanta, Georgia.

Most of the comments so far have been in regard to the research and survey projects because these projects have documented the needs for most development and management projects in recent years. As noted in the early part of this report, land acquisition and development were some of the first uses of the D-J funds. The Commission saw a need for additional fishing waters in areas where there was practically none except a few small creeks. The Commission constructed three public fishing lakes under D-J projects and made improvements and repairs on two lakes. The red tape in constructing lakes under the D-J program was just too confining and the Commission established a lake-building

construction section and completed nine lakes before the section was disbanded in 1963. These nine lakes were built with State funds. Lake Bill Waller was completed with State funds in October, 1975.

Other significant construction projects funded under the D-J Program were as follows: The W. H. Turcotte Research Lab on the Barnett Reservoir completed in June, 1966; a combination storage and volatile materials distillation building was constructed at the Lab in 1968; a 3,360 square foot lab annex was constructed in June, 1973; the W. H. Turcotte Research Lab ponds and holding shed completed in May, 1978, and the Pascagoula oxbow lakes development project completed 5.1 miles of graveled roads to seven oxbow lakes and installed concrete boat launching ramps on each lake.

Under the management category, the fertilization of the Commission's State lakes has been continuous since 1964 under two D-J projects. The effectiveness of the fertilization program in the State lakes is largely due to research work conducted under D-J projects and resulting recommendations.

Technical assistance to owners of small ponds and lakes has been a part of the Fisheries Biologist's duties for a long time. In September, 1971, this phase of work was undertaken on a project and continues to this date on a second technical assistance project.

It has been difficult to tell briefly of the D-J Federal Aid Program in Mississippi and of its important contribution to the State's fishery resources. Hopefully, none have been omitted. The D-J program is very important to the sportsmen of the State and we sincerely hope that we have been "good stewards" in the use of these funds.

FIGURE 1. SUMMARY OF MAJOR PROGRAMS

	Federal Aid in Wildlife Restoration Program	Federal Aid in Sport Fish Restoration Program
PURPOSE	Conservation and management of wild birds and mammals.	Conservation and management of fish.
AUTHORITY	P.L. 75-415, as amended (16 USC 669)	P.L. 81-681, as amended (16 USC 777)
YEAR PROGRAM BEGAN	FY 1939	FY 1951
SOURCE OF FUNDS	Manufacturers' excise tax (11%) on sporting arms, ammunition, bows, and arrows, and (10%) on handguns.	Manufacturers' excise tax (10%) on rods, reels, creels, and artificial baits, lures and flies.
ADMINISTERING FEDERAL AGENCY(S)	U.S. Fish and Wildlife Service.	U.S. Fish and Wildlife Service.
ELIGIBLE GRANTEES	Fish and wildlife agencies of all States and Guam, Puerto Rico, and the Virgin Islands	Fish and wildlife agencies of all States and Guam, Puerto Rico, the Virgin Islands, and American Samoa.
BASIS OF APPORTIONMENT TO GRANTEES	Statutory formula based on area of the State and number of paid hunting license holders, with not less than 0.5% or more than 5% to any State, except for the Hunter Safety program.	Statutory formula based on area of the State (including coastal and Great Lakes waters) and number of paid sport fishing license holders with not less than 1% or more than 5% to any State.
PERIOD OF AVAILABILITY OF FUNDS	The fiscal year for which apportioned and the succeeding fiscal year.	The fiscal year for which apportioned and succeeding fiscal year.
MAXIMUM SHARE BORNE BY FEDERAL FUNDS	75 percent	75 percent

Hunter Education Target Range Program	Anadromous Fish Conservation Program	Endangered Species Program
Advance the safety marksmanship and sportsmanship for firearms and bow and arrow users and prevention of all accidents and hazards associated with hunting.	Conservation and management of anadromous fish and Great Lakes fish which ascend streams to spawn. Does not apply to utilization.	Conservation of endangered and threatened species.
P.L. 91-503	P.L. 89-304	P.L. 93-205
FY 1972	FY 1967	FY 1975
One-half the manufacturers' excise tax (10%) on handguns and (11%) on bow and arrows.	Annual appropriation by Congress.	Annual appropriation by Congress.
U.S. Fish and Wildlife Service.	U.S. Fish and Wildlife Service and National Marine Fisheries Service.	U.S. Fish and Wildlife Service and National Marine Fisheries Service.
Fish and wildlife agencies of all States.	Fish and wildlife agencies, commercial fishery agencies and cooperators in all coastal and Great Lakes States.	Fish and wildlife agencies of all States, the District of Columbia, the Commonwealth of Puerto Rico, American Samoa, the Virgin Islands, Guam, and the trust territory of the Pacific Islands.
Statutory furmula based on population of the State to the population of all States with not less than 1% or more than 3% to any State.	Administrative decision according to resource need.	Administrative decision according to international commitments, readiness for program, number of endangered and threatened species, potential for their restoration and the immediate need for a program.
The fiscal year for which apportioned and the succeeding fiscal year.	The fiscal year for which apportioned.	The fiscal year appropriated and the succeeding fiscal year.
75 percent	50%, except 66-2/3% for multi-State cooperative projects.	66-2/3%, except 75% for multi-State cooperative projects.

REFERENCES

Manual for the Federal Aid in Fish and Wildlife Restoration Program and the Anadromous Fish Conservation Program, 1973 revision. United States Department of the Interior, U. S. Fish and Wildlife Service.

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Status Report: Mississippi Marine Fisheries Management

by

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Abstract

With passage of the Fisheries Conservation Act (PL 94-265) in 1976 the United States, for the first time, established authority for unilateral management of marine fisheries by Federal authorities; extended U.S. jurisdiction for fisheries to 200 miles off shore; mandated that fishery management be based on the best available scientific evidence; required that stocks be managed in accordance with national standards throughout their range and established Optimum Sustainable Yield as the national objective of fishery management. Eight regional management councils with responsibility for developing fishery management plans, were established. The Department of Commerce was given authority to implement plans after they were approved by the Secretary. The congress assured management based on National standards throughout the range of a stock by providing, under certain conditions, for preemption of state management in territorial waters.

A review of current jurisdiction indicated a need for three closely coordinated levels of fishery management: 1) by Federal authorities in the Fisheries Conservation Zone, 2) by joint action of the states in territorial waters for those stocks that cross state boundaries and 3) by unilateral action of the states in territorial and internal waters.

Under State management, Mississippi commercial fishery landings in 1978 amounted to about five times the volume and over six times the value recorded 30 years ago (1949) by the Bureau of Commercial Fisheries. State, regional, national and world production must be taken into account by State managers.

Council, regional and state management plan development were discussed. In development of a Proposed Management Plan for Mississippi Marine Finfish, 23 problems have been identified after consideration of requirements for accomplishing the goal of Optimum Yield. It was concluded that plans at all three levels must be closely coordinated.

Introduction

Fishery management, like environment and ecology has become a new part of the vocabulary of many Americans with almost as many conceptual variations. What, then, is fishery management? By dictionary (Webster's New Collegiate

Dictionary, 1977) definition, fishery is "the act, process, occupation or season of taking fish or other sea animals". Management is "judicious use of means to accomplish an end". The nominal "end" to be accomplished has always been associated with "conservation". However, Gulland (1974) noted that:

> "Since most fishermen are convinced that all other groups of fishermen, whether from the next village or from the next country, are foreigners intent on ruining their livelihood, management has often been the excuse for marine Luddism, in which the new and efficient gear is banned in the name of conservation. Jealousy and fear of new methods were the reason for the prohibition of the trawl or 'wondyrechoun' in the Thames estuary in the reign of Edward III some 700 years ago, just as they are for the prohibition of such effective gear as monofilament gill nets in many fisheries today."

Many authors (Cushing, 1975; Everhart, Eipper and Youngs, 1975; Gulland, 1974; Rounsefell, 1975; and Ricker, 1975) have reviewed the history of fishery management as it evolved after the real need for management developed in the last decades of the 19th century; the Maximum Sustainable Yield (MSY) concept emerged and dominated and Optimum Sustainable Yield (OSY) became the accepted goal of effective fishery management. Rounsefell (1975) presented a diagram (Figure 1) of various factors that affect a fish population and said that

> "Management consists in manipulating the action of these factors so as to produce the largest available surplus to be harvested."

The Congress of the United States, in 1976 (Public Law 94-265) provided definitions as follows:

> SEC. 3. DEFINITIONS.
>
> (2) The term "conservation and management" refers to all of the rules, regulations, conditions, methods, and other measures (A) which are required to rebuild, restore, or maintain, and which are useful in rebuilding, restoring, or maintaining, any fishery resource and the marine environment; and (B) which are designed to assure that --
>
> (i) a supply of food and other products may be taken, and that recreational benefits may be obtained, on a continuing basis;
>
> (ii) irreversible or long-term adverse affects on fishery resources and the marine environment are avoided; and

(iii) there will be a mulitplicity of options available with respect to future uses of these resources.

