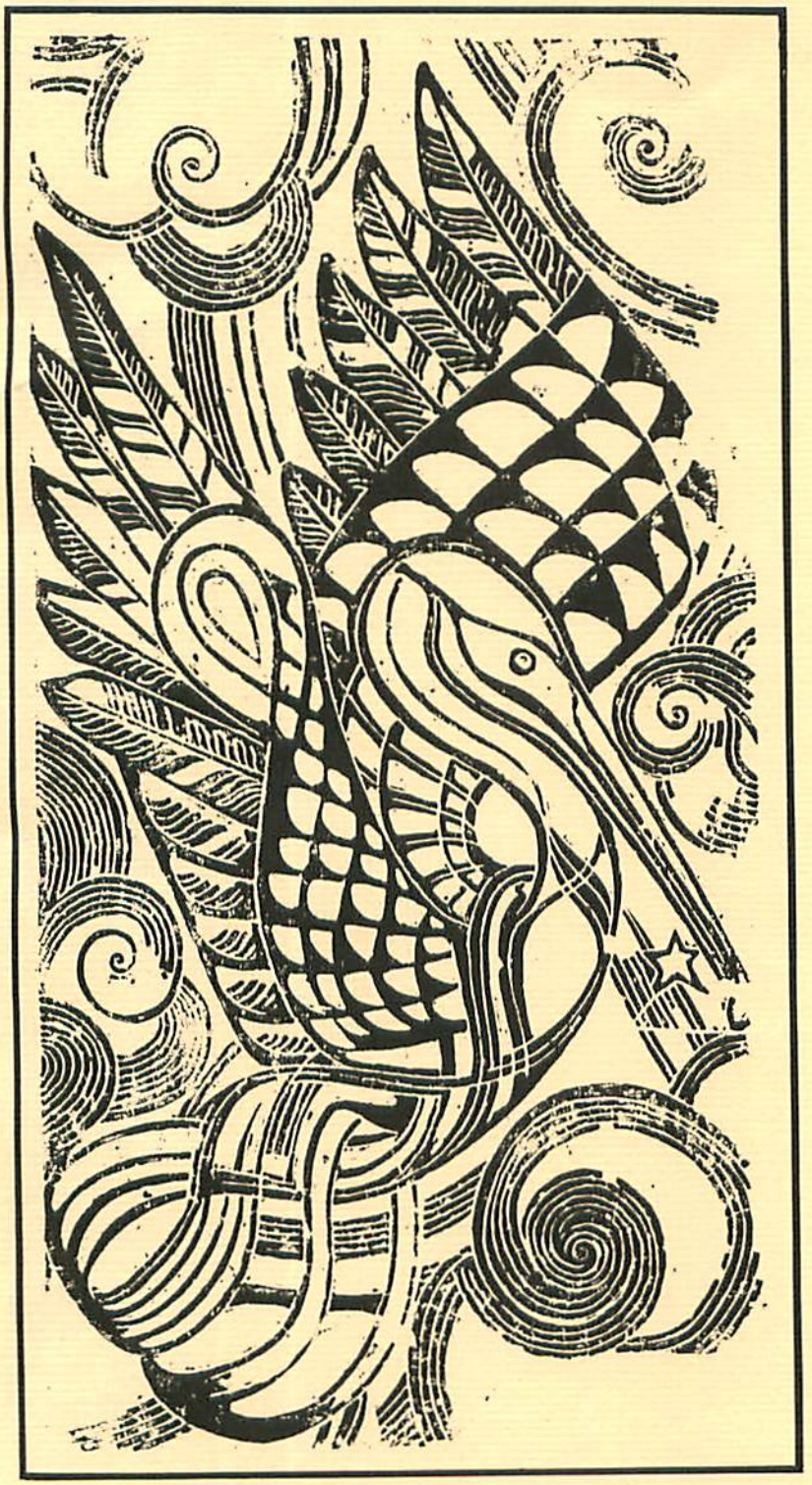

1977 ANNUAL REPORT
MISSISSIPPI-ALABAMA SEA GRANT CONSORTIUM
JANUARY 1, 1977 TO JUNE 30, 1978

MASGP-78-028

MISSISSIPPI-ALABAMA SEA GRANT CONSORTIUM
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Assistant Director for Administration	Ms. Dianne Jones
Coordinator of Coastal Zone Management Activities	Mr. J. Baron McIlwain
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1977 ANNUAL REPORT
MISSISSIPPI-ALABAMA SEA GRANT CONSORTIUM

Mississippi-Alabama Sea Grant Consortium
P.O. Drawer AG
Ocean Springs, MS. 39564
601-875-9341

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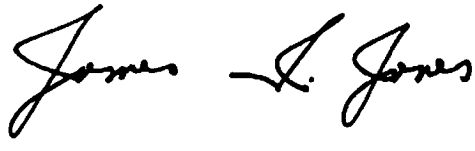
PREFACE

This 1977 Annual Report marks the completion of the early experimental development phase of the Mississippi-Alabama Sea Grant Consortium. During this period a number of varied management and administrative mechanisms have been tried, most to be later modified or abandoned. The difficulties of managing a two state program, encompassing nine distinct research institutions spread over an area of almost 100,000 square miles are formidable indeed. This "incubation period" was essential to arriving at a point of development in which program management and administration could be achieved both effectively and efficiently, at a realistic cost, while producing significant research, education and other products. That this has been accomplished is evident by a review of the progress of the program as this is being written, some months following the completion of the 1977 effort. In early 1977, under new leadership, the program was charged with developing a more focused direction, increased research capability and versatility, with more responsive and effective management techniques. Partial documentation of the success in addressing these charges lies in the recently announced elevation of the program to Institutional status, and in the coincident major federal support increase.

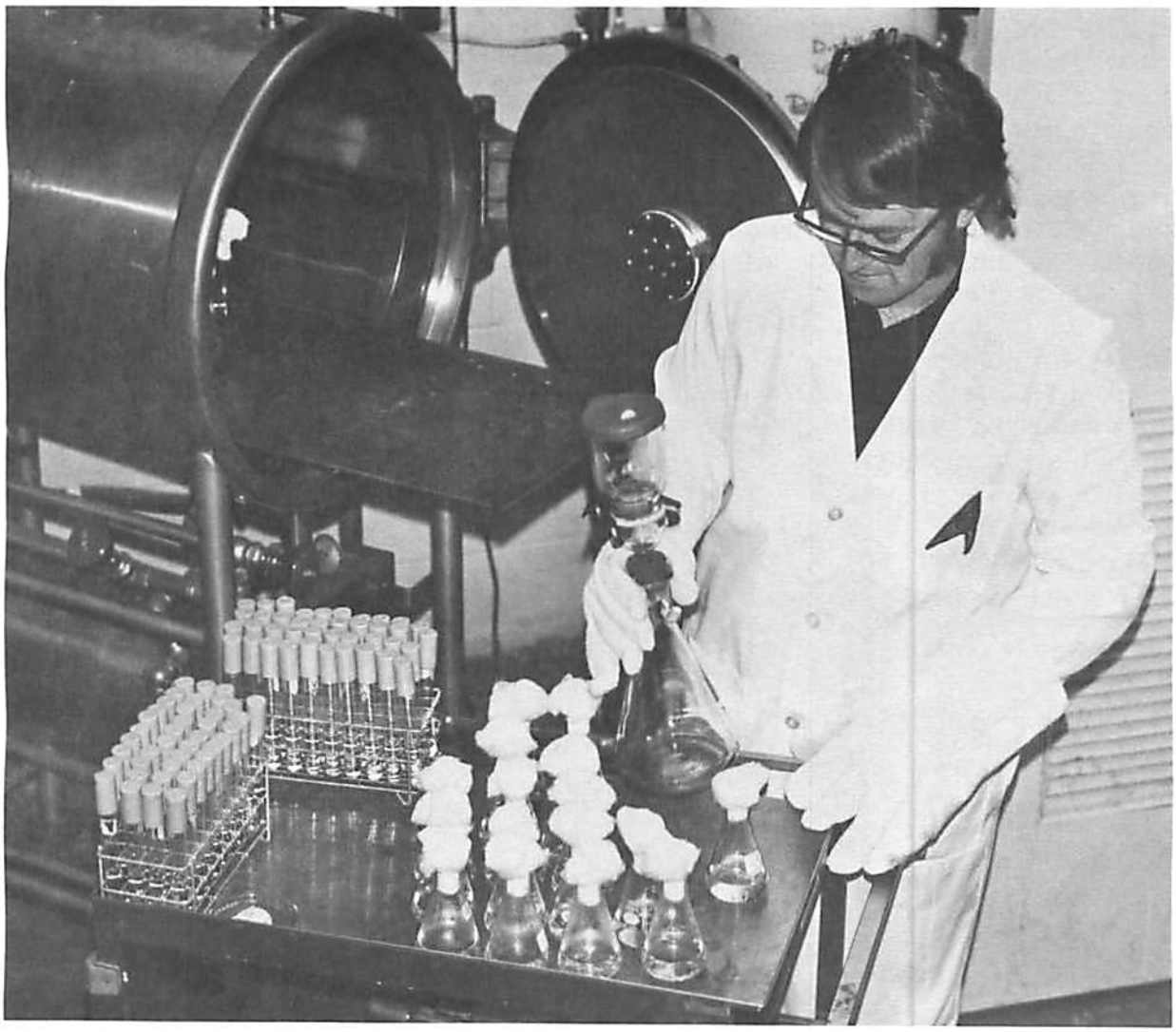
The unique essence of the Sea Grant lies in a number of factors, including its ability to identify public applied research needs with speed and accuracy; evaluation of these needs with a minimum of delay, through a broad program of public participation, identification of the best available research or other required talent available; and finally to provide the mechanisms and funds to resolve the need or solve the problem. It is further absolutely essential that the information or knowledge become speedily and readily available to that segment of the population concerned with the problem - those who most probably identified it in the first place. Thus, the effort ends at its point of origin, with those persons or that segment of the public who identified the unresolved need initially, and who ultimately receive the most benefit from its resolution.

All elements of this scenario must be included for a "successful" Sea Grant effort to have been concluded. The lack of any one of them prevents the procedure from going full-circle, and does not provide the necessary guarantee that the appropriate user-community receives the full benefit of the research or other effort. Through the Mississippi-Alabama Sea Grant Consortium the varied requirements described above are met, providing the basis for the comprehensive and coherent effort in research, education and advisory services. Quality research and responsive program management provide the maximum opportunity for the best available researchers and managers to identify and solve significant problems for the public good. It further provides that the results of the research will be quickly transmitted to the appropriate public sector in a form both easily available and readily understandable.

The coastal areas of Mississippi and Alabama share a number of common characteristics and problems. The logic of developing a two-state consortium to address these problems has been proven through the past and continuing successes of the MASGC Program. While each of the individual coastal areas of the two states is small compared to the total area of each, they provide economic, recreational and other resources important to the state far in excess of their relatively small proportional areas. Increasing emphasis upon the importance of coastal resources, both environmental and economic, requires that a comprehensive understanding of the complex socio-economic, environmental and other characteristics of this region be achieved as quickly as possible. Stresses upon this limited, and often fragile, environment must be balanced against the needs of the people of the area, as well as state and national requirements. With sufficient understanding of the complex interactions between development and continued uncontrolled growth on the one hand; and conservation, balanced growth and environmental considerations on the other, an appropriate compromise may be defined and achieved. This unique and irreplacable resource can be fully utilized for the optimum economic and social benefits while still maintaining sufficient environmental integrity to guarantee that none of the living resources contained within the region are overdeveloped or overutilized to the point of their loss or destruction. Rational resource management, achieved through research, education and legislation will guarantee that this unique coastal area remains economically productive as well as highly desirable as a place to live, work and play. Through its continuing program of public service encompassing research, education and advisory service activities, the Mississippi-Alabama Sea Grant Consortium strives to achieve that goal.



Director, MASGC
December 15, 1978



RESEARCH

Inherent to the concept of Sea Grant is support for original research in areas that pertain to the coastal area. Much of our effort in this area can be termed applied with a primary concern for those groups in the coastal area in need of technological advice. Yet Sea Grant is striving for a balance of applied and basic research as we recognize the long-term as well as the short-term needs of the coastal community. With this in mind, the diversity of research projects during 1977 reflects both the complex problems and the technological needs of the coastal community.

COASTAL RESOURCES

Finfish, shellfish, and other species desirable for human consumption are dependent on the environment in which they live. Within this framework, the objective of this section is two-fold; firstly, to gain insight into coastal productivity; secondy, to study the life histories of key organisms in economic and ecological terms. To accomplish the first objective a study was initiated on marsh productivity and ways to increase this productivity. Towards the second goal, ecological studies on the slipper lobster, oyster and American eel were undertaken.

SLIPPER LOBSTER FISHERY POTENTIAL IN THE NORTH CENTRAL GULF OF MEXICO 30(2)

George F. Crozier — University of Alabama in Birmingham
Robert L. Shipp — University of South Alabama
James Langdon — University of South Alabama

SUMMARY: THE ECOLOGY AND BIOLOGY OF THE SLIPPER LOBSTER *(Scyllarides nodifer)* ARE BEING STUDIED TO DETERMINE THE POTENTIAL FOR A COMMERCIAL FISHERY. PRELIMINARY RESULTS INDICATE THE SPECIES IS LOCALLY COMMON, ALTHOUGH IN AREAS NORMALLY AVOIDED BY TRAWLERS. THERE HAS BEEN PROGRESS, ALTHOUGH FURTHER STUDIES ARE NEEDED, IN ASSESSING HABITAT PREFERENCES, LIFE HISTORY ATTRIBUTES, FOOD, HABITS, MARKETING FEASIBILITIES, AND OTHER FACTORS NECESSARY FOR THE CONTROLLED DEVELOPMENT OF A SLIPPER LOBSTER FISHERY.

The need for supplementary fishery resources in the northern Gulf of Mexico is recognized because of increasing fuel costs, high public demand, and the unstable harvests and fluctuating prices of current fishery stocks. The overall goal of this 2-year project is to determine whether or not the commercial exploitation of the slipper lobster *(Scyllarides nodifer)* is economically feasible. To accomplish this objective, baseline studies on the life history of the slipper lobster, trapping techniques, and marketing feasibility are underway.

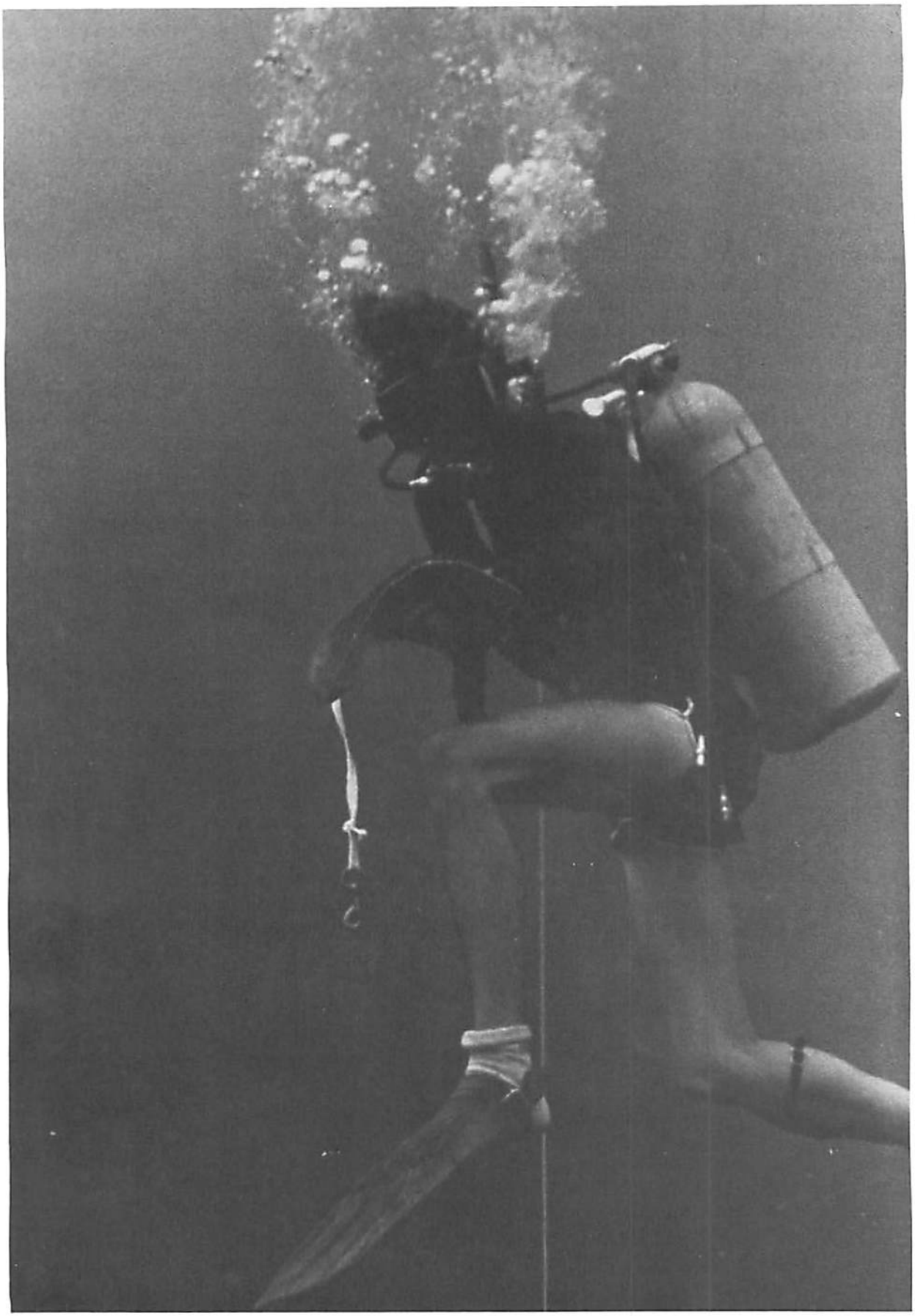
The first priority was to determine the location and abundance of the slipper lobster in the northern Gulf of Mexico. Test trawls indicated the slipper lobster was locally common, especially on rubble bottom areas normally avoided by commercial boats. Trawling data from these areas, however, were not an efficient way to measure population levels so observations are planned from the submersible, *Diaphus*, to supplement the stock assessment. During the 1978 part of the study, visual inspection of the rubble bottom sites with remote television systems should yield conclusive observations on the abundance of the slipper lobster.

