ANNUAL REPORT

of the

MISSISSIPPI SEA GRANT PROGRAM

AUGUST, 1973

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COVER –

The cover and other drawings appearing in this report are courtesy of Joe Moran, renowned Biloxi, Mississippi artist.

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Submitted by:

Universities Marine Center
Ocean Springs, Mississippi 39564

This report describes the Mississippi Sea Grant Program from November 30, 1971, to February 28, 1973.

INTRODUCTION

The National Sea Grant College and Program Act, co-sponsored by Senator Claiborne Pell of Rhode Island and Senator Warren G. Magnuson of Washington, became a reality on October 15, 1966. The purpose of the Act was " . . . to accelerate national development of marine resources, including their conservation, proper management, and maximum social and economic utilization . . . ." It was immediately embraced by many of the universities of our coastal states as an excellent means of understanding and improving our coastal and marine resources. University programs in each state were different in their scope and direction depending upon the particular needs of the state, its geographical composition, its previous use of marine resources, as well as the expertise incumbent in the university system.

Mississippi, traditionally dependent upon the sea for its seafood and tourist industries, joined the Sea Grant Program in June of 1971. The first grant was received by the Universities Marine Center, a unique consortium representing the Gulf Coast Research Laboratory, Mississippi State University, University of Mississippi and The University of Southern Mississippi. In September of 1972 another major step forward was taken when Mississippi and Alabama joined forces to create the first two state Sea Grant Program in the country, and the Universities Marine Center became the Mississippi-Alabama Sea Grant Consortium. Joining forces with the above mentioned universities were Auburn University; Tuskegee Institute; The University of Alabama at Birmingham, Huntsville, and Tuscaloosa; and the University of South Alabama.

This report covers work done by Mississippi during the period of November, 1971, through February, 1973. Many of the programs undertaken do not neatly fit the time frame of an annual report; however, we feel that much has been accomplished during this period. In close cooperation with the Mississippi Marine Resources Council, a Coastal Zone Management Plan was inaugurated which resulted in Mississippi being one of the first states in the country to apply for a grant under the Coastal Zone Management Act. Assistance was also provided to members of the Mississippi Legislature in passing a Wetlands Act earlier this year. Awareness of the potential of the Mississippi coastal zone has been engendered by the Coastal Leaders Program and an Advisory Services Program, which is resulting in a new and progressive approach to coastal zone problems.

In establishing our Sea Grant Program, we have given high priority to the needs of the State of Mississippi as specified in our philosophy of providing technical data and recommendations to citizens, public officials, and agencies responsible for the intelligent use of our marine resources.

Sidney D. Upham

Sidney D. Upham, Ph.D.
Director
Mississippi-Alabama Sea Grant Program

ACKNOWLEDGEMENTS

The Director of the Mississippi Sea Grant Program wishes to acknowledge the support of the Institutions comprising the Consortium.

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Mississippi State University

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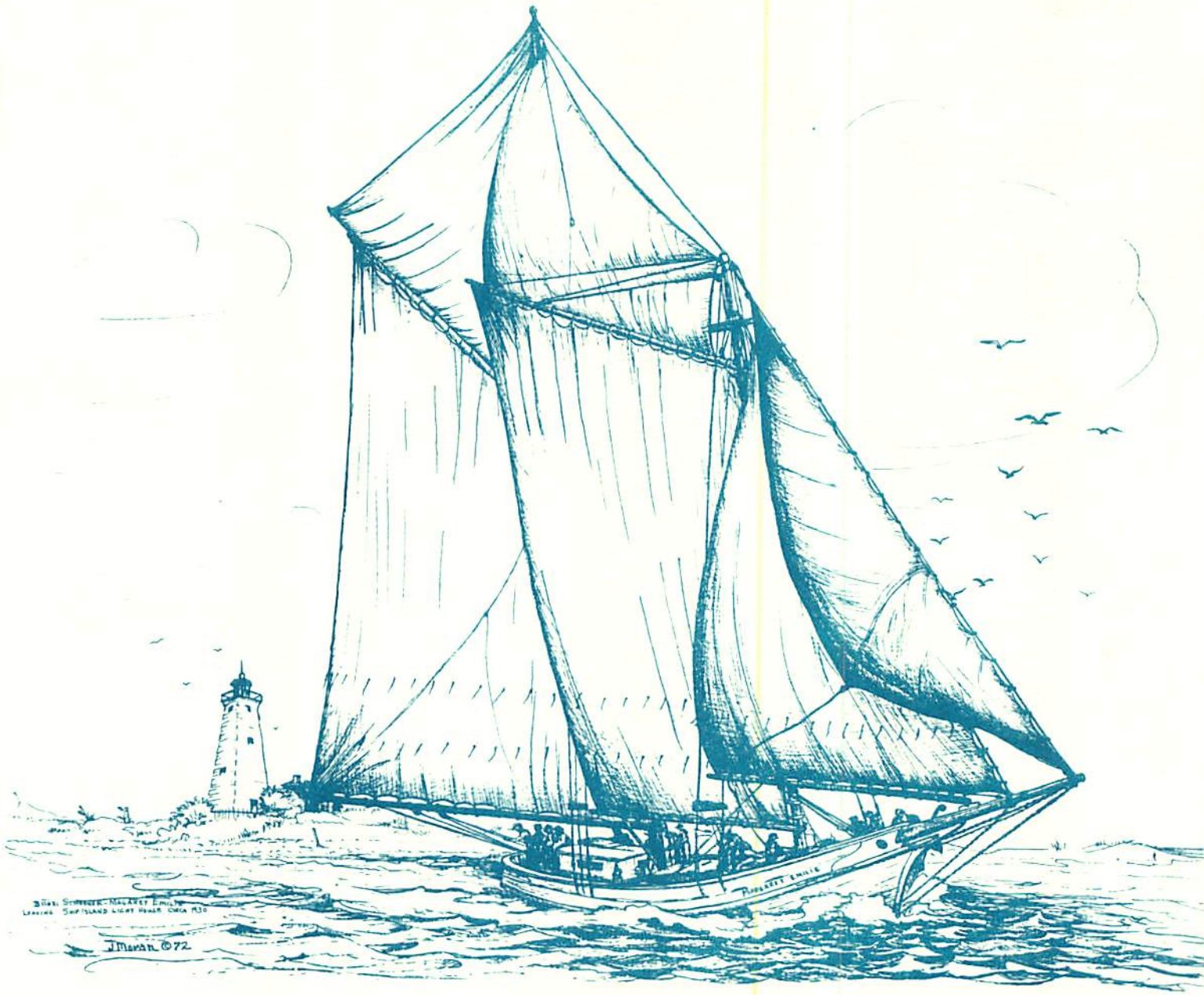
PROGRAM DIRECTION AND DEVELOPMENT



The hull of the Biloxi Schooner, **Margaret Emilie**, located at the rear of Joe Moran's Studio in Biloxi, is listed in the National Registry of American History, and is to be restored and maintained by the City of Biloxi as a monument to the history of boatbuilding and fishing. This original drawing of the **Margaret Emilie** by Joe Moran is presently under consideration by the United States Post Office to be used on a stamp to commemorate Biloxi's 275th anniversary, to be celebrated in 1974.

Project No: M/M-1
Title: Program Direction and Development
Principal Investigator: Sidney D. Upham, Director, Universities Marine Center

The Sea Grant Program for the State of Mississippi is directed and administered by the Consortium - the Universities Marine Center - an entity distinct from and independent of the administration of the four institutions comprising that Consortium: the Gulf Coast Research Laboratory, Mississippi State University, The University of Mississippi, and the University of Southern Mississippi. Drawing on the strengths of the four institutions for research involved in the projects, the Universities Marine Center provides guidance and assistance to all principal investigators, thereby maintaining a coordinated effort to achieve the goals of the program. Staff members have established working relationships with key personnel in the university system, state and local government, and industry.

The administrative responsibilities of the staff include preparation of reports, dissemination of information to those involved in the program, and general surveillance over all projects.

The original Program comprised four areas of investigation: Program Direction and Development, Marine Coastal Law, Pollution, and Fisheries Development. Growth and experience dictated the addition of three more areas - Engineering in the Ocean, Industrial/ Socio-Political Development, and Advisory Services - completing the seven-part program.

When the seven areas of applied research were defined, proposals submitted by the various biologists, chemists, political scientists, sociologists, economists, lawyers, and engineers were reviewed by the Director and selected for inclusion on the basis of viability, applicability, and potential. The total program was then presented to the Management Committee of the Consortium for approval or modification. The Program, as approved by the Management Committee, became the Mississippi Sea Grant Proposal. This Proposal, when approved by the Sea Grant Site Visit Team, became the Mississippi Sea Grant Program.

Title: Coastal Leaders Program
Principal Investigator: D. C. Williams, Jr., Director, Bureau of Business Research and Associate Professor of Economics, University of Southern Mississippi

Research in the fields of political science, sociology and economic development are of tremendous importance to the Mississippi Coastal Zone. This is the fastest growing region in Mississippi, not only for rate of economic growth but population growth as well. Its contribution to the economy of the State is greater than its proportionate share of the population. However, the rapid development is not the result of any balanced plan. Consequently, while the aggregate effect of recent growth has been positive, there are wide variations in economic and social impact among the municipalities and counties of the coastal region. Methods of attracting new industry and of improving industries already established cover such a wide range of areas of overlapping interests that it is vital that an overall program be established in sociology, political science, economics, and education which will aid in the development of the coastal region and at the same time protect the desirable natural environment.

Accordingly, a Committee on Industrial Socio-Political Development was formed, and with the assistance of faculty members of the Gulf Coast Research Laboratory, Mississippi

State University, the University of Mississippi, and the University of Southern Mississippi, has outlined a plan to accommodate the development of such a program in the area of behavioral sciences as applied to the Coastal Zone. From the exercise of this plan has emerged a major part of the continuing Sea Grant Program.

A four-phase plan for identification and prioritization of industrial and socio-political problems of the Gulf Coastal Region was developed and implemented.

Phase I. A leadership analysis conference of the Coastal Zone was held involving university personnel in the fields of business and economics, sociology, urban development, political science, and communications together with selected coastal leaders to identify the formal and informal opinion and policy leadership positions of the coastal counties. Coastal representatives participated in outlining research needed for the study area. This meeting served to establish rapport between the academic and coastal communities and to establish mutual trust. Coastal leaders were selected from a variety of sources to give the most comprehensive representation to the coastal region.

Phase II. A pilot investigation in the field was conducted in the form of a sequence of interviews with the leadership list developed in Phase I. These interviews were designed to determine patterns and influence of government institutions and the views and opinions of the leaders. Questionnaires were prepared in joint sessions by members of relevant disciplines with the assistance of local coastal leaders chosen from the areas of business, regional planning, port commissions, and local or county governments. The questionnaires were prepared in such a way that interview responses could be coded to produce a comprehensive problem list.

Phase III. Concurrent with the execution of Phase II there was a formal record investigation to compile and categorize previous research pertaining to the Coastal Zone. Documents held in libraries, archives, courthouses, and other repositories were included. A systematic and consistent means of examination of these documents was devised, and Phase III was completed with the publication in December of 1972 of the **Index of Publications Relative to the Mississippi Gulf Coast.** This publication has been distributed to coastal leaders, academic personnel, and libraries.

Phase IV. A coastal leaders conference was held April, 1973, with more than one hundred leaders in attendance. The report prepared in Phase II was used as a basis for assigning priorities to the various problem areas. These areas were defined as Pollution, Tourism and Recreation, Transportation, Industrial Development, and Education. Coastal leaders and academic personnel were asked to select problem areas of interest, and citizens task forces were formed to further define problems and to establish methods for resolving them. Finally, and most important, this project has combined the specialized expertise of academicians from relevant disciplines in all four institutions with the knowledge and cognizance of local coastal leadership in the first systematic and definitive Mississippi Gulf Coast profile and problem listing. From the identification and prioritization of these problems has emerged a continuing Sea Grant Program.

Mississippi-Alabama Sea Grant Program

The most innovative and significant single accomplishment of Program Direction and Development was the institution of the first two-state Sea Grant Program in history when the States of Mississippi and Alabama joined forces to develop and conserve their common marine resources.

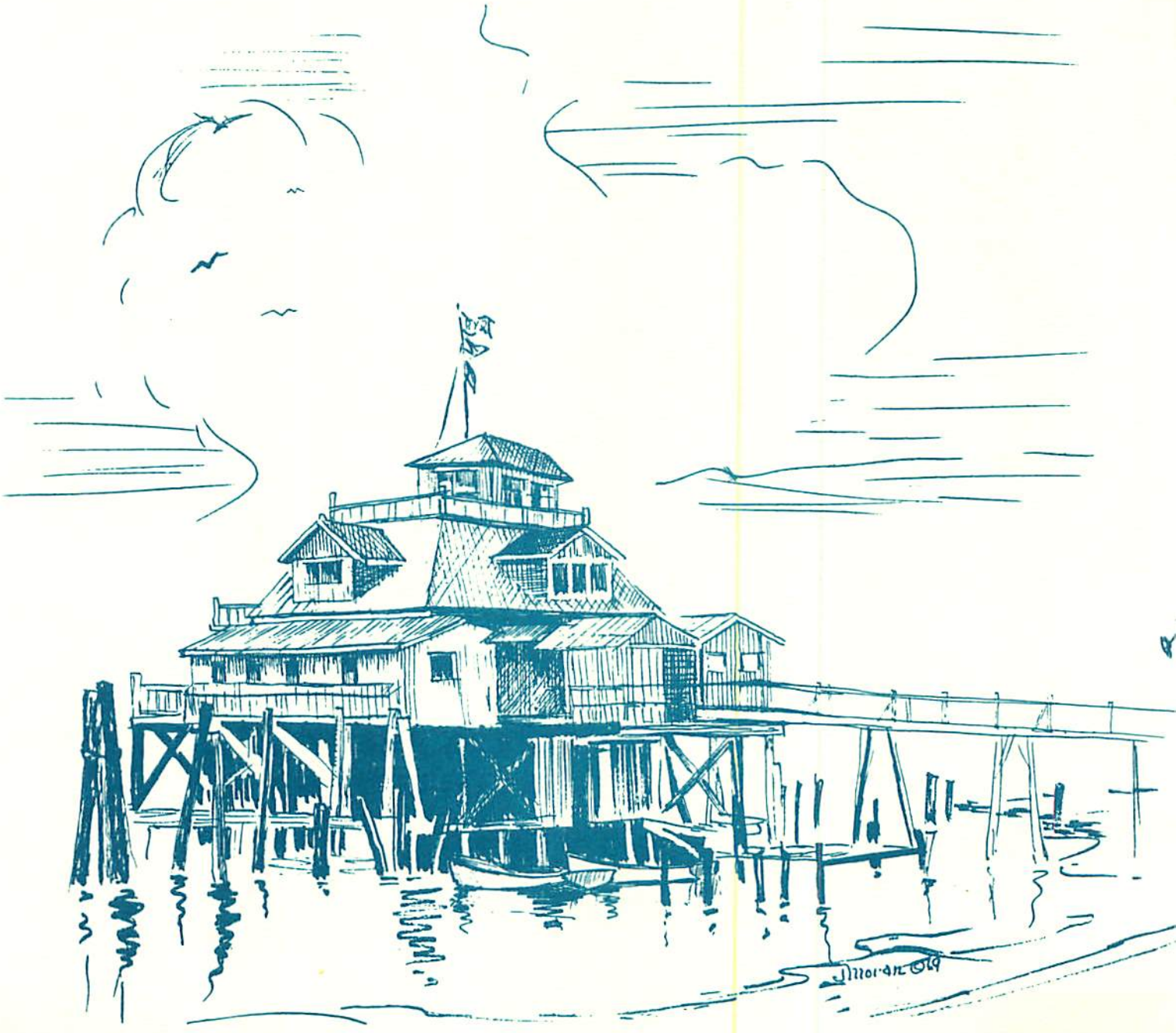
Dr. Sidney D. Upham, Director of the Mississippi Sea Grant Program, and author of the

two-state concept, recognized the superiority of a cooperative and regional approach to the solution of mutual problems and the conservation of common marine resources. The union of the two States has focused the concerted efforts of all their major universities on problems of the marine environment.

This historic "first" in the field of Sea Grant activity has been highly praised by President Nixon, the Governors of the two States, and many others from the academic community and governmental agencies.

By an act of the Management Committee of the Consortium, the name of the Universities Marine Center was changed to the Mississippi-Alabama Sea Grant Consortium early in 1973.

MARINE COASTAL LAW



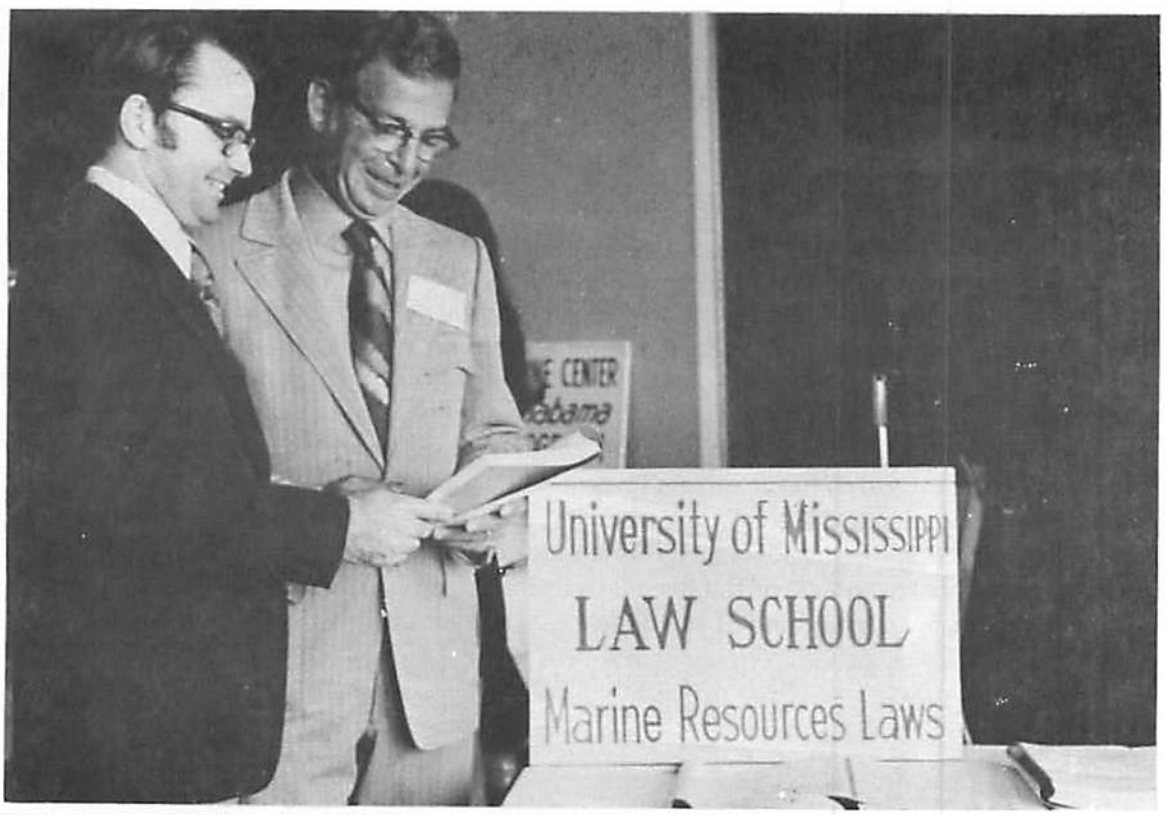
Project No: R/P (1)-1

Title: Legal Problems of the Gulf Coastal Region

Principal Investigator: Frank L. Maraist, Professor of Law, School of Law, University of Mississippi; Stephen Gorove, Professor of Law and Director of the Graduate Program, School of Law, University of Mississippi

Legal problems arise out of and vary with the activities of men as they pursue their economic and personal goals. Thus, as would be expected, one finds many legal problems in the coastal zone which are peculiar to it. As in many coastal states, the Legislature of the State of Mississippi is comprised chiefly of legislators from inland areas. Of eighty-two counties, Mississippi has but three which are bordered by the sea. It is only in recent years that state governments, generally, have become very noticeably aware of the peculiar importance of the sea to the people and the economy. As yet there is no sizable body of statutory state law dealing with the special problems of the sea and coast.

Legal problems of the Gulf Coastal Region is a research project that was started in June of 1971. The purpose of this study is to first complete the collection of constitutional, statutory, and regulatory provisions, together with annotations of the appropriate decisions by the courts, and the organization and classification of this body of laws into a usable form for the benefit of industry, government, and science. Having made such compilation and having so arranged and classified it as to make it more intelligible, it is proposed to examine this body of laws to determine its adequacy from the economic and administrative points of view. Finally, its purpose is to discover the conflicts and other deficiencies in this body of laws and recommend appropriate changes.



State Representative Gerald Blessey and Dr. Sidney D. Upham review the newly published volumes of Mississippi Coastal Law.

The first phase of this work, the collecting of the constitutional, statutory and regulatory provisions and judicial decisions has been completed and put into usable form. This body of laws has been published in seven general categories:

1. Property laws
2. Laws relating to living resources
3. Laws relating to mineral resources
4. Laws relating to recreational activities
5. Laws relating to environmental control
6. Laws relating to navigation
7. Laws relating to administrative organization

This collection was accomplished through the use of conventional legal research media (Indices, catalogs, encyclopedias, digests, codes or regulations, etc.).

The second phase of this work which involved interdisciplinary analysis of this body of laws by appropriate scientists, economists, administrators and political scientists, is in progress at this time. This analysis will determine the adequacy of the body of laws from a scientific, economic, and administrative point of view. This analysis will be followed after some appropriate interval by a meeting of the consultants in each field to hear the individual reports, comments, and recommendations. A series of meetings will be held involving the interaction of the several consultants, and it is anticipated that a consensus as to criteria of adequacy will develop in each field.

The third phase of this work is the systematic and full description of the legal framework in terms of its scientific, economic, and administrative adequacy. This proposed study will be used to develop a body of literature affording a comprehensive view of coastal and marine problems related to the coastal zone. It is hoped, also, that the skills developed in pursuing this methodology would provide a technique for the solution of other problems crossing disciplinary lines.

While the compilation of laws is the most impressive tangible accomplishment of this program, there are other less visible effects which are of significance, and should be noted here. One of these is the maintenance at the School of Law at the University of Mississippi, of a "data bank" of laws affecting the marine and coastal zone, cross indexed and maintained in such a manner as to allow the legal arm of the Sea Grant Program to provide meaningful research on a day to day basis. In addition, the legal branch of the Sea Grant Program has cooperated with various state agencies, officers and subdivisions in the evaluation of pending legislation affecting the marine and coastal zone. A third important effect results from the manner in which research has been conducted. Much of this research has been performed by outstanding second and third year law students. Many of these students now have graduated, and have entered state and local government and the practice of law in Mississippi, bringing with them a keen awareness of the peculiar value of the state's marine and coastal zone, and a knowledge and understanding of the basic legal problems of the marine and coastal zone.

Project No: E/D (2)-1
Title: Law of the Coastal Zone
Principal Investigator: Frank L. Maraist and Stephen Gorove.

The School of Law at the University of Mississippi has long seen the need for both legal and scientific research in problems of the coastal zone. Professors having special interest in this area have attended each session of the Law of the Sea Institute at Kingston, Rhode Island, as well as conferences on marine and coastal zone problems in Miami, Florida, and Charleston, South Carolina.

An informal survey was made to determine the need for legal studies in the coastal area. As a result of this survey, a new course in Marine Law was developed, approved by the University Academic Council, and added to the curriculum.

The new course, called the Law of the Coastal Zone, has been taught continuously since its inception in 1971 and has received gratifying acceptance by the students.

The Law of the Coastal Zone covers the following areas:

I. Law of Littoral Titles
   - A. Historical Development of Ownership of Oceans and Tidelands
   - B. Present Ownership of Tidelands
   - C. Accretion, Reliction, and Reclamation of Tidelands

II. Mississippi State Agencies in Coastal Areas
   - A. Rights of Littoral Owners

III. Jurisdictional Conflicts in Coastal Areas (Federal, State, and Local Agencies)

IV. State-Federal Boundaries

V. Coastal Zone Auhorities

VI. Pollution

VII. Aquaculture

VIII. Disaster Insurance in Coastal Areas.

Project No: E/D (2)-2
Title: Master of Marine Law and Science
Principal Investigator: Frank L. Maraist and Stephen Gorove.

It became readily apparent to the faculty of the School of Law at the University of Mississippi that some problems of marine law cannot be fully understood without the participation of other disciplines. Research needs and goals of other disciplines must be understood, and to this end it is felt that experts in the physical sciences must be utilized. Legal institutions must be developed which have sufficient flexibility to permit them to respond to facts developed by research. This end cannot be realized without some notion of the kind of research contemplated and the probable physical consequences to the marine environment and the economy of the area.

In an effort to derive the greatest benefit from the combination of law and the hard sciences, the curriculum for the program leading to the advanced degree of Master of Marine Law and Science has been approved by the faculty of the University of Mississippi School of Law, the Graduate Council, and the Academic Council of the University.

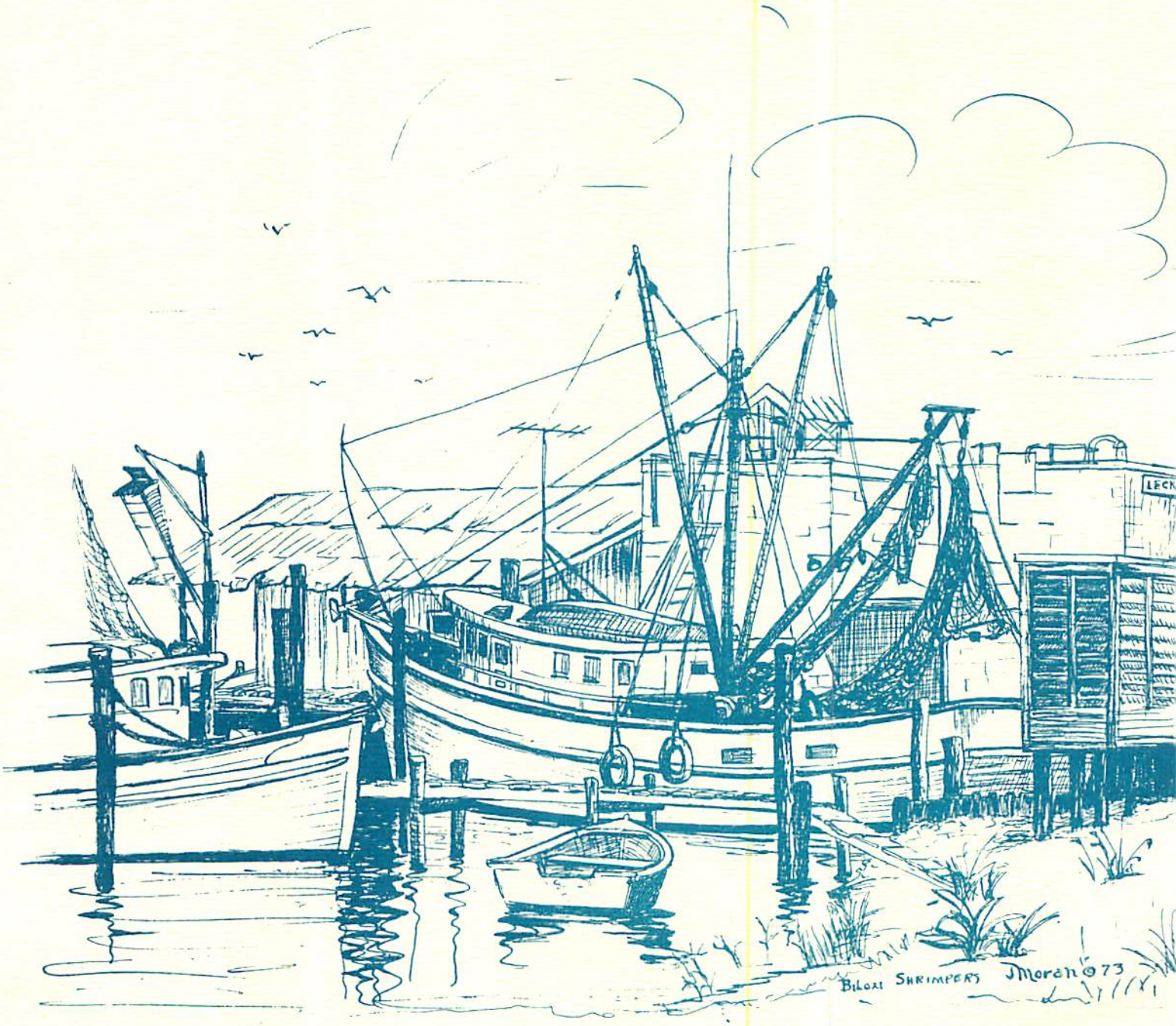
A typical curriculum for the interdisciplinary program leading to the advanced degree of Master of Marine Law and Science is:

SUBJECT	SEMESTER HOURS
LAW	
Law of the Coastal Zone	3
Admiralty	3
Ocean Law	3
Legal Control of the Marine Environment	3
Total	12
BIOLOGY	
Fishery Biology, including Fishery Management	3
Marine Fisheries Biology	4
Marine Botany	4
Marine Invertebrate Zoology	6
Marine Invertebrate Zoology and Ichthyology	6
Total	23
GEOLOGY	
Physical Marine Geology	3
Coastal Plain Geology (Gulf Coastal Geology)	3
Chemical Marine Geology (Waters of the Mississippi Sound)	3
Earth Resources, including Ocean Resources	3
Total	12

Thesis - in any area, approved by director, concerned with marine law and science.