(7) The term "fishery" means --

(A) one or more stocks of fish which can be treated as a unit for purposes of conservation and management and which are identified on the basis of geographical, scientific, technical, recreational and economic characteristics; and

(B) any fishing for such stocks.

These definitions, subject to the usual bureaucratic interpretation, are a part of the laws of these United States.

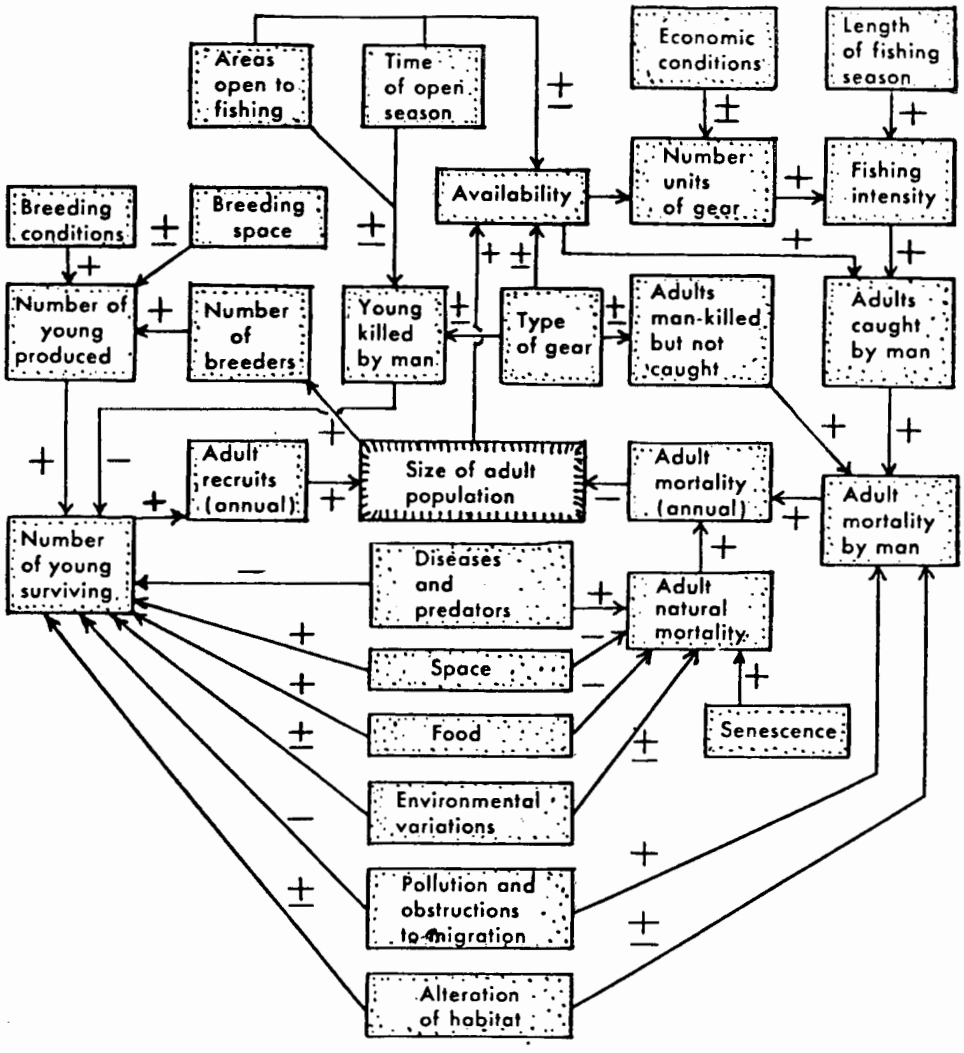


Figure 1. Major and minor factors influencing population size. (Modified from Rounsefell, G.A., and W.H. Everhart. 1953. Fishery science. John Wiley & Sons, Inc., New York. 444pp.) (Rounsefell, 1975, Fig. 13.1.)

Several events leading to increasing interest in and the expanded concept of fishery management should be noted. In the Fish and Wildlife Act of 1956 (Public Law 84-1024) Congress recognized that U.S. fish resources made a material contribution to the national economy and food supply and that, with effective management, these wealth producing renewable resources could be maintained and increased. The Marine Resources and Engineering Development Act of 1966 (Public Law 89-454) established a national policy which recognized the need to rehabilitate U.S. Commercial Fisheries. The Eastland Resolution (Sen. Con. Res. 11 of 1973) declared that it was the policy of the Congress that all necessary support be provided to strengthen and protect the sagging U.S. fishing industry. The resultant Eastland Fisheries Survey provided recommendations based on the views of all sections of the commercial and recreational fisheries interests. The Fishery Conservation and Management Act of 1976 (Public Law 94-265) authorized, for the first time, unilateral management of fisheries by the Federal Government. Although the United States had, for many years, been directly involved in management under numerous Treaties and Agreements on Fisheries (Congressional Research Service, 1977), management of fisheries in territorial seas is delegated to the States. Management in the 12-mile contiguous fishery zone established in October 1966 (16 USC 1091-1094) was not implemented. The fourth session of the United Nations Conference on the Law of the Sea ending on May 7, 1976 provided a revised single negotiating text giving to the coastal countries an exclusive economic zone extending for 200 miles from the base line established in the first Conference.

A fishery conservation zone (FCZ) was described in P.L. 94-265 as the area between a line coterminous with the seaward boundary of each of the coastal States and "a line drawn in such a manner that each point on it is

200 nautical miles from the baseline from which the territorial sea is measured". Exclusive fishery management authority in the FCZ, effective March 1, 1977, was assumed by the United States.

The State of Mississippi has exercised its fishery management authority through a series of commissions. Mississippi general coastline is 2.7% (44 miles) of the total Gulf of Mexico general coastline (Lyles 1968). Over 20% of the reported volume and 7% of the dockside value of Gulf of Mexico landings were landed in Mississippi in the 1949-77 period. The reported volume of 1977 Mississippi landings was about five times as much as 1949 landings with a dockside value more than six times as great. Mississippi landings, volume and value, per mile of coastline are much higher than in any other Gulf State.

Obviously, much of Mississippi's landings of marine fishery products is caught in waters outside the state. Available data (1963-72) show that 57% of the volume and 65% of the value of these landings were caught in other areas and landed in Mississippi (Christmas and Waller 1975). Regulation of fisheries participated in by Mississippi fishermen, whether in state waters or not, will affected Mississippi's fishery industry. Consequently, fishery managers in this State must consider international, national, regional and internal factors if rational management is to be achieved.

Jurisdiction

Public Law 94-265 provides (Sec 102; 16USC 1812) that:

> "The United States shall exercise exclusive fishery management authority, in the manner provided for in this act, over the following:
>
> (1) All fish within the fishery conservation Zone.
>
> (2) All anadromous species throughout the migratory range of each such species beyond the fishery conservation zone; except that such management authority shall not extend to such species during the time they are found within any foreign nation's territorial sea or fishery conservation zone (or the equivalent) to the extent that such sea or zone is recognized by the United States.
>
> (3) All continental shelf resources beyond the fishery conser-

vation zone."

Highly migratory species (tuna) are excluded. (Sec. 103)

State jurisdiction (Sec 30; 16 USC 1856) is assured:

> "(a) In general - except as provided in subsection (b), nothing in this act shall be construed as extending or diminishing the jurisdiction or authority of any State within its boundaries-----
> (b) Exception - (1) If the Secretary finds, after notice and an opportunity for a hearing that
> (A) the fishing in a fishery, which is covered by a fishery management plan implemented under this Act, is engaged in predominantly within the fishery conservation zone and beyond such zone; and
> (B) Any state has taken any action or omitted to take any action, the result of which will substantially and adversely affect the carrying out of such fishery management plan; the Secretary shall promptly ----- regulate the applicable fishery within the boundaries of such state (other than its internal waters), persuant to such fishery management plan and the regulations promulgated to implement such plans."

Eight regional management councils were charged with developing management plans "with respect to each fishery within its geographical area of authority -----." (16 USC 1852). Council plans, subject to review and approval, will be implemented by the Secretary. A Council (or Secretary) may (but is not required to) "incorporate (consistant with the national standards, the provisions of this act, and any other applicable law) the relevant fishery conservation and management measures of the Coastal States nearest the fishery." [Sec 303(b)(5)].