Laboratory studies agree with field observations on slipper lobster habitat preference. There was a weak preference for hard substrates, such as rocks and shells, and a strong preference for shelter-like hard objects with openings or crevices. This cryptic behavior may be related to predation pressures in natural environments. Before definitive answers can be provided studies are needed with larger numbers of animals, better controls, and replications.

Food preference observations have thus far yielded erratic results. Preliminary feeding studies indicated a preference for bivalve mollusks, specifically the American oyster *Crassostrea virginica*. However, recent observations show a preference by slipper lobsters for crustacean flesh over fish or bivalve flesh.

Traps were designed, constructed, and deployed using information gathered from laboratory behaviorial experiments. These tests indicated that the slipper lobster are attracted to shelter-like objects. The traps, however, proved to be too small and fragile, so larger traps will be employed. Observations from the submersible *Diaphus* will be important in redesigning the traps. Shipboard observations indicate lobsters are voracious feeders and during 1978 it will be necessary to determine the optimum bait-trap combination.

In summary, the possibility exists for a slipper lobster fishery, but further studies are needed before the commercial feasibility of such a fishery can be determined. Considerable data have been collected to date. A definitive answer is anticipated by the end of the project period based on work completed, and planned 1978 field observations and laboratory experiments.



THE IMPACT OF COMMERCIAL NETTING AND SPORT *FISHING* ON ECONOMICALLY IMPORTANT ESTUARINE SPECIES

30(3)

Wendell J. Lorio — **Mississippi State University**

SUMMARY: THE INCREASED USE OF LARGE MONOFILAMENT GILL AND TRAMMEL NETS BY COMMERCIAL FISHERIES MAY BE DEPLETING POPULATIONS OF SPORT FISHES SUCH AS SPOTTED SEATROUT *(Cynoscion nebulosus)* AND RED DRUM *(Sciaenops ocellata)*. THE OVERALL OBJECTIVES OF THIS 3-YEAR STUDY ARE TO DETERMINE THE IMPACT OF COMMERCIAL NETTING ON SPORT FISHES, TO COMPARE RELATIVE CATCHES OF SPORT AND COMMERCIAL FISHERIES, AND TO PROVIDE INFORMATION TO STATE AGENCIES RESPONSIBLE FOR MANAGEMENT OF THE MARINE FISHES.

The use of marine resources will normally result in conflict when competing groups exploit a common resource. One example of this is the disagreement between sport and commercial fisheries on the impact of netting, especially the use of monofilament gill nets, on sport fishes. Sport fishermen feel commercial fishermen deplete fish reserves and commercial interests voice the same charge against sport fishermen. State agencies are in a key position to mediate and resolve these issues. Unfortunately this is not presently possible because fishery biologists lack the data base to make valid decisions on the relative impact of commercial and sport fisheries. The goal of this study is to collect and provide this information by looking at the intensity of gill netting along the Mississippi coast and estimating the relative catch of sport and commercial fishermen. When these data are available, management practices can be implemented allowing conservation of the coastal resources for both commercial and sport fishermen.

The relative catch of sport and commercial fishermen are being estimated by creel census. Fishermen are interviewed to determine the location, size and species of catch, type of gear used, and duration of fishing activity. Follow up reports have been made with an 80% success rate. When possible, biological information on stomach contents and fecundity are collected. These data will improve our knowledge of the biology of marine fishes. Aerial counts are underway in all three study areas. These counts are made at least three times monthly on the same day the ground survey is conducted. In this way, projections on total fishery pressure and success can be made. Additionally, it will be possible to locate "hot" and "cold" fishing spots from the aerial surveys.

Results from these surveys are presently being recorded and analyzed by data services of the Institute of Statistics at North Carolina State University. These computer programs are available to other researchers and, hence, will allow comparisons between this study and studies from other regions. Though information is still being analyzed, preliminary results from studies in Louisiana and Texas indicate that sport catches exceed commercial catches by a factor of 2 to 4. It remains to be seen whether or not this is true for the Mississippi Sound.

To date considerable information has been gathered on the problems associated with the common exploitation of marine fishes by commercial and sport groups. These data, however are incomplete. The current objective is to complete data collection and to interpret the findings. In this way, it will be possible to provide accurate, not premature, information to those agencies and individuals responsible for the conservation of Mississippi's valuable marine fishes.

EVALUATION OF THE ECOLOGICAL ROLE AND TECHQUES FOR THE MANAGEMENT OF TIDAL MARSHES ON THE MISSISSIPPI AND ALABAMA GULF COAST *40(3)*

Lewis R. Brown — **Mississippi State University**
Armando A. de la Cruz — **Mississippi State University**
M. Susan Ivester — **University of Alabama**
Judy P. Stout — **University of South Alabama**
Courtney T. Hackney — **Mississippi State University**

SUMMARY: THE AIM OF THIS 3-YEAR PROJECT IS TO PROVIDE INFORMATION ON: (1) THE PRODUCTIVITY AND SPECIES DIVERSITY OF DIFFERENT MARSH COMMUNITIES, (2) THE CONTRIBUTION OF THESE DIFFERENT MARSH COMMUNITIES TO ESTUARINE FOOD WEBS AND COMMERCIAL FISHERIES, AND (3) THE POSSIBILITY OF ARTIFICALLY INCREASING BIOLOGICAL PRODUCTIVITY AND UTILIZATION OF THESE MARSHES. BY ADDRESSING THESE TYPES OF QUESTIONS IT WILL BE POSSIBLE TO PROVIDE PLANNING AGENCIES WITH THE NECESSARY INFORMATION FOR LONG-RANGE COASTAL RESOURCE MANAGEMENT.

Along the Gulf Coast of Alabama and Mississippi are some 32,000 hectares of verdant marshlands which are unique in their floral and faunal diversity. Initial studies indicate the primary productivity of these tidal marshes is high, in the range of 1 to 2 kg/m²/yr. The obvious occurrence of extremely productive fishing and shellfishing grounds at or near the regions of extensive tidal wetlands is indicative of the importance of marshes and swamps in the fertility of coastal waters. In essence, the tidal marshes are not only suitable habitats for a unique group of organisms which have adapted to extreme fluctuations of certain physical and chemical factors, but they are also well-stocked "supply depots" for the estuarine inhabitants.

While all estuarine wetlands are commonly characterized as sites of high productivity, available data are insufficient to support or refute such a sweeping generalization. It appears that marshes more likely differ considerably in primary productivity and nutritional value because

TABLE 1. Types of estuarine marshes.[a]

I. Salt flats (water logged and submerged on storm tides)
  Salt grass, *Distichlis spicata*

II. Salt Meadows (water logged but rarely covered by tidal water)
  Wire grass, *Spartina patens*
  Salt grass, *Distichlis spicata*
  Fimbristylis, *Fimbristylis spadicea*
  Olney 3-square sedge, *Scirpus olneyi*

III. Irregularly flooded salt marsh
  Needlerush, *Juncus roemerianus*
  Giant cordgrass, *Spartina cynosuroides*
  Salt marsh bulrush, *Scirpus robustus*
  Dogtooth grass, *Panicum* spp.
  Spikerushes, *Eleocharis* spp.

IV. Regularly flooded salt marsh
  Smooth cordgrass, *Spartina alterniflora*

[a]Based on Uhler, F.M., and Hotchkiss, N. 1968. Vegetation and its succession in marshes and estuaries along the South Atlantic and Gulf Coast. Proc. Marsh and Estuary Management Symp., L.S.U. 26-32.

of species composition, geographic location, topography, and various other environmental conditions. It should be possible to differentiate between areas which deserve a high preservation priority and other less valuable wetlands where necessary construction, such as causeways, industrial parks, and aquacultural ponds, can take place. Recognizing that pressures to alter or destroy marshlands for developmental purposes have prevailed in the past, and are likely to continue, that question becomes, "Can specific marsh areas or marsh types be managed in some manner to increase the per unit ecological value to replace the value lost by alteration or destruction of other marshlands?"

Controlled burning, cutting, and fertilization have been used singly or in combination to increase the yield of certain ecosystems. These management techniques are applicable to marshlands. With this in mind, the objective of this study is two-fold: (1) to evaluate the comparative ecological importance of different marsh communities in the Alabama-Mississippi coast, and (2) to evaluate the effectiveness of various management techniques to increase per unit yield of marshes.

Data are preliminary but suggest important ecological differences among marsh communities (Table 1). For example, net primary productivity (NPP) differs between *Juncus roemerianus* and *Spartina cynosuroides* marshes and among different management techniques for each marsh community (Table 2). These data are presented in the form of an asymptotic function with periodic components. The coefficient C_0 indicates the overall temporal mean for NPP and the coefficients C_1 and C_2 convey the harmonic components of the function resulting from seasonal variation. Fertilizing increased net primary productivity in the *Juncus* marsh but not in the *Spartina* marsh. Burning and clipping, the other management technique employed, increased net primary productivity in the *Spartina* marsh but decreased net primary productivity in the *Juncus* marsh. These types of differences no doubt exist for the other components of this study. It is hoped this information will be of use to coastal planners in their development of a resource management plan for the Alabama-Mississippi Gulf Coast area.

TABLE 2. Periodic models and summary statistics for the eight *J. roemerianus* and *S. cynosuroides* marshes.

$y = c_0 + c_1 \sin(ct_i) + c_2 \cos(ct_i)$

Community/treatment	c_0	c_1	c_2	r^2	F	df
Juncus burned	561.3	-215.9	77.4	.5324	29	2.51
Juncus control	687.0	-143.2	-182.6	.3936	14.6	2.45
Juncus fertilized	784.3	-135.7	-147.1	.3379	11.5	2.45
Juncus clipped	546.3	-217.8	- 19.7	.6056	34.6	2.45
Spartina burned	812.6	-454.3	-854.1	.8259	121	2.51
Spartina control	606.4	-344.5	-675.8	.6958	350	2.45
Spartina fertilized	615.1	-289.0	-581.1	.6516	41.1	2.45
Spartina clipped	804.1	-427.7	-691.4	.7403	64.2	2.45

Comparisons between treatments	c_0	c_1	c_2
Juncus burned vs *Juncus* clipped	n.s.	n.s.	n.s.
Juncus control vs. *Juncus* fertilized	*	n.s.	n.s.
Spartina burned vs *Spartina* clipped	n.s.	n.s.	n.s.
Spartina control vs *Spartina* fertilized	n.s.	n.s.	n.s.
Spartina burned vs *Spartina* control	*	*	*
Spartina clipped vs *Spartina* control	*	n.s.	n.s.

* = significance at = .05.
n.s. = not significant

ANALYSIS OF THE EEL POPULATION IN MOBILE BAY

06(1)

David M. Dean **University of South Alabama**

SUMMARY: A SURVEY OF THE AMERICAN EEL *(Anguilla rostrata)* POPULATION INDICATES THAT AN ECONOMICALLY FEASIBLE FISHERY DOES NOT EXIST IN THE MOBILE DELTA. AN ECONOMICALLY FEASIBLE FISHERY WOULD REQUIRE A CATCH OF ONE EEL PER TRAP NIGHT. PRELIMINARY DATA RESULTED IN AN APPROXIMATE CATCH OF ONE EEL PER FIVE TRAP NIGHTS. DATA ARE BEING COLLECTED IN OTHER AREAS OF MOBILE BAY TO COMPLETE THE ANALYSIS.

A fishery for the American eel is currently flourishing in some areas on the east coast of the United States. The object of this study is to determine the potential for this type of fishery in the Mobile Delta. Production costs are high so a large eel population must be present to insure commercial success.

Eel are being trapped in standard cylindrical eel pots (82.5 × 22.5 cm) baited with fresh shrimp heads. Eels are nocturnal, therefore traps are set at night and inspected twice at a 4-hour intervals. Four sites within the Mobile Delta were trapped.

A summary of the catch data (Table 1) indicates that an economically feasible fishery for the American eel does not exist. Preliminary results indicate a catch of 1 eel per 5 trap nights. An economically feasible fishery would require a catch of about 1 eel per trap night.

However, these results only apply to the test conditions and locations. Conversations with local fishermen and fish camp operators suggest eels may be more common than the catch data implies. For this reason, further collections are planned in those areas identified from these conversations. When these results are available and interpreted, final evaluation of the feasibility of an American eel fishery in the Mobile Bay area will be possible.

TABLE 1. Number of *Anguilla rostrata* collected in Mobile Bay area

Date	Site 1	Site 2	Site 3	Site 4	Total
June	-[c]	2	0	-	2
July	1[a]	1	1	3	6
August	0	0	1	4[b]	5
September	2[a]	-	2	5	9
October	-	3	2	7[b]	12
November	-	4	3	3	10
December	-	-	-	-	-
January	-	2[a]	2[a]	1[a]	5

[a]Indicates stations where 12 traps were fished; 15 traps were fished at all other stations.
[b]Indicates more than 1 eel collected in a single trap.
[c]No traps set.

SEASONAL AND SPATIAL STUDY OF OYSTER SPAT IN MOBILE BAY AND EAST MISSISSIPPI SOUND 40(4)

Thomas S. Hopkins **University of Alabama, Dauphin Island Sea Lab**

SUMMARY: SEASONAL AND SPATIAL FLUCTUATIONS IN THE NUMBER OF OYSTER SPAT *(Crassostrea virginica)* AND OTHER MARINE ORGANISMS ARE BEING CORRELATED WITH CHANGES IN WATER QUALITY AND OTHER ENVIRONMENTAL PARAMETERS TO DEVELOP A MODEL FOR OYSTER AVAILABILITY. THESE RESULTS WILL BE PROVIDED TO THE ALABAMA SEAFOODS DIVISION AND OTHER INTERESTED AGENCIES FOR OYSTER HARVEST AND BEDDING PREPARATION PLANNING.

Oysters are an important natural resource in Mobile Bay and adjacent waters, although their availability has decreased recently because of environmental pollution. A more efficient management program is needed to maintain present levels. The aim of this study is to correlate fluctuations in the number of oyster spat and other marine organisms with seasonal and spatial variables. More rational planning for the timing and duration of oyster harvesting will be possible when this information is provided to interested agencies.

Four stations were equipped with sampling devices capable of periodic removal. Species identification and enumeration were performed. Two stations were located in the lower parts of Mobile Bay near existing productive oyster reefs. The other two stations were located in less productive areas in upper Mobile Bay.