Candidates are required to complete a minimum of twelve (12) hours and a maximum of fifteen (15) hours of graduate courses in law from among a variety offered, and a minimum of nine (9) and a maximum of twelve (12) hours of graduate courses in specified fields of science.

POLLUTION: PREDICTION



Project No: R/S (4)

Title: The Prediction of Ecological Alterations Caused by Pollutants

Principal Investigator: Lewis R. Brown, Professor, Department of Microbiology, and Assistant Dean of The College of Arts and Sciences, Mississippi State University

INTRODUCTION

Leaders from the Mississippi Gulf Coast have expressed the opinion that pollution is the major problem confronting the coastal area. Periodic closing of oyster reefs has become necessary due to high coliform counts, and pollution has caused sections of the coast to be declared off limits to personnel from Keesler Air Force Base in Biloxi. Both the seafood and tourist industries are vital to the economy of the area, but increased urbanization and industrialization are jeopardizing these important sources of revenue. While the exploitation of offshore petroleum deposits is attractive from an economic point of view, it may further contribute to the pollution problem. Solid waste pollution and air pollution must be considered, but water pollution problems are by far the most important. The solution to the overall problem requires (1) stopping existing pollution, (2) preventing future pollution, and (3) reclaiming areas already heavily polluted. Not only must new and better ways of treating existing sources of pollution be found, but methods must be developed to predict pollution problems prior to their onset. While current technology is capable of removing most of the harmful substances from wastewaters, very little is known concerning the chronic effects of low-level pollutants in the environment. For technology to be useful, research must be conducted under the conditions that exist in the threatened ecosystems. This research is vital, for the science of environmental reclamation is in its infancy.

Since an estuarine ecosystem depends upon organic detritus from the wetlands as a major source of nutrients, destruction of these areas through industrialization and urbanization could spell disaster for those industries dependent upon healthy and productive estuaries. It makes little difference whether an estuarine ecosystem is destroyed by pollution or dies of starvation.

OBJECTIVES

The ultimate objectives of this research project were to formulate a model for predicting the dissemination of pollutants in the receiving waters and to predict the changes that could be expected to occur because of these substances. Once this information was available, pollution control agencies would have the information required to make decisions in terms of tolerable levels of various pollutants in specific areas. In addition, this information will aid in determining the kind and amount of treatment required for new industrial facilities, and the location of such facilities, to insure that irreparable damage is not incurred by the estuarine area.

Specifically, the objectives of this project are (1) to establish "baseline" ecological conditions in the area involved, (2) to determine the effects of various pollutants individually and collectively on the biota of the area, (3) to construct the mathematical models necessary for predicting the dissemination of materials in the area, and (4) to establish "pilot plant ecosystems" for testing the mathematical models and the effects of pollutants on simulated ecologies. The following is a brief description of the research proposed to achieve these objectives.

Establishment of "Baseline" Conditions:

To arrive at meaningful data, it was imperative to initiate surveys of selected estuarine environments to determine not only the numbers and kinds of organisms present but also to establish some of the more important food chains in these environments. Obviously, populations change from season to season and from year to year as a result of environmental conditions beyond the control of the investigators. Thus, it was essential that studies be conducted over a period of several years. Chemical and physical parameters in the areas under survey were to be measured concurrently, and the work coordinated so that the data could be correlated. The establishment of the food chains would require studies of the feeding habits of the more important species in the environment.

Pilot Ecosystems:

Essentially, all tests to determine the toxicity and effects of pollution were conducted in the laboratory employing unicultures. While this is an excellent screening procedure, no account is taken of the interactions of various members of the ecosystem, nor can the changes that are caused by environmental factors be adequately regulated in the laboratory. The "livebox" arrangement for *in situ* tasks is now used in some instances, but there is an urgent need for better methods of extrapolating the laboratory data into the natural environment. Based upon the information derived from the baseline surveys and studies of the food chain, attempts were to have been made to simulate the estuarine population in ponds. While it was not anticipated that a complete simulation of the ecology of the estuaries could be achieved, it was (and is) believed that a partial reconstruction of the overall ecology can be obtained and maintained. If successful, these pilot plant ecosystems were to have been employed to check the accuracy of pollution dissemination data as well as to assess the accuracy of the effects of pollutants on the ecosystems.

Numerical Simulation of Pollutants Dissemination:

Most of the methods employed in predicting the dissemination of pollutants in water have been of empirical nature and have relied upon numerous experimental programs to provide sufficient insight into the nature of the interactions of the various factors. Through the use of high speed digital computers it has become possible to simulate flows involving mass, momentum, and energy transfer in such a way that the total interaction of the various phenomena can be simulated, and the effects of various interactions can be assessed utilizing the computer model.

Pollution Effects Determinations:

The initial investigations on this phase of the program were conducted in the laboratory to assess the acute effects of various pollutants as well as to develop methods for determining chronic effects of various substances. Problems of biological magnification and eutrophication came under scrutiny in these projects. It is realized that laboratory studies without concurrent field studies fail to yield a complete picture of the biological effects of pollution; therefore, it was anticipated that a considerable interaction would exist between the component research projects in this phase of the investigation with those occurring in the baseline studies.

It may well be that the sub-lethal effects of various pollutants are much more meaningful to the overall ecological system than are the acute effects themselves. For example, even though the total biomass of a given species of organisms is produced in the presence of a given pollutant, the size of the organisms themselves may be of vital importance. Also, it has been found that inhibition of specific enzyme systems can be utilized as a monitor of pollu-

tion that has taken place, and chromosomal analyses of selected species may give indications of sub-lethal doses of a given pollutant. Since most of the organic pollutants will be degraded either biologically or through the action of environmental factors, the role of the degradation products on the overall ecology must be assessed. It has been shown that in some instances the degradation products are more detrimental to certain species within an ecosystem than were the original materials themselves.

Alteration of food chains could be used as an early warning system for pollutants; therefore, establishment of complete food chains of selected species in an unpolluted area is fundamental. For example, species diversity of the indigenous microflora of an area is determined by many things, including different pollutants. As resistant organisms proliferate in a polluted situation, all members of the food chains involved are in turn altered by availability or toxicity of their food supply. Additionally, the entire food chains must be established in order to determine the effects of biological magnification of materials toxic to higher members of the food chain and, ultimately, man.

Obviously, the first phase of the program was directed toward establishing the baseline conditions of a typical estuarine environment. The Bay of St. Louis, Mississippi, was selected as the area for study since it typifies the estuarine environment found along the northern shore of the Gulf Coast. The area immediately surrounding this bay is underdeveloped industrially, and both the Jourdan and Wolf Rivers, which discharge into the bay, flow primarily through unpopulated areas and subsequently would not be expected to contribute significant amounts of man-made pollutants.

PROGRAM COORDINATION

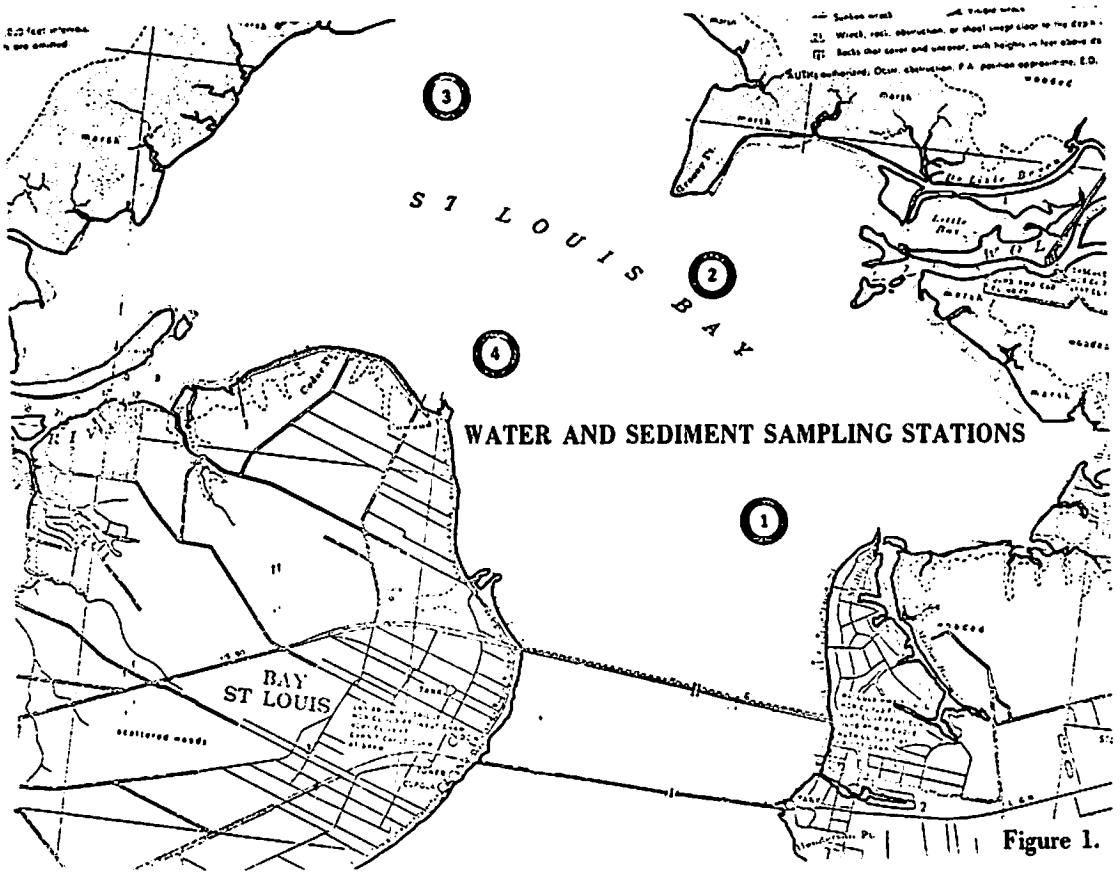
With the exception of the geological investigation, representatives from each program unit herein described were present for the routine monthly sampling trips. All arrangements for these trips were made by Mr. William J. Demoran of the Gulf Coast Research Laboratory. Water samples and sediment samples were collected from each of the four sampling stations, as shown in Figure 1. Additionally, oysters were obtained by dredge and fish trawl. Additional sampling expeditions have been made by individual project leaders as needed for their respective projects.

Detailed analysis of data derived from this investigation is the objective of a separate investigation.

REMOTE SENSING INVESTIGATION

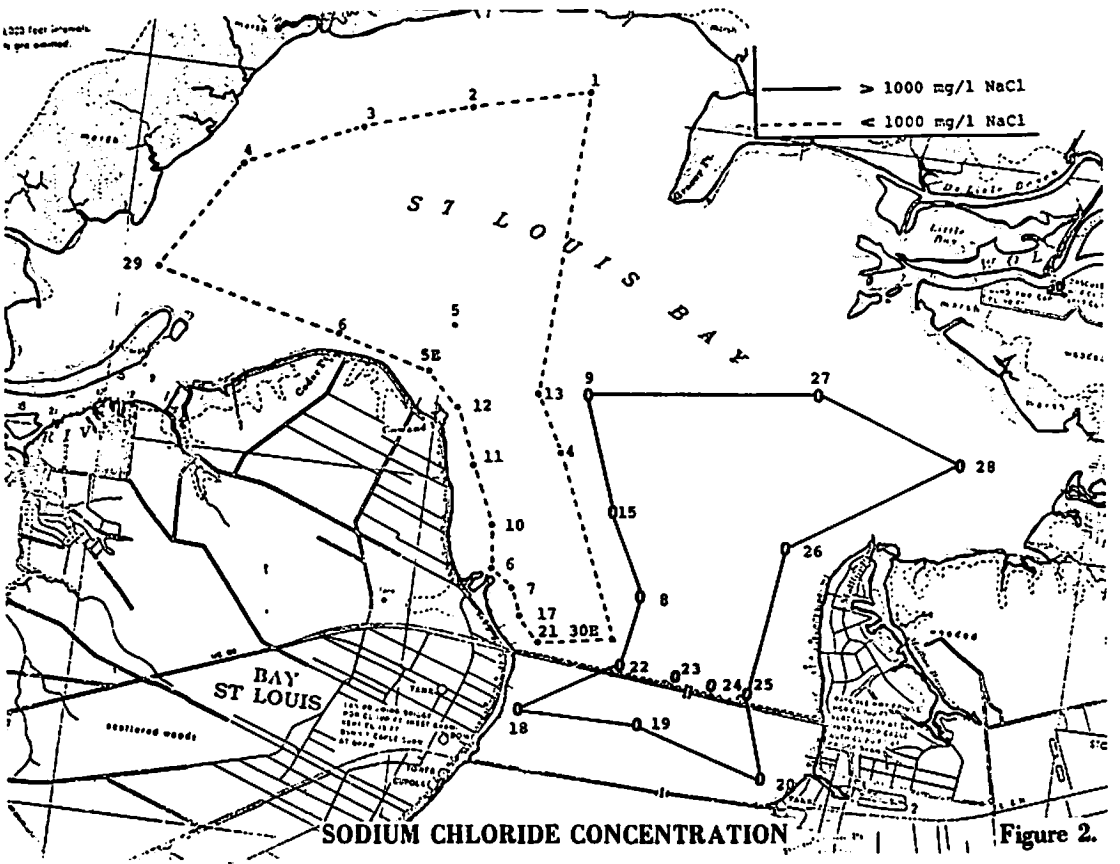
After the initiation of this project, the NASA Earth Resources Laboratory (ERL) situated at the Mississippi Test Facility began a remote sensing program on the Mississippi Sound. The ERL study includes not only remote sensing data but also a number of surface measurements which are used as ground truth. Only two of the approximately 100 ground truth stations for this program are situated in the Bay of St. Louis, and it was felt that by coordinating some of our sampling times to coincide with the remote sensing program a significant new dimension could be added to the project. Consequently, in the "flyover" carried out in April, 1972, approximately 35 samples of the surface water were obtained from the Bay of St. Louis by members of the Sea Grant Program. The following tests were conducted on the water samples: conductivity, color, turbidity, phosphate, sulfate, coliform, primary productivity, metabolic activity, and temperature. All of the remote sensing data has not yet been made available; consequently, correlation with the ground truth data collected by the Sea Grant team has not been made at the present time. Even so, several rather interesting anomalies have been found in the ground truth data alone (see Figures 2, 3, 4, and 5). The infrared imagery of the Bay of St. Louis correlated well with the sodium chloride and turbidity data but poorly for that of the oxygen and sulfate.

Aerial view of the Bay of St. Louis



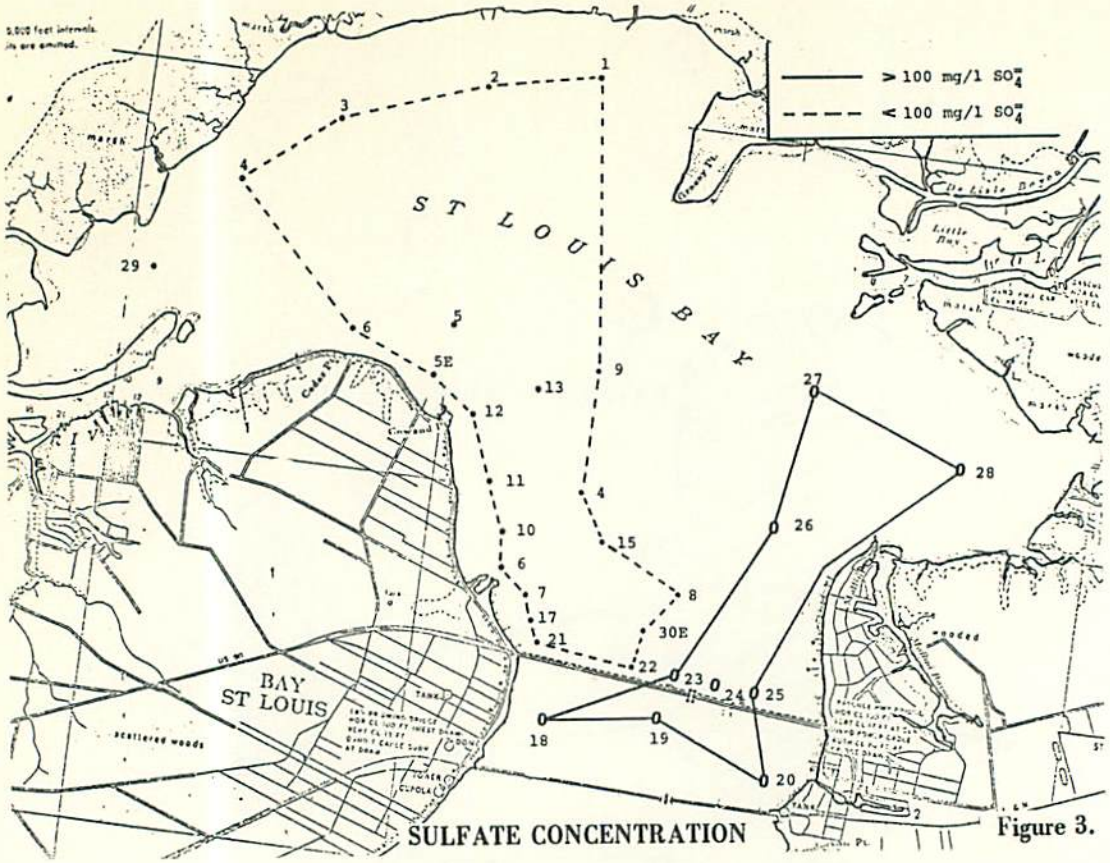
WATER AND SEDIMENT SAMPLING STATIONS

Figure 1.

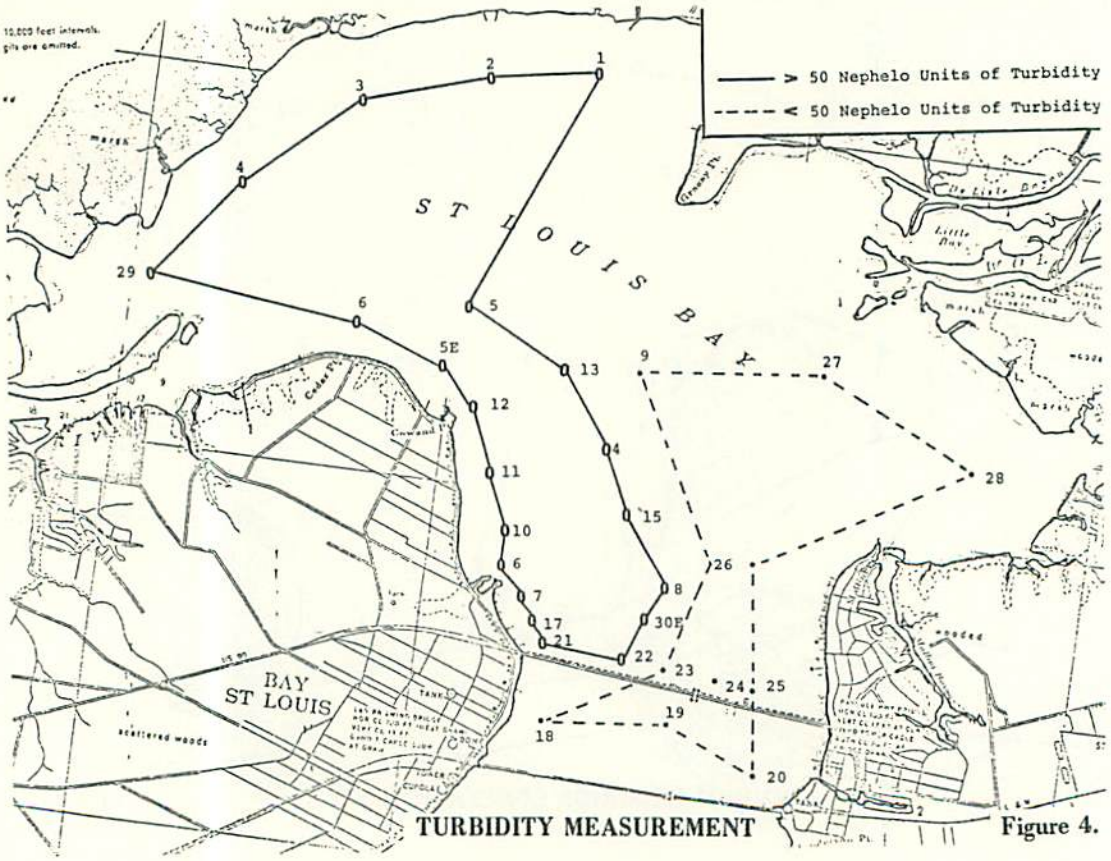


SODIUM CHLORIDE CONCENTRATION

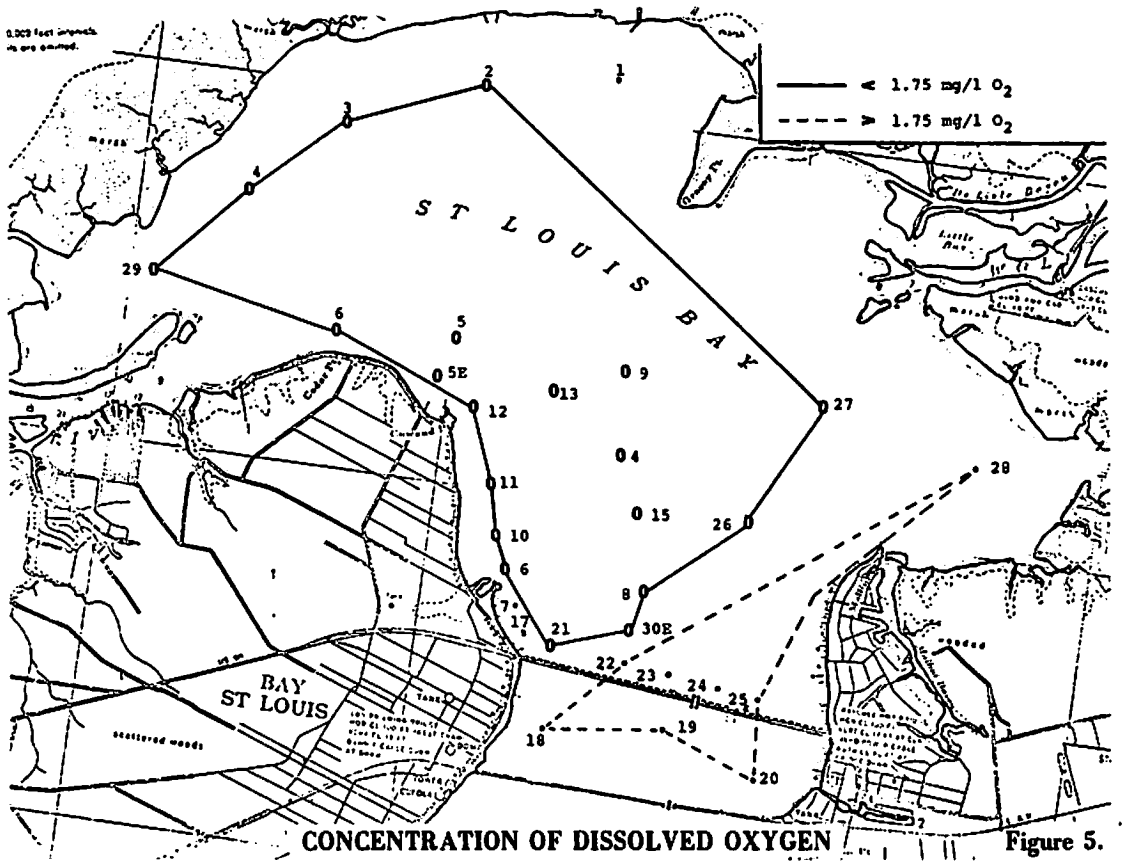
Figure 2.



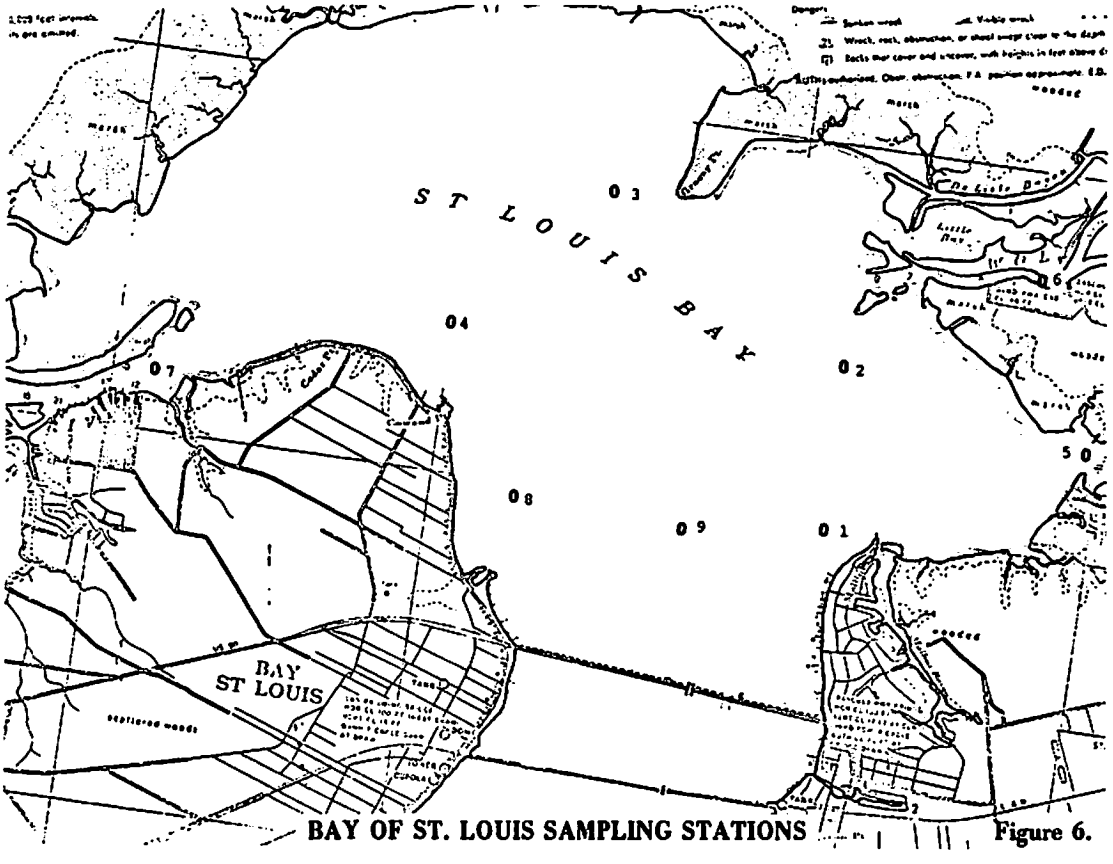
SULFATE CONCENTRATION Figure 3.