Historically, State managers in Mississippi and adjacent States have considered waters north and west of the barrier islands as internal waters with the base line from which the territorial sea is measured extending between appropriate points at each end of the islands. The respective management agencies have promulgated and enforced fishery regulations for the internal waters that did not apply to the terrirorial sea beyond their base line.

Current NOAA charts (11371, 11373 and others) show boundaries of the territorial sea measured from the mainland and all points on the barrier islands.

This failure to utilize the principle of straight baselines recognized in the first convention of the 1958 FAO Conference on the Law of the Sea (ratified by the President of the United States with the advice and consent of the Senate on March 24, 1961) creates large areas of international waters in Mississippi Sound and adjacent areas and places all other Mississippi Sound waters east of Henderson Point at the Bay of St. Louis in the territorial sea.

This interpretation of boundaries of the territorial sea poses serious fishery jurisdiction problems in Mississippi and Alabama. Areas outside territorial are in the FCZ. The States' authority does not extend beyond territorial waters. In the event the Secretary of Commerce chose to preempt regulation in the territorial sea, Federal regulations would be enforced to the baseline along the mainland beaches. Additionally, under 1972 Colregs, the Coast Guard would be forced to move the line of demarkation between inland and international rules of the road to a position that would exclude all international waters from application of inland rules. Consequently large numbers of fishing and recreational craft would be required to satisfy navigational standards for international rules of the road.

Management Plans

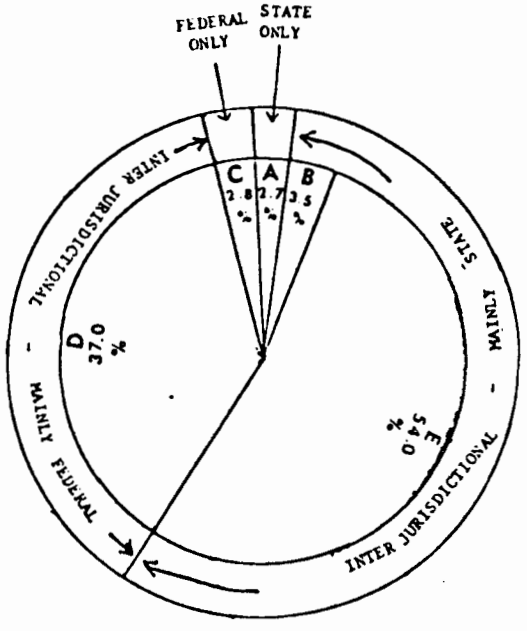
Fishery resources in the Gulf of Mexico are predominantly estuarine dependent (Christmas, 1973). National Marine Fisheries Service (NMFS) examined the jurisdictional distribution (Figure 2) of fish and invertebrate species in the NMFS southeast Region. According to this estimate, 94.5% of these species are interjurisdictional. Only 2.7% (A, Fig. 2) of the resources are recognized as being in State jurisdiction only.

The Gulf of Mexico Fishery Management Council (GMFMC) is currently developing management plans for the following fisheries:

Stone Crab
Groundfish
Reef Fish
Shrimp
Coastal Pelagics
Sharks
Coral
Spiny Lobster
Coastal Herrings
Mackerel

A management plan for billfish has been implemented.

Development of regional management plans for shrimp and menhaden were undertaken by the Gulf State-Federal Fishery Management Board, Chartered under the auspices of the Gulf States Marine Fisheries Commission (GSMFC), prior to the creation of GMFMC. These plans were completed, adopted and implemented in State waters in 1977. Currently, a profile of spotted seatrout and redfish fisheries is being developed by GSMFC. This profile could serve as a basis for developing a regional management plan for these fisheries. These plans provide for regional (interstate) management of stocks of species fished for predominantly in territorial and internal waters and extending across State lines. Although the State-Federal Management board has no authority for management, recommendations resulting from implementation of approved plans have been accepted by the States and appropriate regulations are in force.



A. Species which occur totally within the Territorial Sea and/or internal waters, and are under state jurisdiction.

B. Migratory and/or interjurisdictional species for which fishing occurs predominately in internal waters of a state, i.e., inside harbor mouths.

C. Species which occur totally outside the Territorial Sea and are under Council Jurisdiction.

D. Migratory and/or interjurisdictional species for which fishing occurs predominately within the Fishery Conservation Zone or beyond.

E. Migratory and/or interjurisdictional species for which fishing occurs predominately in the Territorial Sea.

Figure 2. The distribution of fish and invertebrate species by jurisdictional categories in the NMFS Southeast Region.

In Mississippi,fishery regulations have been concerned principally with with oysters, shrimp, crabs and selected finfish. There has been no formal system for the decision making process. An extensive data bank has been developed in the past 20 years. A review of the state of knowledge in each fishery, identification of problems and a prioritized list of research needs was completed in 1971 (Christmas, 1971).

A Proposed Plan for management of selected finfish is being developed under Mississippi-Alabama Sea Grant Project R/CP-1. The Mississippi Marine Conservation Commission (MMCC) selected species for consideration as follows:

Spotted Seatrout	Ground Mullet
White Trout	Croaker
Red Fish	Mullet
Flounder	Sheepshead
Menhaden	Black Drum

Objectives for the management of these species have been developed. Proposed objectives comply with national standards. Descriptions of the fisheries present the current status of knowledge and identify data gaps. Problems have been identified and recommendations for implementing action have been established.

The proposed system for finfish management is shown in Figure 3. This model provides for decision making based on the best available scientific information. The management structure in Mississippi changes on 1 July 1979 when the new Department of Wildlife Conservation (Figure 4) becomes effective. Details of the management structure in the Bureau of Marine Resources have not been made available.

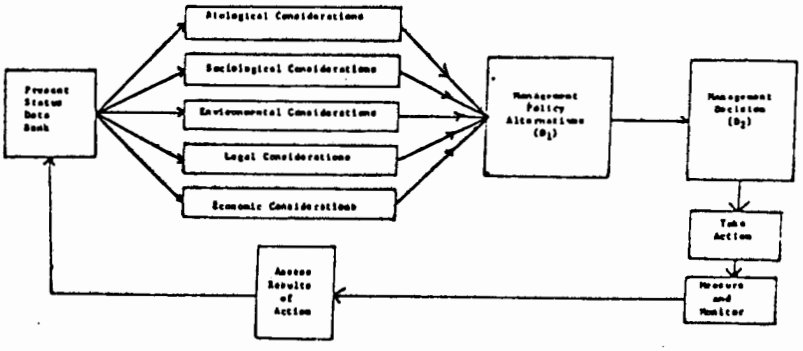
Thus management plan development is in process at three jurisdictional levels:

1) by Federal authorities in the Fisheries Conservation Zone.

2) by joint action of the States in territorial and internal waters for

those stocks that cross state boundaries.

3) by unilateral action of the States in territorial and internal waters.



EXPLANATION OF DECISIONS TO BE MADE

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

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

D_2 The Mississippi Marine Conservation Commission will make this decision by choosing the best alternative in accordance with previously set policies.

Figure 3. Conceptual model of future system for management of Mississippi marine finfish.

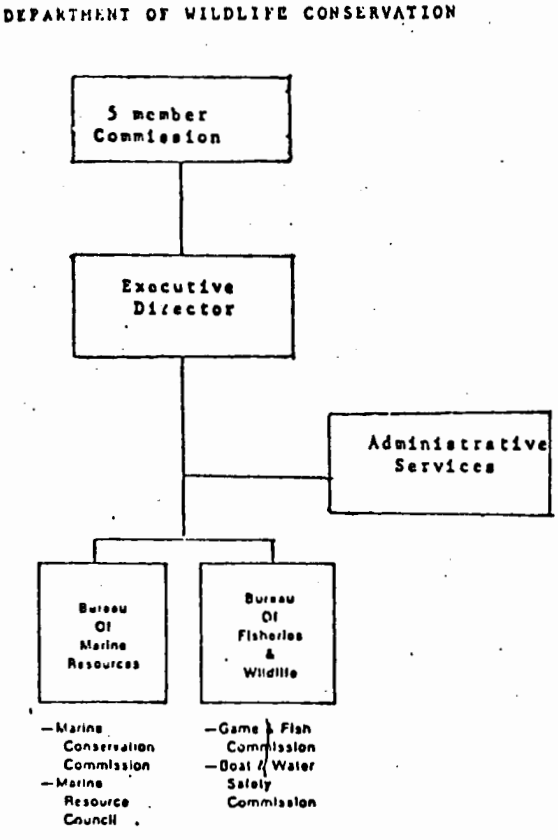


Figure 4. Management structure of the Department of Wildlife Conservation.

Obviously all of these plans must be closely coordinated if rational fishery management is to be accomplished. Regional plans provided a dual process flow model (Figure 5) which is also being included in the proposed plan for Mississippi Marine finfish.