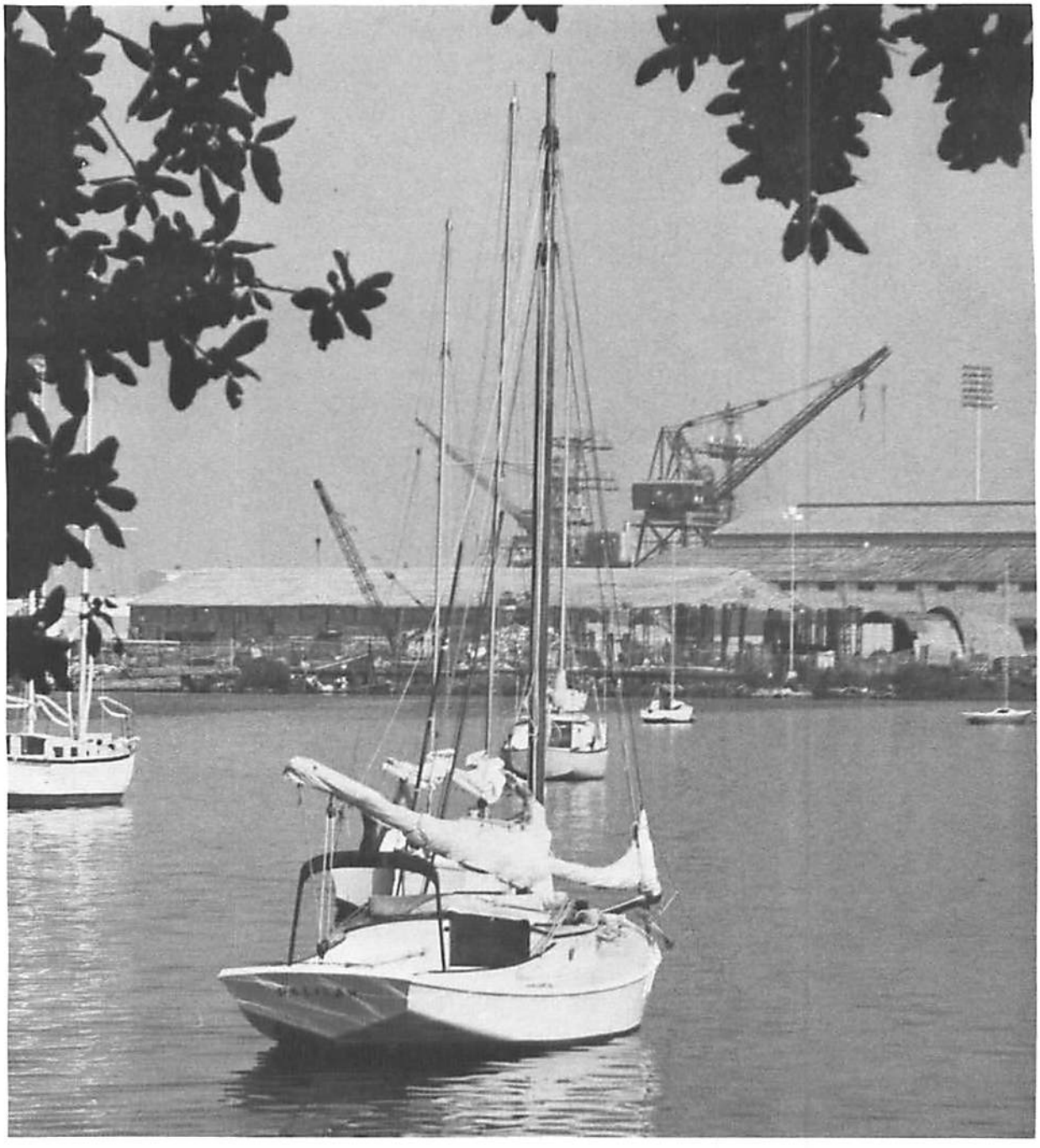
The highest number of oyster spat settling on the sampling plates were 78/M²/day at a station in lower Mobile Bay. The seasonal trend in oyster spat settlement was bimodal with peaks occurring from July 22 to August 5 and from September 8 to October 7. The first peak was less distinct. Settlement patterns in lower Mobile Bay were different from the upper Mobile Bay. For a comparable period, the highest number of oyster spat settling in upper Mobile Bay was 1/M²/day. This figure is significantly less than those reported in 1972 from a similar location. These data suggest deterioration in water quality in upper Mobile Bay.

In agreement with the above conclusion concerning the deterioration of the water quality in Mobile Bay is the finding of large numbers of the polychaete *Polydora websteri*. Previous studies suggest *P. websteri* is an indicator of poor water quality for sessile organisms.

Settlement patterns for the barnacle *Balanus eburneus* were not bimodal, as reported in 1972. During a 1972 study, settlement occurred during the spring and fall. During this study, barnacle settlement was highly irregular at all stations. The reasons for this are unknown. Other invertebrates commonly occurring were: the polychaete worm *Nereis succinea*; the amphipods, *Melita nitida, M. longisetosa* (?) and *Corophium lacustre*; the turbellarian playtyhelminth, *Stylochus* spp.; the bryozoan, *Membranipora* sp.; a juvenile decapod crab, *Eurypanopeus depressus*; the molluscs, *Ischadium recurvum* and *Thais haemastoma*; plus unidentified anemones and worms. Additionally, the eggs of the skillet fish, *Gobiesox strumosus*, were found at stations located in lower Mobile Bay.

PUBLICATIONS

Hopkins, T.S. in press. A study of spatial settings of oyster spat and other organisms in Mobile Bay and east Mississippi Sound in relation to seasonally monitored environmental parameters. MASGC-79-



COASTAL MANAGEMENT

Providing information that will allow the development of Alabama and Mississippi's coastal areas in a way that enhances the local economy and environment is a major goal of the Sea Grant Program. Towards this goal, studies are underway in each state that when combined will provide a model for the region relating industrial activities to environmental parameters. The laws affecting the various activities in the coastal region are complex and continued support for legal studies has been made available. Closely related to this effort is the availability of legal information to the Advisory Service program. Finally, cooperation is continuing with the coastal zone management agencies in assessing the needs of the coastal region.

LINKAGES BETWEEN THE ECONOMY AND THE ENVIRONMENT OF THE COASTAL ZONE OF MISSISSIPPI. PART 1: INPUT-OUTPUT MODEL 14(5)

D.C. Williams — University of Southern Mississippi
Donnie L. Daniel — University of Southern Mississippi

SUMMARY: ECONOMIC DEVELOPMENT IN ONE AREA WILL INFLUENCE SUBSEQUENT ECONOMIC DEVELOPMENT IN OTHER AREAS. FOR EXAMPLE, INDUSTRIAL DEVELOPMENT WILL INFLUENCE DEVELOPMENT OF COMMERCIAL FISHERIES. BASED ON THIS PREMISE, THE OBJECT OF THIS STUDY IS TO ESTABLISH AN EMPIRICAL FRAMEWORK THAT LINKS ECONOMIC ACTIVITIES WITH THEIR ENVIRONMENTAL IMPACTS. IN THIS WAY, A PREDICTIVE MODEL WILL BE AVAILABLE TO COASTAL AGENCIES SO BETTER DECISIONS CAN BE MADE CONCERNING FUTURE ECONOMIC DEVELOPMENT. THE STUDY IS BEING COORDINATED WITH SIMILAR EFFORTS IN ALABAMA AND A MODEL FOR BOTH STATES WILL BE MADE AVAILABLE TO REGIONAL PLANNERS.

This study is a theoretical and operational framework for linking the economic activities of 29 economic sectors within the coastal region of Mississippi with their respective environmental impacts. The procedure is built upon an input-output model which provides a complete picture of economic-ecological interdependencies.

The first phase of the study is the consideration of an input-output model of the region. It is arrayed with 29 endogenous economic sectors that describe the overall economic activities of the region. The economic sectors that determine dollar transactions for the coastal region are described by the "abbreviated" transaction matrix presented in Table 1. The 29 endogenous economic sectors are condensed into 7 macroeconomic factors. The horizontal rows show the distribution of output of each sector to the 6 other economic sectors. The vertical columns show the input needs of each economic sector from the other economic sectors. Hence, each numerical entry in the table is an output of one sector as well as an input of another sector.

An input-output model indicates the amount of commodities and services one economic sector produces and how this is absorbed by other economic sectors in the region. It also shows the types of goods and services produced and the amounts of goods and services a particular economic sector receives. The year 1972 was chosen as the base year because secondary data for the county level were more readily available than for any other recent year.

The interrelationships among the regional economic sectors was further analyzed using the concept of multipliers. Multipliers indicate how an activity of one economic sector influences activities in other sectors. This knowledge is then used to forecast future economic developments as well as to aid economic planning. In this study, output, income, and employment multipliers have been investigated.

Development of an input-output model is completed. A full report (MASGP-78-017) describing the theoretical aspects of an input-output model including findings for the Mississippi coastal region is available from the Mississippi-Alabama Sea Grant Consortium.

Subsequent research is being undertaken to identify and quantify the individual waste residues from the various production sectors. Such research will describe the tradeoff between the environment and economy. Ultimately, the economic activities will be related to the

environment in a manner allowing measurement of the feedback and the impact of each on the other.

The following are examples of how the results can be used: (1) as a basis to assess pollution taxes on the polluting sectors; (2) as a benchmark for making decisions regarding future industrial expansion, and (3) as a guideline to encourage activities less detrimental to the environment.

TABLE 1. An abbreviated transaction matrix for the input-output model for the Mississippi Coastal economic area. Figures are based on 1972 values.[1]

	OUTPUT (SALES)						
INPUT (PURCHASES)	1. Natural Resources	2. Manufacturing	3. Transportation-Communication	4. Wholesale-Retail	5. Financial Real Estate	6. Public Service	7. Government
1. Natural Resources	1979	20516	358	1205	34	4	489
2. Manufacturing	4404	58787	4078	4606	6851	2145	23171
3. Transportation Communication	1430	43466	13669	8005	1964	2980	16829
4. Wholesale-Retail	703	27304	1418	4029	1295	1347	4258
5. Finance-Real Estate	1341	12239	1670	10982	9072	3353	8035
6. Public Service	1	774	106	449	232	664	585
7. Government	446	21942	7182	12061	3902	3387	39452
Endogenous Totals	10015	189257	28484	41913	23350	13886	92828

[1]Thousands of dollars.

PUBLICATIONS

Nissan, E., D.L. Daniel, D.C. Williams, Jr., and T. Green, 1978. Linkages between the economy and the environment of the coastal zone of Mississippi. Part 1: Input-Output model. MASGP-78-017, 117 pp.

COOPERATING ORGANIZATIONS

Troy State University

THE STATUS AND RELATION OF THE COASTAL ZONE TO ALABAMA'S ECONOMY

14(6)

W.E Hardy, Jr. — Auburn University
H.A. Clonts, Jr. — Auburn University
E.W. McCoy — Auburn University

SUMMARY: THE COASTAL REGIONS OF THE UNITED STATES HAVE LONG BEEN AN INTEGRAL AND IMPORTANT PART OF THE NATION'S ECONOMY. IN RECENT YEARS THESE AREAS HAVE EXPERIENCED RAPID POPULATION GROWTH. ASSOCIATED WITH THIS GROWTH HAS BEEN A GROWING CONCERN OVER UTILIZATION AND PRESERVATION OF THE COASTAL REGION'S RESOURCES. A MAJOR PROBLEM FACING THE COASTAL REGIONS IS THE CONFLICT OF INTERESTS BETWEEN THE TRADITIONAL AND THE RELATIVELY NEW INDUSTRIES. BOTH GROUPS ARE DEPENDENT ON WATER. THE MAJOR GOAL OF THIS PROJECT IS TO DESCRIBE THE SCOPE OF INDUSTRIAL ACTIVITY IN THE COASTAL REGION OF ALABAMA SO THAT AGENCIES CAN BETTER PLAN FOR THE NEW DEVELOPMENT.

Historically, the coastal regions of the United States have been, and continue to be, an important facet of the nation's economy. Recently these coastal regions have experienced tremendous industrial growth. Concurrently an awareness and concern for the natural resources of the regions has developed.

Maintenance and preservation of the water resources of the area are easily justified from ethical, moral, and environmental viewpoints. Politics and economics, however, may result in low priorities for environmental and less economically important concerns (*i.e.* seafood and recreational industries).

The development of industrial interaction data is requisite in order for intelligent regulations of industrial development and use of regional natural resources. Such data have not been available for this area and a major goal of this project is the accumulation of this data. The following objectives for an economic analysis are planned: (1) 1st year objective — to describe the scope of industrial activity in the Alabama coastal region (with emphasis on the seafood industry), (2) 2nd and 3rd year objectives are to determine the economic and environmental impact of the Alabama seafood industry on the total resources and other industries of the region and state, to determine possible effects of sector changes in industrial activity in the coastal area on the seafood industry utilization of coastal resources, and state economy, and to determine possible effects of policy decisions involving utilization of coastal resources on coastal zone development, the seafood industry, and state economy.

The 1st year study has resulted in the development of a basic input-output model of the region's economy (Table 1). The major step in developing the model was the collection of data on dollar output, employment and location quotients for each of the 33 sectors in the model. These data were obtained from the State Employment Service, the Cooperative Extension Service, the Geological Survey of Alabama, the Bureau of Census, the National Marine Fisheries Service, and the Bureau of Economic Analysis. When all data were compiled, a computerized aggregation procedure was used to combine the interactions of the 87 sector 1971 national input-output model into a 27 sector regional model. Three more producing, sectors and 3 more consuming sectors were later added to complete the "transaction table", an account of the flow of goods and services between all sectors in the economy. Researchers in Mississippi are using the same model for their coastal

region. The Alabama project's results will eventually be correlated with Mississippi's findings to insure compatibility and eliminate assumption errors. Information provided by this study should be useful to various governmental planning agencies.

TABLE 1. An abbreviated transaction matrix for the input-output model for the Alabama coastal economic area. Figures are based on 1972 date.[1]

	OUTPUT (SALES)									
INPUT (PURCHASES)	Natural Resources	Manufacturing & Construction	Transportation, Communication, & Utilities	Wholesale & Retail Trade	Finance, Insurance & Real Estate	Services	Government	Households	Exports	Totals
Natural Resources	27134	43476	6919	271	4147	576	3285	8272	44580	138,660
Manufacturing & Construction	18760	370937	25391	15071	22989	27514	99890	219270	573677	1,373,499
Transportation, Communication, & Utilities	5530	65124	48982	14400	7345	17969	22735	54806	142547	379,438
Wholesale & Retail Trade	5072	60976	8046	8578	4927	9513	2776	214802	105048	419,738
Finance, Insurance & Real Estate	10001	27179	11066	26387	38958	18599	9283	156946	59303	357,722
Services	2880	50893	11751	23585	15404	19175	17256	135001	48515	324,460
Government	27	1295	18764	4027	3298	1879	20566	4227	243243	297,326
Households	43445	361759	123133	213697	55281	191003	165437	0	164481	1,318,236
Imports	25811	391860	125386	113722	205373	38232	9447	261265	0	1,171,096
Totals	138660	1373499	379438	419738	357722	324460	350675	1054589	1381394	

[1]Thousands of dollars.

MARINE RESOURCES LAW

15(1)

James W. Zirkle — University of Mississippi
Dixie Aldrich Criddle — University of Mississippi

SUMMARY: THE SEA GRANT LEGAL PROGRAM COMPLETED RESEARCH PROJECTS AFFECTING THE STATE'S MARINE RESOURCES IN THE AREAS OF: (1) OIL POLLUTION CONTROL MECHANISMS, (2) MISSISSIPPI WETLANDS PROTECTION PRACTICE AND PROCEDURE, AND (3) RECENT LEGISLATION CONCERNING COASTAL MANAGEMENT. IN ADDITION, ADVISORY SERVICES WERE PROVIDED TO STATE AND COASTAL AGENCIES IN SUCH DIVERSE AREAS AS BOUNDARY DISPUTES, NONRESIDENT COMMERCIAL FISHING, AND COASTAL LAND PLANNING. FINALLY, UPDATING AND ADDITIONS WERE MADE TO THE MARINE RESOURCES LIBRARY.

In 1977 the Sea Grant Legal Program researched problems affecting the state's marine resources, and provided legal opinions and recommendations. This research involves the law of the sea, international law, marine resources management, and various other areas of the law. The Sea Grant Legal Program consists of a research aspect, an advisory aspect, and an educational aspect.

RESEARCH ASPECT

During the year 1977 the Sea Grant Legal Program attorneys completed the following research projects:

1. Oil Pollution Control Mechanisms - Synopsis and Analysis of Statutes and Regulations.

There had been no previous analysis and synopsis of the legal mechanisms of controlling oil pollution. The purpose of the analysis was to provide a detailed picture of federal statutes and regulations as well as case law bearing on oil spill control. Emphasis was placed on federal action occurring after a spill and consideration was given to a number of acts.

2. Mississippi Wetlands Protection Practice and Procedure.

The report consists of: an examination of the importance of wetlands in the estuary and ecosystem, an examination of the Mississippi wetlands protection laws including the statutes and the regulatory procedures, and comparison of the Mississippi laws with those of Georgia, Alabama, and North Carolina.

3. Laws Passed During the 1977 Session of the Mississippi Legislature Affecting Coastal Resource Management and Protection.

Sea Grant attorneys analyzed those laws that were passed during the 1977 session of the Mississippi Legislature that would affect use, development, and protection of the state's marine resources. A synopsis of the law and analysis of its likely effect was published as a quick reference to the laws that were passed.

ADVISORY SERVICES

The Sea Grant Legal Program provided research expertise and counsel to a number of agencies working in the area of coastal resource management, use and protection. The legal program accomplished the following research for these agencies:

1. Program attorneys were involved with the Mississippi Attorney General's Office in a project involving the legal issues of a boundary dispute with Louisiana. The dispute arose over the location of a seaward lateral boundary between Louisiana and Mississippi. Federal support is in proportion to the amount of offshore area within the seaward extended boundaries of a state.