TURBIDITY MEASUREMENT Figure 4.



CONCENTRATION OF DISSOLVED OXYGEN Figure 5.



BAY OF ST. LOUIS SAMPLING STATIONS Figure 6.

Project No: R/S (4)-2

Title: A Study of Organic Detritus in a Salt Marsh-Estuary in Mississippi

Principal Investigator: Armando A. de la Cruz, Associate Professor,
Department of Zoology, Mississippi State University

INTRODUCTION AND OBJECTIVES

The salt marsh is one of the most productive ecosystems in the world. It is basically a detritus system in that the major portion (90%) of the net primary production in the form of plant biomass dies, falls to the ground, fragments, decomposes, and becomes suspended as detritus in the estuarine and neighboring marine waters. Detritus enters the food chain and forms the basis of secondary production in the coastal waters and sea.

This study dealt primarily with factors affecting the nature and composition of the marsh plant detritus entering the food chain of fish and marine invertebrates.

Specifically, the objectives of this investigation were:

1) To study the composition, production, and transport of marsh plant detritus.

2) To determine the nutritional value of detritus and to evaluate its utilization by marsh, estaurine, and marine fauna.

This investigation was carried out in the Bay of St. Louis marsh-estuary, Hancock County, Mississippi, during the period June 1, 1971 to February 28, 1973.

SUMMARY OF RESULTS:

A total of 30 species of marsh plants (primary source of detritus) were identified. The most dominant plants were the needlerush *Juncus roemerianus*, giant cordgrass *Spartina cynosuroides*, bulrush *Scirpus americanus*, and the spike grass *Distichlis spicata*. The standing stock of marsh plant biomass was about 1200 g dry wt m^{-2}, and the net annual primary production of the marsh plants was 990-1100 g dry wt m^{-2}.

The annual decomposition of dead plant materials was about 40% for *Juncus*, 30% for *Spartina*, 35% for *Distichlis*, and 60% for *Scirpus*. These decomposition values represent the rates (in percent of the original material) at which dead plant parts were converted to particulate detritus after one year. Particulate organic detritus becomes suspended in water and is flushed out of the marsh by tide waters. About 3.5 tons per hectare of marsh plant detritus are exported to the estuary per year. There are 2,300 hectares of marsh in St. Louis Bay Estuary which means a total of 8,050 tons of organic detritus transported out of the Gulf of Mexico.

Ash-free dry weight (combustible organic matter) and caloric content of marsh plants and their detritus ranged 90-95% and 4.5-4.7 Kcal/ash-free g, respectfully. Proximate nutritive value analysis of marsh plants and their detritus ranged 39-59% carbohydrates, 3-11% protein and 1-3% fats.

Organic detritus is a major source of food in the estuarine and marine environments. About 10 species of fish and 20 species of invertebrates have been shown to be detritivores.

The significance of these detritivores is that they form the base of the food chain in the marsh-estuarine-marine ecosystems.

Detritus producing marsh plants

Project No: R/S (4)-3

Title: Detritus Feeding in Selected Fishes of St. Louis Bay

Principal Investigator: Glenn H. Clemmer, Assistant Professor,
Department of Zoology, Mississippi State University

During this study period, monthly seining collections were made during both day and night for a total of 54 collections. Approximately 75 species of fishes were collected. *Fundulus similis*, the longnose killifish, was found to be represented in most collections and is one of the few permanent residents in the bay area.

An analysis of foods and feeding of the killifish was made to determine quantitative and qualitative compositions of the food by month, season, and in a 24-hour cycle. Stomach contents were taken from 318 specimens of all available size groups.

Major categories of food organisms were analyzed as to their percentage volumes and percent frequency. Major items were:

1. Crustacea
2. Insecta
3. Annelida
4. Sand

The majority of the food organisms of *F. similis* use detritus as a food source. Odum (1970) described *Palaemonetes* as omnivorous, feeding on benthic and planktonic copepods, amphipods, benthic diatoms, fungi, bacteria, protozoans, and vascular plant detritus. Mysids and ostracods are described as omnivorous scavengers using plant detritus (Gosner, 1971).

Thus, the longnose killifish, as an abundant forage fish, serves as an intermediate step between detritus-algae consumers and top carnivores.

Project No: R/S (4)-4

Title: A Survey of the Plankton and Benthic Microorganisms in the Bay of St. Louis

Principal Investigator: George F. Pessoney, III, Associate Professor and Chairman, Department of Biology, University of Southern Mississippi
Billy J. Grantham, Assistant Professor, Department of Biology, University of Southern Mississippi

The Bay of St. Louis is a shallow estuarine area with two major fresh water sources. These are the Wolf River entering from the northeast and the Jourdan River entering from the northwest. The greater drainage area is the Wolf River system, which drains a sparsely populated area of the Longleaf Pine Belt in the coastal plain. The only other fresh water source that empties directly in the Bay is Bayou Portage, which enters on the eastern border and represents a small drainage area.

The volume of fresh water entering the Bay is frequently of sufficient magnitude to produce very low salinities. This information was gained from water samples obtained at the sample stations depicted in Figure 1. Surface salinities varied from a low of 0.1 parts per thousand (PPT) to a high of 21.3 PPT. Salinities were less than 10 PPT at all stations on three of the sampling dates and all were less than 1.0 PPT during February.

Dissolved oxygen values were always well within the range of those found in areas not subjected to gross pollution.

Data on plankton collections in this survey are from settled total plankton samples and are therefore predominately restricted to phytoplankton forms. Plankton samples were also obtained at the sampling stations depicted on Figure 1. Thirty-two samples from eight collection trips have been analyzed. The sampling procedure was to collect a two liter total water sample at each station. Preservatives were added immediately after collection and the samples returned to the laboratory. These samples were placed in 1000 ml graduated cylinders, allowed to settle for 48 hours and the upper 950 ml were carefully removed. This was done with a siphon covered by a 200 mesh net to reduce the removal of planktonic forms. The remaining 50 ml along with 10-20 ml of rinse water was placed in bottles until counted. Counting was accomplished by conventional Sedgewick-Rafter counting cells and by use of a Wild microscope and a 20 X objective.

One hundred and sixty different taxa have been found in the above samples. These forms are in eleven major groups. The diatom order Pennales was the most diverse group with sixty-seven different forms followed by the order Centrales with fifty-one. Diatoms were the most abundant forms encountered. Others encountered were the groups Chlorophycophyta, Pyrrophycophyta, Cyanophycophyta, and six lesser groups.

If the total numbers of planktonic forms per sampling date are compared it is readily apparent that the plankton community is quite similar at all stations.

Total plankton levels dropped during the fall and early winter months with decreasing salinities. The lowest concentrations occurred in October and a slight increase was observed in samples collected in December. The samples collected one month later (January) revealed a significant increase for stations 1, 3, and 4. Although the concentration for station 2 increased over the December level it was considerably lower than the other three stations. The peak that occurred at stations 1, 3, and 4 in January was at a very low salinity with all surface readings less than 2.0 PPT. This increase was due to a pulse by *Nitzschia* and was dropping back to lower levels in February. Although this reduction occurred, the drop was

not to levels as low as those encountered during the fall low. The *Nitzschia* pulse occurred during periods of low salinities, and on the basis of the data analyzed at this point there is no explanation for it. The centric diatom *Chaetoceros* was present during the first three sampling dates and contributed heavily to the phytoplankton populations. Its occurrence during the winter months has been sporadic, although Pennate forms have been more abundant. This is presumably due in part to increased currents that stir up the bottom sediments bringing the larger Pennates toward the surface.

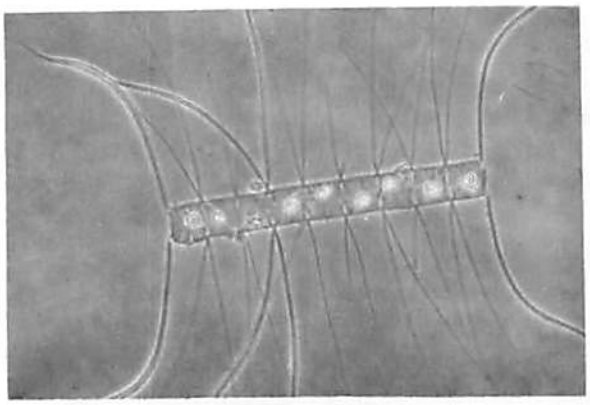
The seasonal parameters of decreased temperatures and reduced salinities no doubt interact to result in the reductions that have been observed. The effects of the influx of fresh water is evident upon analyzing the species of organisms, in that several forms characteristically inhabit fresh water.

Net plankton samples also have been obtained on all collection dates. These samples were primarily for zooplankton determinations. The net samples are necessary so that larger volumes of water may be sampled to collect suitable numbers of the sparse population of zooplankton forms.

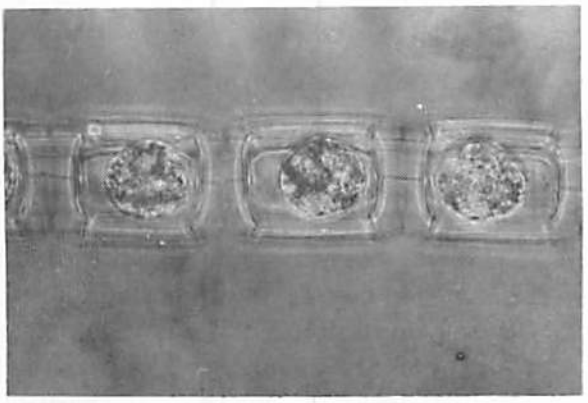
All copepods were identified by dissection and photographic record was made. The copepods that have been identified are *Acartia tonsa, Acartia discaudata, Temora turbinata, Labidocera aestiva* and a species from the genus *Tegastes. Acartia* is the most abundant and is found year round at all four stations. *Temora* is also found year round but becomes very sparse in December, January, February, and decreases most extensively during March. *Tegastes* appears in small numbers from September to March and has not been collected during the other months. *Tegastes* is a benthic copepod, and this may be the reason that it is found in such small numbers. *Labidocera* was found in December of 1971 and again in May and July of 1972. The average total number of organisms per liter per month ranged from 1.10 to 151.34 and the total number of organisms per liter per station ranged from 0.9 to 218.03.

The preparation of permanent microscopic and photographic slides will lead to a very meaningful publication on brackish water forms of the Mississippi Coast.

DIATOMS ENCOUNTERED IN THE SAMPLES

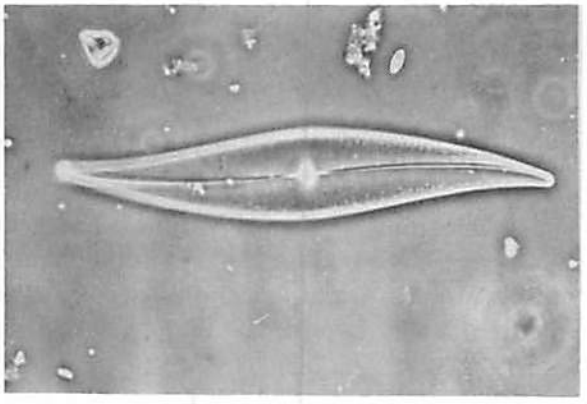


Chaetoceros affinis

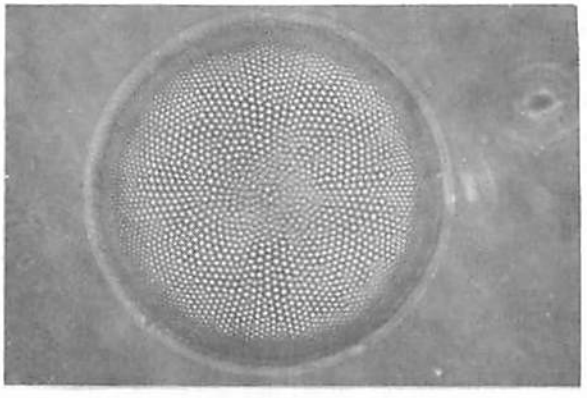


Lithodesmium

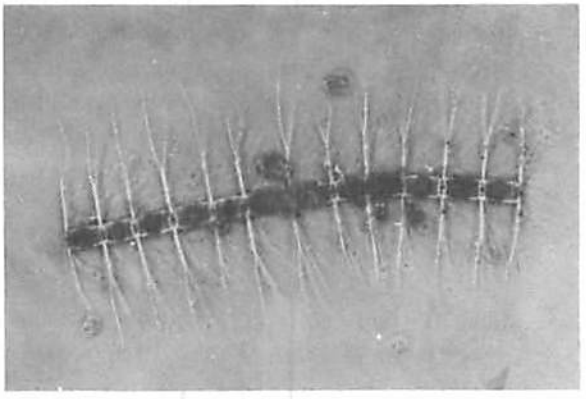
Lithodesmium (valve view)



Pleurosigma



Coscinodiscus



Bactasterium

Project No: R/S (4)-5

Title: A Study of the Benthonic Organisms in the Bay of St. Louis

Principal Investigator: Arthur G. Fish, Associate Professor,
Department of Biology, University of Southern Mississippi

The benthonic survey of the Bay of St. Louis, Mississippi was divided into two facets which were conducted separately: The Benthonic Environment Exclusive of the Interstitial Environment, and the Interstitial Organism Survey.

The Benthonic Environment Exclusive of the Interstitial Environment

In addition to the four stations that were established prior to the initiation of this survey, six additional stations were designated, Figure 6. The additional stations were felt to be necessary to completely sample the Bay and its various environments. The data compiled by Hoskins of the Geology Department of the University of Southern Mississippi were used to select stations which reflected bottom composition more closely than the four stations selected originally. These six stations can be divided into two dredging stations, two sifting stations and two scraping stations where samples were collected by the stated means.

In addition to the monthly collections, additional collections were made bringing the total number of collection trips in the first six months to seventeen. The additional trips were made in the belief that monthly trips were inadequate to sample the Bay. The additional trips included all stations and increased sampling from a monthly to a two-week basis. Inclement weather, however, prevented some trips from taking place on a two-week basis.

Of the samples collected all those obtained by oyster dredge and by trawl have been sorted and the organisms identified. Those collected by Peterson dredge, however, are as yet incomplete. Identification is proceeding slowly, particularly with regards to the annelid worms, since taxonomic keys are old and inadequate for this region.

Data on temperature distribution, salinity, and oxygen solubility have been collected simultaneously with the biological collections for all stations.

Interstitial Organisms Survey

The interstitial organisms survey has not progressed as rapidly as the benthonic survey for a variety of reasons: the time required to isolate the organisms, their extremely small size, and the number of samples to be sorted.

In general, the variety of organisms is disappointing. No arthropods have been found, contrary to the case of the Sound proper. Only nematode worms and forams have been isolated. Their numbers vary and there may be some correlation with station and degree of pollution at stations. The very unstable bottom may also prove to be a limiting factor in that organisms which are capable of living under the degree of pollution to be found at our stations will not appear there because of turbidity.

Summary

The data gathered so far indicates that the Bay of St. Louis has an impoverished interstitial fauna consisting primarily of nematodes and formanifera. The number of species of these forms is small. The arthropod fauna is practically non-existant and with the exception of a few clams no other animal representatives have been found. The poor fauna composition may be due to the unstable bottom which according to Hoskins, contains more than 50% water in the sediment. At each disturbance of the shallow water of the Bay, the bottom

is resuspended and eventually settles out again only to be disturbed again by the next wind sequence. During the summer the winds shift to the southeast and blow daily, which probably suspends much of the sediment. This constant disturbance could easily make the environment very inhospitable for the majority of organisms.

Project No: R/S (4)-6 and R/S (4)-7

Title: The Microflora of the Bay of St. Louis and Its Relationship to the Food Web

Principal Investigator: Lewis R. Brown, Professor, Department of Microbiology, and Assistant Dean of the College of Arts and Sciences, Mississippi State University

Lyman A. Magee, Chairman of the Department of Biology, Professor of Microbiology, University of Mississippi

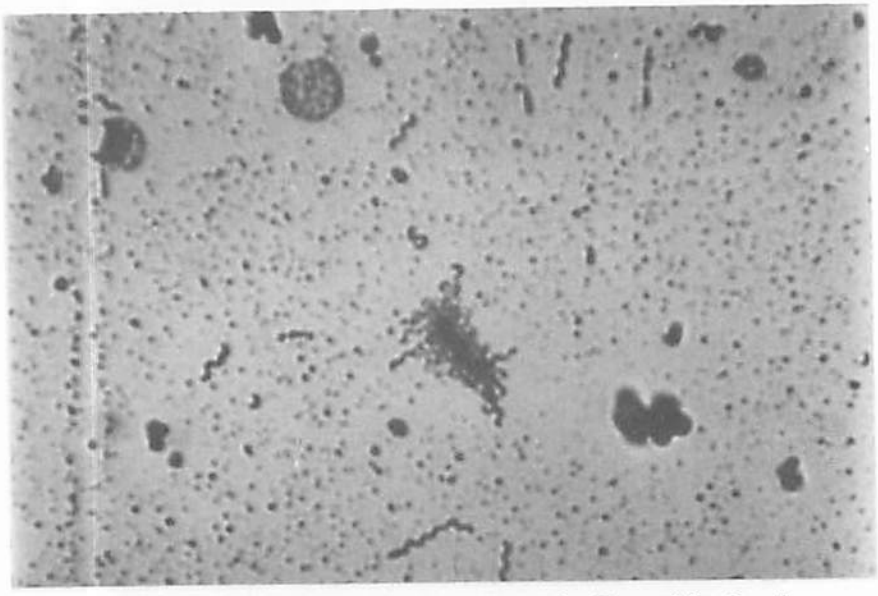
David W. Cook, Head, Microbiology Section, Gulf Coast Research Laboratory

Pollution Indicator Organisms David W. Cook

The number of coliform, fecal coliform and enterococci bacteria present in the waters and sediments of St. Louis Bay were monitored on a regular basis as an indicator of fecal pollution. Sampling was conducted at four stations from which surface water, bottom water, and sediment samples were collected and at five additional stations where only surface water samples were collected. (See Figure 6.) All water samples were collected on a bi-weekly basis and sediment samples on a monthly basis. Temperature, salinity, pH, and turbidity measurements were made on all water samples.

The results obtained to date indicate:

1. Enterococci are a poor indicator for fecal pollution in these waters because of the poor correlation with the other indicator bacteria.
2. The numbers of coliform and fecal coliform bacteria at all stations increase greatly with a decrease in salinity of the water.
3. The coliform and fecal coliform population within the sediment vary directly with the population in the overlying waters.



Bacillus sp. found in sediments from the Bay of St. Louis

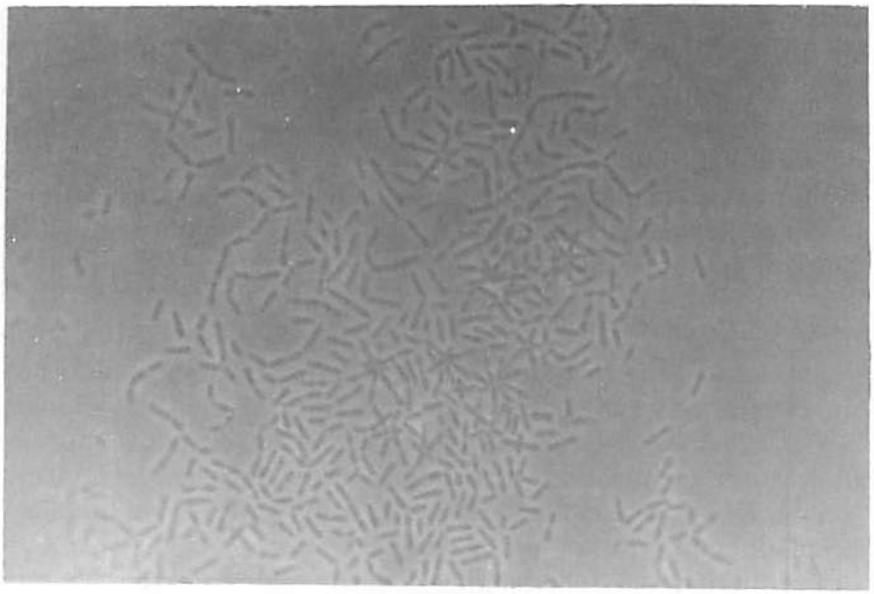
Mineralizing Bacteria David W. Cook

One measure of the mineralizing capabilities of a bacterial population is the total number of heterotrophic bacteria present. Total heterotrophic bacteria counts were made

on all water and sediment samples. Taxonomic studies were made to determine the predominant bacterial types found in the sediments.

Microorganisms capable of transforming various compounds in the nitrogen cycle, carbon cycle and sulfur cycle were enumerated in all sediment samples. Satisfactory techniques were developed for all groups of organisms within these cycles except the nitrogen fixing bacteria and the photosynthetic sulfur bacteria.

The total bacterial population within the sediment is quite large, averaging in excess of 1,000,000 bacteria per gram. Representatives of the following physiological groups have been found in all sediment samples: ammonifiers, nitrifers, denitrifers, sulfate reducers, sulfur oxidizers, organic sulfur reducers, lipolytic, cellulytic, chitinoclastic, and proteolytic.



Bacteria from estuarine waters

Preliminary Survey of Certain Microbiological Organisms in the Bay of St. Louis

Lyman A. Magee

Viruses

Monthly samples were examined for the presence of bacteriophages for *Escherichia coli, Enterobacter aerogenes, Salmonella schottmuelleri,* and *Shigella alkalescens.* In addition, ten bacterial species isolated from the marine environment were used as test hosts for viruses. Samples were also tested for the presence of anaerobic bacteria and streptomycetes. The samples used were surface and bottom water, bottom sediment, and the gut of fish and oysters.

No bacteriophages pathogenic for the marine bacteria were found. No viruses pathogenic for *S. schottmuelleri* or *S. alkalescens* were found. Bacteriophages for *E. aerogenes* were detected in surface water samples from Stations 1, 2, 3, and 4 (Figure 1) in December and January, but not in other samples. Phages for *E. coli,* were found frequently in surface water samples and in the fish gut in one case.

Quantitative measurement of *E. coli* viruses was done on surface water samples in December and January. The highest number of viruses (2400/100ml) was found at Station 1 in January.

Bacterial viruses that use selected intestinal bacteria as hosts were studied with the aim of gaining some knowledge of the distribution and persistence of viruses in marine waters. There was widespread distribution of bacteriophages for *Escherichia coli* but only rarely were viruses specific for *Enterobacter aerogenes* found. There was marked seasonal fluctuation in the prevalence of the viruses, with the greatest numbers occurring during winter months and the least during late summer and early autumn. This fluctuation could have been due to variations of fecal pollution, prolonged survival of the host bacteria during the colder months, or prolonged survival of the viruses themselves during the colder months.

Anaerobic Bacteria Lyman A. Magee

Anaerobic bacteria in the Bay were studied because some of them are important in biochemical conversions of wastes and because some of them are of importance in food-borne diseases.

Isolation and laboratory culturing of strict anaerobes is quite difficult and often unsuccessful since atmospheric oxygen quickly kills them. As was expected, the shallow waters of the Bay yielded very few anaerobes; sediment and animal gut samples yielded the greatest number. Culturing difficulties made it impossible to do quantitative determinations of the anaerobes in the various samples. Of the isolates identified, the great majority were in the spore-forming genus *Clostridium*. A number of *Bacteroides* were isolated, and *Fusobacterium* was isolated on two occasions and *Viellonella* on one occasion.

Higher Bacteria *(Achtinomycetales)* Lyman A. Magee

The fungus-like bacteria in the order Actinomycetales were studied because of their abundance in the soil and consequently the possibility of their use as indicators of soil contamination and because they are of importance in the degradation of organic matter. No attempt was made to quantitate the actinomycetes since accurate quantitation would have been very difficult in samples such as fish gut. Instead, an attempt was made to identify as many different types as possible in each sample.

Eight different types were found during all of the studies and they all were in the genus *Streptomyces*. Only one of these grew well on salt-water media, indicating that most of the isolates were soil or freshwater organisms. The persistence of *Streptomyces* in saline waters has not been determined, but the surprisingly low numbers of these found in these samplings suggests that they may not have a long survival time in saltwater.

Pesticide Resistant Microorganisms Lewis R. Brown

This phase of the investigation was concerned mainly with: (1) the concentrations and certain colonial characteristics of the microbes occurring in the water and sediment samples, and (2) the effects of selected pesticides on microbial numbers and on representative pure culture isolates.

Information was derived from three tests – plate counts, replica plates, and filter disc assays.

The plate counts were conducted to furnish information on the concentration of microbes in the samples and to allow tabulation of certain arbitrarily chosen colonial characteristics (size and pigmentation) of the microbes as the result of growth on the medium.

Replica plate results provided data on the relative inhibition effects among five test compounds and between the individual test compounds and the parent nutrient agar. A difference in colony counts between or among replicated plates containing different test substances was the criterion used to measure inhibition effects.

The test compounds were mirex, DDT, parathion, DSMA (disodium methyl arsenate) or Panogen 15.

The filter disc assay technique was the final step in the analysis of the samples in this particular phase of the investigation. The filter disc assays provided an assessment of the inhibitory effects of selected compounds on representative pure culture isolates obtained from the replica plates. The test compounds were mirex and DDT (Chlorinated hydrocarbons), DSMA (an arsenical compound), parathion and malathion (organophosphates), PMA, Panogen 15, Panogen PX and Ceresan L (mercurial compounds), and water and acetone (solvent controls). The effects of the test compounds were characterized by the degree of inhibition of growth of the pure culture isolates around the discs containing the individual test compounds.

From a qualitative viewpoint some trends in the data could be detected. For example, the total count at a given station tended to fluctuate both in numbers and in predominant colony types with respect to time. Also, as a whole, top water samples exhibited the lowest counts, followed by bottom water samples and sediment samples, the latter exhibiting the highest counts. Generally, pigment-producing microbes were present in surface and bottom water samples but absent in sediment samples.

Replica plate data and subsequent filter disc assays demonstrated that certain microbes were resistant to the test compounds except for the mercurial compounds. At the concentration tested these compounds were highly inhibitory to microbes present in the samples. Further, the replica plate data revealed that the test compounds could influence pigmentation but no definite trends have been established.

Though some trends could be detected, considerable variation in the data limited the number of such trends which could be quantitated. However, the observed variations in data may correlate well with certain chemical changes, current flow, rainfall, turbulence, etc. Further, use of statistical analyses may point out significant trends from the data *per se* and with respect to a given parameter or combined parameters. Such statistical analysis is currently underway.

Hydrocarbon-utilizing microorganisms Lewis R. Brown

Previous investigations have indicated that the enumeration of the hydrocarbon-utilizing nitrate-reducing bacteria and the hydrocarbon-utilizing sulfate-reducing bacteria may be useful in determining low levels of pollution from petroleum. Samples from the Bay of St. Louis, which is virtually devoid of pollution from petroleum products, and samples from areas subjected to chronic oil pollution have been analyzed. No conclusions can be made at this time due to a lack of data.

Marsh Grass Microflora Lewis R. Brown

Because of the importance of marsh grass in the estuarine ecosystem, studies have been initiated to determine the kinds of organisms responsible for degradation of the marsh grass. Attempts to make quantitative estimates of the number of organisms capable of degrading marsh grass in the various samples have proved largely unsuccessful. Considerable effort has been devoted to developing a quantitative method for estimating marsh grass decomposing microorganisms.