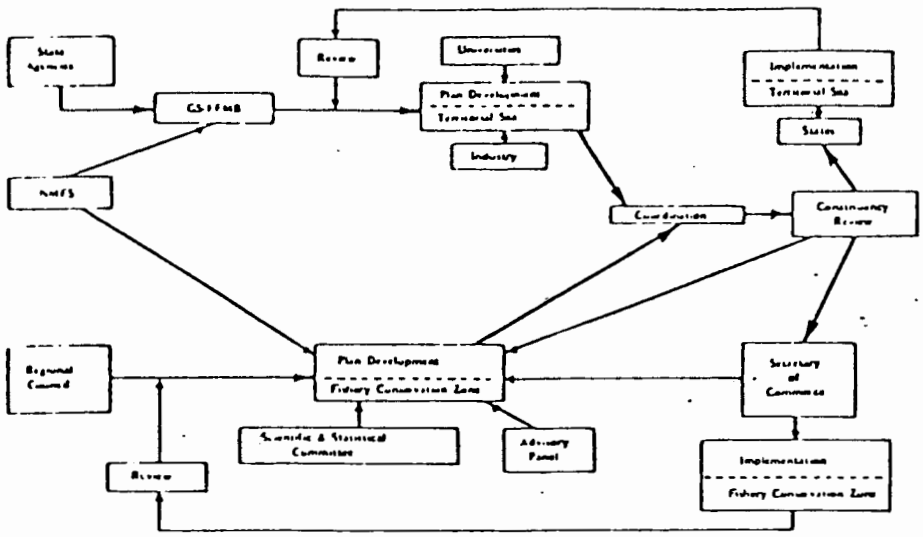


Figure 6. Dual process flow model

In general, although there is a very extensive data bank available for fishery management decision making, there are many gaps that require filling. Perhaps the most outstanding of these is the inadequacy of fishery catch statistics, especially for recreational fisheries. Correction of these inadequacies is urgently needed. In Mississippi, stocks are generally healthy and productive although deterioration of the estuarine environment is causing problems, especially for oyster fishermen. Adoption of a plan for marine finfish currently being developed, development of plans for the other fisheries and full implementation of these plans with continuing research to fill data gaps will lead to achievement of the optimum yield goal in Mississippi.

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SELECTED OBSERVATIONS ON THE BEHAVIOR OF GULF MENHADEN, BREVOORTIA PATRONUS

by

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INTRODUCTION

A series of investigations, beginning in 1971, have been conducted by the National Fisheries Engineering Laboratory (NFEL), of the National Marine Fisheries Service (NMFS), to evaluate and demonstrate capabilities of remote sensing systems for fishery applications. Primary target species for many of these investigations was the Gulf menhaden (Brevoortia patronus) because of their surface schooling nature, existence of a well developed and cooperative commercial fishery, and close proximity to the Laboratory. While the intent of the investigations was primarily remote sensing system application and evaluation, nevertheless a significant amount of incidental behavior information was collected. This paper summarizes some of this information; greater detail can be found in papers by Kemmerer (1979); Kemmerer and Butler (1977); Kemmerer, Benigno, Reese, and Minkler (1974); Vanselous (1976); and Roithmayr and Wittmann (1972).

GULF MENHADEN BIOLOGY AND FISHERY

Considerable information exists on the biology of Gulf menhaden with most of it referenced in bibliographies by Gunter and Christmas (1960); Reintjes, Christmas, and Collins (1960); Reintjes (1964); and Reintjes and Keney (1975). An excellent summary of menhaden biology has been compiled by Christmas and Etzold (1977) as background material for a regional menhaden management plan.

Members of the family Clupeidae, adult menhaden are relatively small, measuring about 17-cm fork length and weighing about 100 gms. They are coastal pelagics forming large, dense schools in coastal waters from April to October. An offshore movement for spawning begins in early fall, and eggs and larvae are transported from offshore to estuarine nursery areas by currents. Juvenile manhaden recruit into the fishery after about one year and normally live about two years. The commercial catch is dominated by one- and two-year olds with three- and four-year old fish being relatively rare. Sexual maturity is attained by age three, although late zero-year class fish and many one-year olds are able to spawn.

Twin-boat purse seining is the principal harvest method employed in the commercial fishery. Fishing normally takes place during daylight hours and involves aircraft and surface vessels. Pilots flying the aircraft locate the schools and then provide tactical information for capture operations. Aboard each fishing vessel are two small purse boats (11 to 12 meters in length)

with a purse seine divided between them. The purse boats are lashed together so they can operate as one to pursue selected menhaden schools for encirclement and capture. After encirclement, the bottom of the net is pursed and excess net is pulled back into the purse boats. Fish are then pumped from the net into the hold of the fishing vessel. Each complete fishing operation, from sending out the purse boats to pumping fish, is referred to as a set. In an average day, a fishing vessel will make three to six sets. Commercial landings of menhaden in the Gulf have exceeded 486,000 metric tons every year since 1971. Peak yields occurred in 1971 with an estimated 728,000 metric tons landed and again in 1978,the best year on record, with 820,000 metric tons landed.

OBSERVATIONS ON BEHAVIOR

Adult menhaden begin to move into nearshore coastal waters in April and then appear to remain close to shore until about October. Fishing begins mid-April when most of the catches occur relatively far offshore. During the middle of the fishing season, June and July, when yield is maximum, most sets occur relatively close to shore. There was no indication of any offshore movement toward the end of the fishing season in the data base; however, a published review of NMFS exploratory fishing records from the northern Gulf suggests that offshore movement begins in October and reaches a maximum in December (Roithmayr and Waller, 1963).

Comparisons of average set size and annual yield in 1972, 1975, and 1976 suggest that average school size increases with increased abundance. This apparent relationship, however, may simply represent a natural bias of fishermen to select the larger schools for capture when fish are plentiful. Average school size in Mississippi waters appeared to be significantly smaller than off Louisiana. This difference persisted throughout the fishing seasons.

There was no indication of any change in average school size as a function of month during the fishing seasons. Mean set size varied between months but not in any consistent or significant fashion. Mean set size off Louisiana was much larger on the first day (Monday) of the fishing week (Monday through Friday or Saturday) than on any of the other fishing days. Off Mississippi, however, set size remained relatively constant throughout the week.

A persistent daily movement and school behavior pattern appeared in the menhaden catch data. The schools were relatively small and close to shore in the morning. Shortly after daybreak, the schools began to move offshore and to coalesce forming larger schools during the day. The schools also appeared to move into relatively deep, turbid waters thereby decreasing availability to the fishermen. Near dusk, the fish would move close to the surface and out of turbid waters. This was the period when the most numerous and largest sets were made by the fishing fleet. At night, the schools fractionated and began moving back to shore. Additionally, the schools tended to disassociate their tight schooling aggregations and to move more at random than during daylight hours when the schools seemed to group relatively close together.

A suggestion that the daily movement pattern might be triggered by varying light intensities was tested by examining average distance from shore as a function of cloud cover (e.g. overcast, partly cloudy, and clear). Sets were made significantly further offshore on cloudy days than during clear periods. Additionally, the fish appeared to be more available on partly cloudy days than on clear days.

Examination of oceanographic measurements taken from sites of menhaden capture indicated the water turbidity and color correlated significantly with menhaden distribution. Menhaden appeared to prefer waters with a mean secchi disc visibility of about 1.1 meters regardless of geographic area, year, or season. No relationships were apparent from thermal measurements with fish found in waters of 20 to about 32^{o} C throughout the fishing season. Salinity measurements also were highly variable, although there was some indication that menhaden prefer waters between 5 and 25 ppt salinity.

Significant relationships were found between menhaden distribution and radiance measurements acquired from LANDSAT-1 and -2. Correlations were significant with all four multispectral scanner bands (500-600, 600-700, 700-800, and 800-1100 nanometers), although the most precise relationships generally were found with the 600-700 nanometer band. These relationships supported those found with surface truth secchi disc and color measurements.

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A QUANTITATIVE PROCEDURE FOR COLLECTING LARVAL FISHES IN A SURF ZONE HABITAT

by

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ABSTRACT

Utilization of most littoral environments by larval fishes is poorly understood, in part due to sampling problems. The development of a larval fish surf net has made it possible to quantitatively study the ichthyoplankton in nearshore waters of a Gulf Coast barrier island.

In the surf zone, a primary peak in larval fish abundance occurred between late spring and early summer 1978, with a secondary peak occurring in the late fall. The dominant larvae collected in the surf zone were Anchoa spp., Trinectes maculatus, Bairdiella chrysoura, Menticirrhus spp., Sciaenops ocellata, Leiostomus xanthurus, and Brevoortia patronus. Sampling of surface waters between 200 and 500 m offshore indicated peaks in abundance during May and June. Anchoa spp., Citharichthys sp., Trinectes maculatus, Chloroscombrus chrysurus and an unidentified gadid represented the major species found in these nearshore waters.