2. Recent Louisiana legislation governing fishing and an opinion of its effect on nonresident commercial fishermen was furnished by the Sea Grant Legal Program.

These laws were analyzed for Mississippi fishermen who were interested in complying with them and challenging any unlawful discrimination.

3. The federal government has claimed lots in the Mississippi Sound for offshore leasing purposes. The Mississippi Attorney General's office is now preparing a brief of the law contending that the areas under dispute are historic inland waters and the federal government has no claim to these areas.

4. Citizens of Waveland, Mississippi were upset because the oyster reef off Waveland had been closed due to pollution of the water. Legal research resulted in identification of available remedies. These data were provided to the Sea Grant Advisory Service for distribution to interested individuals.

5. A general procedure on what action a citizen can take to alleviate any type of water pollution was furnished the Sea Grant Advisory Service.

6. The Sea Grant Advisory Service requested and received information on federal statutes providing for loans to oyster farms.

7. Assistance was provided to the Mississippi Marine Resources Council by researching state law that provide the necessary powers for a coastal zone management program.

8. A beach legal assessment was completed for the Mississippi Marine Resources Council.

EDUCATIONAL ASPECT

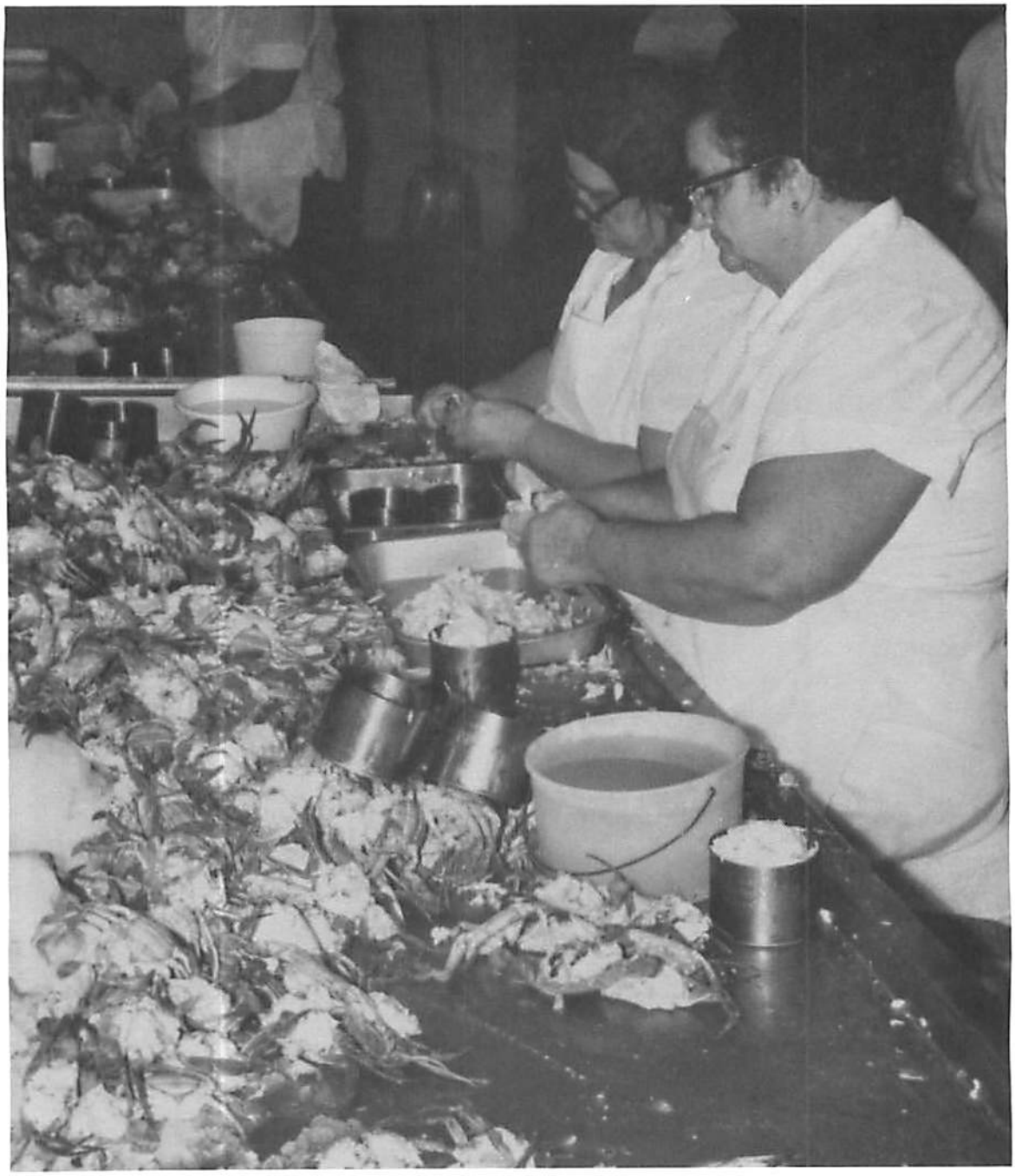
The Sea Grant Legal Program continues to add to and update its extensive Marine Resources Library at the University of Mississippi Law School. This library is available not only to professors and law students, but to state agencies and the State Attorney General's Office. Preparation to revive the "Law of the Coastal Zone" course at the University of Mississippi Law School was initiated. Finally, academic credit in the law school is provided for legal research papers completed in any area of law pertinent to the Sea Grant mission.

PUBLICATIONS

1978. Oil pollution control mechnisms — statutes and regulations. MASGC-78-014.
1978. Laws passed during 1977 session of Mississippi legislature affecting coastal resource management, use and protection. MASGC-78-012.
1978. Mississippi wetlands protection — practice and procedures. MASGC-78-013.

COOPERATING ORGANIZATIONS

Mississippi Marine Resources Council



SEAFOOD PROCESSING

Our primary goal in this area has been to serve as a link between the seafood processing industry and the academic community. In this manner, the historical economic base of the area will have the technology available to remain an important component of the coastal community. Indeed much of the character of the coastal environment arises from the activities of the industry, be it the large shrimp fleet or the independent oyster harvester. Secondly, necessary constraints by state and federal agencies to insure environmental quality, as well as the changing societal relationships on the small seafood processor. Sea Grant feels an obligation to the small seafood processor to provide the technology to function within these constraints.

CIGUATERA FISH POISON

08(2)

Norman J. Doorenbos — University of Mississippi
Charles Hufford — University of Mississippi

SUMMARY: CIGUATERA FISH POISON IS A COMMON PROBLEM IN TROPICAL AND SUBTROPICAL MARINE WATERS THAT CAN CAUSE DEATH WHEN CONSUMED. THE LONG-RANGE GOALS OF THIS PROJECT ARE TO: (1) IDENTIFY THE SOURCE OF THE TOXIN, (2) ESTABLISH GUIDELINES FOR DETERMINING SAFE FISHING AREAS, AND (3) TO STUDY THE ACTION OF THE CIGUATERA TOXIN ON THE NERVOUS SYSTEM. RECENT, THOUGH INCOMPLETE, FINDINGS SUGGEST THE CIGUATERA TOXIN DEPLETE NEUROTRANSMITTERS AND/OR CAUSE DEGENERATION OF NERVOUS TISSUE.

Ciguatera fish poison appears to be the most important marine toxicity problem in the world today judging by its impact upon the health of many people and its presence in the fishes associated with tropical and subtropical reefs. Ciguatoxic fish have been reported from the Red Sea, Indian Ocean, Pacific Ocean, Caribbean Sea and the Gulf of Mexico. A total of 148 cases were documented in the United States alone though this estimate is no doubt low because most physicians either do not recognize ciguatera symptoms or do not complete appropriate reports.

Fish are apparently tolerant of the ciguatera toxins though humans who eat ciguatoxic fish become ill. Toxic symptoms include abnormal functioning of the nervous system. Recovery is slow and may require weeks. Death from ciguatera poisoning sometimes results.

Identifying the source of the toxin has proved to be a difficult problem. On several occasions investigators have announced success in discovering the source of the ciguatera toxin only to find out later that they were in error. Most investigators have centered on benthic organisms since ciguatera poisoning most frequently results after consumption of bottom feeding fishes. Dr. Scheuer of the University of Hawaii has been involved in the ciguatera field for over 20 years and concludes recent claims about the source of the toxin are unfounded.

The purposes of this study are to be: (1) uncover the source of the ciguatera toxin, (2) establish guidelines for determining safe fishing areas, and (3) to study the action of the ciguatera toxin on the nervous system. While these objectives are broad in scope, during 1977 progress has been made in each area.

Over 2,000 specimens of fish, most trapped during a survey of waters of the Virgin Islands, were assayed for ciguatera toxin. The extracts were purified and tested for toxin using a brine shrimp assay. From these extracts about 200, including samples which tested positive as well as negative, were tested on mice for confirmation of the bioassay.

Three ciguatera-like toxin producing microorganisms isolated from the guts of surgeonfish were demonstrated to be a *Bacillus*. Each of these cultures has different growth requirements and produced different toxins. Each culture produced more than one toxin. Two toxins were isolated in semi-pure form from cultures of one of the *Bacillus*. They each had LD_{50} values below 100 mcg/kg. in mice. Neither of the toxins had any effect on action or membrane potentials. Hence, they are probably not ciguatera toxins.

The isolation of the toxins in pure form was made very difficult because of the small quantity of toxins present compared to the solvents used for the extraction. Consequently simpler media which would still meet the requirements of these bacilli were sought. The medium which seemed to meet these requirements was prepared from sodium phosphate, ammonium phosphate, glutamic acid, asparagine, glycine, sucrose, thiamine, biotin, rubidium,

aluminum, potassium, zinc, vanadium, ferric, cobalt, and cupric salts in the form of their chloride, iodide, or sulfate salts.

It was demonstrated during 1977 that it is feasible to establish which local waters are safe to fish and which are not by trapping and testing territorial fish. This was accomplished in a study of the waters off the British Virgin Islands. The results of this study form the basis of a master's thesis written by William Davin and presented at a Food and Drugs From the Sea Conference. In summary, this study confirmed that certain areas along the 100 fathom line east of the British Virgin Islands contain many toxic fishes.

Incidental to the fish trapping study, improvements were made in procedures used for trapping fish using equipment employed by local fishermen. The importance of placing traps immediately adjacent to live coral was demonstrated. Many reef fish species will not normally travel very far from the reef to explore and enter a trap. Fish populations tend to be much lower along dead coral reefs. As a result of this study a positive impact upon fish production by the local fish industry has been realized.

Samples of ciguatera fish toxin from the Virgin Islands have been demonstrated to lower action and membrane potentials among invertebrates. These effects are similar to effects reported for ciguatera toxins from the Pacific. This is the first time that these effects upon the nervous system have been demonstrated for Caribbean ciguatera toxins and provides further evidence that the ciguatera toxins on the Caribbean and Pacific are similar.

Effects of the ciguatoxins on spontaneous and electrically stimulated lateral ciliary activity on the gill of the bivalve, *Elliptio* sp., were studied. Perfusion of the gill with a 1% suspension of crude ciguatoxins in 1% Tween 60 caused a significant decrease in the basal average rate of ciliary activity. These reductions are accompanied by (a) a reversal in propagation of the metachronal wave pattern exhibited by lateral cilia, (b) a stoppage in ciliary activity of individual gill filaments within a particular gill field, (c) a reduction in the cilioexcilatory neurotransmitter (serotonin) within gill nerve axons. The latter observation may indicate a selective depletion of this neurotransmitter and/or a degeneration of nerve axons.

PUBLICATIONS

Davin, Jr., T.W., N.J. Doorenbos, and W.D. Longest. 1978. The geographic distribution of ciguatoxic fish in the eastern half of the British Virgin Islands. *in* P.N. Kaul and C. Sinderman, eds., Drugs and Food From the Sea, Myth or Reality, Univ. Oklahoma Press, Norman. pp 209-220.

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COOPERATING ORGANIZATIONS

Century America Corporation

DETECTION OF HEPATITIS AND ENTEROVIRUS CONTAMINATION OF SELECTED SEAFOOD PRODUCTS 35(2)

Rudolph D. Ellender — University of Southern Mississippi
B.L. Middlebrooks — University of Southern Mississippi
David Cook — Gulf Coast Research Laboratory
Edwin Cake — Gulf Coast Research Laboratory

SUMMARY: SEAFOOD AND SEAFOOD PRODUCTS ARE POTENTIALLY A MAJOR SOURCE OF VIRAL TRANSMISSION. DATA ARE AVAILABLE REGARDING VIRAL CONTAMINATION OF OYSTERS AND CLAMS, BUT MANY OTHER GROUPS (SHRIMP, CRABS, FISH, ETC.) HAVE NOT BEEN ADEQUATELY CHARACTERIZED FROM A VIROLOGICAL STANDPOINT. INFECTIOUS HEPATITIS IS A WELL-KNOWN VIRAL DISEASE TRANSMITTED BY CONTAMINATED OYSTERS. HOWEVER, THE GENERAL PUBLIC IS NOT AWARE THAT NUMEROUS OTHER VIRUSES, PARTICULARLY ENTEROVISUSES, MAY BE CONTRACTED BY CONSUMPTION OF CONTAMINATED SEAFOOD. THE NEED FOR ISOLATION AND DETECTION OF VIRUSES IN FOODS IS WELL-KNOWN, BUT DEVELOPMENT OF TECHNIQUES FOR ACCOMPLISHING THESE GOALS HAS BEEN DIFFICULT. THE MAJOR GOALS OF THIS PROJECT WERE TO ANALYZE AND COMPARE AVAILABLE TECHNIQUES FOR DETECTING AND QUANTIFYING VIRAL CONTAMINANTS IN FRESH AND PROCESSED SEAFOODS. TECHNIQUES EXAMINED INCLUDED: (1) COLLECTION OF SEAFOOD SAMPLES, (2) ENTEROVIRUS EXTRACTION AND CONCENTRATION, (3) EFFICIENCY OF VIRUS RECOVERY AND (4) RADIOIMMUNOASSAY OF SELECTED SAMPLES SEEDED WITH HEPATITIS B SURFACE ANTIGEN.

Viral contamination of foods in a potential major problem, worldwide. Seafood, unfortunately, is uncharacterized virologically as are most of the other foods we consume. Much laboratory data have been accumulated regarding viral contamination, viral detection, and recovery of seeded viruses, but data demonstrating the usefulness of such techniques by those responsible for product quality control are lacking.

Although there has been much publicity in recent years of hepatitis contamination in oysters and clams, little has been done in researching viral contamination in other seafoods. Numerous other viruses, including the enteroviruses, also cause human disease. Enteroviruses cause such clinical syndromes as: paralysis, meningitis, pneumonia, pericarditis, hepatitis, diarrhea, and a host of other illnesses in humans. Most commonly these viruses are associated with raw seafoods (oysters and clams), but evidence indicates that viral pathogens may also occur in well-cooked products, if handled by infected persons prior to packaging or before the food is served.

Some viruses (type 1 poliovirus and certain coxackieviruses) show considerable immunity to normal processing and storage techniques. Such viruses added to foods prior to storage at low temperatures were shown to be viable after certain time intervals, the longest of which was 5 months at -20° C. Several researchers have studied recovery of viruses from different food groups. Recovery levels vary according to protein content of food, pH of extraction buffers, and viral dose initially applied to the sample. Many other researchers have been concerned with possible viral disease associated with the consumption of seafood and other marine products.

The greatest amount of seafood and viral contamination research has been conducted on oysters. These shellfish are sometimes incriminated as viral transmitters because they are grown in waters subject to fecal contamination, they are consumed raw, without removal of the

digestive system, and they concentrate viruses during the filter-feeding process. Several outbreaks of hepatitis A virus have been traced to the consumption of raw oysters. Enteroviruses and reoviruses have also been detected from oyster samples taken from fecally polluted estuaries. There is no method currently available for detecting oyster-borne hepatitis — indirect enterovirus analysis has been used as evidence for contamination of oysters.

Other commercially available marine organisms (fish, shrimp, crab, etc.) have been infrequently examined for viral contamination. Certain organisms, particularly shrimp and crabs, are detrivores or benthic filter-feeders. Such organisms are subject to contamination by viruses, as they live in such close association with potentially fecally contaminated substrates. Fish may become contaminated by ingestion of previously contaminated inshore species. It is obvious that there is an ever-increasing need to understand possible associations of viruses and marine products. This need has two obvious facets, health of the consumer and economic security of the seafood industry. Virtually no data exists for viral contamination of seafood in the northern Gulf of Mexico. The major goals of the project were to: (1) extract enteroviruses and hepatitis B viruses from seafood samples, (2) detect enteroviruses and hepatitis B viruses in seafood samples, and (3) quantify viral levels in seafood tissues.