Up to the present time, a total of 10 cultures have been obtained which will grow in fresh marsh grass mineral-salts medium. Identification of these cultures has not been completed.

Project No: R/S (4)-8

Title: An Ecological, Distributional, and Taxonomic Survey of the Fishes of the Bay of St. Louis Drainage Area

Principal Investigator: J. William Cliburn, Professor of Biology, University of Southern Mississippi

Sampling was begun in the Bay of St. Louis in August, 1971, using trawls, and has continued roughly on a monthly basis, utilizing the four stations set up for investigation by the total Sea Grant Project. See Figure 1. Other collections have been made in the St. Louis Bay drainages using rotenone (in areas where the use of seines is not practical or possible).

A summary of fish species collected at each station on specified dates has been recorded along with salinities and temperatures. A seasonal fluctuation in total numbers of fish for each station has been found, and is in fair agreement with the expected. However, unusually low total numbers were observed on December 7, 1971, and on February 18, 1972, and cannot be explained in terms of observed physical conditions of salinity and temperature. It may be noted that surface temperature was indeed lowest on these two dates for each station, although the difference between December 7 and January 11 is hardly significant. It is doubtful that temperature offers an explanation for the low catches.

Salinity is a more variable environmental characteristic in the Bay than is temperature, due primarily to the influx of fresh water following rains. No correlation is seen between salinity and the total numbers of fish collected at each station. In the final analysis, salinity may be an important factor which determines the dominant species composition of the fauna. Three species – *Anchoa mitchlli, Micropogon undulatus,* and *Leiostomus xanthurus* – are commonly taken in the Bay at all conditions of temperature and salinity and during all parts of the year. These are certainly the dominant species occurring in the Bay.

Cynoscion arcnarius, Archosarqus probatocephalus, and *Brevoortia patronus* also are commonly collected, but in much smaller numbers. Thirty other species were collected more or less sporadically in the Bay of St. Louis during the collections now reported, and may be considered as stragglers which occasionally enter the area. Of these, *Arias felis* and *Bairdiella chrysura* are somewhat distinctive as they were quite numerous during September and October at some stations, and became uncommon only during the colder months. Their occurrence seems to be related to temperature, while no particular relationship can be seen for other species not mentioned above. Of the casual stragglers in the Bay, all are fishes of saline waters with the exception of *Lepisosteus osseus,* of which two were collected in October and ten in February. While this fish is considered a fresh water species, it is commonly associated with brackish or saline waters and its occurrence is not unexpected.

Intensive collections have been made in the drainages of the Wolf and Jourdan Rivers. Because of the nature of these streams, work in the upper parts of the basin was done with minnow seines and dip nets. Collections were made in larger parts of the streams near their mouths with rotenone, as well as with minnow seines and dip nets.

Species collected in the Jourdan and Wolf Rivers in both fresh and tidewater have been recorded as to numbers, dates, temperatures, and salinity.

Project No: R/S (4)-9
Title: Liver Enzymes as Pollution Indicators
Principal Investigator: John P. Hickenbottom, Assistant Professor,
Department of Pharmacology, University of Mississippi

This project was based upon earlier findings in rats and other mammals which indicated that certain liver enzymes are markedly affected by carbon tetrachloride and other chlorinated hydrocarbons. Accordingly, livers were collected from marine catfish and croakers, along with whole oysters; all samples were quick-frozen between slabs of dry ice at the site of collection in an attempt to minimize the rapid changes in enzyme activity which are known to occur in mammals during periods of anoxia or epinephrine release. In a further attempt to minimize such changes, all fish were anesthetized with ethyl m-aminobenzoate metanesulfonate prior to excision of the livers.

For determination of baseline values for the parameters of interest, fish samples were taken at each of the four sampling stations - see Figure 1 - in the Bay of St. Louis in September, 1971, and March and June, 1972. Oyster samples were obtained from an established reef in the same bay in July, 1971, and March, 1972. The following is a summary of the assays:

Glycogen phosphorylase: The activity in oysters is much lower than that normally found in mammalian tissues, while that in catfish liver and in croaker liver is much higher. All three species, however, show tremendous variability between samples, indicating that even the precautions that were taken were insufficient to prevent the rapid changes in enzyme activity which are observed in mammalian species under adverse conditions.

Glucose-6-phosphatase: This enzyme gave results very similar to those seen with glycogen phosphorylase. That is, oysters had low activity while that in catfish and croaker liver was high, but the variability in all three species was unreasonably high.

ATP: The ATP content in all three species was markedly lower than that seen in mammalian liver. The content was lowest in oyster, intermediate in croakers, and highest in catfish; the values in the three species differed significantly from each other and from that reported for rat liver. Variability was no problem with this metabolite.

Glucose: Marked variability in the values seen with oyster, but less so with the other two species.

Glycogen: This metabolite showed the greatest variability of any parameter yet measured, to the extent that the assays probably are worthless.

Glucose-6-phosphate: There was little variability within a given species for this metabolite, although the value for oysters was significantly lower than for catfish and croaker liver. All three species gave values markedly lower than have been reported for mammals.

On the whole, the greatest variability was seen in the parameters which, it had been hoped, would be the most useful for detecting the effects of chlorinated hydrocarbons. The activity of glycogen synthetase, the fourth parameter which had been included with glycogen, glycogen phosphorylase, and glucose-6-phosphatase, has not yet been assayed. It appears that data collected in the field is of questionable quality, and that such baseline information will have to be obtained under controlled laboratory conditions.

Project No: R/S (4)-10

Title: The Chemical Definition of an Ecosystem, The Bay of St. Louis

Principal Investigator: Charles R. Brent, Professor of Chemistry
University of Southern Mississippi

INTRODUCTION

This report is concerned with an investigation that was part of a larger interdisciplinary study which dealt with the establishment of ecological baseline conditions within St. Louis Bay.

The determination of chemical variables was central to the definition of an ecosystem. Reliable precise data on the chemical composition of water samples was needed to establish a baseline against which ecological change and the effects of chemical pollution could be detected. Coupled with the simultaneous biological sampling, a cause and effect relationship between chemical parameters and biological processes should be evident.

The chemical parameters with which this investigation should be concerned were evident through a review of general estuarine chemistry and the geography of the region. The methods of analyses were, for the most part, well established.

GENERAL CHEMISTRY OF ESTUARINE SYSTEMS

The chemistry of a typical estuary is complicated by the fact that the two interfaces of particular interest, the surface and the bottom, lie in such close proximity to one another. Because of this and because of rapid, radical changes in the chemical and physical parameters due to localized effects of wind, waves, and tides, estuaries are little understood in terms of the kinds and magnitudes of chemical reactions which can occur at:

(1) the water-atmosphere boundary,
(2) the water-biosphere boundary, and
(3) the water-sediment boundary

Whereas, with ocean water, many of the concentrations of the major inorganic elements may be predicted (with some degree of accuracy) based upon some other chemical parameter such as chlorinity, this is not the case for the estuary. Since the estuary is subject to fresh-water inputs and effects of local weather and tides, relative concentrations of ionic and molecular species in the water system are seldom what one could call constant, from estuary to estuary, or even within a given estuary. Local rainfall contributions to streams and rivers feeding the estuary affect more than the dilution of ionic species; under the proper conditions, rainfall and the subsequent rise in stages of rivers feeding an estuary can produce changes in flow and mixing patterns within the estuary, which can drastically change chemical concentrations at any given sampling point.

As with ocean waters, the chemical composition of estuaries may be conveniently expressed in terms of:

(a) dissolved inorganic species
(b) dissolved gases
(c) dissolved organic matter, and
(d) particulate species in suspension

In general, major inorganic elements found in estuaries include chlorine, sodium, magnesium, sulfur (as $SO_4^{=}$), calcium and potassium. The "normal" ratios of these elements in estuaries are often altered from those found in ocean water; however, dilution of estuaries by river water alters ratios of sulfate, chloride, calcium, and magnesium since river waters, in general, contain more sulfate than chloride and more calcium than magnesium.

In addition to major inorganics, there are minor and trace elements, many of which are of more direct biological importance than major elements. Among these are bromine, carbon, strontium, boron, silicon, and fluorine. The trace elements include phosphours (as phosphates), iodine as iodate and iodide, iron, zinc, copper, and molybdenum. For trace elements, concentrations may vary significantly as a function of location, time of day, season, and biological activity. For all these inorganic species, it is important to note that interaction between estuary waters and the sediments at the bottom interface constitutes an important key to estuary chemistry.

Dissolved gases, particularly oxygen and carbon dioxide, constitute a second class of chemical species which must be considered in any discussion of estuary chemistry. In surface waters, of which estuaries mostly consist, primary sources of oxygen are atmospheric oxygen and plants. Photosynthetic activity is closely related to production of oxygen. On the other hand, respiration activity leads to utilization of dissolved oxygen and results in production of carbon dioxide. Carbon dioxide buffers estuarine systems via the carbonate-bicarbonate equilibrium as well as by reaction with certain metal ions. In general, at constant pH, CO_2 is a function of salinity and temperature, increasing with salinity and decreasing with temperature. The relationship between pH and carbon dioxide content is more complex, however, and is not at all well understood at this time.

Concentrations of both gases in estuarine waters are variable and are related closely to temperature, and, in the case of CO_2, to the pH. In addition to oxygen and carbon dioxide, hydrogen sulfide is also present at or just below the water-bottom interface, resulting in anaerobic conditions.

Dissolved organic material is normally present in sea water in concentrations ranging from 0 to 6 mg/liter. For estuaries, however, particularly in cases in which productivity is high, concentrations of organic carbon may be much higher. Other components of dissolved organics (which may be found as nitrate and phosphate) are nitrogen and phosphorus. Organics dissolved in estuarine waters include carbohydrates, proteins, amino acids, organic acids, and various vitamins.

Particulate matter comprises the last class of chemical species found in estuaries. This class includes organic detritus, absorbed material on detritus, complexed metal species, and suspended minerals. Of particular importance are the metals which are associated with particulate organics and the part which they play in the estuarine ecosystem. It is quite possible that seasonal variations in essential trace metals in estuarine waters are a function of absorption processes which result from an abundance (or lack) of particulate organics.

Field Methods and Laboratory Analyses

A. **Field Methods**

1. **Sampling Sites and Frequency.**

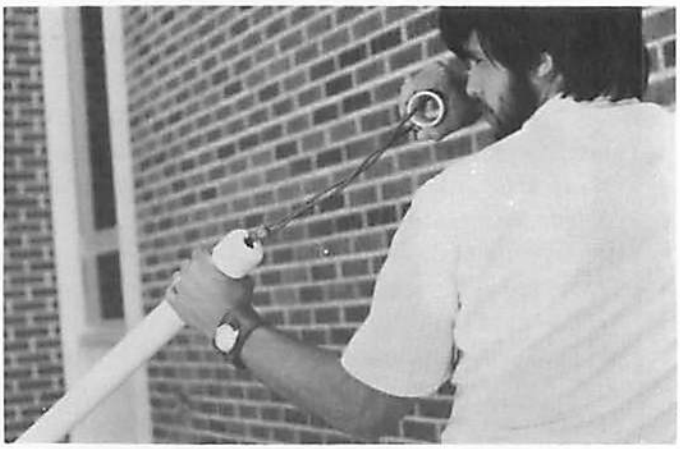
   Four preselected sites for sampling within the bay were visited on an average of one time per month. Boat transportation and site identification were provided by the Gulf Coast Research Laboratory.

2. **Sampling.**

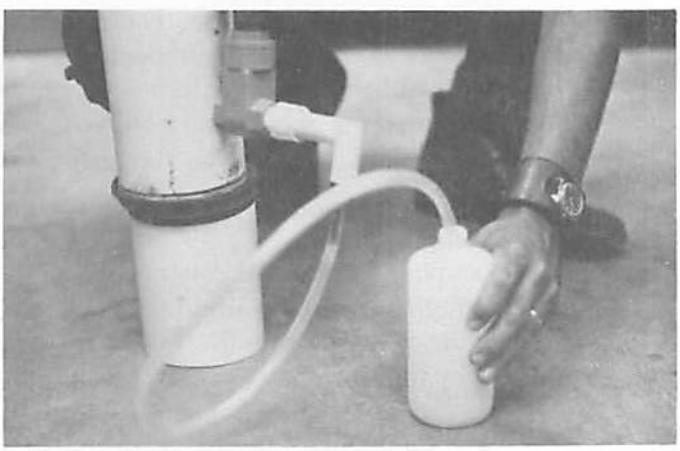
   The water column sampler used in this project was especially designed and built for the St. Louis Bay excursion (see figure 7). The sampler, constructed almost entirely of polyvinyl chloride and rubber, withdraws enough water in one operation to provide surface, middle, and bottom samples for analysis; the sampler was shown to maintain stratification of the bay water. Obvious stratification of the bay water with depth was observed at certain sampling points by comparing the data on: temperature, salinity, pH, Eh, BOD, TOC, Cl^-, Br^-, I^-, and $SO_4^=$.

Figure 7.

The Shallow Bay Water Sampler



Seating and Locking Stopper in bottom of Sampler



Withdrawing Samples

Temperature. The temperature ranged from a high of 29.5°C in July and August, 1971, to a low of 12.5°C in February, 1972. Vertical gradients in temperature usually ranged from 0 to 2° warmer on the surface than at the bottom, with the most pronounced gradient on sunny days, and when wave action was minimal.

Salinity. The salinity within the bay showed a wide seasonal variation of 22.5 0/00 in February; the "freshness" was related to the rainy season. Salinity in almost all cases increased with depth. The most pronounced gradients were seen during the rainy season. The most level results occurred during periods of extremely high and extremely low salinity when wind and wave action was heavy.

pH. The pH ranged from a high of 8.16 in July when salinity was high to a low of 6.16 in February when salinity approached zero.

Eh. The Eh consistently displayed a gradient with depth at specific locations, but seasonal variations and variations from station to station have not yet yielded to correlation.

Dissolved Oxygen. Dissolved oxygen showed seasonal variations ranging from 5.7 mg/l in September to a high of 10.0 mg/l in January. The variations are, of course, controlled primarily by temperature and salinity. Dissolved oxygen gradients are extremely minor, probably because of the shallow depth of the bay.

Biochemical Oxygen Demand (BOD). The BOD ranges from .5 mg/l in February to 3.3 mg/l in September indicating that the bay has the highest load of organic waste in the month with the lowest rainfall. The mean value of about 1.5 mg/l is characteristic of a relatively clean body of water, compared to some systems which receive municipal wastes.

Total Organic Carbon, TOC. The total organic carbon ranges from 6 to 7 mg/l. The seasonal trend is for an increase in organic carbon during the cold, wet winter months. We are postulating that the rate of decomposition of organic matter is higher in the summer, and that the input into the bay is highest in the winter due to the heavy influx of runoff.

Inorganic Carbon. Inorganic carbon content of the bay reaches a high of 17 mg/l in October and decreases to 2 mg/l in January and February. It appears that pH, salinity, and possibly temperature are controlling the inorganic carbon levels.

Chloride, Bromide, Iodide, and Sulfate. The chloride, bromide, iodide and sulfate concentrations follow within experimental error, the same seasonal trends and stratification as the salinity.

Nitrites. The nitrite concentration ranged from 0 to 10 μg/l; most values were near the detection limits of the method used. I think that it would be safe to say there was essentially no nitrite ion present. The high dissolved oxygen content probably prevents the accumulation of NO_2^-.

Nitrates. Seasonal variations in nitrate ion concentration ranged from .01 mg/l, the lower detection limit, in the summer and fall to 0.75 mg/l in February. Runoff from rainfall and low temperatures may contribute to the accumulation of NO_3^- during the winter months.

Sulfide and Sulfite. Sulfide and sulfite concentrations were always below the detection limits 0.1 mg/l for $S^=$ and 0.05 mg/l for $SO_3^=$.

Phosphates. Phosphate levels measured by the stannous chloride reduction method were below the detection limit of .05 mg/l except in January when levels ranging from 0.14 to 0.26 mg/l $PO_4^{\equiv}$ were measured.

Nitrogen, total kjeldahl. Total ammonia and organic nitrogen showed no seasonal trends. There is some evidence for stratification during the warmer months; the highest levels are found near the bottom.

Magnesium and Calcium. The total divalent cation concentration reported as mg Ca^{++} per liter was measured with a divalent cation electrode. The precision of the measurement leaves something to be desired. Atomic absorption will be used on future samples if the calcium concentration is considered to be of significance.

Heavy Metals, Copper, Lead and Zinc. The heavy metals are present at extremely low microgram per liter levels, with lead being the least abundant, copper slightly higher and zinc the most abundant heavy metal of the three. Concentrations are generally below 5 μg/1 in bay water except for a few zinc determinations which were higher.

Summary and Conclusions

The chemical composition of the Bay of St. Louis is governed primarily by salinity changes resulting from winds and tides as well as from freshwater inputs from the Jourdan River and from the Wolf River. Gradients in salinity and in salinity governing variables have been observed and found to be a function of salinity itself. Periods of high salinity produce well-defined vertical gradients in concentrations of many anions. During these periods, winds and tides have little effect on the vertical gradients. Dilution effects from rainfall in the areas surrounding the Bay tend to reduce these gradients and, occasionally, even cause inversions. Generally, the Bay may be characterized by its low mean salinities and its sensitivity to influx of freshwater.

(1) A baseline has been established for the concentration levels of twenty-two chemical species in the Bay of St. Louis. Results of this study indicate that few, if any, chemical changes are occurring in the Bay due to the effects of nearby population centers, local industries, or run off into rivers which empty into the Bay. Original estimates of the chemical "purity" of the Bay have proved to be correct.

(2) The most important chemical parameters in the Bay are chlorinity and its major accompanying salinity related species. Low levels of nutrients found in the Bay are also significant, apparently limiting productivity, particularly during periods of low freshwater input.

(3) In terms of chemical considerations, particularly organic carbon levels, nutrient concentrations, and values for biochemical oxygen demand, the Bay of St. Louis does not appear to be as biologically productive as might be expected. Clear indications of biological activity have been observed as shown by nitrate and phosphate levels, particularly during periods of expected phytoplankton blooms, yet these levels are low compared to bays which might be considered "productive". Organic carbon values for the four standard stations in the Bay are low compared, for example, to Timbalier Bay, in Louisiana, where values of organic carbon near 20 mg/1 are not uncommon.

(4) Salinities vary from maxima of about 20 ppt to minima which approach freshwater conditions. The Bay has been found to be a "low salinity" bay, a fact which should be borne out by biological data. Indications of horizontal as well as of vertical gradients in salinity have emerged from month-to-month and mean data for the four stations sampled.

(5) The absence of the lower oxidation states of nitrogen and sulfur has been noted. Levels of sulfide, sulfite, and nitrite have never been observed to exceed the minimum limits of detection, even for bottom water samples. This is indicative of an oxidizing rather than a

reducing environment and is in good agreement with dissolved oxygen and Eh data. Anaerobic activity above and near the water sediment interface does not appear to be significant.

(6) The mean concentration levels of trace metal constituents in the Bay are not significantly higher than would be expected. Relative concentrations of zinc, copper and lead showed slightly higher levels for zinc than for copper, with levels of lead rarely exceeding the minimum detectable value of 0.2 ppb.

(7) The future chemical conditions in the Bay of St. Louis will depend largely upon industrial development in the area surrounding the Bay as well as upon increases in population centers in the Jourdan River area and on the northern shore of the Bay. Population shifts to the vicinity of the Bay and subsequent decisions regarding handling and disposal of sewage wastes resulting from this population will, in large measure, influence levels of organic carbon, levels of biochemical oxygen demand (and consequently dissolved oxygen), and nutrient concentrations. As a result, productivity patterns and the general chemistry of the Bay of St. Louis could conceivably be drastically altered.

Project No: R/S (4)-11

Title: Distribution and Significance of Copper, Zinc, and Lead in Oyster Reefs and Surrounding Sediment in the Bay of St. Louis

Principal Investigator: Bahngrell W. Brown, Professor of Geology, University of Southern Mississippi
Ervin G. Otvos, Head, Geology Section, Gulf Coast Research Laboratory

This study was intended to establish the "baseline" data of the sedimentology and sediment chemistry of the Bay of St. Louis and the Bay Entrance Oyster Reef. This data would serve as a comparison with future states of the Bay sediments, presumably more affected by pollution. The influence of the oyster reef on the surrounding sediments were also studied. In order to obtain Holocene bay sediments and to establish the geological framework of the Holocene in the Bay area, five core holes were drilled in the Bay and several near the shore.

Thirteen short cores were taken by a hand-held PVC coring instrument with an attached plastic liner. Nine samples were from the periphery of the Bay Entrance Oyster Reef and four more from scattered additional Bay locations. The core samples were 1 to 1½ ft. long and were subsequently segmented into three parts - top, middle, and bottom - for mechanical and chemical sediment analyses. The sandy nature of bottom sediments prevented coring in certain locations. Peterson dredge samples were obtained from the uppermost 10-14 cm of the sediment column. Field sampling took place in the autumn of 1971. Laboratory analyses proceeded until the end of February, 1973.

Evaluation

The data available on heavy metals are insufficient for drawing firm conclusions about the migration and concentration characteristics of the biophile and heavy metal elements. It is obvious that higher clay and organic carbon content in the sediments favor their concentration. As the St. Louis Bay oyster reef sediments also indicated, sandy sediments contain low concentrations of these elements and clayey ones include high concentrations. The absorptive powers of clay and organic carbon surfaces clearly account for these regularities.

In agreement with Brown's data (1972), the drillhole samples contained only low heavy metal concentrations. While oysters concentrate Zn in their soft tissues, this is not true to the same extent for Pb. The high lead concentrations (277-1021 ppm) of the dry meat samples (Brown, 1972) stands out as an unexplainable anomaly. The only slightly polluted waters in St. Louis Bay are not likely to cause such a striking lead enrichment. Biloxi Bay and Biloxi Back Bay are surrounded by a significantly more densely inhabited and industrialized area and are exposed to much more pollution than the Bay of St. Louis. Two wet-drained oyster samples from Biloxi Bays contained only 1.05 - 1.20 ppm Pb; 33-55 ppm Cu and 1000 - 1090 ppm Zn, according to the Gulf Coast Health Sciences Laboratory, Dauphin Island, Alabama.

Vertical differences in the biophile and metal element concentrations of drillhole cores were not sufficient either for drawing general conclusions about migration directions or about the concentration of heavy metals.

ACCOMPLISHMENTS OF THE TOTAL RESEARCH EFFORT FOR THE PREDICTION OF ECOLOGICAL ALTERATIONS CAUSED BY POLLUTANTS

It was anticipated that five years would be required to make the pilot plant ecosystem operational. Two years of baseline data would be required to attach any scientific validity to the description of the Bay of St. Louis ecosystem. Less than one year of data has been collected; therefore, the scientific objectives of the program are incomplete. Nevertheless, several significant accomplishments have been achieved.

1. The data on this comprehensive baseline survey of the Bay of St. Louis is on file at the Mississippi-Alabama Sea Grant Consortium Office and should serve as a meaningful scientific contribution, particularly when the statistical analyses on the total program are complete. This work is in progress.

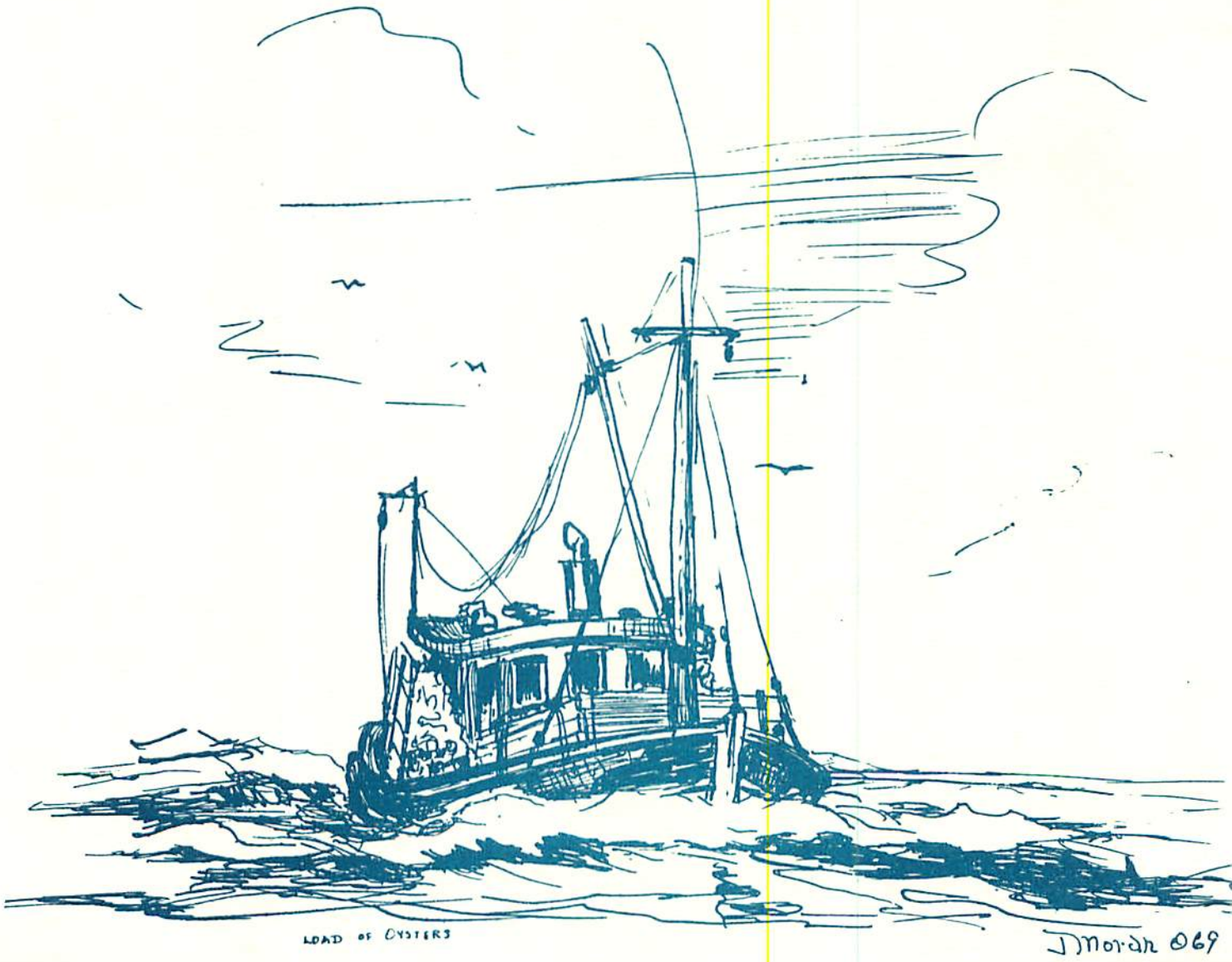
2. A multidisciplinary, multi-institutional team of senior scientists and graduate students functioned in a coordinated scientific program. This accomplishment alone has had a major beneficial effect on the research efforts in the State of Mississippi by achieving a pooling of scientific manpower in a common effort. Since the initiation of the Sea Grant program, members of this team have combined their efforts in other marine related programs and have been successful in winning several contracts from other federal agencies.

3. Many of the principal investigators, with limited or no previous experience in marine oriented research, were able to gain valuable marine research experience.