INTRODUCTION

The sampling of ichthyoplankton in various environments often requires modifications of equipment and collecting techniques. Sampling in open waters for larval fishes is usually accomplished by the use of conical plankton nets or modified mid-water trawls. The development of epibenthic sleds has improved sampling efficiency of benthic habitats. Modifications in the sampling of surface waters (Miller 1973 and Lindsay et al. 1978) have also proved useful under certain circumstances. The channel net designed by Lewis et al. (1970) is very effective for capturing larvae in rivers and estuarine waters with significant tidal fluctuations. It is especially useful in obtaining live specimens.

The littoral regions of most aquatic environments are poorly understood in relation to larval abundance and utilization. These nearshore areas are often inaccessible to the craft used in ichthyoplankton surveys. The interface between the open oceans and land masses, the exposed beaches, presents one such inaccessible region.

The ichthyofauna in the surf zone of exposed beaches has not often been studied, but Modde (1979) suggested that these areas may serve as nursery grounds for certain marine species of fishes. Previous studies in these areas (Gunter 1958; Springer and Woodburn 1960; McFarland 1963; Anderson et al. 1977; Modde 1979) have not dealt with larval fishes, but rather with juveniles and adults. The larval fishes that have been reported in these studies were captured in seines ($\geq$ 3 mm mesh) and did not generally represent early larval stages.

This study investigates the abundance and distribution of larval fishes occurring in the surf zone and nearshore waters of Horn Island, a Gulf Coast barrier island. Knowledge concerning the importance of such surf zones to the larval stages of various marine fishes is sparse.

MATERIALS AND METHODS

Net Construction

Quantitative sampling of larval fishes in a surf zone of an exposed beach has been facilitated by the development of a larval fish surf net. The rectangular net was made from 571 micron mesh Nitex netting material and has a 2.5 to 1 mouth to length ratio (Fig. 1B). The net has a width of two meters and a height of one-half meter. The netting has been reinforced by sections of nylon utility cloth. All stitching was accomplished on a standard size sewing machine using a dacron thread. The seams were bound together with a nylon twill tape.

The frame and runners for the net (Fig. 1A) were constructed from 18 mm PVC plastic pipe. A two meter section of galvanized pipe was inserted into both the top and bottom sections of the frame to give it added weight and rigidity. The runners were constructed to add support to the frame.

Sample Design

The surf net was towed in the surf zone in approximately 50 cm of water by two men. It was pulled with a 30 m nylon line attached to a bridle on the net. The use of a bridle allowed towing to be carried out with minimum disturbance to the water being sampled. The net was pulled as rapidly as possible, depending upon water conditions.

Replicate tows were taken with the surf net at each of four beach stations located along the western end of Horn Island (Fig. 2). A predetermined distance was marked off on the beach face prior to sampling. This distance was then sampled at a depth of approximately 50 cm. Multiplying the distance sampled by the area of the net mouth, which is one square meter, represents the amount of water filtered by the net.

Five offshore stations (Fig. 2) were also sampled, with the use of a one-half meter conical plankton net (505 micron mesh). A flowmeter was placed in

the mouth of the net to give an estimation of the amount of water filtered. These stations were located between 200 and 500 meters offshore, on the south side of a prominent longshore bar. An additional offshore station (Station 9) was sampled in the Gulf portion of Dog Keys Pass. Replicate collections were made only in the surface waters at these stations and were made parallel to the corresponding beach stations. The beach stations were established to coincide with those set up by Modde and Ross (personal communication) in 1976 for their study of fishes in the surf zone of Horn Island.

RESULTS

All data regarding larval abundance for sampling dates in 1978 are presented as number of all larvae per 100 m^3. Larval fishes present in the surf zone at Station 2 and numbers of larvae occurring at the corresponding offshore station, Station 7 are shown in Fig. 3. At both stations a peak in larval abundance occurred in the late spring and early summer. A secondary peak occurred in the surf zone in the late fall, which was due primarily to the movement of Leiostomus xanthurus and Brevoortia patronus into the Mississippi Sound at this time.

Stations 3 and 6 showed similar distributional trends (Fig. 4). Two separate peaks in larval abundance occurred, due primarily to the large numbers of anchovies collected between early May and late June. The separate peaks were caused by either spawning of more than one species of Anchoa or a protracted spawning of a single species. The lack of a secondary peak in the fall at the offshore stations was most likely due to a failure to sample bottom waters in these areas, where Leiostomus xanthurus would be expected to occur.

The dominant larvae collected from the surf zone and offshore stations are shown in Table 1. These larval fishes represent the major species collected from each area between April and the end of June. In the surf, anchovies,

sciaenids, and Trinectes maculatus were dominant. The anchovies may possibly include several species (Anchoa cubana, Anchoa hepsetus, Anchoa lyolepis, and Anchoa mitchilli). Separation to the species level was not possible for engraulid larvae smaller than 10 mm. The sciaenids were represented by Bairdiella chrysoura, Menticirrhus americanus and Menticirrhus littoralis. The primary larvae occurring at the offshore stations were anchovies, an unidentified gadid, three members of the flatfish order Pleuronectiformes (Citharichthys sp., Trinectes maculatus, and Symphurus plagiusa) and the carangid Chloroscombrus chrysurus.

In the summer, July through September, engraulids and sciaenids were the most abundant larvae collected in the surf zone (Table 2). The sciaenids were represented by Menticirrhus americanus, Menticirrhus littoralis and Sciaenops ocellata. Anchovies and Chloroscombrus chrysurus were the most abundant larvae collected at the offshore stations.

In the fall, October through December, Leiostomus xanthurus and Brevoortia patronus were the dominant species collected. These larvae principally represented the catch from December, since numbers of larvae collected were extremely low during October and November with no species being dominant.

DISCUSSION

The plankton net used in my study of the surf zone was not elevated above the runners of the frame, allowing for that water adjacent to the substrate to be sampled. This is unlike most other ichthyoplankton sleds (Tabery, 1976) where the net is elevated above the substrate.

The seasonal abundance of larval fishes and the abundance of juvenile fishes in the surf zone of Horn Island showed very similar patterns. Seasonal peaks for juvenile fishes collected in the surf zone with a seine by Modde (1979) between 1975 and 1977 occurred later in the year than did the peaks in larval

abundance, which were found in 1978. This would be expected, as those fishes spawned in late spring and late fall would not be susceptible to capture by seining until somewhat later in the season.

The numerically dominant species of fish found by Modde (1979) in the surf zone of Horn Island for the three years prior to my study were somewhat different than the most abundant larvae collected in 1978 (Table 3). Anchoa lyolepis and Harengula jaguana were numerical dominants, being represented primarily by juveniles. The differences observed between the abundance of larvae and the abundance of juvenile fishes in the surf zone seems to indicate that the surf zone does serve as a nursery area for certain species, as they appear in coastal waters after being spawned some distance out to sea (Houde 1977). Of the dominant species of early larval fishes collected, only the Menticirrhus are believed to spend a majority of their life cycle in the surf zone.

The difference in larval abundance between the surf zone and the offshore stations is intriguing especially since the areas are separated by only 500 m or less. These differences would likely have been even greater had the benthic habitat been sampled at the offshore stations.

Since other studies of this nature have not been undertaken, I can not be sure if these differences were caused by current patterns unique to Horn Island or if this is indeed the general pattern of larval distribution in most surf zone habitats.

ACKNOWLEDGMENTS

I would like to express my thanks to Dr. Cynthia Easterling of the Home Economics Department at the University of Southern Mississippi who made the construction of my surf net possible, Dr. Stephen Ross, my major professor for his valuable advice, and all those who endured with me on collecting trips, especially Robert McMichael, Jr. Financial aid for this study was provided by the Biology Department at the University of Southern Mississippi and a Sigma Xi Research Grant. The use of equipment provided by the National Park Service Coastal Field Research Laboratory is greatly appreciated.

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Table 1. Dominant larval fishes collected in the spring, 1978.

	SURF	OFFSHORE
SPRING	*Anchoa* spp.	*Anchoa* spp.
	Sciaenidae	Gadidae
	Trinectes maculatus	Pleuronectiformes
		Chloroscombrus chrysurus

Table 2. Dominant larval fishes collected in the summer and fall, 1978.

	SURF	OFFSHORE
SUMMER	*Anchoa* spp.	*Anchoa* spp.
	Sciaenidae	*Chloroscombrus chrysurus*
FALL	*Leiostomus xanthurus*	*Brevoortia patronus*
	Brevoortia patronus	

Table 3. Dominant fishes collected in the surf zone of Horn Island by Modde (1979).