Oyster, crab, shrimp and fish samples were obtained from retail outlets along the Mississippi Gulf Coast and in the Hattiesburg area. Informational data were obtained from these outlets regarding source of the purchased product. Samples to be tested were weighed into 25 or 50 gram lots and seeded with known dilutions of specific viruses. The seeded samples were then stored at -20°C. until ready for analysis. Two methods for enterovirus extraction were used in the study, the Kostenbader and Cliver method and the Sobsey method (procedures are described in Table 1). Quantitation of virus numbers was accomplished by plaque assay, using a double agar overlay procedure. Viruses utilized for seeding and recovery experiments were polio-virus (type 1, Sabin) and coxackievirus (type 3, Nancy). The stock virus was grown and titered in animal cells and individual pools were stored at -70° C. Samples of dilution inoculum were stored and later assayed to determine viral input.

Detection of HBsAg (Hepatitus B surface antigen) was accomplished by radioimmunoassay. Laboratory experiments were designed to estimate HBsAg levels in oyster homogenate (OH). Problems were encountered initially because of unknown substances present in oyster tissues which interfered with this serological technique. Efforts to reduce and minimize the effects of these unknown substances by acid, ether, heat, and enzyme treatments were ineffective, but dilution of the oyster homogenate eliminated this problem, allowing detection of 20 ng/ml of HBsAg in OH.

Procedures for enterovirus extraction described in the study are not representative of standard techniques, but represent the current state of the art for this type of assay. Extractions using the Kostenbader and Cliver techniques exhibit considerable variation of virus recovery. The more consistent recoveries were observed with viral input ranged between 10^1 and 10^4 PFU (Plaque forming units)/ml. Inputs above or below these levels gave erratic results, even in replicative samples. The results of the experiments utilizing the Kostenbader and Cliver method demonstrated that the technique will detect enteroviruses in seafood. There are, however, several shortcomings inherent to the procedure. The procedure in its present form does not appear to be applicable to large sample analysis. The filtration steps are also time-consuming and are in need of further modification.

The Sobsey technique of virus extraction was developed solely for the analysis of oyster tissues and shows promise for adoption as a standard method. This procedure (Table 1) due to final precipi-

tation step is less time-consuming than concentration by ultrafiltration. Larger dilution factors required by the Sobsey method permit utilization of larger sample sizes of tissue. The major problem of this method is the difficulty of filtration. This problem can be overcome, however, by washing, prefiltration, or in the case of shrimp and crab samples, by freezing and thawing of the tissues prior to initial centrifugation.

Virus-seeded oysters used in the Sobsey method were all from the same retail lot and were known to have consistent viral

TABLE 1. Extraction Procedures

PROCEDURE OF KOSTENBADER AND CLIVER (1973)	MODIFIED PROCEDURE OF SOBSEY (1977) (Personal Communication)
1. Homogenize oyster sample in 1:4 ration of tissue: diluent (Glycine-NaOH buffer at pH 8.8)	1. Homogenize oyster tissue in distilled H_2O (1:8 ration of tissue to water); drop pH to 5.0; conductivity should be less than 1500 mg/1 NaCl. (See Figure 1A)
2. Stir 15 minutes at RT; add 2 ml of 1% Cat-Floc per 100 ml suspension.	2. Centrifuge at 1900 X g for 10 minutes; discard supernatant.
3. Stir 15 minutes at RT; let stand 15 minutes at RT.	3. Resuspend sediment in Glycine-saline pH 7.5 (0.05 M Glycine, .8% NaCl) solution (1:8 volume); homogenize and readjust pH to 7.5
4. Filter suspension through GF-F membrane; sterilize sample by 0.22 membrane filtration.	4. Centrifuge at 1900 X g/10 minutes and retain supernatant.
5. Concentrate by ultrafiltration.	5. Filter supernatant through 0.45 μ filter.
6. Analyze concentrate.	6. Concentrate by: a. ultrafiltration, or b. precipitation.
	7. Precipitation method: 1. pH filtrate of 5 to 4.5 2. After ppt forms, centrifuge as before; collect ppt and dissolve in sterile 0.1 M disodium phosphate (1:20 to 1:30 ml original sample volume).
	8. Assay concentrate.

inputs. The average recovery from oysters was 71%, slightly higher than reported by Sobsey. Recovery rates from crab (64%) and shrimp (61%) seem to indicate that the method, although developed solely for oyster tissues, is applicable to these tissues as well.

The Sobsey method performed better, overall, in viral extraction than did the Kostenbader and Cliver method. The fact that the Sobsey method lends itself to large sample sizes overcomes certain inherent problems (variability in virus recovery efficiency and filtration problems). This method merits further research and modification to eliminate these problems.

Radioimmunoassay to detect HBsAg in seafood tissues is not without its problems. The Austria II technique developed by Abbot labs is designed to detect HBsAg from sera, not from animal tissues. In order to utilize control systems, negative and positive homogenates must be used to quantitate results. A majority of HBsAg added to the homogenate tends to remain in the supernatant after centrifugation. Centrifugation was necessary, as bits of seafood tissue adhered to the plastic bead and if not removed during washing, produced erratic gamma counts. Centrifugation helped to reduce this problem. Statistical techniques were employed to determine the minimal amount of HBsAg detectable in seafoods by radioimmunoassay. It was concluded that 20ng/ml must be present in a homogenate to be detectable by this method.

When the radioimmunoassay technique was performed on oysters from varying sources the minimal cutoff limit was variable, ranging from 5-20 ng/ml. A factor contributing to this variability was the quality of oyster tissue. A colloidal lipid-like material, present in certain instances, reduced the sensitivity of the test procedure. Antigen recovery was most efficient when dealing with washed, retailed oysters. Natural oysters, not being cleaned during the processing procedure, presented the greatest problem in quantitation by radioimmunoassay.

Attempts were made to determine if the Sobsey method could be used to concentrate HBsAg added to an oyster homogenate. The results of this experiment appear valid, although some problems were encountered. A portion of the antigen was apparently either destroyed during the intermediate steps of the extraction procedure or remained bound to oyster solids. There is some evidence that by reducing initial antigen concentration, the problem might be averted.

The results of this project indicate that extraction, detection, and quantitation of hepatitis B virus and enteroviruses in seafood is possible. Present technique will require some modification to accomodate large sample sizes and reduce time-consuming steps, but such modifications should not be too difficult to develop. Refinement of these procedures will make economical quality control techniques available to microbiology labs, and insure that the consumer is provided with a safe product.

PUBLICATIONS

Ellender, R.D. 1978. The detection of hepatitis and enterovirus contamination of selected seafood products. MASGC Interim Technical Report.

Ellender, R.D. in press. The detection of hepatitis B antigen in oyster tissue. J. Invert. Pathol.

COOPERATING ORGANIZATIONS

National Marine Fisheries

GREEN DISCOLORATION IN BREADED SHRIMP - CAUSES AND PREVENTION 35(3)

Paul Toom **University of Southern Mississippi**

SUMMARY: PRODUCT DISCOLORATION IS A PROBLEM TO THE FROZEN SEAFOOD INDUSTRY. ONE OF THE MORE COMMON PROBLEMS IN THE SHRIMPING INDUSTRY IS THE GREEN DISCOLORATION FREQUENTLY FOUND IN RAW FROZEN BREADED SHRIMP. GOALS OF THIS PROJECT ARE TO: (1) DETERMINE THE CAUSE OF GREEN DISCOLORATION, (2) GAIN AN INSIGHT INTO PROCESSING CONDITIONS WHICH MIGHT PROMOTE DISCOLORATION, AND (3) DEVELOP A METHOD FOR PREVENTING DISCOLORATION SUITABLE FOR USE BY THE SEAFOOD PROCESSOR.

Product discoloration is a major problem of the frozen seafood industry. This problem is most evident in the shrimping industry, where a green discoloration is often encountered. Presence of the discoloration has a negative economic impact on the shrimping industry. Information obtained from this study regarding the causes and prevention of this condition will have a significant effect on reducing the economic loss.

Shrimp flesh and frozen breading were obtained from shrimp exhibiting green discoloration. Flesh and breading from the affected area were removed and extracted, using 5 ml of pH 8.0 Tris buffer (0.01 M), to identify the chemical composition of the green color. The resulting suspensions were centrifuged, separated, and filtered. The supernatants were scanned spectrophotometrically from 900 mm to 350 mm. A rise in absorbance was noted as the scan approached 350 mm for both samples and controls. The pellets from the centrifuge tubes were noted to contain a dark greenish-grey band, suggesting possible insolubility of the discoloring component in Tris buffer. The greenish-grey precipitate was removed from the pellet, suspended in 5 ml of hexane and recentrifuged; the supernatant remained colorless.

Microscope slides were prepared of the colored pellet and examined microscopically. All particles within the pellet assumed a greenish tint. No evidence of fungal or crystalline elements were noted. Further extractions were carried out using Tris buffers of varying pH and concentration, phosphate buffer, distilled water, and methanol. Results from these extractions were as before, with the exception of the methanol extraction, from which all color was removed from both the supernatant and the pellet. These procedures have indicated that the causative agent of the discoloration is an inorganic substance, probably an ammonium salt of iron. Further studies indicate that the discoloring constituent is formed during the growth of a bacterium *(Pseudomonas fluorescenes)* on affected shrimp.

The appearance of the discoloration accompanies a rise in temperature during processing. Shrimp which remain frozen during processing do not develop the discoloration. Those shrimp maintained a 4° C or above for prolonged periods of time frequently become affected by green discoloration.

Maintaining shrimp at temperatures below 4° C during processing is a successful technique for preventing green discoloration. Processors should insure that shrimp are maintained at these temperatures during processing. Certain chelating agents (EDTA, sodium citrate, etc.) have also been effective in preventing discoloration, even during prolonged periods of elevated temperatures, during processing. The incorporation of such chelating agents and maintanance of proper temperature should prevent discoloration.

SHRIMP QUALITY: NEW TECHNIQUES FOR THE SMALL PROCESSOR

35(4)

Paul M. Toom — University of Southern Mississippi
Newton Fawcett — University of Southern Mississippi

SUMMARY: THOUGH NECESSARY, FEDERAL FOOD AND DRUG ADMINISTRATION (FDA) REGULATIONS REQUIRING EXPENSIVE AND TIME-CONSUMING QUALITY CONTROL PROCEDURES BURDEN SMALL SEAFOOD PROCESSORS. THE FDA PROCEDURES ARE PERFORMED TO PREVENT MARKETING OF A DECOMPOSED PRODUCT. THE MAJOR GOAL OF THIS PROJECT IS TO RESEARCH AND DEVELOP NEW TECHNIQUES OF QUALITY CONTROL WHICH CAN BE PERFORMED QUICKLY, WITH LITTLE EXPENSE, BY PERSONNEL HAVING LITTLE OR NO SCIENTIFIC BACKGROUND. AN INITIAL STEP TOWARD ACHIEVING THIS GOAL IS THE IDENTIFICATION OF DECOMPOSITION BY-PRODUCTS IN SHRIMP. MAJOR DECOMPOSITION BY-PRODUCTS HAVE PREVIOUSLY BEEN IDENTIFIED AS AMMONIA AND INDOLE.

The small seafood processor, typically lacks the personnel, money, and time required to perform the quality control procedures outlined by FDA guidelines. These procedures are time-consuming, expensive, and require some technical "know-how." Ideally, the small processor should be able to perform quality control procedures which are both inexpensive and rapid. "Dipstick" techniques are used successfully in quantitative measurements of various substances (blood glucose, urine glucose, blood alcohol, etc.). Development of a "dipstick" technique for quantifying decomposition by-products in raw and processed shrimp will make quality control determinations feasible for the small seafood processor.

Current procedures quantify levels of indole and ammonia as by-products of seafood decomposition. Anaerobic pathways of bacteria involved in tissue decomposition yield ethanol may also be quantified easily. Gas chromatographic studies have indicated that ethanol levels are present in shrimp in levels proportional to the degree of decomposition. Measurement of bisulfite (a seafood preservative) levels would also be useful as a backcheck on proper preservation methods during the icing-down procedure.

Gas chromatographic studies using ethanol as an indicator of product decomposition have led to the development of a method for quantifying ethanol. Specifically, we have been utilizing the enzyme alcohol dehydrogenase coupled to the coenzyme NAD (Fig. 1). The NADH formed can be directly correlated to ethanol concentrations and has the additional advantage of reacting

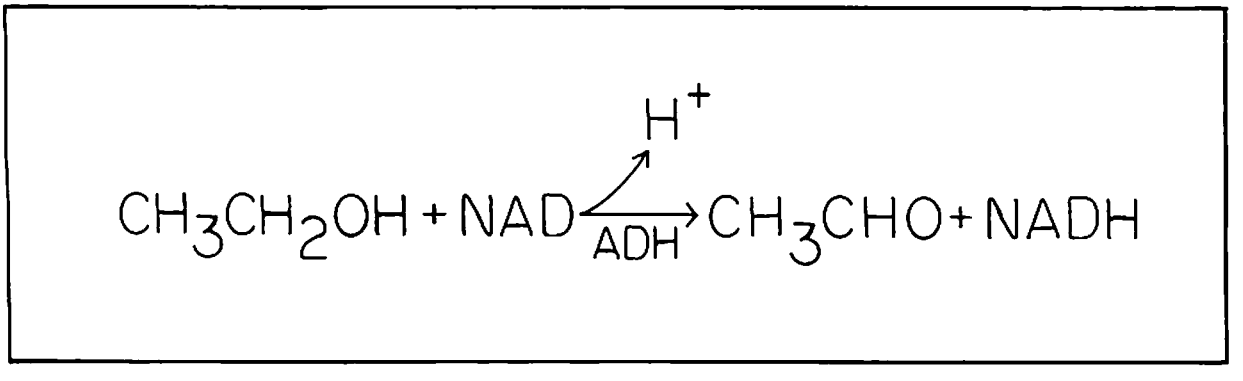

FIGURE 1. Reaction for estimating concentration of ethanol (CH_3CH_2OH).

with various dyes. The dye-reactant property permits the adaptation of the reaction to "dipstick" techniques.

Utilizing gas chromatography techniques, a series of shrimp, provided by the National Marine Fisheries Service, were analyzed for ethanol. The shrimp analyzed were in varying states of decomposition. Those samples in the more badly decomposed states were shown to exhibit higher ethanol concentrations. Subsequent studies suggest that samples stored at freezer temperatures over prolonged periods of time show a decrease in ethanol values. It is assumed that ethanol is so volatile that it leaves the sample, even at freezer temperatures of -20° C. This characteristic appears to indicate that ethanol would not be a valid indicator of product decomposition as the shrimp are iced-down as soon as they are caught.

A similar enzyme system is being developed to analyze ammonia levels in shrimp. The enzyme system used in this procedure is the glutamate dehydrogenase system (Fig. 2). NAD can then be directly correlated to ammonia levels, and the ability of NAD to be coupled with a dye system, again facilitates the development of a relatively quick and simple "dipstick" procedure.

The second year of this project should see the development of proposed "dipstick" procedures. An unexpected benefit of the project has been received; a relatively simple spectrophotometric procedure for ammonia quantitation has been developed. This procedure is statistically comparable to the standard federal methods. No significant difference (analysis of variance) was noted when the results of the two procedures were compared. Progress made in the first year of the project, coupled with the prospective developments of the second year, should provide a significant breakthrough for the small seafood processor. The developed techniques will be both economical and simple enough to be utilized by all members of the seafood industry.

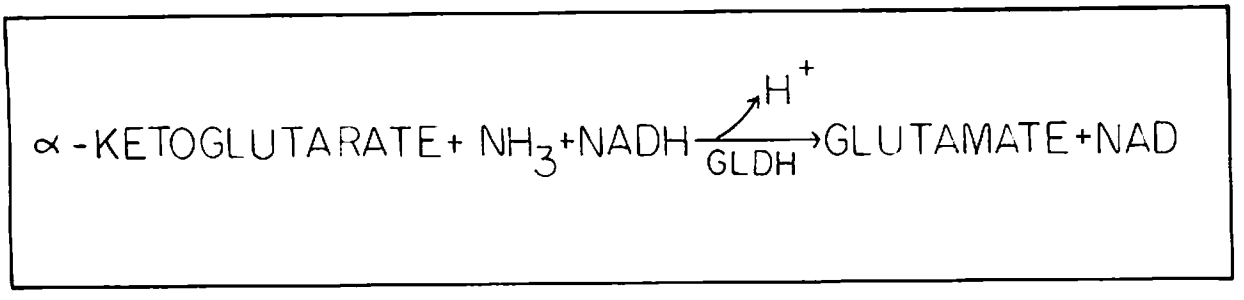

FIGURE 2. Reaction for estimating concentration of ammonia (NH_3).