4. Several graduate students obtained their degrees.

5. Data from individual investigations resulted in numerous publications and have provided a basis for other research.

POLLUTION: ECOLOGICAL STUDIES



Project No: R/G-1

Title: Selective Algal Inhibition by Aquatic Angiosperms

Principal Investigator: George F. Pessoney, III, Associate Professor and Chairman, Department of Biology, University of Southern Mississippi;
Robert T. van Aller, Dean of the Graduate School and Professor of Chemistry, University of Southern Mississippi

The maintenance of the correct type, mass, and diversity of phytoplankton is an increasingly serious problem in water resources management. Too few phytoplankters in water curtail production by limiting the primary productivity, while too many often result in a waterbloom of unwanted types. If too many of the wrong types of algal plankton develop in a water system, they decrease the oxygen in the water and, therefore, adversely affect its productivity by killing fish or encouraging the growth of anaerobic bacteria, resulting in an odor problem. However, if the algae are too severely limited by control measures the food chain is broken and primary productivity comes to an end. Current treatment of acute algal problems consists of massive applications of commercial algacides such as copper sulfate, potassium permanganate, Silvex, or 2, 4, D. Such treatments are costly, are nonselective as to the type of algae controlled, and are temporary.

Biologists have long been faced with the problem of why certain types of plants grow in certain localities. The investigation of this problem has followed three pathways: the limiting effects of sunlight, the eutrophication process, and the possibility that plants have a self-regulatory mechanism through competitive inhibition.

Preliminary data strongly indicated that there was an inhibitory effect between the flowering plants *Chara foliolosa* and *Eliocharis microcarpa* and certain green and blue-green algae. It soon became evident that there definitely was an inhibitor, that it is possibly selective, and that it is a widely occurring and separable compound found in higher plants. The prospect of a biological control for a biological problem represents a permanent solution and is always the most effective means of control.

Filamentous algae mats in a freshwater pond

Chemical Characterization of Algal Inhibitors

INTRODUCTION

During the past fourteen months work has been continued on an accelerated basis to isolate, purify, and bioassay naturally occurring compounds which selectively inhibit the nuisance algae which frequent controlled environments and coastal waters. Assays, which quantitate the amount of inhibitor present in *Chara foliolosa* and *Eleocharis microcarpa,* have been run for thirty algal representatives. Work is in progress to extend these investigations to include large polyculture algae, as well as bioassays on non-target organisms. Also, this facet of work is being extended to include other plants thought to produce inhibitors. This extension of ongoing work has two purposes: First, it will identify a class of compounds which inhibit algae in the natural environment. Second, it will make it possible to have plants readily available for extraction during all seasons of the year.

As expected, the extraction of a pure product and its chemical characterization has been the most difficult object of the investigation thus far. The thrust of work in this continuing program will be to solve extraction and characterization problems. The selective inhibition of nuisance algae remains an economically important line of research for the control of these organisms in highly eutrophic systems.

Characterization of Algal Inhibitors

Chemical and physical methods have been employed to isolate algal inhibitors from *Eleocharis microcarpa* and *Chara foliolosa*. Bioassays of separated fractions have been accomplished using *Nostoc* and *Plectonema* algae cultures with the paper disc diffusion method. Results of work on *Eleocharis* indicate the activity can be reproducibly separated by extracting dried *Eleocharis* with boiling water, methanol, or acetone. Best results are obtained with water, as extracts are highly active and contain relatively little pigmented material. The yield is .08% of the dried material. The water extract is partitioned with ether at various pH ranges, the activity being partitioned into ether between pH of 3 to 5. The yield is .07% of dried material. Preparative thin layer chromatography (TLC) of this material on silica gel with ethyl acetate as the eluting solvent gives seven bands, three of which are active. The largest band, when recovered, represents a 0.007% yield of dried material. Infrared spectra of those bands indicate long chain saturated aliphatic carboxylic acids with other functional groups, probably hydroxyl. Attempts have been made to further purify these bands; however, approximately one-half to two-thirds of the material remains at the origin each time a separation attempt is made, indicating that air oxidation or some other degradative process is taking place. Since good separation with TLC necessitates starting with a relatively pure fraction, a new column technique employing lipophilic Sephadex is presently being evaluated. Also, steps are being taken to keep air oxidation to a minimum.

Most studies to date on *Chara foliolosa* have been biological; however, some chemical information has been gained. For example, activity is partitioned into Ethyl Acetate of a higher pH, 5 to 7, indicating that the activity is less acidic than that from *Eleocharis*. Preparative TLC gives one band in the upper portion of the plate (strongly fluorescent) that appears to be much purer than the bands from *Eleocharis*. At this time, it appears that activity from *Chara* will be the easier to purify and is different from that of *Eleocharis*.

In the present research in three channel catfish fingerling ponds, *Chara foliolosa* was sampled during September and October, 1971. The ponds were assigned numbers one through three in decreasing order with respect to the amount of *Chara* present in each pond. Pond 1 had approximately 50% of the bottom covered by *Chara*. Ponds 2 and 3 had 25%

and 10% coverage respectively. Distinct differences in water clarity were observed among the three ponds. Pond 1 had 50% coverage, was clear, and the bottom was visible throughout the pond. Pond 2, with 25% coverage, was clear to approximately 2 feet below the surface, while Pond 3, with 10% coverage, was muddy. Other ponds are usually muddy or have visible phytoplankton blooms present.

The present research was influenced by the suggestion that growth limiting factors are produced by aquatic macrophytes. The investigators first hypothesized that total phytoplankton in the three ponds was reduced as compared to adjacent ponds and that total phytoplankton per liter would differ between the three ponds according to the amount of *Chara* present. Furthermore, the reduction in total phytoplankton was probably due to the antibiotic inhibitory action of *Chara* against the algae.

Since plankton analysis of the three respective ponds revealed a reduction in blue-green algae and an increase in diversity of primarily green algae, it was noted that the inhibitor could possibly be selective and inhibit primarily blue-green algae. Further, plankton analysis as well as chemical analysis revealed that: (1) Phytoplankton did differ among the three ponds with respect to coverage by *Chara* and (2) that chemical and physical factors between the ponds were similar.

Initial assay of the aqueous *Chara* extract against *Plectonema notatum* prompted further investigations as to the effect of the extract on a variety of algae. The investigations consisted of: visual observations of the effect of differing concentrations on various algae grown in liquid and agar culture, live cell counts of various algae grown in liquid culture at one concentration at 5, 10, and 15 days, and long term effect of one concentration on one alga.

Summary

The assay of extracts from fresh weight *Chara foliolosa* demonstrate the existence of a selective algal inhibitor within the plant cells. The inhibitor is most effective in inhibiting the growth of the Cyanophycophycean algae. The blue-green algae are differentially sensitive between genera and in some cases, to species. The Chlorophycophyta are mixed in response to the *Chara* extracts. Unicellular flagellates and colonial flagellates indicate a stimulatory effect produced by the *Chara* extract. Other green algae are inhibited to varying degrees by the extract. The Yellow-green algae assayed was inhibited in growth at high concentrations of the *Chara* extract. As a general rule, each genus, with the exceptions above, reacted adversely and differently to the varied concentration of *Chara* extract.

The inhibitor was found to be extractable from acidified H_2O with ether, indicating a functional acidic group on the inhibitor and that the compound was highly water soluble at neutral and alkaline pH. The amount of the inhibitor in 1.0 g. of fresh weight *Chara foliolosa* was computed to be approximately 1.415 mg. The inhibitor was stable at 4°C for 12 months. The compound was effective in a sterile culture of *Plentonema notatum* for 3 months.

Eleocharis microcarpa was shown to contain an extractable selective algal inhibitor. The inhibitory compound was found to be potent and labile in organic solvents. Laboratory assays proved the compound to be algicidial to certain algae. Pond waters, which contained large mats of the sedge, were found to be high in diversity of green and yellow-green algae and consistently low in blue-green algae. Those ponds were consistently low in blue-green algae, even though they were heavily fertilized by agricultural drainage.

The inhibitory compound was not extracted from the pond waters but the above mentioned findings indicate *Eliocharis microcarpa* to have an effect on the algal diversity in the ponds in which it is found in the aquatic form.

Extracts from *Eleocharis microcarpa* and *Chara foliolosa* selectively inhibit alga. Note the growth over the sensivity discs of the green algae *Chlamydonomas eugametous* and *Scenedesmus quadrocauda*. Figures 1 and 2.

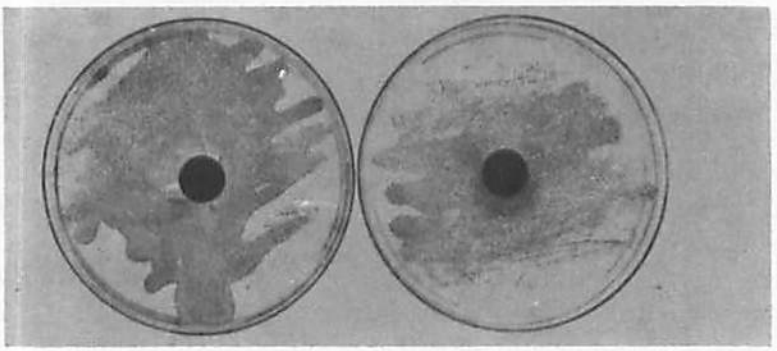


Figure 1.

Control *C. eugametous* — Extract of *E. microcarpa*

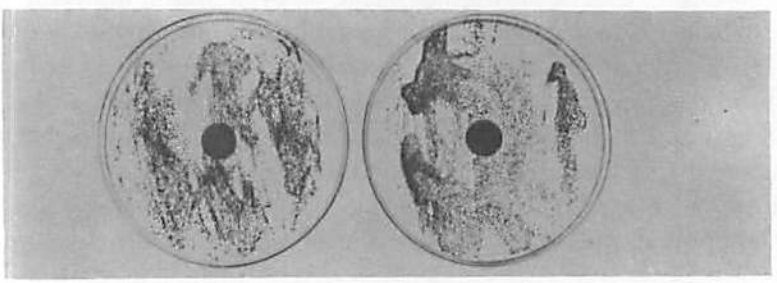


Figure 2.

Control *S. quadrocauda* — Extract of *C. foliolosa*

Note the zones of inhibition around the sensivity discs of the four cultures of blue-green algae, Figures 3 through 6.

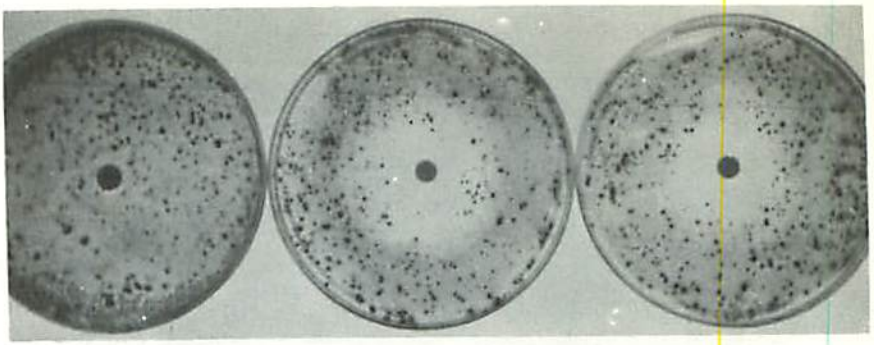


Figure 3.

Control
Plectonema notatum

Extract of
E. microcarpa

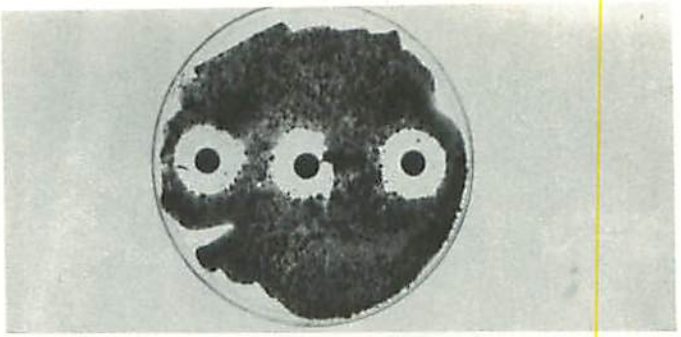


Figure 4.

Control
Anabaena flos-aquae

Extract of
E. microcarpa

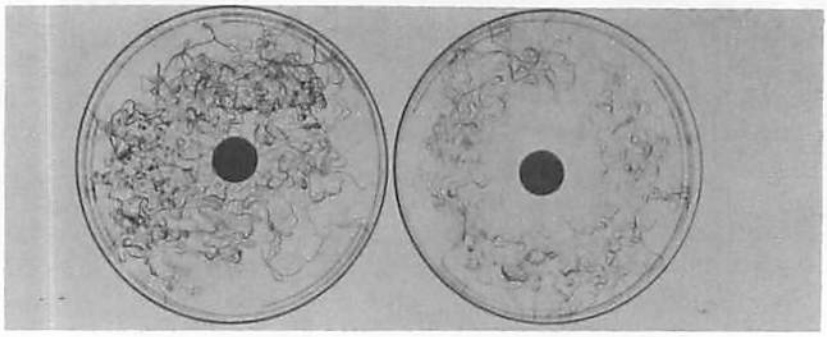


Figure 5.

Control
Anabaena catenula

Extract of
C. foliolosa

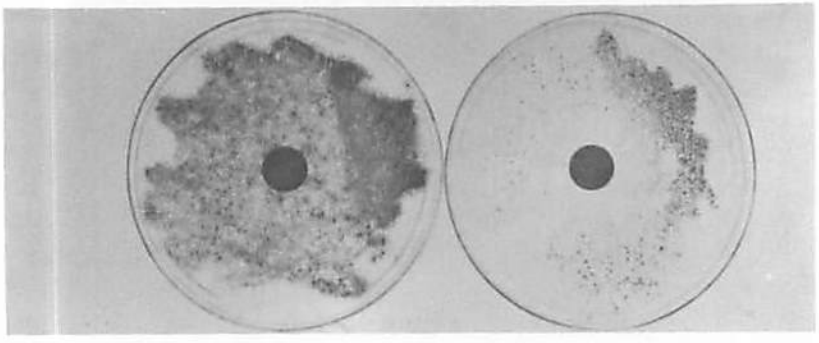
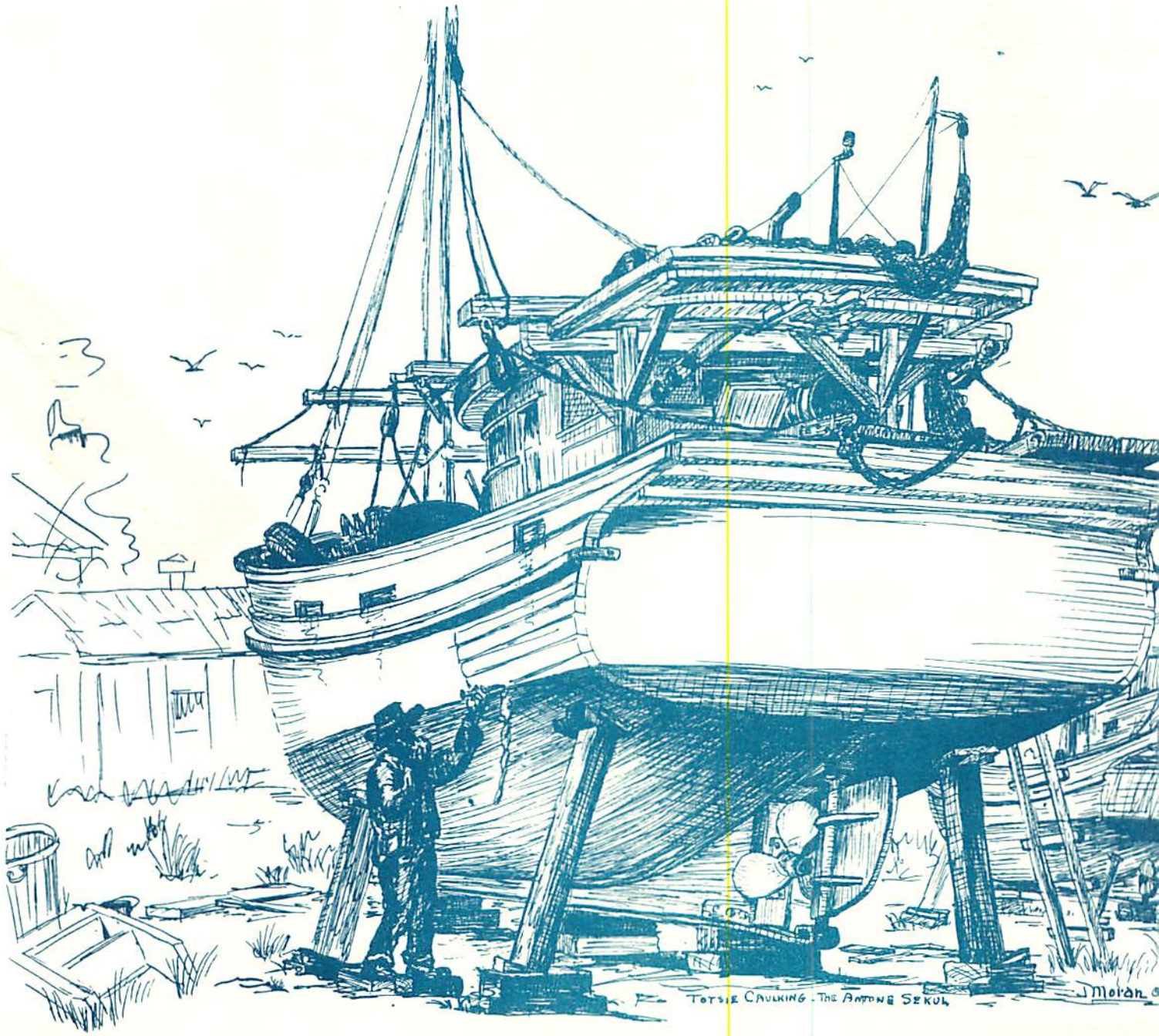


Figure 6.

Control
Lyngbya sp.

Extract of
C. foliolosa

ENGINEERING IN THE OCEAN



Project No: R/O-1

Title: Underwater Reconnaissance Vehicle Design

Principal Investigator: J. E. Thomas, Director, Institute of Engineering Technology, Mississippi State University

Richard D. Benton, Associate Professor, Institute of Engineering Technology, Mississippi State University

Wilbur R. Seidel, Mechanical Engineer, National Marine Fisheries Service, Pascagoula, Mississippi

RUFAS II (Remote Underwater Fishery Assessment System) is an unmanned, towed, underwater vehicle whose mission is bottom and midwater surveillance under remote control and monitoring from the towing vessel on the surface. The RUFAS II system was designed to operate to a depth of 2,400 feet.

The value of an operational RUFAS II in gathering data required for better definition of resources of the Continental Shelf and Slope out to 2,400 feet is not difficult to visualize. The amount of information that can be gathered may well be useful to more segments of the marine community than those merely associated with biological resources. Geology and mineral resources could be revealed as well as various physical oceanography phenomena.

The development of this system followed the successful design, development, and operation of a shallow water (300 feet) RUFAS I system by the National Marine Fisheries Service. RUFAS II is considered an extension of RUFAS I with increased depth capability (2,400 feet) necessitating stronger pressure vessels and a much more complete towing system. The chief difference between RUFAS I and RUFAS II is in the deeper operating capability and increased flexibility of the latter. The 400 fathom depth requirement demanded stronger pressure vessels and a much longer cable presenting critical design requirements. The longer cable of the RUFAS II system dictated the requirement of reducing the cable diameter. This, in turn, required the system electronics to be more elaborate.

There is a great interdependence of variables associated with this system. For instance, cable size was determined by the electrical requirements for power, communications, and control. Structural requirements depended on vehicle drag, cable drag, cable immersed weight, shock loads from ship motion, etc. Cable weight, lift, and drag, in turn, influenced the angle and curve of the cable, which is important for the vehicle to have the required maneuverability for bottom surveillance.

RUFAS Equipment Configuration

The equipment layout for the RUFAS II vehicle is shown in the cutaway view (Figure 1). Watertight integrity was obtained by enclosing most electrical equipment and the film camera inside two 28 inch diameter spheres. The spheres used here are surplus helium storage spheres made of 6AL4V titanium alloy heat treated to a minimum yield of 146,000 psi. These spheres were extensively modified for RUFAS service in order to save time and money. However, standard deep submergence aluminum spheres are commercially available for this application.

Material

Aluminum alloy (6061) was the primary material used to construct the RUFAS II vehicle (Figure 2). Fiberglass members were moulded for springs and where double curved surfaces were required Plexiglass windows are used to make the vehicle streamlined and to prevent motion of the vehicle when the TV camera and lights are moved by the pan and tilt mechanism.

Television System

The television system for RUFAS uses a Hydro Products Model TC 125 camera mounted on pan and tilt mechanism (Figure 3) of our design. Two Hydro Products Model LT-7 Thallium Iodide lights which are also mounted on the pan and tilt mechanism provide illumination for the TV camera. Ballast transformers for the lights are located in the rear sphere. On board the towing ship, two 14" solid state 10 MHz television monitors are provided for the RUFAS operators and a Westinghouse Model TG30C27A video tape recorder completes the television system.

Data Camera System

The data camera used on RUFAS II is a Flight Research Company Model IV 35mm camera with a 16.5mm Angeniux lense. This camera is equipped with a 1,000 foot film magazine which gives the RUFAS II system 2.5 times the film capacity of the RUFAS I system. Illumination for the film camera is provided by the Hydro Products Model PF720 200 watt second strobe light.

Sonars

The RUFAS II system uses two Heath Model MI-101 digital depth sounders. One of these modified sonar units has its transducer pendulum mounted so that it measures the vehicle height above bottom. The transducer for the second sonar unit is also pendulum mounted, but in such a way that it measures the clearance ahead. This forward looking unit has been modified to ignore target returns within 80 feet of the vehicle so that side lobe reflections will not jam the system. The operator readouts of both sonars uses analog meters. Both a light and an alarm tone are used to alert the operator when the vehicle is too close to the bottom or an obstacle is detected ahead of the vehicle by the forward looking sonar.

Vehicle Control System

The vehicle is controlled by the two vanes in the stern (Figure 4) which are manipulated by the control servo. This servo uses two motors, one for climb-drive, the other for roll. The climb-drive motor moves the vanes up and down together. The roll motor drives the vanes through a differential gear which will cause one vane to move up and the other to move down. The operator has two options in the control of the vehicle. In one, he can set in a particular vane angle and in the other he can put in a desired height above bottom. In the first case, the input signal is nulled by feedback from the vane position and in the latter case, the feedback is provided by the down looking sonar.

Operator's Consoles

There are two operator's consoles in the tow vessel (Figure 5). One console is for the vehicle operator. This console has readouts of vehicle, roll and pitch, port and starboard vane angles, a live TV picture, and the sonar readouts. It is also equipped with the vehicle controls and alarms. The second console is for the data operator. The TV picture at this console can be live or from the Video Tape recorder. This operator will operate the TV system and the data camera system. He will also monitor the electrical power meters and operate the video tape recorder.

Telemetry System

The RUFAS vehicle is connected to the consoles and tow vessel through the tow/electrical cable. This double armored, steel jacketed cable contains four power conductors, an

RG 59 coaxial cable, and a small twisted pair of communications wires. Three phase, 60 cycle, power is supplied to RUFAS through the four power conductors. A variable transformer is supplied to the data operator's console so that adjustment may be made to compensate for voltage drop in cables of different lengths or generator voltage levels.

The signals transmitted over the twisted pair are two simultaneous audio tones generated by phase lock loop circuitry in response to operator switch functions. These tones are decoded by a phase lock loop receiver on RUFAS to activate motors and relays on the vehicle. This system can provide up to sixteen commands to the vehicle including emergency vane control signals.

The television signal is transmitted baseband over the RG 50 coax. The primary up and down link telemetry signals are frequency multiplexed and transmitted over the same coax with the TV signals. The down link telemetry uses a carrier frequency of 25 MHz. and the up link system a frequency of 20 MHz. Filters isolate the TV and telemetry systems.

Testing Phase

The RUFAS II system was tested in the tow tank operated by the United States Geological Survey at the Mississippi Test Facility in late January, 1973. Results of this initial evaluation of the newly developed RUFAS II system were quite favorable. They showed the basic vehicle design to be sound.

The second RUFAS II tow tank test was conducted in May, 1973. The overall results of the tow tank test were excellent. RUFAS II has demonstrated the capability to automatically fly itself at a predetermined height above the ocean bottom. In addition, the telemetry and subsystems all performed satisfactorily during the test. At this point of RUFAS II development, the tow tank tests have provided most of the answers possible from this test mode. The next major step in the development of RUFAS II will be an at sea, full system, operational type evaluation. It is anticipated that the National Marine Fisheries Service research vessel OREGON II will be available for these sea trials in early August, 1973.

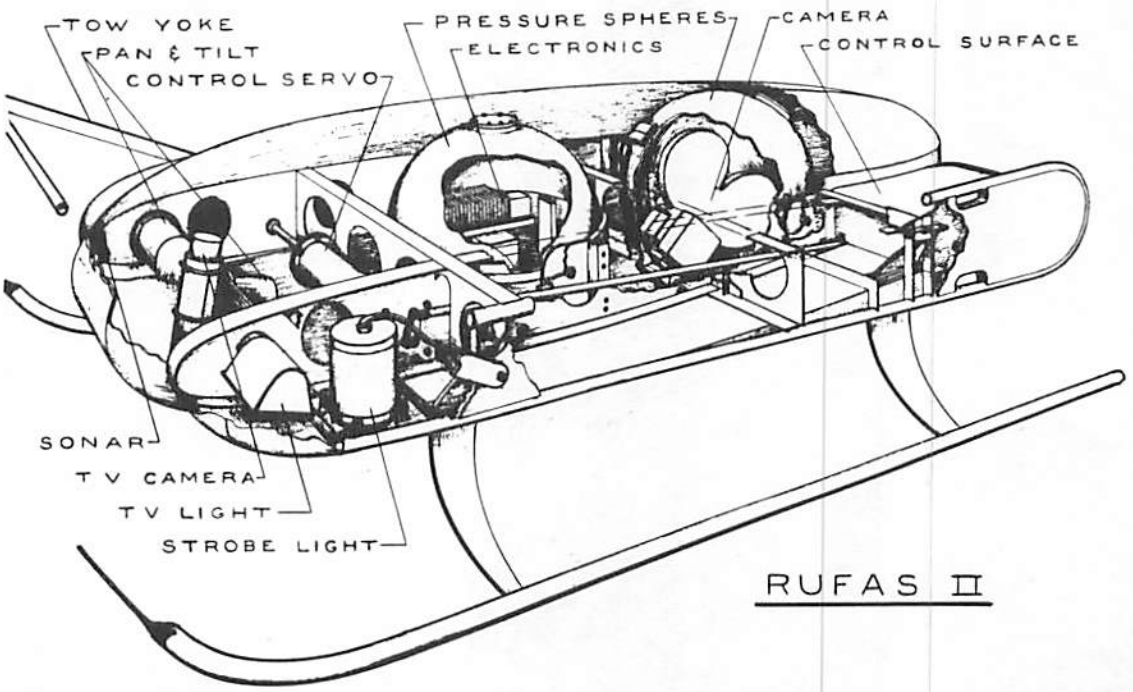


Figure 1. Cutaway view of the RUFAS II vehicle.