SPECIES	PERCENT FREQUENCY	TOTAL NUMBER
Anchoa lyolepis	47.3	64028
Harengula jaguana	64.3	59713
Anchoa hepsetus	44.6	3751
Trachinotus carolinus	56.3	3167
Menticirrhus littoralis	67.0	1297

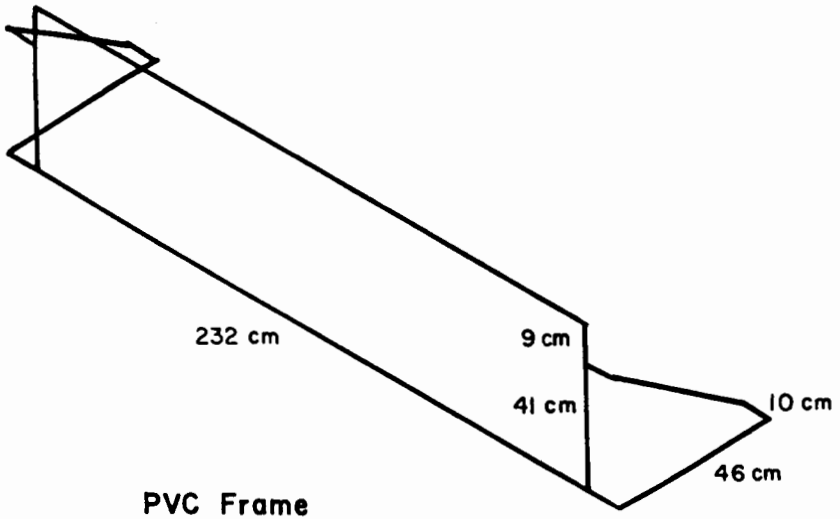
FIGURE LEGENDS

Fig. 1. Shape and dimensions of larval fish surf net. (U - Utility Cloth, N - Nitex Netting)

Fig. 2. Location of sampling stations, Horn Island, Jackson County, Mississippi.

Fig. 3. Numbers of all larvae collected at station 2 and station 7.

Fig. 4. Numbers of all larvae collected at station 3 and station 6.



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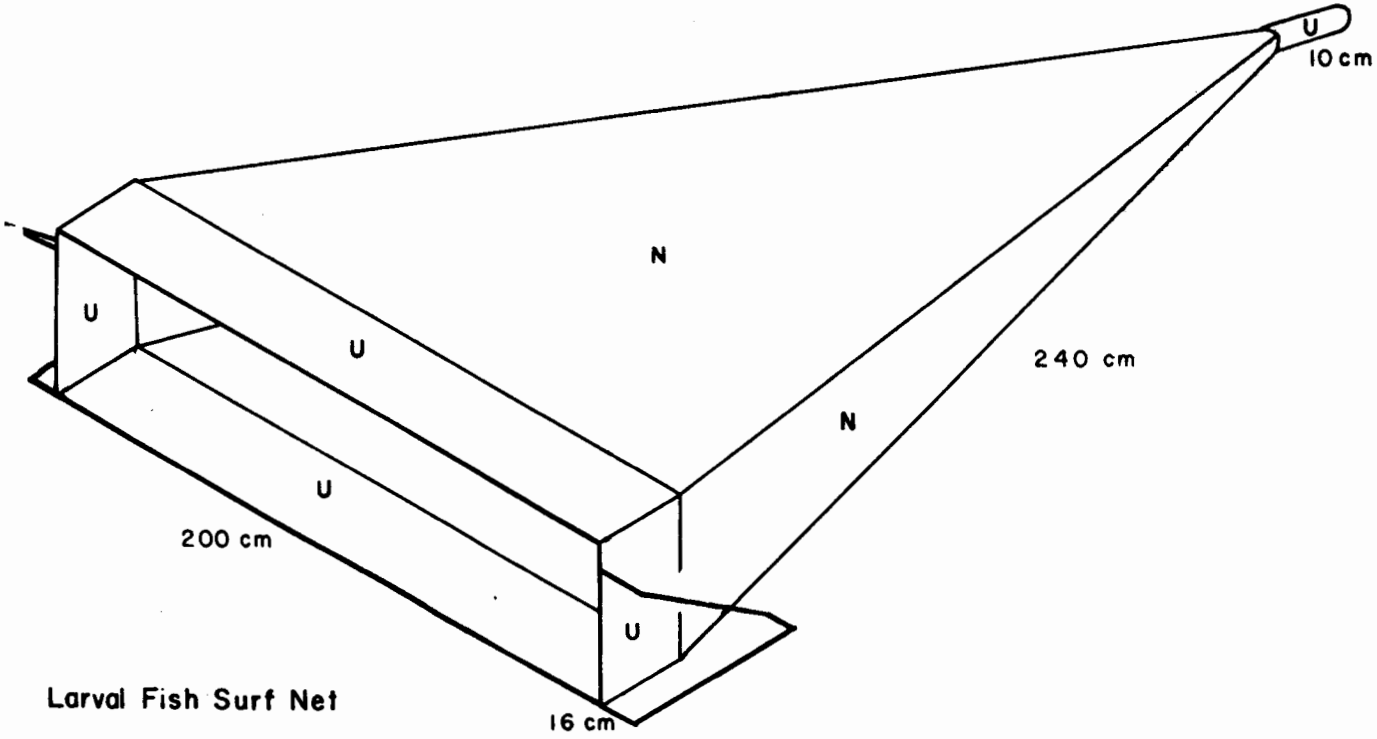

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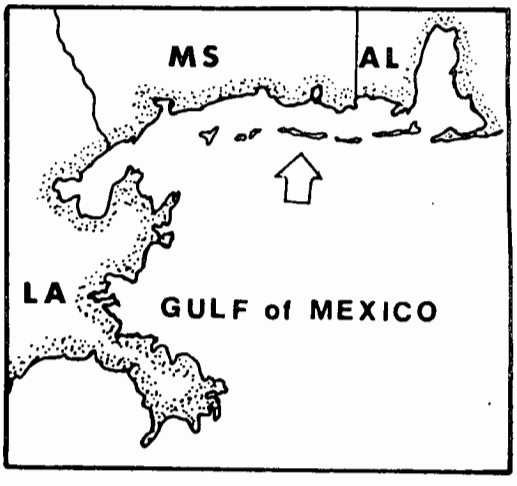