TREATMENT OF SEAFOOD PROCESSING WASTE WATER BY ELECTROLYSIS

45(3)

Richard D. Benton

Mississippi State University

SUMMARY: AT PRESENT, WASTE WATERS FROM GULF COAST CANNERIES ARE DISCHARGED DIRECTLY INTO ADJACENT WATERWAYS WITHOUT TREATMENT BECAUSE MUNICIPAL SEWER SYSTEMS ARE NOT EQUIPPED TO HANDLE THE LARGE DISCHARGE OR THE UNPREDICTABLE FLOW. BY 1983 FEDERAL REGULATIONS WILL REQUIRE THAT THE EFFLUENT FROM ALL PLANTS RECEIVE COMPLETE TREATMENT. WITH THIS IN MIND, THE OBJECTIVE OF THIS 4-YEAR PROJECT HAS BEEN TO DEVELOP AN ELECTROLYSIS TREATMENT SYSTEM CAPABLE OF MEETING THE NEEDS OF THE SEAFOOD INDUSTRY. A PILOT PLANT HAS BEEN CONSTRUCTED AND TESTED AND APPEARS TO MEET THE REQUIREMENTS SET BY THE ENVIRONMENTAL PROTECTION AGENCY.

The treatment of seafood processing waste is a significant problem for the seafood industry. Federal and state regulations require that all shrimp processing plants install a screening device to remove heads, hulls and processing debris from their waste water prior to discharge. In addition, EPA guidelines require that by July 1, 1983, the effluent from all plants must receive complete treatment prior to discharge.

Mississippi State University has conducted extensive research from the NASA program in the treatment of waste by electrolysis. While the electrolysis of sewage is not as economical as standard treatment, it was determined to be highly effective in the treatment of concentrated waste.

PHASE I: LABORATORY EVALUATION

Preliminary tests were conducted to determine the applicability of electrolysis as a means of treating shrimp processing waste water. These tests were encouraging. Significant decreases in chemical oxygen demand, biochemical oxygen demand, protein, ammonia, and phosphate occurred.

Initial tests used direct current and platinum electrodes, and satisfactory results were obtained with the addition of NaCl. The electrolytic process then produced flocculating bubbles and hypochlorous acid. This is the commercial process for waste treatment on boats. However, this process alone does not appear practical for the large flow rates required by the shrimp processing industry.

It was found that excellent results could be obtained using alternating current and aluminum electrodes. This process can be more accurately named electroflocculation than electrolysis. Electrical stimulation of the aluminum electrodes in the waste water produces free hydrated aluminum hydroxide which precipitates organic matter. Results depended somewhat on pH but compared favorably with what is defined by the EPA as best available technology. A decision was made to construct an apparatus to investigate the technique.

PHASE II: DESIGN AND CONSTRUCTION OF FIELD TESTING APPARATUS

The test unit has two storage tanks with a combined capacity of about 500 gallons. The unit is equipped with three combination AC/DC power supplies. The electrolysis chambers consist of three plexiglass towers, each 7.5 inches square and 99 inches tall. A floc catch basin is provided at the top of the towers to separate the floc from the waste water.

PHASE III: FIELD TESTING

A complete series of field tests was conducted during 1977. These tests were conducted at about two-week intervals from mid-May until mid-August.

The test apparatus was designed so runs could be made with test chambers connected in parallel or connected in series. In the parallel mode of operation, comparisons could be made of various electrode configurations and materials with the same initial waste material. It was found that parallel plate aluminum electrodes with a spacing of ¼ inch between plates worked best. The application of 10 amperes of direct current produced the maximum reduction in BOD in the minimum amount of time.

In the series mode of operation the waste material was treated in the first column, transferred to the second column, and to the third column for final treatment.

This allowed for the investigation of various combinations of currents and electrode material in the treatment of waste material of different concentrations. It was found that the electrolysis method was not effective after the original treatment had been completed. The process appears to be exponential with 90% of the BOD reduction occurring in the first five to ten minutes of treatment.

The effect of the addition of flocculating chemicals to the waste water prior and during electrolysis was also investigated. The addition of 100-200 PPM of ferric sulfate improved the operation. Best results were obtained with 140 PPM ferric sulfate in combination with a 20 amphere direct current.

The above combinations of chemicals and electricity reduced the 5 day BOD from 1410 mg/1 to ca. 240 mg/ 1 in about 10 minutes. These results were consistent providing the materials were treated immediately. However, if the waste water was stored for later treatment then the same amount of treatment produced a smaller reduction in BOD. Typical results for waste material held for over one hour range from 500 to 900 mg/1.

CONCLUSIONS

1. The combination of 100-200 PPM ferric sulfate and 20 ampere minutes per gallon waste water produces a satisfactory reduction in BOD if the waste water is treated expeditiously.

2. Holding the waste water prior to treatment reduces the effectiveness of the method. The oxygen in solution is much more difficult to remove than that which has not entered solution.

3. The present design of a full scale plant with a 200 gallon per minute flow would require a 80-100 KW DC power supply.

4. A system for de-watering the foam and recovering the floc was not developed. This must be done if this system is to be used.

ENVIRONMENTAL, LEGAL, AND MANAGEMENT ASPECTS OF PROPOSED OYSTER DEPURATION FACILITY 06(2)

Edwin W. Cake — Gulf Coast Research Laboratory
David W. Cook — Gulf Coast Research Laboratory
Marvin T. Bond — Mississippi State University
D.C. Williams — University of Southern Mississippi

SUMMARY: POLLUTION OF ESTUARINE AND INSHORE WATERS OF THE MISSISSIPPI SOUND REDUCE THE OYSTER FISHERIES CATCH BY APPROXIMATELY 75% ANNUALLY. OYSTER PRODUCTION ALONG THE MISSISSIPPI GULF COAST HAS AVERAGED ONLY 33,000 BARRELS PER YEAR SINCE 1970 WITH AN ESTIMATED 100,000 BARRELS PER YEAR THAT ARE NOT HARVESTABLE AS A RESULT OF THIS POLLUTION. THESE UNHARVESTABLE OYSTERS REPRESENT APPROXIMATELY 2.5 MILLION DOLLARS LOST TO THE STATE ECONOMY YEARLY. LARGE POPULATION INCREASES IN COASTAL AREA IN RECENT YEARS HAVE RESULTED IN CLOSURE OF MANY OYSTER REEFS BECAUSE OF DOMESTIC POLLUTION. THE MAJOR GOAL OF THIS PROJECT WAS TO STUDY THE FEASIBILITY OF DEVELOPING AN OYSTER DEPURATION FACILITY IN THE MISSISSIPPI GULF COAST AREA. SEVERAL FACTORS MUST BE ADDRESSED BY THIS STUDY: (1) ECONOMIC ASPECTS, (2) PLANT DESIGN AND CONSTRUCTION COSTS, (3) ENVIRONMENTAL ASPECTS, (4) LEGAL ASPECTS, AND (5) MANAGEMENT ASPECTS. THIS PROJECT ADDRESSED THE ENVIRONMENTAL, LEGAL, AND MANAGEMENT ASPECTS OF THE PROPOSED FACILITY. THESE ASPECTS WERE EXAMINED AND FOUND TO BE COMPATIBLE WITH PRESENT COASTAL RESOURCES MANAGEMENT POLICIES.

The oyster fishery is a major part of the overall seafood industry along the Mississippi Gulf Coast. In recent years the number of harvestable oysters has diminished to approximately 33,000 barrels per year. This figure, however, represents only about 5% of the total resource available. Approximately 100,000 barrels of oysters, from area reefs, would be available if they were not in areas presently closed because of domestic pollution. Projections indicate that the entire shellfishery may eventually be lost if the present trend continues.

Oysters, however, can be taken from domestically polluted areas, cleansed, and marketed. The U.S. Food and Drug Administration presently recognizes two cleansing method. One method, relaying, involves harvesting oysters from polluted areas, transplanting them to approved waters, and waiting at least 14 days before final harvest. This "double harvest" method is frequently unsuitable as the second harvest is usually incomplete, resulting in a net loss of oysters. The second method, depuration, involves removing the oysters to an onshore facility where oysters undergo self-cleansing in tanks fed by ozone or ultra-violet irradiated waters. Oyster depuration requires 48 to 72 hours with bacteriological testing to insure that the depuration process has been completed. The relaying method is the more economically feasible procedure. However, if population and pollution projections prove correct, areas for relaying may disappear. If this occurs then a complete loss of the oyster fishery would result. Clam depuration plants are currently operating in the United States and oyster depuration plants are operating in Europe. Hence, depuration appears to be the best way to insure continuation of the oyster fishery.

The major goal of this project is to acquire data assessing the feasibility of an oyster depuration plant. This study did not, however, address either the economic

aspects or the plant design and construction cost of the facility, as funds and time were limited. Funds sought from other sources will be used to obtain data relevant to these aspects.

Requests for information were sent to various federal, state, and local agencies that would participate in any future depuration facilities in the Gulf of Mexico region. A total of fifty responses have been received, reviewed and summarized. Meetings by the project investigators and federal, state, and local officials have taken place, regarding procurement of information applicable to the development of the depuration facility.

Information gleaned through these reports, meetings, and workshops have been compiled and summarized. The criteria examined in this project indicate that the development of an oyster depuration facility would be compatible with present coastal resource management policies.

ENVIRONMENTAL STUDIES

Despite the economic importance of the Mississippi Sound to Alabama and Mississippi's economy, little is known of its physical environment. To alleviate this lack of knowledge, studies are being initiated and planned to investigate the geophysical-ecological parameters of Mobile Bay and the Mississippi Sound. A second effort of the environmental study section is to find ways to reduce the pesticide quantities entering the coastal environment. Considerable progress has been made in the development of a controlled-released mechanism that holds promise of someday reducing the insult of pesticides on the coastal environment.

UTILIZATION OF MARINE PRODUCED POLYSACCHARIDE SUBSTRATES TO REDUCE PESTICIDE MOBILITY 42(1)

Charles L. McCormick **University of Southern Mississippi**

SUMMARY: CROP DESTRUCTION BY INSECTS AND WEEDS IS AN INCREASINGLY IMPORTANT CONCERN AS THE WORLD'S POPULATION GROWS. CONTROL OF THESE AGRICULTURAL PESTS IS NECESSARY IF THE EARTH'S FOOD NEEDS ARE TO BE MET. UNFORTUNATELY, THE PESTICIDES USED TO COMBAT CROP PESTS ARE OFTEN HARMFUL TO BENEFICIAL PLANTS AND INSECTS. THE NON-SPECIFICITY OF MANY PESTICIDES RESULTS IN DAMAGE TO NON-TARGET, AS WELL AS TARGET, ORGANISMS. PESTICIDES OFTEN SHOW UP, IN HARMFUL LEVELS, IN NATURAL WATERWAYS AND IN MUNICIPAL WATER SUPPLIES. THE PROBLEM OF PESTICIDE MOBILITY WILL REQUIRE CAREFUL STUDY IF THE ENVIRONMENT IS TO BE PROTECTED. THE DEVELOPMENT OF CONTROLLED-RELEASE (C-R) PESTICIDES WOULD AID IN SOLVING MANY OF THE PROBLEMS OF PESTICIDE MOBILITY. POLYMERS SHOW MUCH PROMISE IN THIS AREA. A MAJOR GOAL OF THIS PROJECT IS TO DEVELOP POLYMER SYSTEMS CONTAINING CHEMICALLY ATTACHED PESTICIDES. A TREMENDOUS NATURAL RESOURCE OF POLYMERS OCCURS AS A BY-PRODUCT OF THE SEAFOOD INDUSTRY. MILLIONS OF POUNDS OF CHITIN (AND RELATED SUBSTANCES) ARE GENERATED AS WASTE PRODUCTS OF THE MARINE INVERTEBRATE FISHERIES INDUSTRY. CHITIN OFFERS GREAT POTENTIAL AS A POLYMER-BINDING SYSTEM FOR PESTICIDES. TO DATE SEVERAL SUCCESSFUL POLYMER-PESTICIDE SYSTEMS HAVE BEEN SYNTHESIZED AS A RESULT OF THIS PROJECT. FURTHER RESEARCH INTO C-R SYSTEMS IS PROGRESSING RAPIDLY AND COMMERCIAL PRODUCTION SEEMS IMMINENT.

As the world population increases, agriculture becomes increasingly more important. A major problem facing the agricultural industry is crop damage by insects and undesirable plant species (weeds). Control of agricultural pests is necessary if the world's food needs are to be met. Pesticide use will be the major solution to the agricultural pest problem. One of the major drawbacks to pesticide use is pesticide mobility. Many pesticides are, typically, non-specific, affecting both harmful target organisms and beneficial or harmless non-target organisms. The mode of application (broadcast) of most agricultural pesticides permits, and often enhances, leaching and transport into natural waterways and, in many cases, municipal water supplies.

The deep South is a prime agricultural area and use of agricultural pesticides is common. The Mississippi River drains approximately one-half of the United States. Along the river's banks is some of the finest cropland in the world, all subject to heavy treatment by agricultural pesticides. Runoff is heavy and significant amounts of the pesticides eventually find their way to the Gulf of Mexico. The action of these insecticides may have profound effects on marine invertebrates (crabs, shrimp, lobster, copepods, etc.). An ideal solution to the problem of pesticide mobility would be the development of Controlled-Release (C-R) pesticides. The main environmental problems with the standard techniques for applying pesticides are the large amount necessary and the short time the pesticides are effective (Fig. 1). Both these problems are partially alleviated by the use of the C-R pesticides.

The first year efforts of this project have centered around the polymer, polyvinyl alcohol. Future efforts will attempt to utilize marine-produced polysaccharides as delivery systems. The marine-produced polysaccharides being examined are chitin, chitosan, cellulose, and a few others. Chitin and its derivative, chitosan, are now

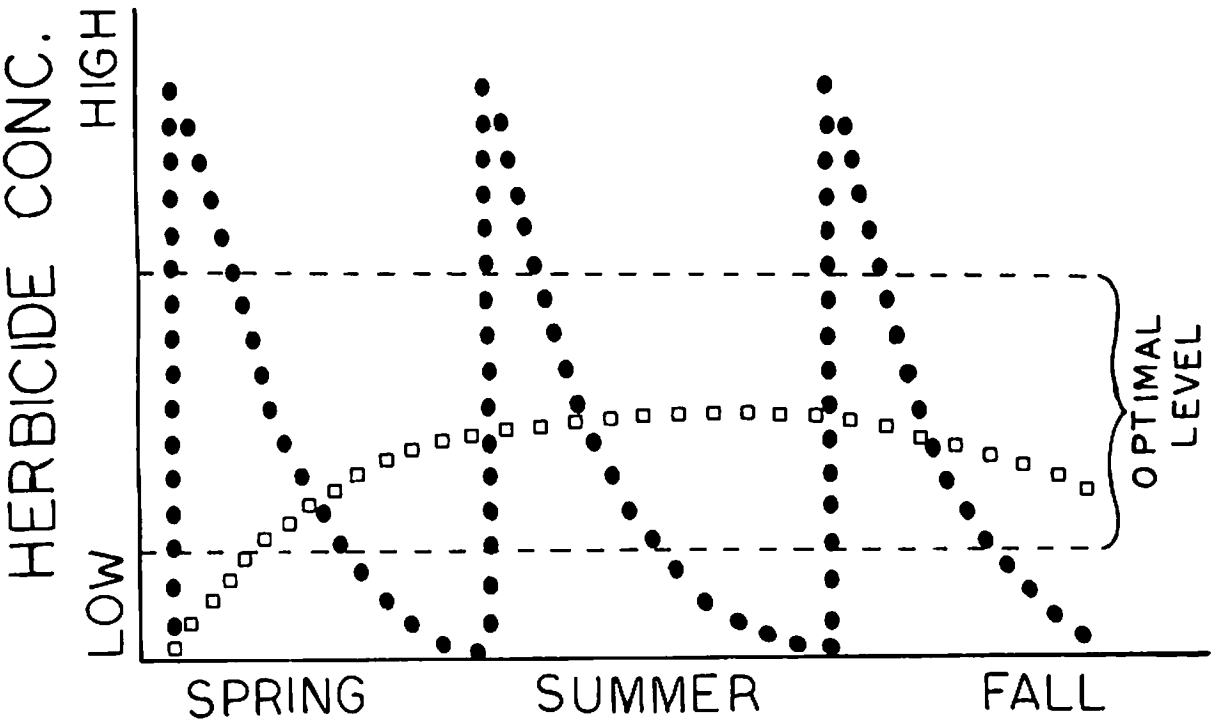

FIGURE 1. Comparison of dosage requirements and release times for D-R pesticides application (□ □ □) and standard aerial application (• • •).

being produced from the several hundred million pounds of seafood waste being generated annually. A number of applications for chitin and chitosan have been identified, but few offer the commercial potential of C-R pesticides.

The initial portion of this project deals primarily, with the development of C-R herbicides. Three agricultural herbicides (2,4-D, Dalapon, and Metribuzin) have been studied based on their widespread usage. Two of these herbicides (2,4-D, and Dalapon) are chlorinated and are expected to be persistent in the environment. Metribuzin, however, is photo-degradable and seems to be a good choice for use in a C-R system.