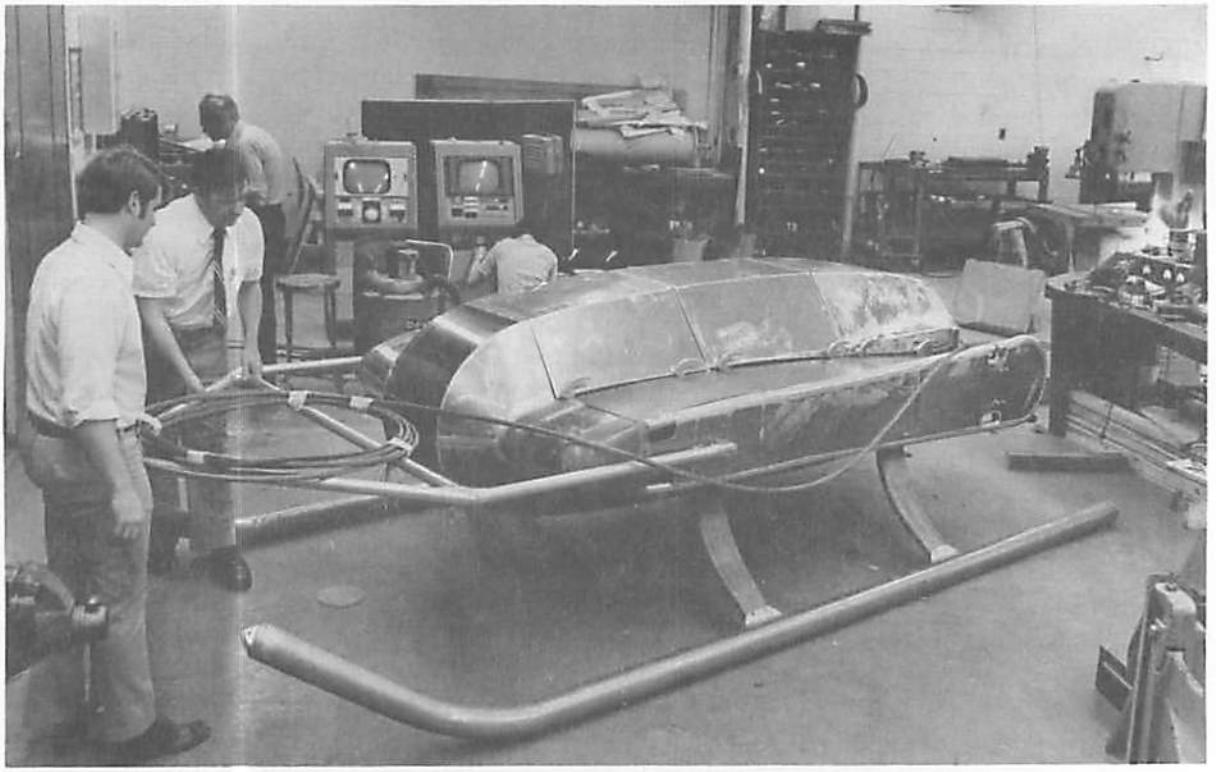


Figure 2. RUFAS II vehicle being prepared for initial tow tank testing.

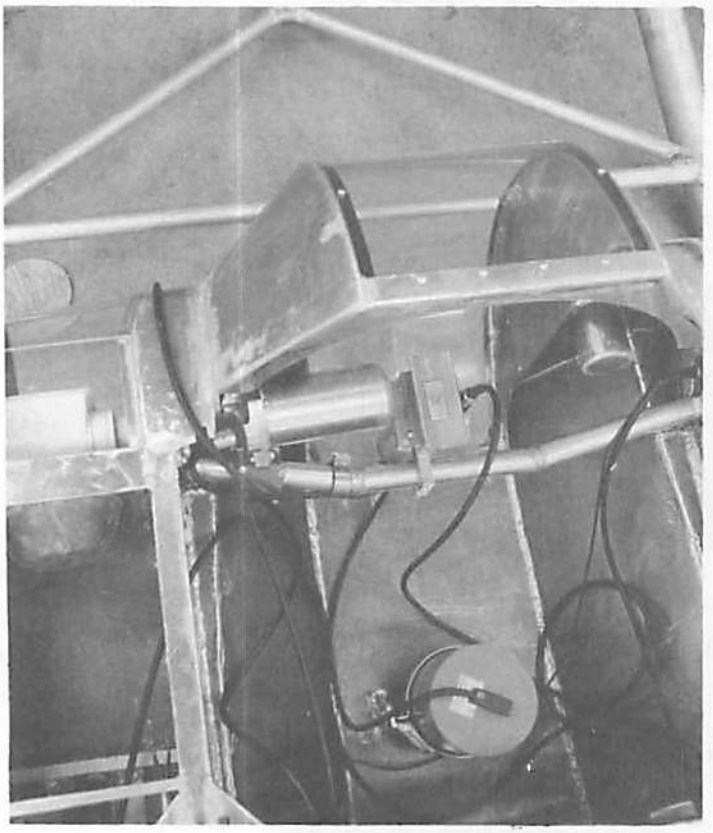


Figure 3. Interior view of RUFAS II vehicle. The pan and tilt mechanism, the strobe light and one of the thallium iodide lights can be seen. The TV camera has been removed.

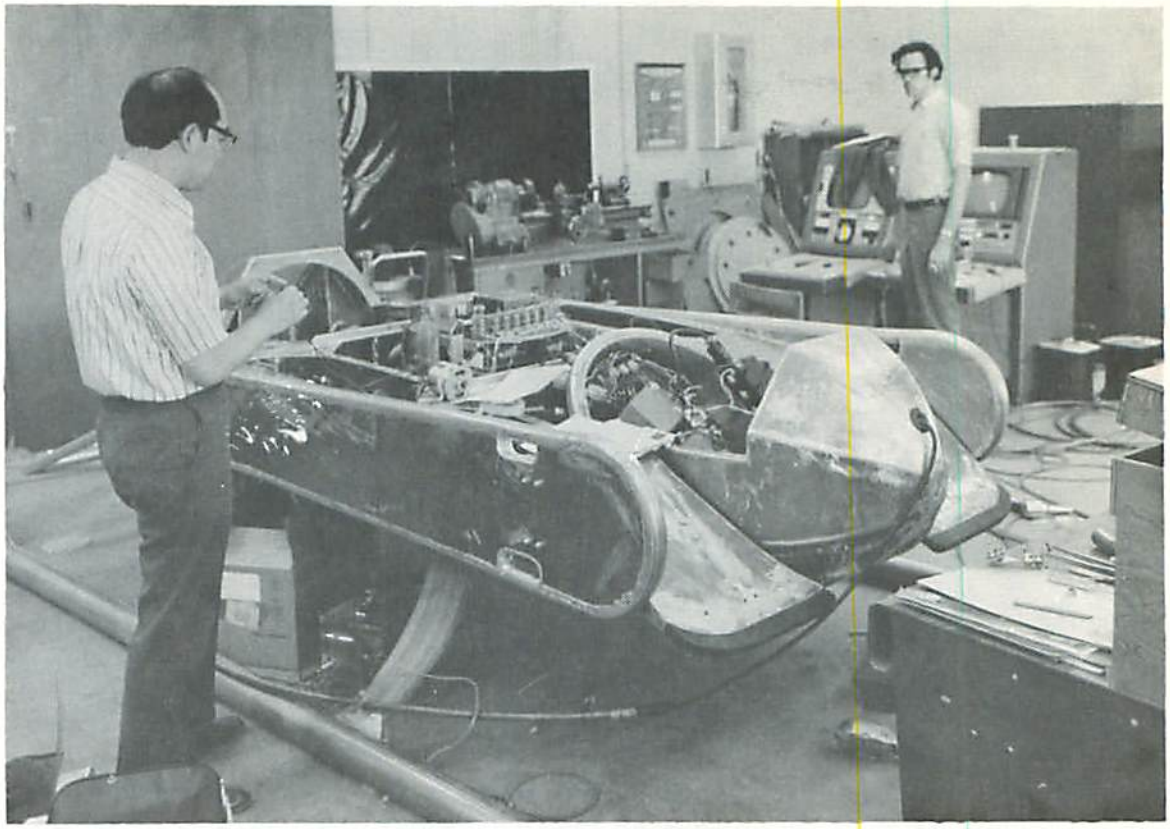


Figure 4. View of the RUFAS II vehicle from the rear with hatches and sphere covers removed. The rubber edged control vanes can be seen in this picture.

Figure 5. Operator's consoles and video tape recorder.

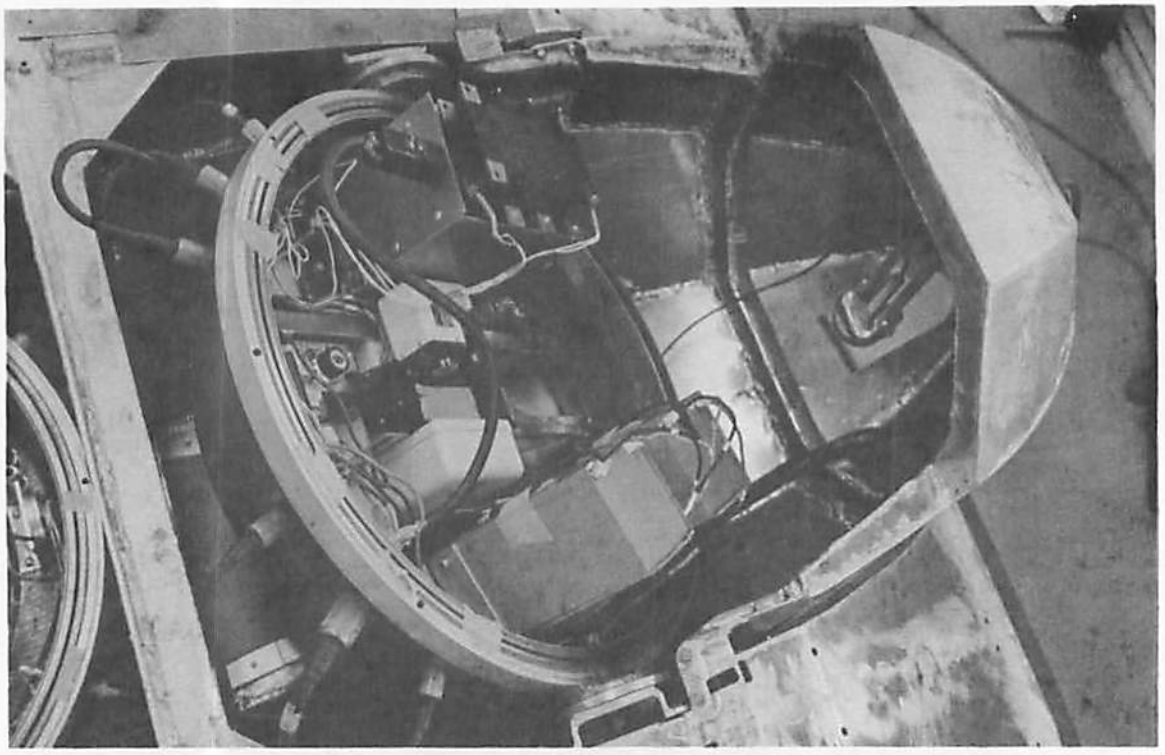


Figure 6. Photograph of the stern of the RUFAS II vehicle with hatches and sphere covers removed. The transducer for the down looking sonar can be seen in its pendulum mount. The data camera and some transformers can be seen in the rear hemisphere.

Figure 7. Technician making an adjustment on the intervolemeter which controls the time between consecutive data pictures.

Project No: R/O-1

Title: A Curriculum in Marine Engineering Technology

Principal Investigator: J. E. Thomas, Director, Institute of Engineering Technology, Mississippi State University

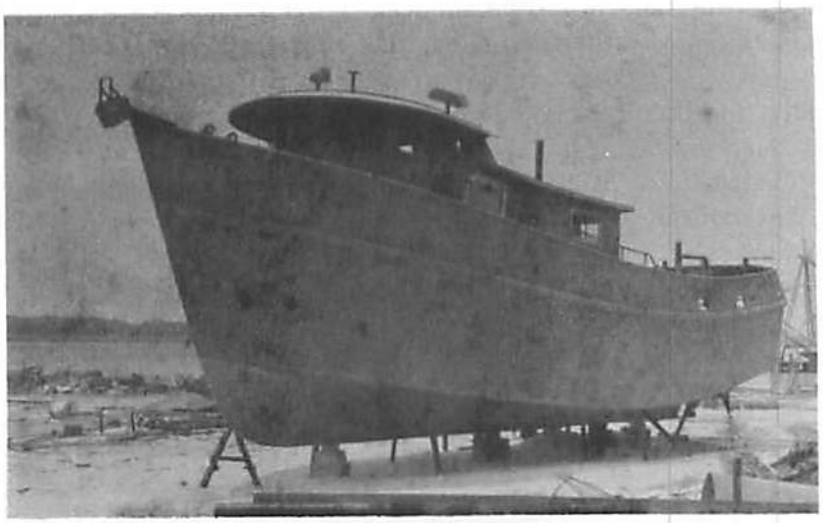
Richard D. Benton, Associate Professor, Institute of Engineering Technology, Mississippi State University

Engineering education, in recent years, has emphasized a broadening of the basic education of the engineer while maintaining emphasis on the technical area of specialization. In order to accomplish these dual goals, engineering education has seen a reduction of the emphasis on the application of the engineering principles to the solution of practical problems.

Engineering technology has been defined as "that part of the technological field which requires the application of scientific and engineering activities. It lies in the occupational spectrum closest to the engineer."

Engineering technology at the baccalaureate degree level has become the necessary educational interface between the engineering curriculums which are preparing research, development and design oriented engineers and the vocationally oriented programs which prepare technicians and craftsmen.

There is a very critical need for programs to educate those young people who are interested in building ships and operating shipyards.



Fishing boat nearing completion in a Biloxi shipyard.

The Curriculum in Marine Engineering Technology, developed by Mississippi State University as a Sea Grant project, has produced highly competent manpower to work in those industries concerned with ship construction, ship repair, and shipyard operations. This curriculum has been developed in consultation with representatives of large shipbuilding firms. These representatives have given assurance that graduates of this program fill an urgent and serious need which exists throughout their industry.

These Marine Engineering Technologists understand the principles of ship structure and ship propulsion and thus are able to communicate with marine designers. They also understand and are interested in ship construction and shipyard operation, and are welcome

members of the team of specialists who will design, build, and operate the marine vehicles of the future.

The engineering technologist who has earned a baccalaureate degree in engineering technology is a new emergent on the education and industrial scene.

Functioning at the highest technical level, he will have great strength in the special skills which are essential to the translation of complex technical concepts into economical, reliable and functional realities. More simply said, he is a specialist in engineering applications. For this reason he will discharge many of the duties in the areas of applications and establish routine design formerly performed by engineers, while looking ahead to a future in management. This new emergent will approach industry with two major qualifications. First, he will be an individual whose basic interests and aptitudes lie in the applications of principles and practice. Secondly, he will have an education that provides the mathematics, physical science and humanities necessary to a technical education in depth.

Thus it is that the engineering technologist of the space age will qualify for positions in manufacturing, quality control, testing operations, design and engineering sales. He will be prepared to accept future managerial positions as well as those requiring great technical competence.

The support received from Ingalls Shipbuilding Corporation of Pascagoula, Mississippi, and Avondale Shipbuilding Corporation of New Orleans, Louisiana, in initiating this new curriculum in Marine Engineering Technology has been outstanding. Ingalls assisted in the initial student recruiting in two significant ways: First, a representative of the Ingalls Personnel Department accompanied the director of the Institute of Engineering Technology of Mississippi State University, on visits to each of the 17 junior colleges in Mississippi. In addition to assisting in presentations to the students, Ingalls also produced brochures of the curriculum as well as posters which were sent ahead to give notice of the upcoming recruiting visit. Secondly, Ingalls furnished summer employment for every student who showed an interest in the Marine Engineering Technology curriculum.

Ingalls donated Naval Architecture books to the Institute and made a sizable contribution of two ship models. Industrial cooperation of this magnitude allows students to taste of the real world.

THE CURRICULUM

SUMMER EMPLOYMENT

ETC 1020 Sophomore Work Summer	0

Junior Year

Fall Semester

CET 2003 Mechanics and Materials I	3
EET 2201 Electronics Computing Laboratory I	1
EET 2202 Electronics Computing Technology I	2
GET 2103 Applied Calculus	3
GET Applied Thermodynamics	3
MAT 2004 Shipbuilding Technology I	4
	16

Junior Year (continued)

Spring Semester

GET 2014 Mechanics and Materials II	4
GET 2113 Applied Mathematics	3
GET 2403 Metals Technology	3
MAT 2104 Marine Engineering Technology I	4
MAT 2603 Naval Architecture Technology I	3
	17

Summer Employment

ETE 1030 Junior Work Summer	0

Senior Year

Fall Semester

MAT 3014 Shipyard Operations Technology I	4
GET 3323 Applied Dynamics	3
MAT 3114 Marine Engineering Technology II	4
MAT 3614 Naval Architecture Technology II	4
GET 2603 Oceanography I	3
	18

Senior Year (continued)

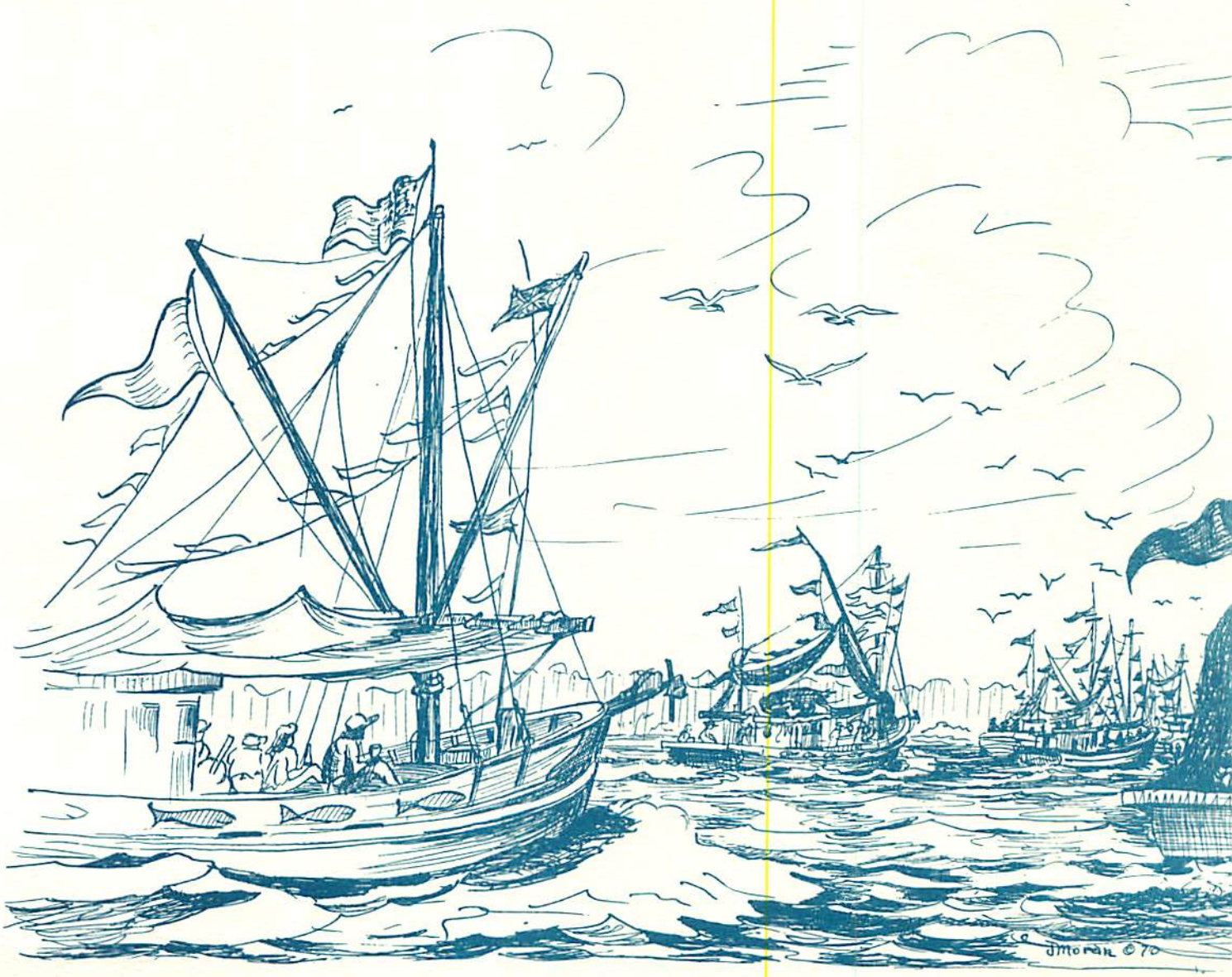
Spring Semester

MAT 3024 Shipbuilding Technology II	4
MAT 3123 Marine Engineering Technology III	3
MAT 3404 Shipboard Ventilation	4
MAT 3623 Naval Architecture Technology III	3
GET 2503 Oceanography II	3
	17

Because of the importance of on-the-job understanding of ship construction. It is planned that each student will have two periods of summer employment in a marine industry. The two coordinated work periods will give the student experience with the hardware of ships and bring a practical enrichment to the course work.

Response by representatives of the shipbuilding industry has been enthusiastic. They point out that the supply of domestically educated engineers and naval architects is severely limited and that the marine engineering technologist is a valuable asset to their operation. The first seven graduates of the Marine Technology curriculum accepted positions with four major shipyards. The second class, also comprised of seven graduates, received a total of twenty-one job offers averaging $872 per month. It is significant that every company which hired a member of the first graduating class also made an offer to a member of the second class.

FISHERIES DEVELOPMENT



Project No: R/T (1)-1

Title: Magnitude of Sportsfishing in Biloxi Bay and Mississippi Sound

Principal Investigator: Thomas D. McIlwain, Marine Biologist,
Gulf Coast Research Laboratory
Wendell J. Lorio, Department of Wildlife and Fisheries,
Mississippi State University

INTRODUCTION

Sportsfish surveys across the country have emphasized the importance of fishing in estuarine areas. These surveys have provided statistics for use in management, conservation, and legislative action. Information derived from the present survey will be of importance for the maintenance and preservation of the Mississippi Gulf Coast sportsfishery, to which the tourist industry and local recreation are closely related.

Charter boats in Biloxi small craft harbor

The Mississippi Gulf Coast has for many years had a very active commercial and sportsfishery. In 1972, a record catch of fish and shellfish was landed by commercial fishermen. The estimated dock side value of this catch was in excess of $16 million, with an economic impact of approximately $96 million on the coastal counties. Interest in sportsfishing has increased during the past several years due primarily to an expanding coastal population, an intensified emphasis on the tourist industry, and a general trend among the public to an increase in aquatic activities.

Preliminary results of this sportsfish survey (Jackson, et. al., 1972) show a catch per unit of effort of 3.8 fish per hour for Biloxi Bay. That figure compares favorably with the best fishing to be found anywhere. The same species of fish are sought by both sports and commercial fishermen; however, catch and economic data are recorded only by commercial fishermen. But starting in January, 1973, data is being gathered relative to catch rate and economics of the sportsfishery.

This survey is documenting the absolute magnitude of sportsfishing activity in Biloxi Bay and Mississippi Sound and providing primary data for several variables. These data include species composition, seasonal occurrence, and numerical abundance of those fishes

taken in the sportsfishery. Additional information is being gathered on the number of fishing parties and boats, boat source (personal or rented), methods of fishing, residence of fishermen, and seasonal factors.

Methods and Procedures

Information provided by this survey was obtained by interviewing fishermen in the field, including those in boats and those fishing from piers. Charter boat logs were sent to many of the captains to obtain information regarding the "big game" catches. A postal card survey was initiated to obtain information from those who fish from smaller boats, docks, and piers.

This survey has been conducted by one man who roved the area interviewing fishermen in boats and on piers. The Biloxi Bay and the adjacent Mississippi Sound were divided into six broad areas defined by prominent landmarks (Figure 1). Area I is located in the western end of Biloxi Bay, and is followed, moving eastward, by areas II, III, and IV. Area V consists of the mouth of the Bay and the area southward to the north shore of the barrier islands, Ship Island and Horn Island. The sixth area is Graveline Bayou, which is located approximately six miles east of the mouth of Biloxi Bay. Information was recorded for each area and was analyzed accordingly.

There were two specific areas that were sampled in the course of the survey. These areas were the old Biloxi Bay Bridge and the Broadwater Hotel Marina, which is located on the beach front of West Biloxi. These areas were the most highly utilized and most accessible for sampling purposes.

Information obtained from sportsfishermen included the number of males and females per party, the residence of each, the kind of fishing, the kind and types of bait used, the number of hours spent fishing, and the composition of catches as to species and number (Figure 2). A boat count was also included in each sampling day to determine the total fishing pressure on each area. This information was used to compute the total pressure and obtain an estimate of the total catch.

Sampling days were set up on a stratified-random sampling design. Weekends, Saturdays, Sundays and holidays were sampled, and the number of days not sampled was equal to the number of weekend days in the month. Thus, for any given month approximately seventy-five percent of the days were sampled. The boat counts for days not actually sampled were computed from previous daily averages. A normal working day began at 8 a.m. and ended in the late afternoon. As many fishermen as possible were interviewed during this time. The daily boat count was begun at 9 a.m. and usually took about 1 ½ hours to complete. A complete tour of Biloxi Bay and the adjacent Mississippi Sound was made counting all boats engaged in fishing, but Graveline Bayou and the offshore islands were excluded. A similar boat count of the Bay and Sound was made beginning at 4 p.m. each day. It was determined by interview and analysis of the postal card survey that approximately 60% of the anglers on a given day were fishing during the time of the boat counts. This was found to vary only slightly throughout the duration of the survey. With this information, a reasonable estimate of the total catch, in numbers, was determined. A list of the species encountered during the survey is illustrated in Table I.

Results and Discussion

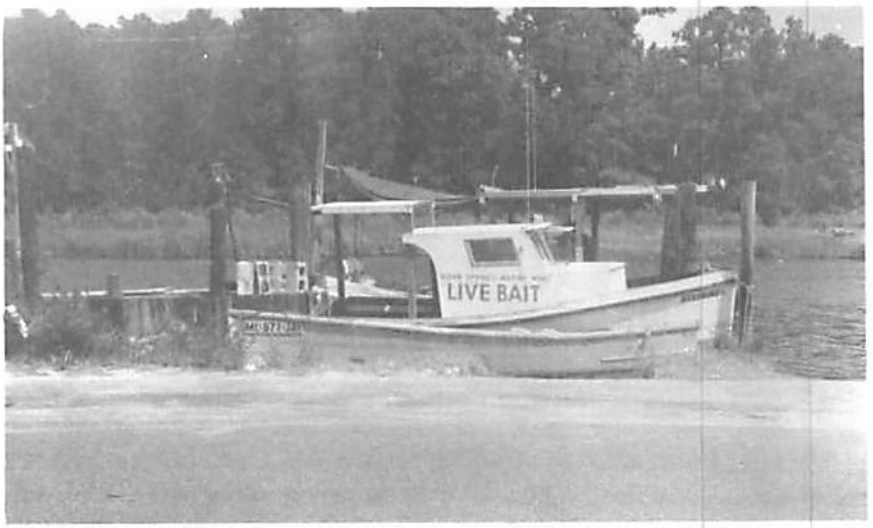
An indication of the receptiveness and enthusiasm of the Mississippi Gulf Coast angler is the 42.35% return from the postal card survey. Other researchers have reported a rather disappointing return rate of from 30 to 36%.

Male and female anglers accounted for 83.2% and 16.8%, respectively. Preliminary data indicated that 81.44% of the anglers were male. The decline in female anglers has not been explained.

All age groups enjoy good fishing

The percentages of personal and rented boats were also determined, since this has considerable economic significance. It was found that the percentage of rental boats increased from summer to fall and winter. A reversal of this trend was evident in the spring. This increase in boat rentals is brought about by a number of factors, one being that the inclement weather of late fall and early winter drives game fish from the Bay, and many anglers fish in the tidal rivers where boat liveries are in abundance. The subsequent movement of game fish into the Bay in the spring reverses the trend. The average number of people per boat throughout the entire survey has remained relatively constant at 2.26.

There are three types of sportsfishing along the Mississippi Gulf Coast: still fishing, trolling, and casting. Still fishing is the most popular and productive, and live shrimp is the preferred bait.



Live bait boat in Ocean Springs harbor

Accumulation of data from the boat count made it possible to estimate the total number of fishermen and to determine those months in which the most intensive fishing occurred. (Table II). November, 1971, accounted for the greatest number of fishermen in this sample period. Throughout 1972 fishing was poor as reflected in the total number of fishermen, hours fished, and fish caught per unit of effort. An overall catch of 1.4 fish per unit of effort was recorded for this sample period, whereas the previous survey reported a 3.8 fish catch per unit of effort. The latter figure may be somewhat high, and the 1.4 fish per hour catch rate may be a more accurate figure.