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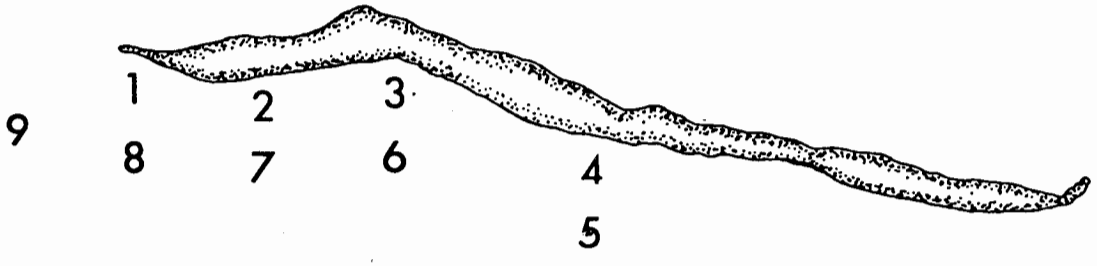
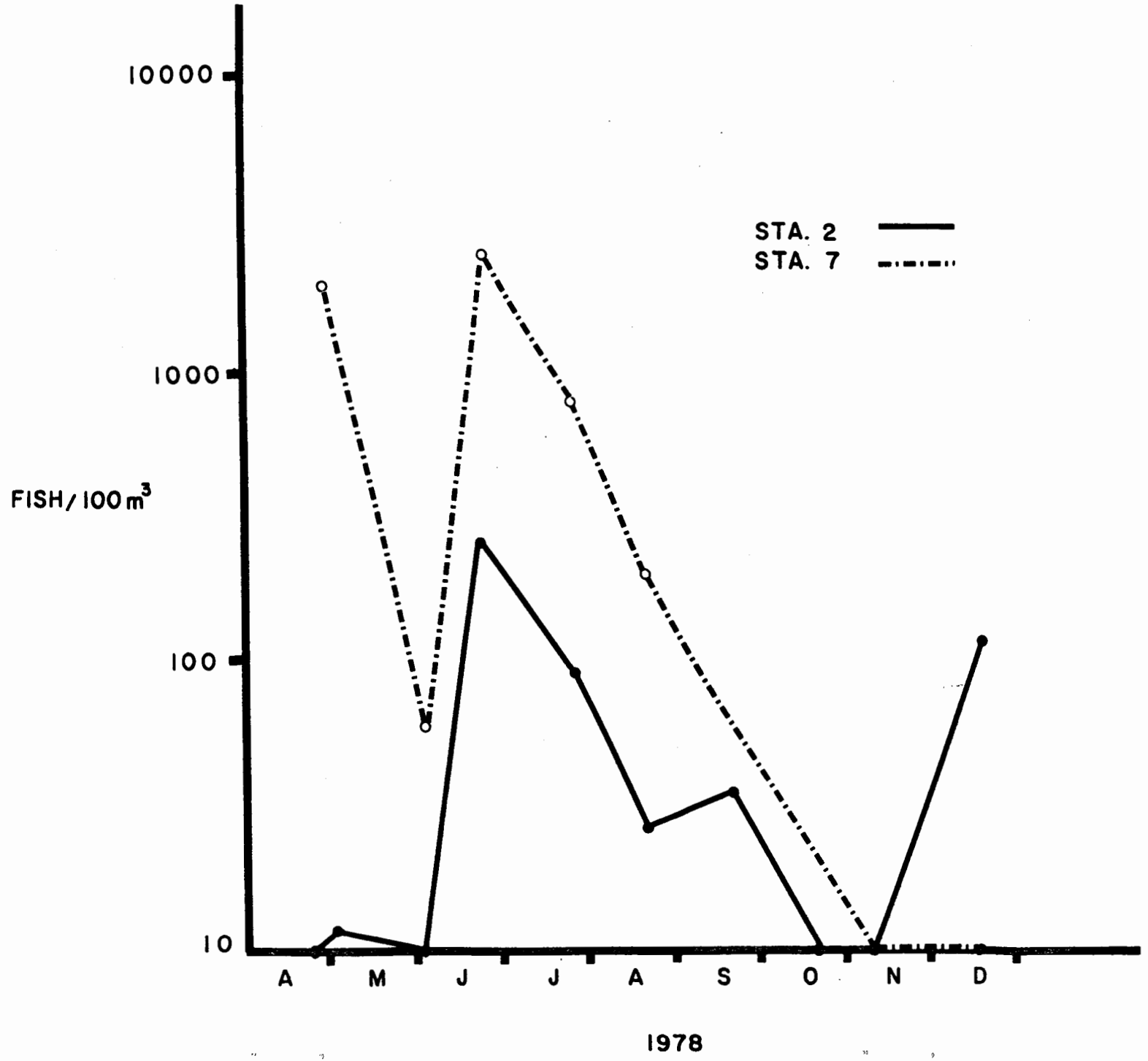


GULF of MEXICO

10 KM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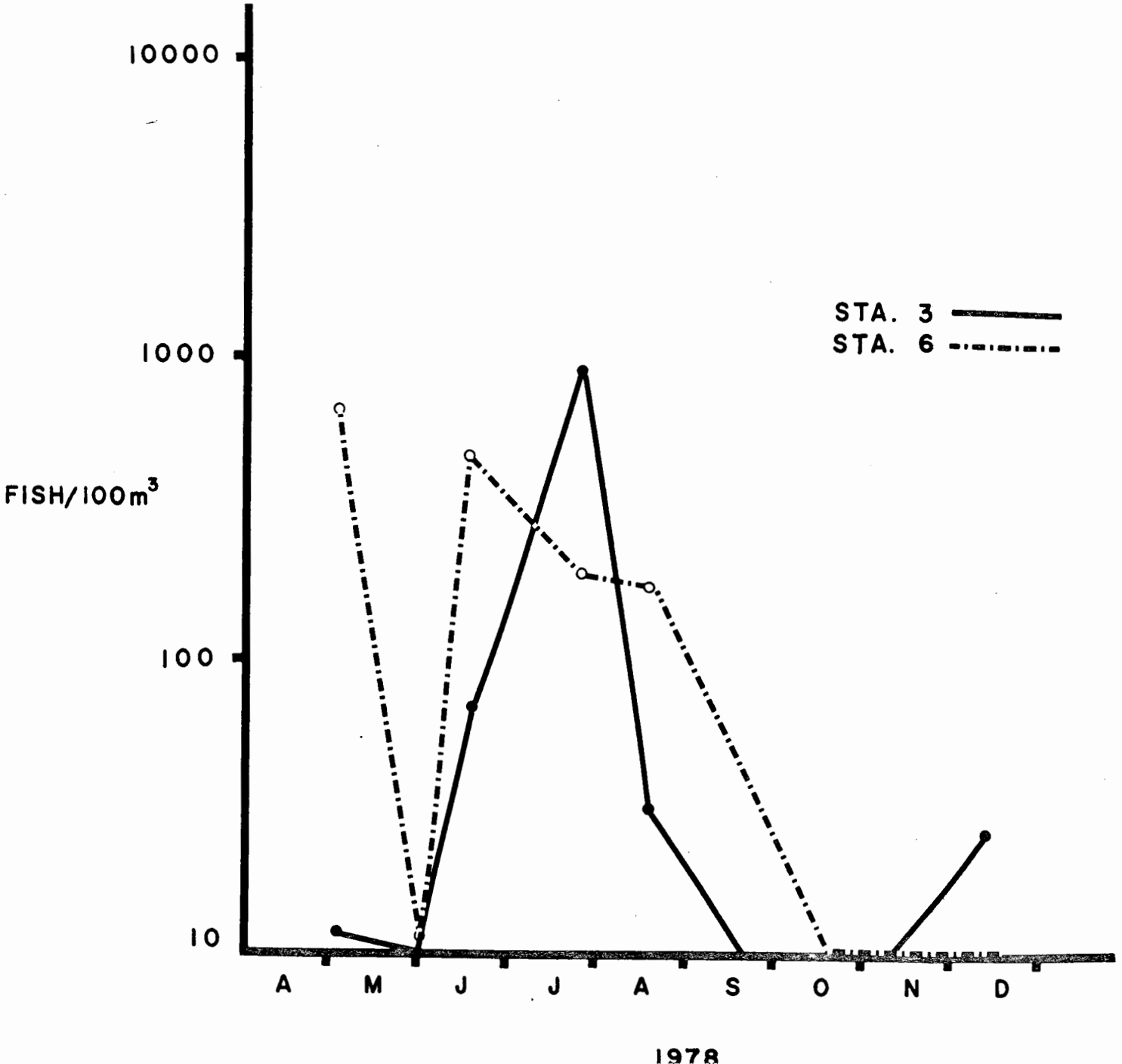
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INCIDENCE OF FISH DISEASES IN MISSISSIPPI 1970-1978[1]

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From January 1970 to December 1978, the fish disease laboratories of the Extension Wildlife and Fisheries Department investigated 1,056 cases. Most of the fish kills investigated occurred in commercial catfish ponds, although the others occurred in both public and private streams, lakes and ponds. A few of the cases reported were from commercial fish farms in adjacent states. These 1,056 cases were kills that were actually investigated.

The figures for incidence, both seasonal and total, are somewhat biased. This is due to the fact that most Mississippi catfish farmers have been to one or more fish disease workshops or short courses conducted by the Mississippi Cooperative Extension Service, and as a consequence have purchased a microscope and do a lot of their own diagnostic work. Also, most catfish farmers can diagnosis an oxygen depletion problem as good or better than many fishery biologists. Thus, we are seldom called in on an oxygen problem by a fish farmer. The total number of disease problems associated with our fish kill investigations is much higher than the actual number of cases we looked at. This is because often more than one disease organism is contributing to the mortalities, e.g., Ich, columnaris and Aeromonas hydrophila. Thus, if fish are infected with all three organisms it is difficult to determine which is the primary cause of the losses.

Fish diseases can and do occur anytime of the year, but certain times are more conducive for disease problems to occur. Meyer (1970) pointed out

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[1]Presented at the Annual Meeting, Mississippi Chapter of the American Fisheries Society, University of Southern Mississippi, Hattiesburg, February 15, 1979.

that April was the worst month and that the five month period from March to July was the worst time for disease problems. Although our data (Fig. 1) does not agree with this we do agree that this period is potentially the most dangerous time for a fish farmer. Our data (Fig. 1) shows that more kills occurred during August to October (367 cases or 34.8%) than any other time. April had the fourth highest number of cases.

Parasites are more often implicated in fish kills than any other single category of diseases. They can cause great losses if not caught in time, but fortunately most fish parasites are easily controlled with few exceptions.

Trichodina, a protozoan, was implicated as being involved in 243 or 23% of the cases investigated. This is a very common ectoparasite on the gills and body of freshwater fish. It can and does cause problems in every month of the year but is most frequently involved from March to October. The two peak months were April when young fish are hatching and in October where production fish are crowded prior to harvesting.