The polymeric systems studied were selected on the basis of their biodegradability into non-toxic forms, availability from marine sources, and solubility in organic solvents. The polymers chitin, chitosan, and cellulose seem to offer the greatest promise in these areas. Pesticide selection was based on: (1) concerns of mobility, (2) soil or contact activity, (3) extent of current agricultural

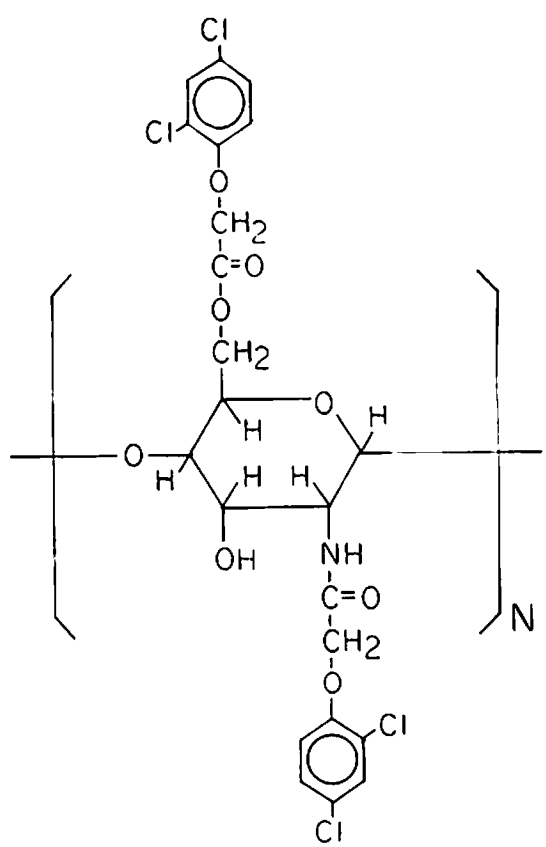

FIGURE 2. Chemical model for pesticide attachment to a marine polysaccharide.

utilization, (4) selectivity, (5) persistence.

Five polymers containing pendant metribuzin were chosen for study: 22-S, 23-S, 41-S, 45-S, and 50-S. Three of the polymers (23-S, 45-S, and 50-S) were linear polymers and two (21-S and 41-S) were highly cross-linked microporous solids. The latter system requires both hydrolysis of the urea bond and diffusion from a water-swollen, cross-linked matrix for metribuzin release. Plots of solution concentration versus time indicated that linear polymers released metribuzin much more rapidly than the cross-linked systems. Linear polymers released their herbicides rapidly over the first few hours, followed by a slower gradual release for several days. The cross-linked polymers released very little pesticide initially or long-term.

The preliminary results of the project indicate the polymeric C-R systems can be designed which should: (1) reduce pesticide mobility, and (2) provide more effective long-term treatment of crops, and (3) enhance agricultural production. Perhaps the most significant result has been the generation of immense interest from governmental, industrial, and public sectors. Cooperative support of the project has been offered by a number of agencies. Significant progress has been achieved in the synthesis of new polymer C-R systems based on chitin and chitosan.

PUBLICATIONS

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McCormick, C.L., K.E. Savage, and B. Hutchinson. 1977. Development of a controlled-release polymer systems containing pendant metribuzin. Proc. International Control Release Symp. 28-40.

COOPERATING ORGANIZATIONS

Hopkins Agricultural Chemical Corporation
U.S.D.A. Weed Science Laboratory

DESCRIPTIVE CHARACTERISTICS OF THE PHYSICAL ENVIRONMENT OF MOBILE BAY AND EAST MISSISSIPPI SOUND

50(2)

William Schroeder **University of Alabama**

SUMMARY: A MULTI-PLATFORM OCEANOGRAPHIC SURVEY HAS BEEN CONDUCTED FOR THE PAST THREE YEARS TO DELINEATE HYDROGRAPHIC AND CIRCULATION REGIMES IN MOBILE BAY AND THE EASTERN MISSISSIPPI SOUND. PREVIOUS WORK BY OTHER RESEARCHERS CONTRIBUTED LIMITED CHRONOLOGICAL COVERAGE. THE WATERS OF THIS AREA PLAY A FUNDAMENTAL ROLE IN THE DEVELOPMENT OF COASTAL ZONES OF MISSISSIPPI, ALABAMA, AND NORTHWEST FLORIDA. THE MAJOR GOAL OF THIS PROJECT WAS TO PERMIT COMPLETION OF DELINEATION OF CURRENT REGIMES, DISTRIBUTION OF SALINITY AND DISSOLVED OXYGEN FIELDS, AND INITIATION OF A 5-YEAR CLIMATOLOGICAL CHARACTERIZATION OF MOBILE BAY AND THE EASTERN MISSISSIPPI SOUND.

Previous work by researchers in the Mobile Bay and eastern Mississippi Sound regions has been useful, but provided limited chronological coverage. The principal investigator of the present project has conducted a 3-year survey involved in delineating hyrdographic and current regimes in this region. The waters of this area play a critical and fundamental role in the coastal zones of Mississippi, Alabama, and northwest Florida. The projections for population and industrial growth in the region have made the characterization of these waters an immediate need.

Major goals of this project are: (1) characterization of current regimes, (2) determination of distribution of various parameters (salinity, dissolved oxygen, and temperature) within the waters of the region, (3) a 5-year climatological characterization of the region, and (4) publication of a regional Physical Environment Atlas.

During 1977 ten 26-hour surveys of the Mobile Bay Main Pass were carried out. These surveys collected data on vertical temperature profiles, salinity (conductivity), and dissolved oxygen. These surveys were carried out at three preselected stations at 5- to 6- hour time intervals. In addition seven lower Mobile Bay aerial surveys were carried out during specific 26-hour surveys.

Nine surface drogue releases, seven in Mobile Bay and two in the eastern Mississippi Sound, were carried out. Single and multiple releases were made. Continuous monitoring platforms were utilized at three stations. Meteorological data were collected in both a specific observation time frame and on a continuous recording basis. These data were phoned in on a real-time schedule in order that they could be utilized by National Weather Service Offices at Mobile, New Orleans, and Miami. These data are routinely placed on the NWS/NOAA Weather Wire and RAWARC Severe Weather Warning System. Date from all of the above sources have been utilized in preparing an "up-date" package for the "Physical Environment Atlas of Coastal Alabama."

PUBLICATIONS

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MISSISSIPPI SOUND: HIGH ENERGY AND HAZARDOUS AREA IDENTIFICATION BY WAVE REFRACTION ANALYSIS 50(3)

Charles K. Eleuterius — Gulf Coast Research Laboratory

SUMMARY: MISSISSIPPI SOUND IS A RELATIVELY SHALLOW, ELONGATED BASIN HEAVILY USED BY INDUSTRIAL AND RECREATIONAL VESSELS. THE SEAWARD BOUNDARY OF THE SOUND IS MARKED BY SEVERAL BARRIER ISLANDS. THIS PHYSICAL STRUCTURE OF THE BASIN RESULTS IN THE AREA BEING SUSCEPTIBLE TO HAZARDOUS WAVE CONDITIONS DURING TIMES OF INCLEMENT WEATHER. THESE HAZARDOUS WAVE CONDITIONS GENERALLY DEVELOP QUICKLY DUE TO THE SHALLOWNESS OF THE SOUND. MANY SHORELINE FACILITIES ARE CONSTRUCTED WITHOUT REGARD TO PREVAILING WEATHER AND WAVE CONDITIONS. EROSION, DAMAGING WAVE OSCILLATIONS, AND SILTATION OF HARBOR ENTRANCES MAY RESULT, IN PART, DUE TO DISREGARDING OF THE AFOREMENTIONED CONDITIONS. THE MAJOR GOALS OF THIS PROJECT WERE TO: (1) GATHER BATHYMETRIC DATA FOR TEN SPECIFIC AREAS OF THE MISSISSIPPI SOUND, (2) GENERATION OF CONTOUR CHARTS OF MAXIMUM WAVE HEIGHTS UTILIZING WAVE REFRACTION DATA, AND (3) GATHER DETAILED BATHYMETRIC DATA IN AREAS WHERE EROSION PROBLEMS AND NAVIGATION HAZARDS EXIST.

The Mississippi Sound is a relatively shallow, elongated basin with its major axis oriented parallel to the Gulf of Mexico. Barrier islands form a boundary between the Sound and the northern Gulf of Mexico. There are 10 cities located along the tidal shoreline of the Sound resulting in the region being designated a metropolitan area. Population projections indicate that the area will contain 20% of the state's population within 15 years.

The Sound is an important area directly or indirectly supporting most of the economic activities in the area. Two deepwater port facilities at Gulfport and Pascagoula service seafood and industrial fisheries, recreational vessels, charter boats, intercoastal vessels, and foreign trade vessels. To service the larger vessels, narrow deep passages have been constructed that permit entrance to harbor facilities and passage through shoal areas.

The combination of heavy traffic, narrow deep passages, and the overall shallowness subject the area to quickly developing hazardous wave conditions. Additionally many small port facilities, piers, jetties, etc., have been constructed with little regard to wave climate or other physical properties of the Mississippi Sound. Disregard for these conditions has resulted in major problems. At certain locations, erosion of shoreline occurs at the rate of 10 to 20 feet per year. Commercial and recreational vessels have been battered, grounded, and sunk in certain areas of the Sound. The major goal of this project is to compile data on bathymetry, wave refraction, and wave direction within the Sound.

A computer file on bathymetric data is being compiled, rendering this material readily available when required. Aerial photography was employed to supplement and complement bathymetric data on file. Although some unanticipated problems developed, due to climatic conditions, the aerial imagery survey is providing some wave refraction patterns worthy of consideration. All base charts are completed and in the form of overlays, thus facilitating the use of computer-generated graphics of wave refraction patterns.

MARINE EDUCATION AND TRAINING

In addition to the acquisition of information on the coastal environment there is a need for speedy and accurate distribution of these findings to other scientists and the general public. With this concept in mind, the emphasis in 1977 has been to support the preparation of two manuals dealing with coastal resources - one covering salt marsh plants and one covering fish parasites.

ILLUSTRATED GUIDE TO SALT MARSH PLANTS OF THE NORTH CENTRAL GULF OF MEXICO 70(3)

Lionel N. Eleuterius **Botany Section, Gulf Coast Research Laboratory**

SUMMARY: THIS WORK WILL FULFILL A GREAT NEED FOR A CONCISE MANUAL OF THE SALT MARSH PLANTS OF MISSISSIPPI AND ALABAMA COASTAL AREA. RECENTLY MOST OF THE PLANT SPECIES KNOWN TO OCCUR IN THIS REGION WERE IDENTIFIED THROUGH THE USE OF 12 REFERENCE MANUALS AND MORE THAN 60 SCIENTIFIC PAPERS. THE RESULT OF THIS STUDY WILL BE A SINGLE MANUAL WHICH WILL ELIMINATE THE NEED FOR ANY OTHER REFERENCE. IDENTIFICATION KEYS SUPPLEMENTED BY DETAILED DRAWINGS OF TAXONOMICALLY IMPORTANT FEATURES OF EACH PLANT WILL BE INCLUDED ALONG WITH CONCISELY WRITTEN DESCRIPTIONS OF VEGETATIVE AND REPRODUCTIVE STRUCTURES, HABITAT AND GENERAL DISTRIBUTION.

The purpose of this work is to produce an illustrated guide and key to the vascular plants of the tidal marshes of Mississippi and Alabama. The resulting publication will fill a void regarding the botanical aspects of coastal salt marsh ecology in the northern Gulf of Mexico. The professional scientist, student and layman will find the work of value, because it provides under one cover the essential information needed to identify most of the tidal marsh vascular plants known to occur in this Gulf Coast region. Furthermore, it eliminates the need for numerous reference materials previously required.

Species — Approximately 150 species, representing about 40 families, have been sorted from herbarium specimens. Several uncommon and/or new records have been recently taken from local marshes and identification of these specimens is in progress. Living specimens or photographic documentation of species in flower or fruit will supplement herbarium specimens of preparation of illustrations.

Organization — Species are being grouped by plant families. The largest groups include the Poaceae (grasses), Cyperaceae (sedges), Asteraceae (compositities), Chenopodiaceae, Juncaceae (rushes), Fabaceae (beans) and Apicaeae Much detailed work is required in the drawings, especially in illustrating the grasses, sedges, and rushes. These are difficult groups to illustrate properly and illustrating trials are in progress.

Guide to the vascular plants. Keys to families genera and species, supplemented with pertinent illustrations (line drawings) will allow rapid identification of most vascular plants occuring in the tidal marshes of Mississippi and Alabama.

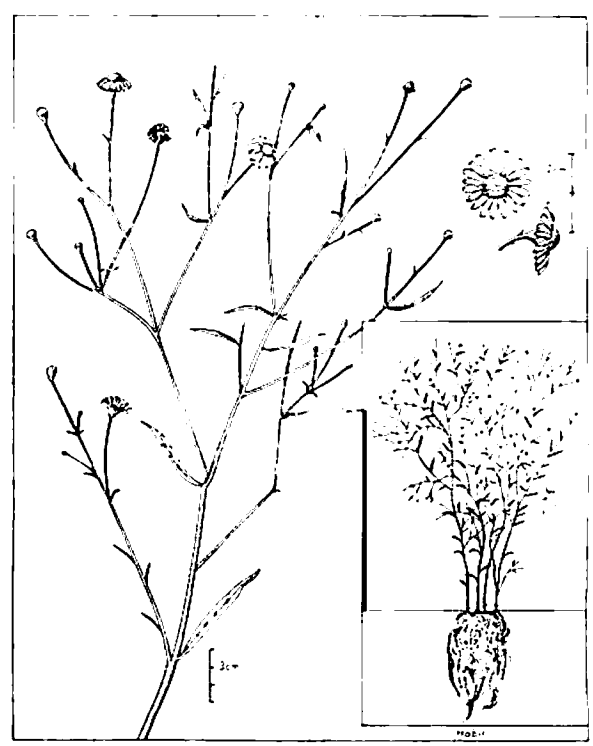


FIGURE 1. A line drawing of flowers and/or seeds is included for each plant species. The insert illustrates the plant habit and root system.

Taxonomic descriptions are being prepared. Research, including comparative work from the literature, is being synthesized for an up-to-date taxonomic evaluation of each species. Descriptions of seeds, flowers and vegetative structures as well as notes on the ecology and distribution will be included for each species as needed.

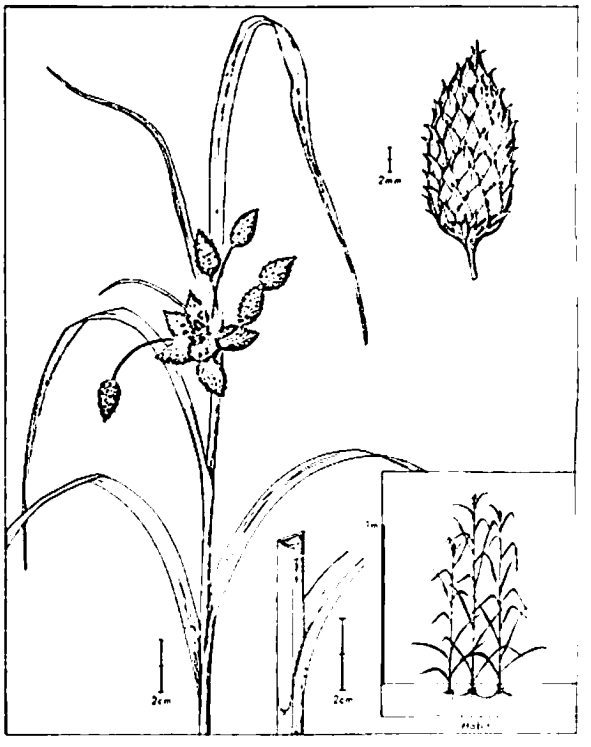


FIGURE 2. Details of certain unusual plant characteristics such as the triangular shape of the stem in this illustration, aids in accurate plant identification.

PUBLICATIONS

Eleuterius, L. in prep. Illustrated guide to salt marsh plants of the north central Gulf of Mexico. MASGC-79-

HANDBOOK OF MARINE PARASITES OF THE NORTHERN GULF OF MEXICO 08(1)

Robin M. Overstreet Gulf Coast Research Laboratory

SUMMARY: THE PRIMARY OBJECTIVE OF THIS PROJECT HAS BEEN TO PREPARE FOR PRINTING A GUIDEBOOK COVERING THE MAJOR DISEASES AND PARASITES ASSOCIATED WITH MARINE AND ESTUARINE INVERTEBRATES AND VERTEBRATES. THE GUIDEBOOK IS DESIGNED FOR STUDENTS AS WELL AS THE LAYMAN. THE PARASITIC GROUPS INFECTING BIRDS, MAMMALS, AND REPTILES WILL BE TREATED, THOUGH IN A LESS EXTENSIVE MANNER THAN THOSE INFECTING FISHES AND COMMERCIALLY IMPORTANT SHELLFISHES.