Table III gives a graphic depiction of the composition of catches during the sampling period. White trout accounted for the greatest percentage followed by the atlantic croaker, the spotted sea trout, and ground mullet. These four species accounted for over 85% of the total catch. A further examination of Table III reveals a downward trend in numbers of fish caught. The catch for the first four months was 308,797 fish as compared to a total of 19,454 caught during this sampling period. This figure of 19,454 is low because data available for January, February, March, and April of 1972, is unreliable due to unseasonably cold weather, unusually heavy rains, and equipment failure. Generally, fishing in 1972 and early 1973 has been extremely poor. There is, as of yet, no valid explanation for this fact. Data now available will be compared with that obtained from January through April of 1974 to establish a more accurate trend.

It is often beneficial to determine the residency of the anglers participating in the sportsfishery along the Mississippi Gulf Coast. More than 83% of the anglers interviewed were from Jackson and Harrison counties. Only about five percent were from other states. The other 12% were from other Mississippi counties.

Data from charter boat logs were generally difficult to obtain. Although some captains cooperated splendidly many found it inconvenient to burden themselves with additional tasks. Continuing efforts are being made to solicit the cooperation of all charter boat captains. The data which has been received from that group indicates that fishing in 1972 was down significantly when compared to previous years. The charter catch is mainly spanish mackerel, king mackerel, bonita, jack crevalle, and lemon fish with a few big game fish including wahoo, sailfish, tuna, and white and blue marlin.

Waiting for a bite

CONCLUSION

Data obtained from this study will form a basis from which it will be possible to monitor year to year changes in the sportsfishery which occur naturally or due to environmental degradation caused by man. It is quite evident that there are dramatic fluctuations in the fishery, and this study will help provide the key to understanding them.

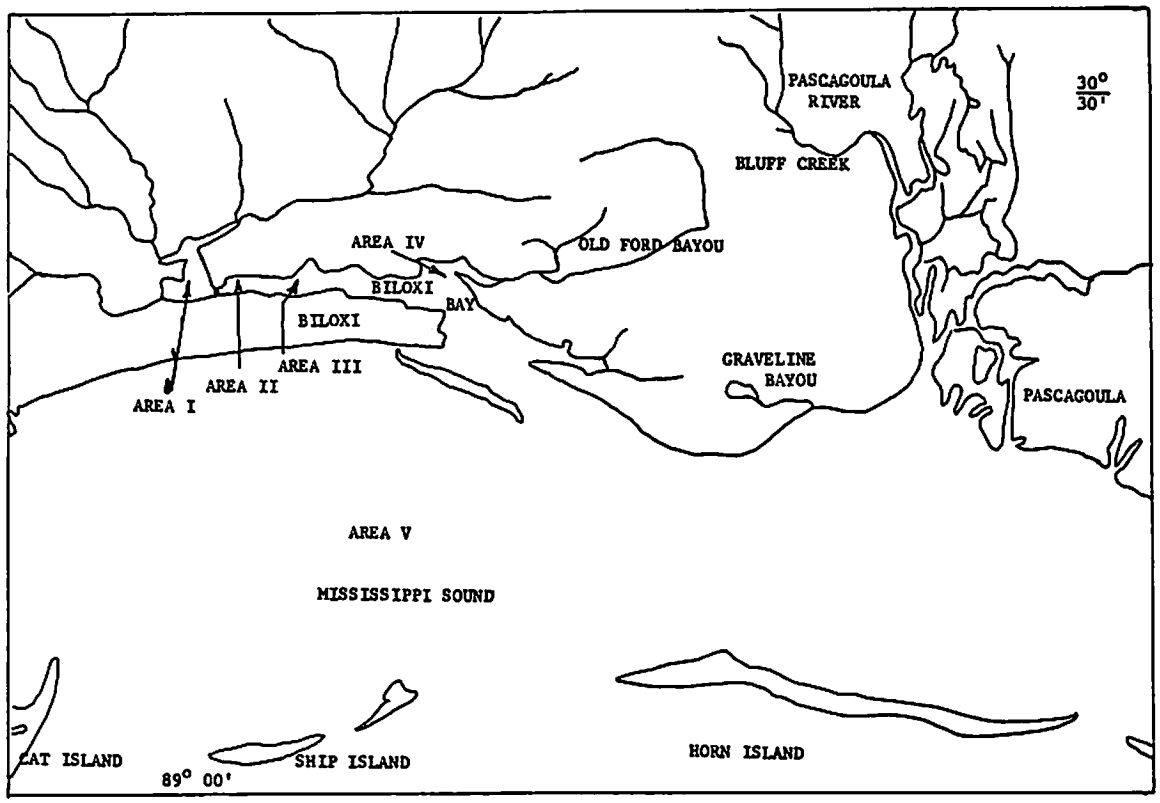


Figure I. A map of the sampling area for the sportsfishing survey of the Biloxi Bay and the adjacent Mississippi Sound from July 1 to December 31, 1971.

Figure II. A sample data sheet used in the sportsfishing survey of the Biloxi Bay and the adjacent Mississippi Sound from July 1 to December 31, 1971.

MISSISSIPPI GULF COAST
SPORT FISH SURVEY

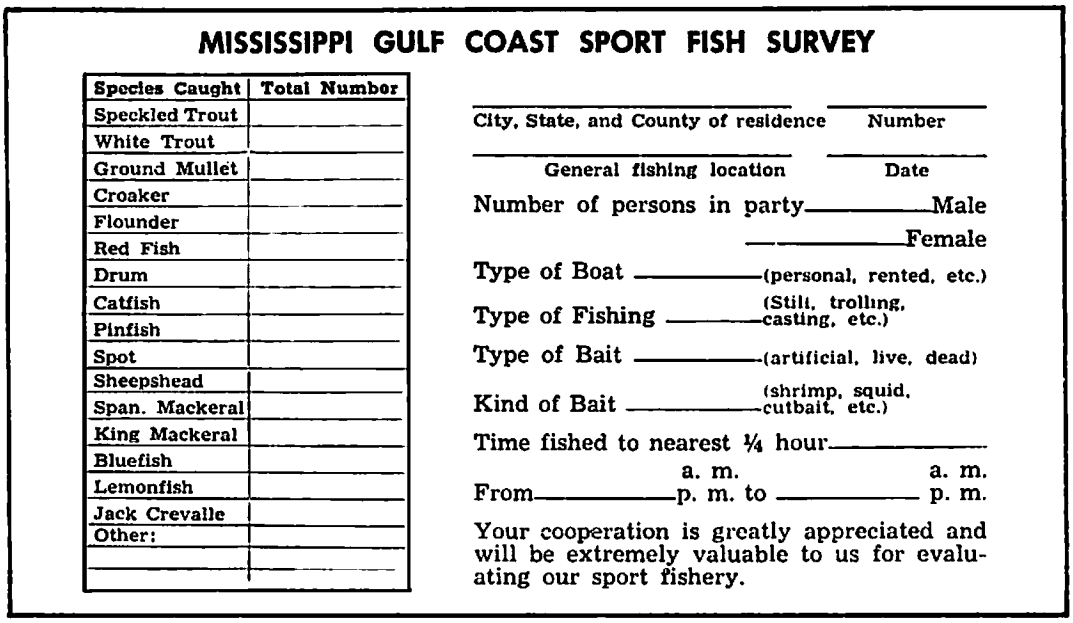
Number_____
Date_____
Residence(County or State)_____

Fishing Location_____
Number of persons in Party_____Male
_____Female
Type of Boat_____(Personal, rented, etc.)
Type of Fishing_____(Still, Trolling, Casting, etc.)
Type of Bait_____(Artificial, live, dead)
Kind of Bait_____
Particular Species fished for_____
Time fished to nearest 1/4th hour_____
A.M. A.M.
From_____P.M. to _____P.M.

Species Caught	Total Number	Average Length	Average Weight
Speckled Trout			
White Trout			
Ground Mullet			
Croaker			
Flounder			
Red Fish			
Drum			
Spanish Mackerel			
King Mackerel			
Blue Fish			
Lemon Fish			
Other			

Investigator_____
(Signature)

Figure III. A sample postcard questionnaire used in the sportsfishing survey of the Biloxi Bay and the adjacent Mississippi Sound from July 1 to December 31, 1971.



MISSISSIPPI GULF COAST SPORT FISH SURVEY

Species Caught	Total Number
Speckled Trout	
White Trout	
Ground Mullet	
Croaker	
Flounder	
Red Fish	
Drum	
Catfish	
Pinfish	
Spot	
Sheepshead	
Span. Mackeral	
King Mackeral	
Bluefish	
Lemonfish	
Jack Crevalle	
Other:	

City, State, and County of residence _____ Number _____

General fishing location _____ Date _____

Number of persons in party _____ Male

_____ Female

Type of Boat _____ (personal, rented, etc.)

Type of Fishing _____ (Still, trolling, casting, etc.)

Type of Bait _____ (artificial, live, dead)

Kind of Bait _____ (shrimp, squid, cutbait, etc.)

Time fished to nearest ¼ hour _____

From _____ a. m. p. m. to _____ a. m. p. m.

Your cooperation is greatly appreciated and will be extremely valuable to us for evaluating our sport fishery.

Table I. A list of the common species of fish caught by fishermen in Biloxi Bay and the adjacent Mississippi Sound from July 1 to December 31, 1971.

COMMON NAME	SCIENTIFIC NAME
SPOTTED SEA TROUT	*Cynoscion nebulosus* (Cuvier)
WHITE TROUT	*Cynoscion arenarius* (Ginsburg)
CROAKER	*Micropogon undulatus* (Linnaeus)
FLOUNDER	*Paralichthys lethostigma* (Jordon & Gilbert)
RED FISH	*Scianenops ocellata* (Linnaeus)
SEA CATFISH	*Arius felis*
GAFTOPSAIL CATFISH	*Bagre marinus* (Mitchill)
PINFISH	*Lagodon rhomboides* (Linnaeus)
PIGFISH	*Orthopristis chrysoptera* (Linnaeus)
TOAD FISH	*Opsanus tau* (Linnaeus)
SAND TROUT	*Cnyoscion nothus* (Holbrook)
CUTLASS FISH	*Trichiurus lepturus* (Linnaeus)
BLACK DRUM	*Pegonias cromis* (Linnaeus)
SHEEPSHEAD	*Archosargus probatocephalus* (Walbaum)
SPOT	*Leiostomus xanthurus* (Lacepede)
GROUND MULLET	*Menticirrhus americanus* (Linnaeus)
BLUE FISH	*Pomatomus saltatrix* (Linnaeus)
SPANISH MACKERAL	*Scomberomorus maculatus* (Mitchell)
LEMONFISH	*Rachycentron canadum* (Linnaeus)
JACK CREVALLE	*Caranx hippos* (Linnaeus)
LADYFISH	*Elops saurus* (Linnaeus)
ATLANTIC SPADEFISH	*Chaetodipterus faber* (Broussonet)
BONITA	*Sarda sarda* (Bloch)
SHARKS	*Carcharinus* spp.
RAYS	*Dasyatis* spp.
LARGEMOUTH BASS	*Micropterus salmoides* (Lacepede)
BLUE GILL	*Lepisosteus oculatus* (Winchell)
BLACK CRAPPIE	*Pomoxis nigromaculatus* (Le Sueur)
WHITE CRAPPIE	*Pomoxis annularis* (Rafinesque)
REDEAR SUNFISH	*Lepomis microlophus* (Gunther)
FRESH WATER CATFISH	*Ictalurus* spp.
AMERICAN EEL	*Anguilla rostrata* (Le Sueur)

Table II. Number of Fishermen, Hours Expended, Total Catch and Catch per Unit of Effort in the Mississippi Coast Sportsfishing

Month	Estimated No. of Fishermen	Total Fishermen Hours	Estimated Total Catch (lbs.)	Average Catch per Hour
November, 1971	3,092	10,977	28,211	2.6
December, 1971	886	2,186	5,312	2.4
January, 1972	–	–	–	–
February, 1972	–	–	–	–
March, 1972	–	–	–	–
April, 1972	–	–	–	–
May, 1972	403	1,170	2,325	2.0
June, 1972	870	3,060	4,710	1.5
July, 1972	1,364	5,580	8,339	1.5
August, 1972	713	3,069	5,239	1.7
September, 1972	630	2,850	6,900	2.4
October, 1972	961	4,433	5,022	1.1
November, 1972	390	2,070	1,830	.9
December, 1972	210	620	403	.7
January, 1973	93	155	31	.2
February, 1973	84	140	42	.3
Total	9,696	36,310	68,364	1.4 (average)

Table III. Composition of catches from the Mississippi Coast sportfishery and their respective percent composition

Species	Nov '71 #	%	Dec. #	%	Jan. #	%	Feb. #	%	Mar. #	%	Apr. #	%	May #	%	June #	%	July #	%	Aug #	%	Sep. #	%	Oct. #	%	Nov. #	%	Dec. #	%	Jan. '73 #	%	Feb. #	%	Total #	%
Spotted sea trout	270	37.76	159	35.49	-	-	-	-	-	-	-	-	146	12.22	133	5.28	348	8.08	135	5.00	115	8.12	173	5.92	58	7.99	73	37.44	-	-	23	74.19	1633	
White trout	146	20.42	89	19.87	-	-	-	-	-	-	-	-	77	6.44	549	21.80	1251	29.05	1181	43.74	530	14.28	1030	35.26	299	41.18	1	.51	-	-	-	-	5153	
Ground mullet	76	10.63	17	3.79	-	-	-	-	-	-	-	-	63	5.27	168	6.67	297	6.90	49	1.81	104	7.82	230	7.87	103	14.19	2	1.03	-	-	-	-	1109	
Croker	57	7.97	68	15.18	-	-	-	-	-	-	-	-	367	30.08	889	35.31	1394	32.37	672	24.89	2453	66.55	634	21.70	116	15.98	23	11.79	9	69.23	4	12.90	6786	
Flounder	52	7.27	33	7.37	-	-	-	-	-	-	-	-	13	1.09	36	1.43	69	1.60	26	.96	16	.43	42	1.44	7	.96	10	5.13	-	-	2	6.45	306	
Red fish	8	1.12	9	2.01	-	-	-	-	-	-	-	-	-	-	8	.32	114	2.65	51	1.89	47	1.28	93	3.18	16	2.20	5	2.86	-	-	1	3.23	352	
Cat fish	9	1.26	-	-	-	-	-	-	-	-	-	-	349	29.21	505	20.06	600	13.93	472	17.48	335	9.09	429	14.69	33	4.55	2	1.03	-	-	-	-	2734	
Pin fish	8	1.12	-	-	-	-	-	-	-	-	-	-	6	.50	68	2.70	57	1.32	16	.59	32	.87	119	4.07	26	3.58	2	1.03	-	-	-	-	334	
Black drum	25	3.50	16	3.57	-	-	-	-	-	-	-	-	24	2.00	33	1.31	44	1.02	33	1.22	4	.11	21	.72	26	3.58	11	5.64	-	-	-	-	237	
Sheepshead	20	2.80	48	10.71	-	-	-	-	-	-	-	-	8	.67	35	1.39	45	1.05	14	.52	17	.46	120	4.11	32	4.55	66	33.85	4	30.77	1	3.23	411	
Pig fish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	.20	-	-	1	.04	1	.08	4	.14	-	-	-	-	-	-	-	-	13	
Spot	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	.07	-	-	3	.10	-	-	-	-	-	-	-	-	5	
Sand trout	7	0.98	-	-	-	-	-	-	-	-	-	-	2	.17	19	.75	1	.02	-	-	1	.03	6	.21	-	-	-	-	-	-	-	-	38	
Oyster fish	4	0.56	-	-	-	-	-	-	-	-	-	-	15	1.26	42	1.67	6	.14	15	.56	9	.24	4	.14	-	-	-	-	-	-	-	-	95	
Cutlass fish	3	0.42	-	-	-	-	-	-	-	-	-	-	1	.08	-	-	-	-	-	-	-	-	2	.07	-	-	-	-	-	-	-	-	6	
Sharks	-	-	-	-	-	-	-	-	-	-	-	-	3	.25	12	.48	7	.16	-	-	-	-	1	.03	-	-	-	-	-	-	-	-	23	
Rays	-	-	-	-	-	-	-	-	-	-	-	-	7	.59	7	.28	2	.05	3	.11	-	-	-	-	8	1.10	-	-	-	-	-	-	27	
Spanish mackerel	3	0.42	-	-	-	-	-	-	-	-	-	-	-	-	1	.04	7	.16	12	.44	-	-	1	.03	-	-	-	-	-	-	-	-	24	
Blue fish	1	0.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	
Jack crevalle	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	.03	1	.03	-	-	-	-	-	-	-	-	2	
Lady fish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	.08	21	.49	17	.63	1	.03	-	-	-	-	-	-	-	-	-	-	41	
Gars	-	-	1	0.22	-	-	-	-	-	-	-	-	-	-	-	-	11	.26	-	-	1	.03	-	-	1	.14	-	-	-	-	-	-	14	
Spade fish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	.04	2	.05	-	-	10	.27	7	.24	-	-	-	-	-	-	-	-	20	
American eel	1	0.14	-	-	-	-	-	-	-	-	-	-	-	-	5	.20	12	.28	1	.04	2	.05	1	.03	-	-	-	-	-	-	-	-	22	
Largemouth bass	20	2.80	8	1.79	-	-	-	-	-	-	-	-	5	.42	-	-	14	.33	-	-	3	.08	-	-	-	-	-	-	-	-	-	-	50	
Redear sunfish	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Bluegill	3	0.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	
Crappie	2	0.28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	
Freshwater cat fish	-	-	-	-	-	-	-	-	-	-	-	-	8	.67	-	-	-	-	-	-	2	.05	-	-	-	-	-	-	-	-	-	-	10	
Striped bass	-	-	-	-	-	-	-	-	-	-	-	-	1	.08	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	
TOTAL	715	100.01	448	100.00									1195	100.00	2518	100.01	4196	100.01	2709	99.99	1685	100.00	2921	99.98	726	100.00	195	100.01	13	100.00	31	100.00	19,454	

Project No: R/F (2)-1

Title: Development of a Large-Scale, Minimum-Labor-Input System for Mass Rearing of *Crassostrea Virginica*

Principal Investigator: William H. Brown, Assistant Professor, Department of Agricultural and Biological Engineering, Mississippi State University;
C. David Veal, Agricultural and Biological Engineering, Mississippi State University

Oyster culture has been in progress for several centuries, but to a great degree private concerns in the United States still try to use and preserve the natural oyster beds. Forty years ago, Japan began growing oysters attached to ropes suspended from rafts or bouys. This utilization of the entire water column achieved an astounding increase in production. An average yield from a conventional bed is 600 pounds per acre, while the raft method yields as much as 16,000 to 32,000 pounds per acre. In addition to increased production, oysters are not subjected to bottom predators or other unfavorable bottom conditions.

During recent years the larger oyster production areas of the Atlantic and Gulf Coasts have been threatened by pollution of the oyster beds and by increasing use of these areas for other activities. During this time, several studies have indicated that off-bottom oyster production is feasible. Disease problems were reduced and high growth rates were noted in several cases. Each of these studies was conducted, however, on a small scale requiring large labor inputs which were deterrent to economical operations. A large scale support system to take advantage of off-bottom culture utilizing a high percentage of the water column and designed so that labor inputs are minimized seems desirable and feasible. The system as conceived and developed in this program must, in addition to being economically feasible, be unobjectionable to the public by eliminating the unsightly use of racks in tidal waters or floating barges in deep water.

The objective of this research project was to develop and evaluate a structural design and materials specifications for a submergible vessel capable of off-bottom support of growing oysters on a large scale. To achieve this objective, artificial cultch material was collected and screened for suitability. The criteria for acceptance was a combination of high strength and light weight, a resistance to fouling, and the ability to hold the oyster until it reaches marketable size. In addition, the material must be reusable or must have a low market value.

Cultch test vehicles were constructed and evaluated in 1971 and 1972. Each of the units accommodated 24 materials to be evaluated as artificial cultch test specimens. The site of the placement of the CTV's was in Biloxi Bay near the Gulf Coast Research Laboratory's Pier. The depth of the water was 6 ½ to 8 feet depending upon tidal flow. Tidal flow at the site was approximately 3 knots. Late summer spawning failed to produce a significant spat set. Spat were observed, however, in sizable numbers in sheltered areas of the CTV's, suggesting that it may be necessary to obtain a spat set in a location with little tidal flow, then move the production vessels to areas of more rapid tidal flow where more favorable growth rates would be obtained. Inspection of the CTV's in the latter part of 1971 disclosed severe problems with fouling from barnacles, hydroids, and other marine organisms.

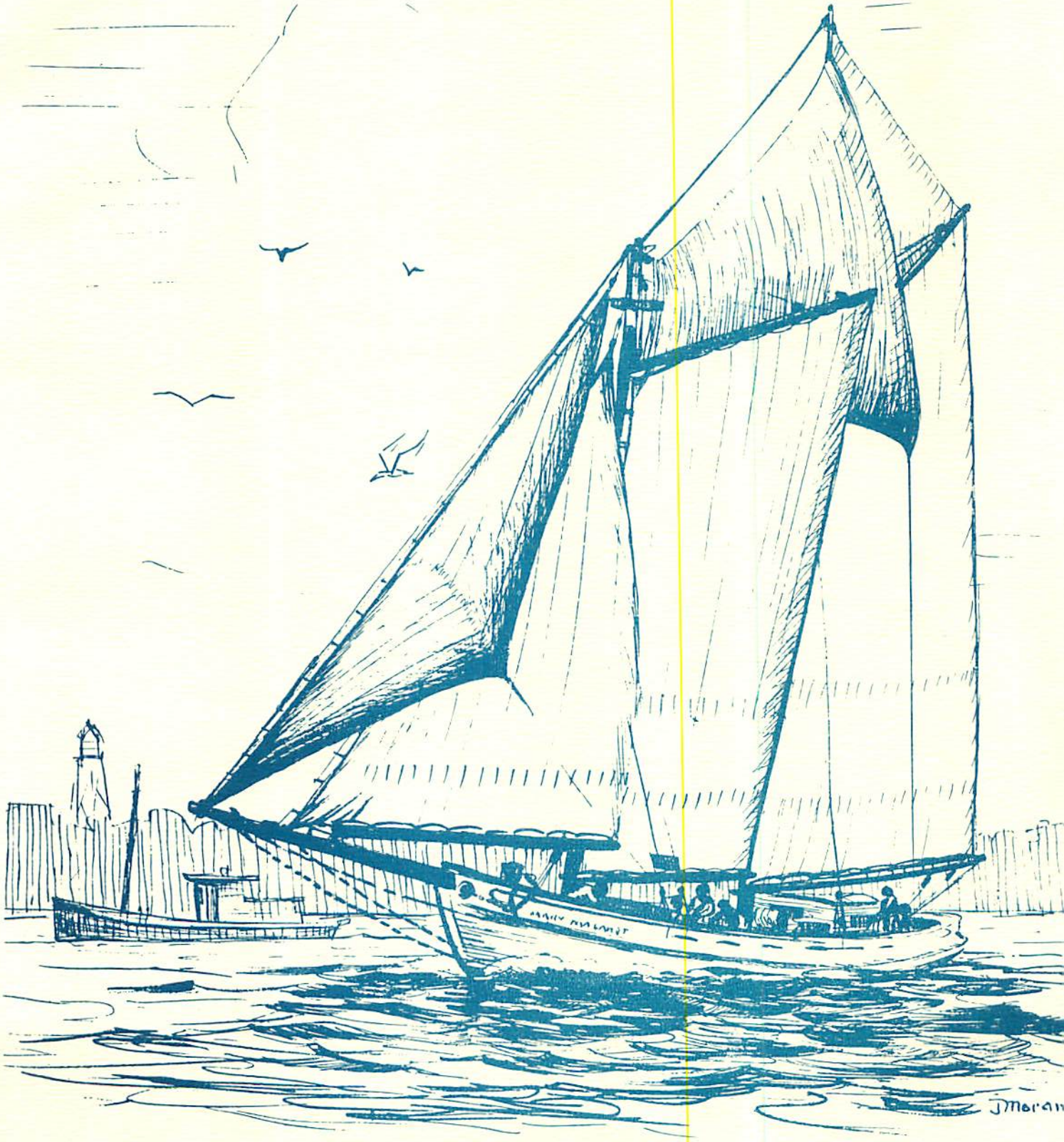
During 1972 the CTV's were placed in different test locations on the Mississippi Coast, but they were separated by approximately 30 miles. One CTV was located near Pascagoula with little or no tidal flow, the other CTV was located near the previous site in Biloxi Bay. Very good spat sets were obtained in June and again in August, September and November; however, the majority of each set disappeared at some time between the monthly inspections. Moderate infestation of oyster drills and marine flatworms were noted. Oyster

drills prey on large oysters, and flatworms feed on the oyster spat.

It is the opinion of the investigators that in order for off-bottom oyster culture to be successful in the warmer waters of the south, that a system must be developed for setting spat on the most desirable materials in a controlled, predator-free environment and allowing them to reach a size of 5 - 10 millimeters. From this protected area the spat would be moved to the CTV's located in the growing areas. These areas should have tidal flows of 3 to 5 knots or higher for optimum growth. It is estimated that an oyster would reach marketable size in 10 to 12 months in waters on the Mississippi Coast. Allowing the spat to set in a controlled environment would eliminate competition from flatworms, barnacles, and other competing predatory organisms. In addition, a controlled spat set could be obtained in order to produce a more desirable oyster from the size and shape standpoint, since single oysters are more desirable for the half-shell market. Data collected during previous summers indicates that yields as high as 3 bushels per 8 square feet of surface bottom could be attained with relative ease, as compared with yields of 1 bushel per 64 square feet for the rare areas of extremely high natural production.

The objective of this project was accomplished. It was determined that oysters will attach to and grow on several materials tested, and significant progress was made in the design and testing of the CTV's.

INDUSTRIAL/SOCIO-POLITICAL DEVELOPMENT



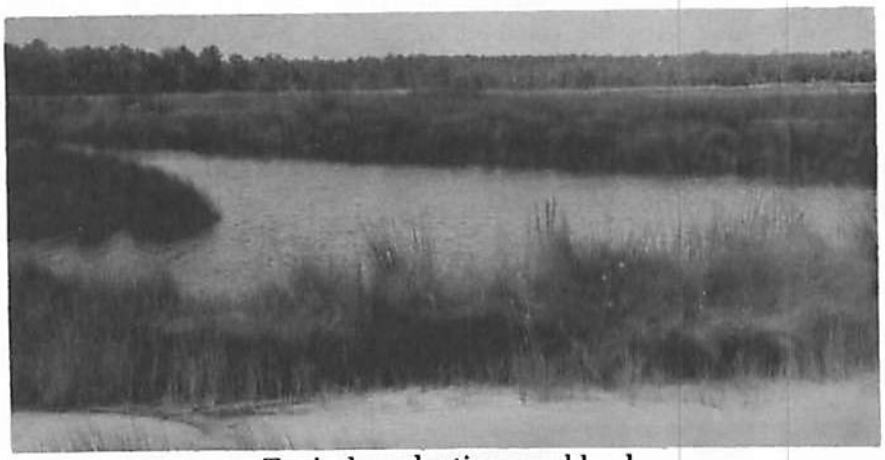
Project No: R/E-1

Title: The Importance of Estuaries to the Mississippi Gulf Coast and the Establishment of Protective Legislation

Principal Investigator: Clyde E. Cook, Chairman, Department of City Planning, University of Mississippi

The purpose of this study was to determine the need and feasibility of land use and environmental controls to protect Mississippi's coastal environment. Particular attention and emphasis were given to methods for protecting the aesthetic values, quality of living, and economic welfare of the coastal zone. In the absence of such standards and controls, our coastal tidelands have been consumed by urban development at an alarming rate. Courted for so long by local officials as economic panaceas, population increases and poorly planned industrial expansion, in concert with a loosely defined state policy toward the use of coastal lands, have begun to handicap the economies they were supposed to enhance; the law of diminishing returns is actively present. Analysis of how the coastal zone's aesthetics, living quality, and economy is being handicapped by these elements was the major objective of this study.