Scyphidia, another common ectoparasitic protozoan, is primarily a problem in young fish and is usually found in conjunction with other parasites or bacterial infections. Heavy numbers of Scyphidia on the gills interfers with respiration and can cause serious losses even in large fish. It causes more problems in April and July but was commonly involved in fish kills throughout the year.

Chilodon and Costia are ectoparasitic protozoans which can cause catastrophic losses of fish unless controlled in time. Losses are particularly severe among young fish. Costia can occur in any month but most frequently causes problems in March and April. Chilodon was not encountered frequently, only being implicated in 24 cases (23%). It can also cause problems year-round but the greatest incidence was in April.

Henneguya, Epistylus and Trychophrya occur infrequently but can cause problems through out the year.

Ichthyophthirius is most prevalent in the winter and spring because high water temperatures are lethal to certain stages in the life cycle. Optimum temperature for the development of Ich is 70^{o} which explains why it is seen most often in March and April.

Bacterial diseases, specifically Aeromonas and columnaris, are the second and third most frequently encountered disease problems. Frequently the onset of these bacterial diseases is rapid and catastrophic losses can occur unless corrective measures are taken immediately.

Aeromonas infections were implicated in 201 (19%) of the cases investigated and can occur in any month. Outbreaks are most frequent in April and in August and reflect stresses due to temperature changes in the spring and low oxygen levels associated with high water temperatures, crowding and overfeeding in the summer.

The incidence of columnaris infections peaked in the late summer and early fall and is related to the stress of overcrowding or handling when stocking fingerlings into grow-out ponds. Problems due to columnaris are infrequent when water temperatures are below $50\text{-}55^{o}$ F. Most of the columnaris outbreaks in December, January and February occurred during brief warm spells.

Myxobacteria infections, the so-called "Winter Fungus", are most common in winter and early spring when water temperatures are cold. No myxobacteria infections were found from May to September. Almost always a secondary fungus infection is found associated with the myxobacteria infections.

Pseudomonas occurred infrequently and can probably cause a problem at any time during the year.

slow release of the pesticide results in chronic losses rather than acute losses.

Losses due to toxic algae are rather infrequent and occur only in summer months. They are associated with heavy blooms of blue-green algae and are characterized by losses only during the middle of the day and by a strong musty odor around the pond.

The incidence and frequency of various fish diseases does have management implications for the fish farmer. By being aware of how frequently and when a specific disease is likely to occur, a fish farmer can take precautions to prevent such an occurrence or at least catch it at the start and minimize his losses.

LITERATURE CITED

Meyer, F. P. 1970. Seasonal fluctuations in the incidence of disease on fish farms. In A Symposium on Diseases of Fishes and Shellfishes. Ed. S. F. Snieszko, Sp. Publ. No. 5 AFS: 21-29.

Cleidodiseus pricei, the gill fluke of catfish, was the most frequently encountered monogenetic trematode during the nine year period. They are present and can cause problems year round. C. pricei most frequently causes problems in the spring in young catfish, but if high enough populations develop they can cause losses of large catfish.

Oxygen depletions occurred from April to September with the greatest incidence in July and August when water temperatures are high and dense phytoplankton blooms develop. Our data is not an accurate reflection of the magnitude of this problem among commercial fish farmers in Mississippi because most fish farmers monitor the oxygen in their ponds closely. We are contacted by fish farmers with oxygen problems only infrequently. Most of the cases our laboratories investigated involved private farm ponds.

Channel catfish virus disease is a problem in young channel catfish less than five inches long and occurs only when water temperatures are 68° F. (20° C.) or higher. Therefore, the incidence of CCV is restricted to the summer months. It occurs infrequently but can be devastating when it does with losses approaching 100 percent.

Pesticide-caused losses show two peaks of frequency: one in August and September and the other in January. These three months had 63% of the cases involving pesticides. The reason for the high incidence of pesticide poisoning in August and September is obvious since this is the time of heaviest pesticide use on crops. The peak occurrence in January is due to the release of pesticides that have been stored in body fat during periods of higher water temperatures. During winter months many fish farmers do not feed their fish when water temperatures reach 55° F. and lower. The fish therefore depend on stored fat to provide energy needed at this time resulting in the release of toxic levels of chlorinated hydrocarbons into the blood. Ordinarily this

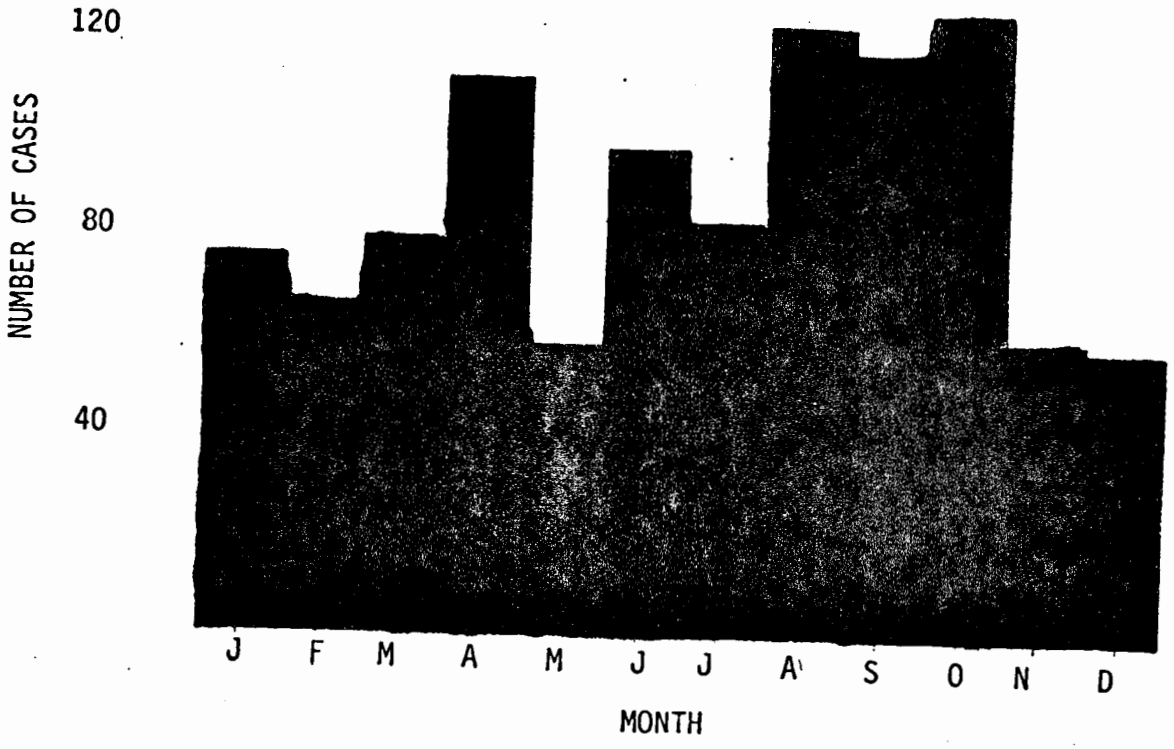

Figure 1. Monthly incidence of fish disease cases, January 1970 to December 1978.

Mississippi Chapter of the
American Fisheries Society
1979 Annual Meeting - February 15

PROGRAM

8:30 - 9:30	Arrival & coffee
9:30 - 9:40	Welcome to University by Dr. Grantham, Chairman, Dept. Biology
9:40 - 10:10	Introduction and review of activities by chapter members
10:10 - 10:30	Comments by Chapter President, Mr. J.Y. Christmas
10:30 - 10:45	Break
10:45 - 11:45	General Business Meeting
11:45 - 12:00	Group Photograph
12:00 - 1:30	Group Luncheon

Presentation of Papers - Wendell Lorio, Program Chairman

1:40 - 2:00	Incidence of fish disease in Mississippi 1970-1978, Tom Wellborn, Miss. State Univ.
2:00 - 2:20	Status report: Mississippi Marine fisheries management, J.Y. Christmas, Gulf Coast Research Laboratory
2:20 - 2:40	A quantitative procedure for collecting larval fishes in a surf zone habitat, David Ruple, Univ. of Southern Miss.
2:40 - 3:00	Activities of the National Engineering Laboratory, NMFS, NSTL, Mississippi Andrew Kemmerer, National Marine Fisheries Service
3:00 - 3:15	Break
3:15 - 3:50	Color enlargement techniques for interpreting SEM photographs of fish scales, Bennie Rohr, National Marine Fisheries Service
3:50 - 4:10	The role of biology in the Mississippi Air and Water Pollution Control Commission, Thomas Boyd, Mississippi Water Pollution Control Commission
4:10 - 4:30	The D-J Federal Aid Program in Mississippi, Harry Barkley, Mississippi Game and Fish Commission