The importance of the tidal marshlands becomes immediately apparent when we consider that at least 95% of Mississippi's coastal fishery resources are estuarine dependent for at least part of their life cycle. Thus, if the productivity of this state's coastal waterbodies is destroyed or altered, the tourist and fishing industries must immediately suffer, not to mention concomitant losses of aesthetic and recreational values.



Typical productive marshland

To fully appreciate the concentration of wealth in Mississippi's coastal zone, we need only consider that in 1970 these waters produced 3,200,000 pounds of fish per linear mile. In economic terms, Mississippi's fishing industry has in recent years represented an $11,000,000 annual dockside value of all landings.

In 50 years alone, we are speaking in terms of $550,000,000 if existing production can be sustained. This monetary figure does not take into consideration the tourist industry and employment associated with the fishery business. A dollar value of $400 per acre average annual productive value in a healthy natural state has been placed on the tidal marshlands. This figure is probably low, since the tidelands' value in a healthy natural state must be measured considering their potential productivity many years hence. Without the institution of adequate conservation procedures, however, ultimately the environmental integrity of the coastal zone will be destroyed, and it will become less attractive to industry and people.

Wild alligator in a Mississippi salt marsh

The single most destructive act within the coastal zone has been the extensive filling and dredging in the tidal marshlands, for these acts represent absolutely irrevocable damage to the estuarine ecology; the productive capacity of these waterbodies is gone forever. And, of course, we do not have the capacity to build or construct a marshland. Further, the impact of this encroachment on the life cycles of varied animal and marine species is not yet fully understood. We do not know enough about dynamic circulation, flushing time, dilution factors, dilution distribution, and thus the ultimate disposal of effluents from industry and people, and the total assimilative capacity of estuaries and other waterbodies. Therefore, destruction should be kept at a minimum until more answers are found.

Destruction of a salt marsh

Heretofore the tidal marshlands have been considered wastelands, and have been treated as such. Industrial, commercial, and real estate concerns, with encouragement from local governing bodies, have historically treated the state's tidal marshlands as marginal land to be used for deposition of dredging spoilage and for industrial and residential reclamation projects. Essentially, this comprises a trade-off or sacrifice of marshland production for industrial and residential expansion. In this context, a revaluation of Mississippi's goals and objectives, with greater consideration given to conservation of the coastal zone's natural resources, must be forthcoming. When considering tidal marsh protection measures, it is important to remember that we are speaking of an intrinsically rare commodity; a resource which, unaided, is continually renewing itself.

Mississippi's estuarine areas are beginning to receive the emphasis and consideration they deserve in terms of their economic and aesthetic values to coastal residents, in particular. However, many issues of critical concern still reamin.

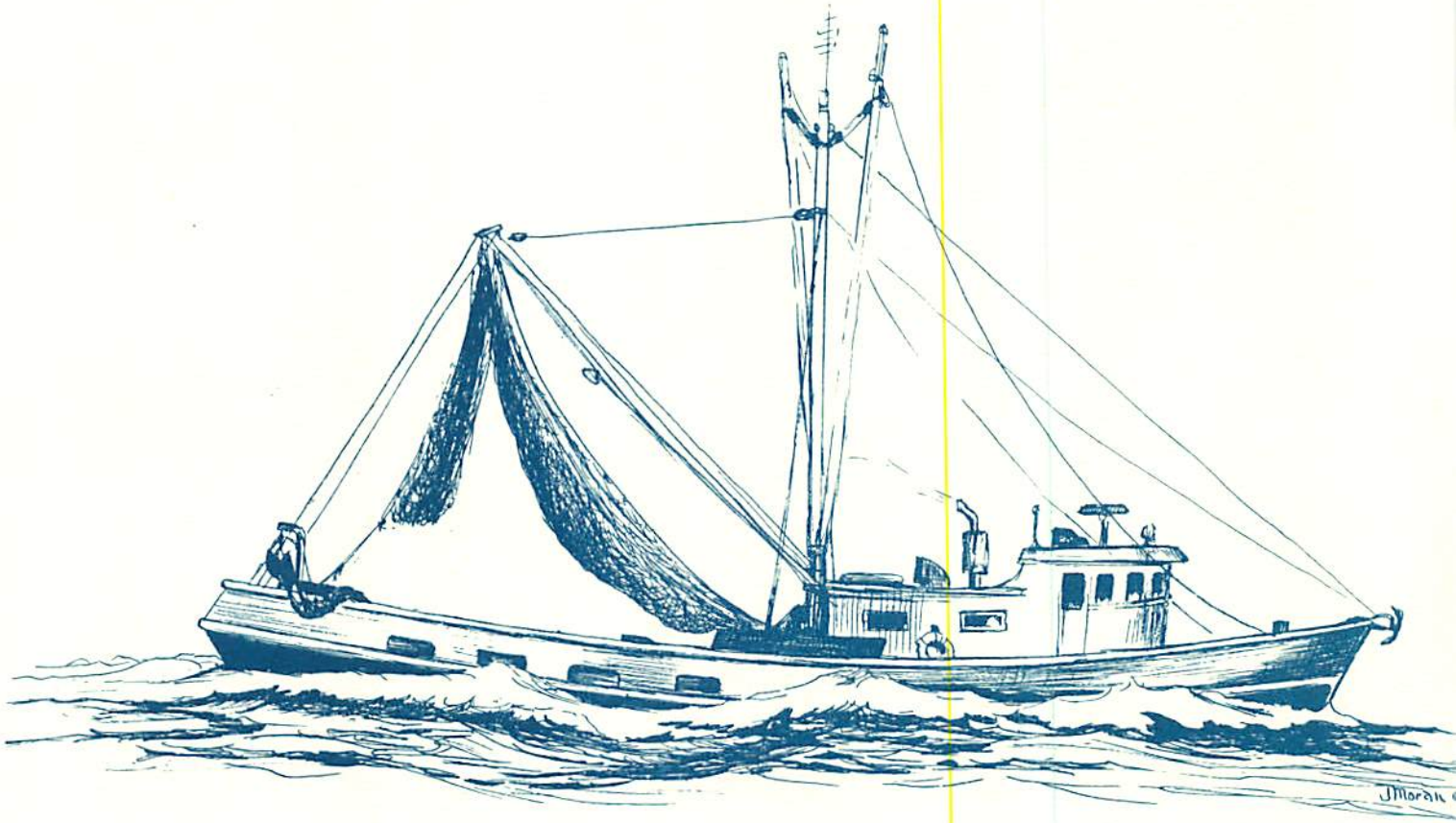
For instance, one cannot overstate the importance to a community of an abundance of fresh water for industrial and domestic use. The marshlands of the estuaries play a prominent role in preventing the intrusion of salt water into the aquifers which presently furnish most of the domestic water supply. Voluminous quantities of water will be necessary for present and projected industrial development in this region, but problems have already been encountered with the supply of the Escatawpa and East Pascagoula River sections. New industries are being planned along the proposed Harrison County Industrial Waterway. The resulting intrusion of population to meet new labor market demands will help push the population of Harrison, Hancock, and Jackson Counties to some 550,000 by 1990. This projected growth will more than double the strain on the present water supply. Underground water reserves are already inadequate for industrial needs, and possibilities of surface storage to meet future demands are under investigation. In brief, without adequate tidal marsh conservation procedures, only about 50% of the fresh water to be needed in 1990 will be available.

Based upon the vast amount of information and data which was drawn upon to prepare this study, it is obvious that little attention has been given to the true value of the tidal marshlands. The desire for an immediate profit has in many cases destroyed a far greater future profit potential. For thousands of years, our estuarine resources have displayed a remarkable ability to resist all types of pollution, but it is now obvious that with continual encroachment the battle is slowly being lost. With the destruction of the tidal marshlands, the demise of the seafood and tourist industries will soon follow.

Irreparable damage done to a salt marsh

The results of this research project have been manifest in three areas: First, the public sector has been made aware of the value of the tidal marshlands. The notion has been dispelled that the marshes are wastelands, and their true value as a precious and irreplacable natural resource has been publicized. Second, a new Sea Grant Project has been initiated to study the current regime and exchange characteristics of the Pascagoula river and adjacent Mississippi Sound. This study will provide information on the circulation of domestic and industrial effluents in these waterbodies and their influence on the estuarine environment. Third, and probably most important of all, several farsighted coastal legislators, realizing that coastal zone management problems fall into the political sphere, fought an uphill battle for more than two years before the legislature of the State of Mississippi passed a Wetlands Bill to drastically curtail encroachment into the tidal marshlands.

ADVISORY SERVICES



Project No: A/ (4)-1
Title: Public Information and Education
Principal Investigator: L. O. Paulette, Leader, Sea Grant Advisory Service

The Mississippi Gulf Coast constitutes a metropolitan area with a population of over 200,000. Population expansion in this region has manifested three major problem areas: Increased demands for outdoor recreational opportunities; a constant encroachment into estuaries and marshlands by subdivisions and industry; and an ever increasing pollution problem provoked by a lack of understanding of the effect new public facilities and services have on the estuaries and water resources of the area.

In such a fast growing community as the Gulf Coast of Mississippi, it is imperative that the public have a good understanding and appreciation of their marine resources and of the contribution these resources make to the quality of the Gulf Coast environment. The people must be able to evaluate the true worth of these resources and to recognize the dangers which threaten them. In addition, they must have the means to make their feelings known to those decision makers who are concerned with the development of the marine environment.

For information to be fully utilized by the public and industry, it must be secured, understood, accepted, and applied to their conditions. Information stored in files, research data unpublished, and all information not utilized by the target audience is worthless.

In an effort to provide the advisory services required to meet the needs of the Coastal Zone, the Universities Marine Center, in conjunction with the Mississippi Cooperative Extension Service, proposed to conduct a Marine Education Program. The overall objective of this Program was "The Maximum Utilization of Our Marine Resources."

The Sea Grant Advisory Service Program is now in full operation. The first year has been a valuable one in establishing Advisory Service operations, identifying and establishing communications with the various marine audiences, and in conducting marine education programs.

Lessons in boating safety are provided for young people

The stated objectives of this broad program were: (1) to achieve a public awareness of the seriousness of pollution and to provide information important for the preservation of our marine resources; (2) to establish a public awareness of the value and situation of our estuaries; (3) to assist young people and adults in becoming aware of fishing potentials; (4)

to identify various marine audiences; (5) to assist in establishing the identity of Sea Grant and the Advisory Services; (6) to conduct workshops for leaders in marine conservation; (7) to increase the appreciation for our marine recreational resources and the skills necessary for their enjoyment; (8) to hold workshops for young people in marine conservation; (9) to conduct seafood training for Extension home economists and homemakers; (10) and to continue to publicize our marine recreational resources.

To achieve the objective of creating a public awareness of pollution, the Advisory Service conducted presentations via radio and television and held a workshop for Extension agents in the 21 southeast Mississippi counties. Pollution caused by agricultural chemicals and feedlot operations and methods for use in overcoming these problems were emphasized.

The Advisory Service published a quarterly newsletter to disseminate information of the value and the critical situation in the estuaries. Programs were given to civic clubs, governmental organizations and school groups on the preservation and importance of the wetlands.

Fishing and conservation clinics were conducted in the coastal counties to create an awareness of our marine recreational opportunities and to increase the skills of our young people. Information and demonstrations were given to 1400 young people. Advisory personnel and local sports personalities participated in these clinics.

Young people are taught the proper method for bait casting

The Advisory Service revised the very popular Sea Grant information brochure, "Enjoy Your Leisure . . . Go Fishing." Twenty-two thousand additional copies were printed, bringing the total to forty-two thousand. These were distributed by chambers of commerce, hotels and motels, Extension Service, and tourist related enterprises.

Work progressed rapidly on the identification of marine audiences. The Advisory Service secured a list of all fishermen holding commercial licenses. Thirty-seven hundred hold licenses for either shrimping, oystering, crabbing, bait dealing, fishing (including menhaden) and seafood dealing in the coastal area. These were identified by type of license and size of boat. These receive newsletters and consult with the Advisory Service on their problems.

An "Old Pro" demonstrates the proper way to bait a hook

Newsletters, news articles, television, radio and personal contacts were used to establish an identity for Sea Grant and the Advisory Service. Three newsletters reaching marine audiences in Mississippi and Sea Grant people around the country were mailed to twenty-five hundred people on the regular mailing list.

The Sea Grant Advisory Service office was established in a central location on the Mississippi Gulf Coast to facilitate personal contact with the various individuals in marine related enterprises who desire to discuss problems or exchange information.

A workshop for extension leaders in the 21 southern counties was conducted to create an awareness of the marine situation and to disseminate information they could use in conducting workshops and conservation clinics in their respective counties.

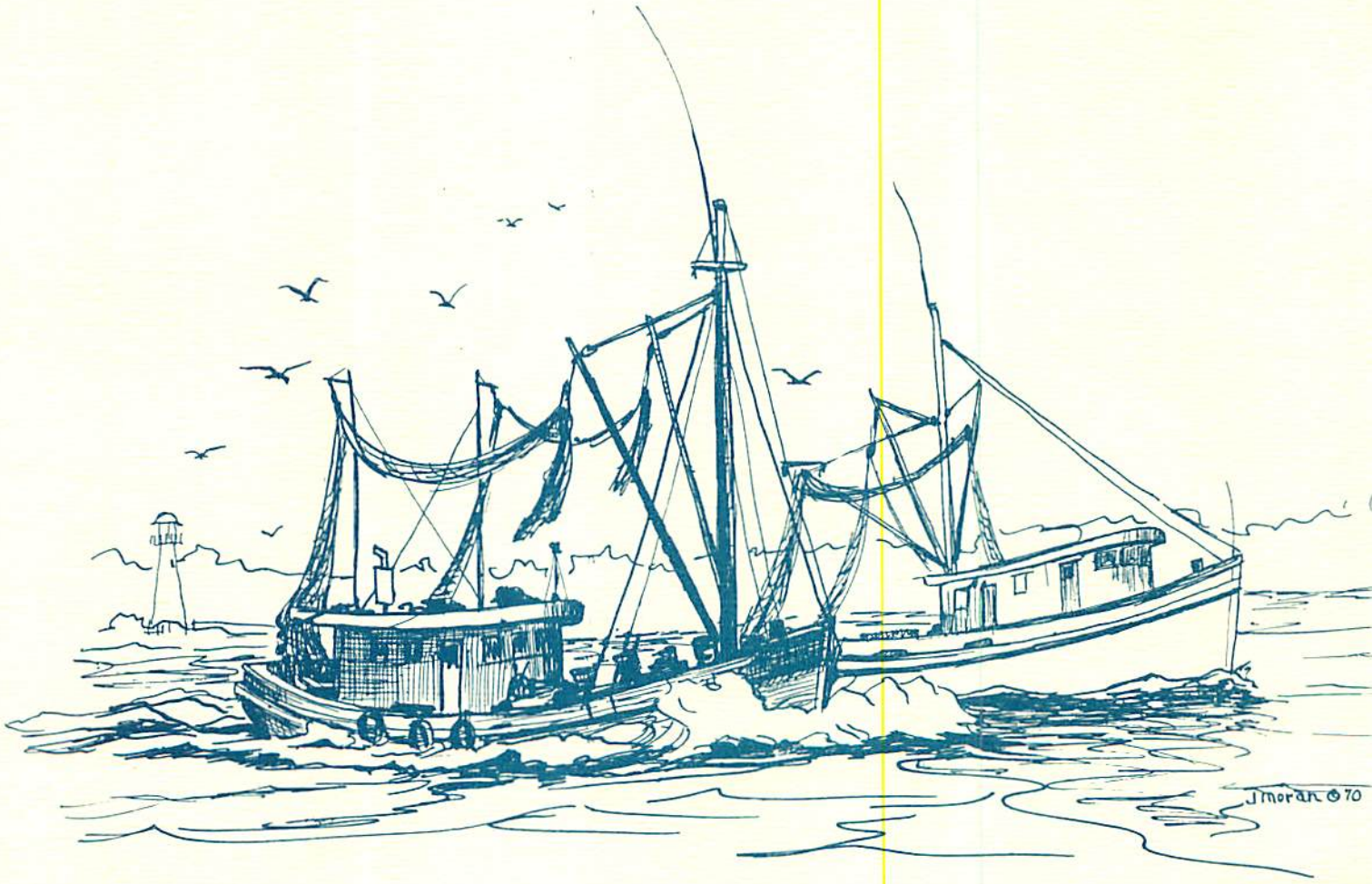
The Advisory Service sponsored and conducted a seafood training program for our Extension home economists. The information presented during the workshop was used by home economists throughout the state in training programs.

The Advisory Service team was made complete when Dr. C. David Veal joined the staff early in 1973.

ACTIVITY SHEET

And

SEA GRANT PUBLICATIONS



ACTIVITY SHEET

	NOAA Sea Grant	Matching
PROGRAM MANAGEMENT AND DEVELOPMENT		
Program Administration	$ 9,561	$ 47,276
Program Development	29,301	29,025
MARINE RESOURCES DEVELOPMENT		
Aquaculture	10,583	15,476
Marine Law and Socio-Economics	54,899	36,386
MARINE TECHNOLOGY RESEARCH AND DEVELOPMENT		
Ocean Engineering	126,865	30,503
MARINE ENVIRONMENTAL RESEARCH		
Research and Studies in Direct Support of Coastal Management Decisions	284	1,054
Ecosystems Research	94,445	99,305
MARINE EDUCATION AND TRAINING		
College Level	120	2,528
ADVISORY SERVICES		
Other Advisory Services	7,406	22,388
TOTALS	$333,464	$283,941

This summary is only approximate. The official financial report will be submitted to NOAA's Office of Sea Grant Programs in accordance with the federal grant requirements.

MISSISSIPPI SEA GRANT PUBLICATIONS

1. Benton, Richard, Bartlett, F. G., Bryant, G. D., and Killen, H. B. "Rufas II, Phase I, "Institute of Engineering Technology, Mississippi State University, Mississippi State, Mississippi, November, 1971. Publication No. MSGP-71-001.
2. Cook, Clyde E. and Bridges, Michael L. "The delineation of and factors affecting Mississippi coastal tidal marshes," (with assistance from Thomas J. Brooks, III, Gerald Langston, Jr., N. B. Carl Laurent, and Michael L. Person). University of Mississippi, University, Mississippi, November, 1971. Publication No. MSGP-71-002.
3. Brown, William H., Veal, C. David, and Demoran, William J. "Mississippi oyster culture research: A progress report," Mississippi State University, Mississippi State, Mississippi, February, 1972. Presented at the Southeast Regional Meeting of the American Society of Agricultural Engineers, Richmond, Virginia, February 13-16, 1972. Publication No. MSGP-72-001.
4. "Mississippi Sea Grant newsletter," No. 1, Spring, 1972. Publication No. MSGP-72-002.
5. Graves, J. O., Jr. "Enteric bacteriophages in St. Louis Bay, Mississippi," University of Mississippi, University, Mississippi, May, 1972. (Master's thesis). Publication No. MSGP-72-003.
6. Magnoli, Michael A. "Amino acids associated with selected algal whole cell, Algal Inhibition Proteins, Cell Wall Peptides and Mucopolymers," University of Southern Mississippi, Hattiesburg, Mississippi, August, 1972. (Master's thesis). Publication No. MSGP-72-004.
7. "Enjoy your leisure – go fishing!" Publication No. MSGP-72-005.
8. Deegan, Uwe Fred. "Applied mathematical modeling of the oxygen distribution in a Mississippi stream," Graduate School, University of Southern Mississippi, August, 1972. (Master's thesis). Publication No. MSGP-72-006.
9. "Mississippi-Alabama Sea Grant newsletter," No. 2, Winter, 1972. Publication No. MSGP-72-007.
10. Brent, Charles R. and Tyvoll, John L. "Interpretation of environmental data for public consumption," Chemistry Department, University of Southern Mississippi, Hattiesburg, Mississippi, November, 1972. Presented at the 24th Southeastern Regional Meeting of the American Chemical Society, Birmingham, Alabama, November, 1972. Publication No. MSGP-72-008.
11. Bergin, W. A. and Brent, Charles R. "An improved method for the determination of total, organic carbon in estuarine sediments," Department of Chemistry, University of Southern Mississippi, Hattiesburg, Mississippi, November, 1972. Presented at the 24th Southeastern Regional Meeting of the American Chemical Society, Birmingham, Alabama, November, 1972. Publication No. MSGP-72-009.
12. Brent, Charles R., Tyvoll, John L. and Williams, Howard P. "Inexpensive water samplers," Chemistry Department, University of Southern Mississippi, Hattiesburg, Mississippi, November, 1972. Presented at the 24th Southeastern Regional Meeting of the American Chemical Society, Birmingham, Alabama, November, 1972. Publication No. MSGP-72-010.
13. Veal, David, Brown, William H. and Demoran, William J. "Developments in off-bottom oyster culture in Mississippi," Mississippi State University, Mississippi State, Mississippi, December, 1972. Presented at the Winter meeting of the American Society of Agricultural Engineers, Chicago, Illinois, December, 1972. Publication No. MSGP-72-011.

14. Williams, D. C. "Establishment of an ongoing Sea Grant Program in marine problems as they relate to industrial and socio-political development of the Gulf Coast Region, Phase III, index of publications relative to the Mississippi Gulf Coast," Bureau of Business Research, University of Southern Mississippi, Hattiesburg, Mississippi, December, 1972. Publication No. MSGP-72-012.

15. Jackson, Gerry A. "A sportsfishing survey of Biloxi Bay and the adjacent Mississippi Sound," Department of Wildlife and Fisheries, Mississippi State University, Mississippi State, Mississippi, December, 1972. (Master's thesis). Publication No. MSGP-72-013.

16. Roush, Donald Howell. "Actinomycetales isolated from Saint Louis Bay, Mississippi," the University of Mississippi, University, Mississippi, December, 1972. (Master's thesis). Publication No. MSGP-72-014.

17. "Progress report of the Mississippi Sea Grant Program", period of June 1, 1971, through October 31, 1971. January, 1973. Publication No. MSGP-73-001.

18. de la Cruz, A. A. "The role of tidal marshes in the productivity of coastal waters," Department of Zoology, Mississippi State University, Mississippi State, Mississippi, March, 1973. Paper presented at 37th Meeting of Mississippi Academy of Sciences, Biloxi, Mississippi, March 15-17, 1973. Publication No. MSGP-73-002.

19. Cook, David W. "Water bacteriology of St. Louis Bay, Mississippi," Gulf Coast Research Laboratory, Ocean Springs, Mississippi, March, 1973. Presented at the Mississippi Academy of Sciences meeting in Biloxi, Mississippi, March 16, 1973. Publication No. MSGP-73-003.

20. Maraist, Frank L. and Gorove, Stephen. "Laws relating to environmental control – part one of two parts," Preliminary Draft, Law Center, University of Mississippi, University, Mississippi, 1973. Publication No. MSGP-73-004.

21. Maraist, Frank L. and Gorove, Stephen. "Laws relating to environmental control – part two of two parts," Preliminary Draft, Law Center, University of Mississippi, University, Mississippi, 1973. Publication No. MSGP-73-005.

22. Maraist, Frank L. and Gorove, Stephen. "Laws relating to general administration and management," Preliminary Draft, Law Center, University of Mississippi, University, Mississippi, 1973. Publication No. MSGP-73-006.

23. Maraist, Frank L. and Gorove, Stephen. "Laws relating to industrial and agricultural activities," Preliminary Draft, Law Center, University of Mississippi, University, Mississippi, 1973. Publication No. MSGP-73-007.

24. Maraist, Frank L. and Gorove, Stephen. "Laws relating to navigation," Preliminary Draft, Law Center, University of Mississippi, University, Mississippi, 1973. Publication No. MSGP-73-008.

25. Maraist, Frank L. and Gorove, Stephen. "Laws relating to living resources," Preliminary Draft, Law Center, University of Mississippi, University, Mississippi, 1973. Publication No. MSGP-73-009.

26. Maraist, Frank L. and Gorove, Stephen. "Laws relating to recreational activities," Preliminary Draft, Law Center, University of Mississippi, University, Mississippi, 1973. Publication No. MSGP-73-010.

27. Maraist, Frank L. and Gorove, Stephen. "Laws relating to mineral and other non-animal resources," Preliminary Draft, Law Center, University of Mississippi, University, Mississippi, 1973. Publication No. MSGP-73-011.

28. Maraist, Frank L. and Gorove, Stephen. "Laws pertaining to property," Preliminary Draft, Law Center, University of Mississippi, University, Mississippi, 1973. Publication No. MSGP-73-012.

29. de la Cruz, A. A. and Gabriel, B. C. "Caloric, elemental, and nutritive value changes in decomposing *Juncus roemerianus* leaves," Department of Zoology, Mississippi State University, Mississippi State, Mississippi, April, 1973. Paper presented at 34th Annual Meeting of Southeastern Biologists, Bowling Green, Kentucky, April 12-14, 1973. Publication No. MSGP-73-013.

30. Gabriel, B. C. and de la Cruz, A. A. "Particulate organic matter in St. Louis Bay salt marsh estuary," Department of Zoology, Mississippi State University, Mississippi State, Mississippi, April, 1973. Paper presented at the 34th Annual Meeting of the Association of Southeastern Biologists, Bowling Green, Kentucky, April 12-14, 1973. Publication No. MSGP-73-014.

31. "Mississippi-Alabama Sea Grant Consortium, April, 1973. Publication No. MSGP-73-015.

32. Hudson, Donald K. "Effects of mercury compounds on algae," University of Southern Mississippi, Hattiesburg, Mississippi, May, 1973. (Master's theis). Publication No. MSGP-73-016.

33. Lewis R. E., Jr., "Anaerobes isolated from St. Louis Bay, Mississippi," the University of Mississippi, University, Mississippi, May, 1973. (Master's thesis). Publication No. MSGP-73-017.

34. Bennett, James. "Notes of life history and food of the longnose killifish *Fundulus similis* (Baird and Girard) in St. Louis Bay, Mississippi," Mississippi State University, Mississippi State, Mississippi, May, 1973. (Master's thesis). Publication No. MSGP-73-018.

35. Fleming, Nicholas A. "Identification, periodicity and control of algae in managed ponds," University of Southern Mississippi, Hattiesburg, Mississippi, 1973. (Master's thesis). Publication No. MSGP-73-019.

36. de la Cruz, A. A. and Gabriel, B. C. "Species composition, standing stock and production of a salt marsh community in Mississippi," Department of Zoology, Mississippi State University, Mississippi State, Mississippi, 1973. Paper to be presented at 1973 Ecological Soc. Amer. (w/AIBS) Meeting, Amherst, Massachusetts, August, 1973. Publication No. MSGP-73-020.

37. Gabriel, B. C. "Composition, production, decomposition, transport and utilization of marsh plant detritus in a Mississippi salt marsh-estuary," Ph.D. Dissertation, Mississippi State University, Mississippi State, Mississippi, August, 1973. Publication No. MSGP-73-021.

38. Guy, William V. "Seasonal distribution of benthic organisms of St. Louis Bay, Mississippi," University of Southern Mississippi, Hattiesburg, Mississippi. Master's thesis. (In progress). Publication No. MSGP-73-022.

39. "Annual Report of the Mississippi Sea Grant Program," period of November 1, 1971, through February 28, 1973. Publication No. MSGP-73-023.

40. "Mississippi-Alabama Sea Grant newsletter," No. 3, Spring, 1973. Publication No. MASGP-73-001.

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