This guidebook will inform those curious about parasites and other symbionts associated with marine and estuarine hosts in the northern Gulf of Mexico. Designed as a teaching aid for students, fishermen, seafood consumers, beachcombers, and even parasitologists, it should allow for better understanding and appreciation of several of the numerous shellfish and finfish symbionts. Even though most selected examples are from Mississippi and other regions along the Gulf Coast, the same or related species occur along the Atlantic seaboard and elsewhere; present information should apply similarly for several but not all of those cases. Some symbionts significantly affect the size and production of a fishery and consumption of the product, whereas others stimulate environmental or academic interests. In the natural environment, parasitic relationships

FIGURE 1. Line drawings of three digeneans from fishes. Left, a hemiurid *(Lecithaster leiostomi)* from a spot. Middle, a zoogonid *(Glaucivermis spinosus)* from a southern kingfish. Right, a cryptogonimid *(Neochasmus sogandaresi)* from a striped bass. These do not begin to exhibit the variety in characteristics among digeneans. Note the ventral suckers, the lobation of the ovary (dark organ), lobation and follicles of yolk gland (lightly stippled organ), and male terminal organ (exists marginally in center worm).

seldom result in harm to the host. Harm, however, often becomes apparent when animals are concentrated and confined, as when they are cultured or otherwise distressed. This guide will discuss some of these cases.

The guidebook is divided into sections discussing the various hosts of parasites. Primary headings refer to basic host-types.The reader, however, must keep in mind that groups of both symbionts and hosts overlap. The same parasite may have a different stage of its life history infecting a shrimp, a fish, and a bird. Consequently, perusal of several sections may help the reader understand more about the symbionts of any particular host.

The guidebook has been written with both the student without a strong biological background and the layman in mind, but it presents additional notes for more serious readers interested in technical aspects. That technical section, in the latter half, directs the reader to references in scientific literature which present supporting data or reviews topics under consideration. An effort has been made to define scientific terminology either in the text or in the glossary at the end of the guide. There are several diagrams, illustrations, photographs, and legends to accompany the text (Fig. 1).

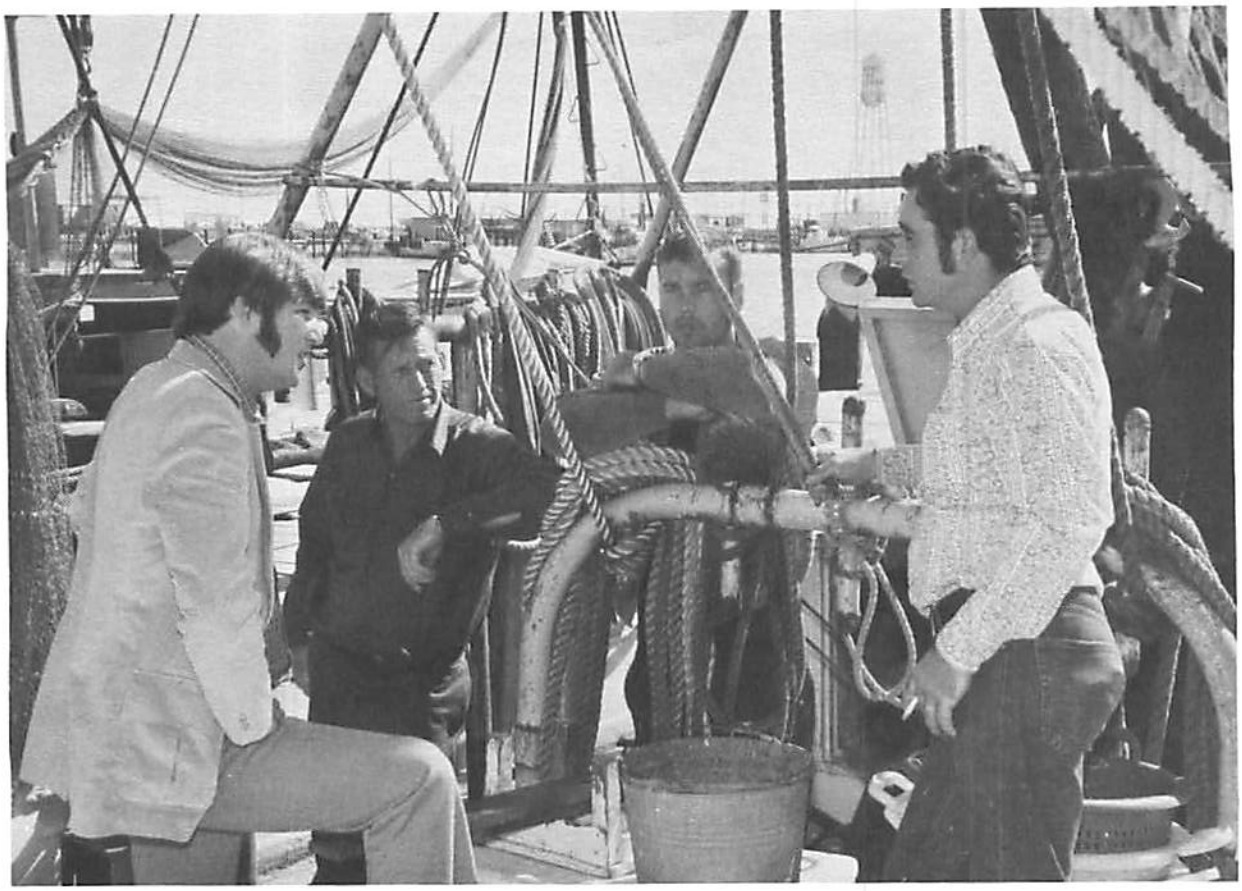
Latin names have been included as well as common names for three reasons. First, some organisms have no common name. Second, a specific common name may refer to more than one animal or one animal may have more than one common name. When most people talk about the blue crab, they are probably talking about *Callinectes sapidus,* but they might also knowingly or unknowingly be referring to *C. similis, C. ornatus,* or a variety of other related crabs. Third and last, knowing the Latin name often allows one to find more easily other literature about the organism.

PUBLICATIONS

Overstreet, R.M. 1978. Marine maladies? Worms, germs, and other symbionts from the northern Gulf of Mexico. MASGP-78-021.

COOPERATING ORGANIZATIONS

National Marine Fisheries Service



SEA GRANT ADVISORY SERVICES

The Advisory Service provides a function for Sea Grant similar to that provided by Co-operative Extension Service for land grant institutions. The Advisory Service is the primary means of communicating with the coastal community for the Mississippi-Alabama Sea Grant Consortium. The primary objective of the Advisory Service is to provide a better way of life through public awareness. This will be accomplished by making a wider segment of the general public familiar with the Sea Grant concept through programs for commercial fishermen, seafood processors, youth groups, and other special interest groups. Another objective of the Sea Grant Advisory Service is to develop stronger working relationships with governmental and non-governmental agencies. It is hoped that through these efforts the general public and the marine industries will benefit.

MISSISSIPPI SEA GRANT ADVISORY SERVICE PROGRAM 71(1)

C. David Veal — Mississippi Cooperative Extension Service
J. Dale (Zach) Lea — Mississippi Cooperative Extension Service

SUMMARY: THE MISSISSIPPI SEA GRANT ADVISORY SERVICE PROGRAM WORKING WITH THE MISSISSIPPI COOPERATIVE EXTENSION SERVICE HAS THE EXPRESSED PURPOSE OF COMMUNICATING INFORMATION TO THOSE INTERESTED IN MARINE AFFAIRS. ACTIVITIES HAVE BEEN PRODUCTIVE AND DIVERSE RANGING FROM SEAFOOD PRODUCT DEVELOPMENT TO TOURISM.

A major function of the Mississippi Sea Grant Advisory Service program is collecting and disseminating information. The information received by the Advisory Service is distributed to groups, agencies, and/or individuals needing such information. The Advisory Service may provide information in such diverse areas as legal rights of fishermen or the scientific problems facing the seafood industry. Problems not addressed by information on file are directed to the appropriate investigators.

The activities of the Advisory Service may be classified into the following general categories: recreational resource development, general public information, resource development, youth education, and interagency cooperation.

RECREATIONAL RESOURCE DEVELOPMENT

Ongoing activities with the 38-vessel Mississippi Charter Boat industry have continued. Under a cooperative agreement with the Marine Science Department of Biloxi High School information pertaining to the analysis of the Mississippi Charter Boat industry was collected. This survey was completed in early August and an analysis of the information is nearing completion. Programs with the Mississippi Gulf Coast Fishing Reefs Association and numerous other fishing associations have continued. Recognizing the importance of recreational fishing to the general public nearly one dozen articles on sport fishing, sport fishing opportunities, techniques, and economic impact were written and distributed through the mass media network in coastal Mississippi.

GENERAL PUBLIC INFORMATION

More emphasis has been placed on public education via mass media, during 1977, than was placed on this area in past years. These activities might be broadly classified as relating to the following general areas: recreational opportunities, seafood preparation, issue explanation, seafood industry trends, tourism industry trends and general public information. In general, all activities were addressed using some form of mass media or combination of available forms of mass media including television, radio, newspapers, as well as exhibits at county fairs, shopping malls and trade shows. A casual review of many publications of advisory services will readily indicate recognition of the impact of recreation on the coastal community. Not only have an excess of 100,000 publications relating to coastal recreation opportunities been distributed this year via chambers of commerce, innkeepers, the Mississippi Coast Coliseum Commission and the State Agricultural and Industrial Board, but numerous radio programs and newspaper articles were used.

In addition, extensive use was made of the local mass media to insure that a large section of the general public would have the necessary information to make rational decisions concerning topics of local interest. Topics include recruitment of

Vietnamese labor into the Biloxi area, proposed ban on catching sponge crabs, and a proposed banning of gill netting. Mass media was also used to keep a large section of the commercial fishing community abreast of current trends in the industry.

RESOURCE DEVELOPMENT

Advisory services played a major role in the temporary solution of labor problems facing the seafood industry by the initiation of a proposal to move Indo-China refugees into the area. These refugees from commercial fishing interest in Vietnam have broad experience in the seafood industry and have made a major contribution to increasing capacity for operation at existing seafood plants. Advisory specialists with the aid of marketing, economic, and food technology specialists from the Mississippi State University Food and Fiber Center and the Cooperative Extension Service have continued work to develop additional economic resources for the Gulf Coast. These resources include, but are not limited to many seafood products including frozen oysters on the half-shell, fresh, frozen and breaded croaker, refabricated shrimp, canned sardines, and canned mullet. In addition, several publications and technical papers have been given by specialists of the Cooperative Extension Service as a direct result of their involvement with Advisory Services.

YOUTH EDUCATION

The addition of a Marine Education Specialist greatly increased youth education efforts of the program. It is our belief that a long-term commitment to youth education will have potentially the greatest pay back for Advisory Service efforts. Special activities for 4-H groups from more than 40 counties have been held. These 2-day marine education workshops give students an in-depth knowledge of marine resources and stimulates interest far beyond the three coastal counties.

Contacts have been established with teachers throughout the state and the State Department of Education in the spirit of cooperative education programs which might be productive and conducive to the expansion of existing cirriculum areas in the school system. Marine Education Specialist participated in the Mississippi Education Association's annual conference and the annual conference of the Mississippi Teacher's Union. These initial efforts plus efforts at establishing marine education programs with coastal schools will have long-term benefits for the State of Mississippi.

INTERAGENCY COOPERATION

The Mississippi Sea Grant Advisory Service's staff, in conjunction with the Alabama Sea Grant Advisory Services Program, sponsored the Gulf Coast Commmercial Fishermen's Symposium which was attended by 60 Gulf Coast fishermen from Florida, Alabama, Mississippi, and Louisiana. The symposium covered topics such as Loran A to C Conversion, using the twin trawl, vessel economics, industry economics and a sound-off session. During the same period, specialists worked closely with minority fishermen from Pass Christian to help form one of Mississippi's first fishery cooperatives. The cooperative, consisting of around 20 blacks, is actively pursuing the pooling of resources to buy processing facilities, fishing vessels, and other needed equipment.

SUMMARY

Advisory Service activities as proposed in 1976 have indeed been diverse and productive. Such activities ranging from seafood product development to tourism and issue explanation have not only broadened the scope of advisory service activities but have hopefully brought increased awareness to the general public. The work of Advisory Services seems never-ending. For every group and problem it helps solve, there is a new audience and need awaiting.

ALABAMA SEA GRANT ADVISORY SERVICE PROGRAM 71(2)

R. Warren McCord — Alabama Cooperative Extension Service
Mac V. Rawson — Alabama Cooperative Extension Service
William Hosking — Alabama Cooperative Extension Service

SUMMARY: THE ALABAMA SEA GRANT ADVISORY SERVICE PROGRAM OPERATES WITHIN THE ORGANIZATIONAL STRUCTURE OF THE ALABAMA COOPERATIVE EXTENSION SERVICE, AND FUNCTIONS AS AN INTEGRAL PART OF EXTENSION'S COMMUNITY RESOURCE DEVELOPMENT GROUP. THIS FRAMEWORK ALLOWS THE SEA GRANT ADVISORS TO DRAW UPON THE CONSIDERABLE RESOURCES OF AUBURN UNIVERSITY'S TEACHING AND RESEARCH FACULTY AND TO UTILIZE THE STATEWIDE VISIBILITY, CONTACTS, AND CREDIBILITY OF THE COOPERATIVE EXTENSION SERVICE.

The program goal is to provide the most current information and technical assistance to all groups, agencies, and private individuals in Alabama who work with the State's marine and coastal resources. Due to the wide diversity of both geographic features and economic and landuse conflicts that continually develop among groups competing for the use of coastal resources, it is imperative that the advisory service program continues its progress toward meeting this important educational goal.

STAFFING

At the inception of the 1977 program year the Advisory Service staff consisted of Dr. R. Warren McCord, State Leader-Community Resource Development, and Dr. Mac V. Rawson, Marine Resource Development Specialist. Other Extension Specialists and county personnel in Baldwin and Mobile Counties were used to augment the staff.

Dr. William Hosking was appointed to the Advisory Service staff as Economist-Marine Resources on October 1, 1977. Mr. Gale R. Trussell, Coastal Recreation and Tourism Specialist, was appointed effective March 1, 1978. The disciplines and capabilities of the three team members will create a unique combination of expertise in dealing with coastal and marine-related problems, issues, and opportunities.

COORDINATION AND COOPERATION WITH OTHER AGENCIES

The Advisory Service staff conducted cooperative programs with the Mississippi Sea Grant Advisory Service, Dauphin Island Sea Lab, Mobile Area Chamber of Commerce, the Gulf of Mexico Fisheries' Management Council, Alabama Department of Conservation and Natural Resources, Shrimp Management Task Force, National Marine Fisheries Service, Alabama Coastal Area Board, and the United States Army Corp of Engineers.

Coordination of program efforts with the Mississippi Sea Grant Advisory Service Program resulted in several jointly sponsored presentations. Two workshops on the use of the Beam Trawl were conducted. As a result of the joint organizational effort of the Mississippi-Alabama Sea Grant Advisory Services the first general meeting of the Gulf Shellfish Packers' Association was held. This meeting included representatives from Louisiana, Florida, Mississippi, and Alabama. An additional effort between the Mississippi-Alabama Advisory Services was the presentation of a number of seminars at the Gulf States Commercial Fishermans' Exhibition held in the Mobile Municipal Auditorium.

ADVISORY SERVICE-RESEARCH COORDINATION

Advisory service staff cooperated and assisted in efforts made by Sea Grant sponsored researchers. Information, contacts, and partial dissemination of interim and final results of research projects were provided by the Advisory Service. Close working relationships were maintained with Dr. George Crozier (MESC-UAB) - "Development of Gulf Coast Artificial Reefs", Dr. William Hardy (Auburn) - "The Status and Relation of the Coastal Zone to Alabama's Economy", and Dr. David Dean (USA) - "Analysis of the Eel population in Mobile Bay".

PUBLICATIONS, NEWSLETTERS, AND MASS MEDIA

Numerous publications dealing with coastal and marine-related issues were completed and received wide distribution. Included were publications entitled: "Shrimp Fishing with Twin Trawls", "Alabama's Artificial Reefs",, "Alabama's Charter Boat Directory", "Issues and Goals for Coastal Alabama", and "Summary Report of Mobile Bay and Mississippi Sound Problem Identification Workshops". Other works in progress include "Alabama Marine 4-H Pilot Manual", "Identifying Intertidal Plants and Animals", "Public Boat Launch Sites on the Alabama Gulf Coast", and a public information leaflet, "Alabama Sea Grant Advisory Service: The Vital Link".

Newsletters directed to various audiences within the fishing community were distributed. The audience included commercial fishermen, fish processors, and charter boat captains. Mass media methods have been used throughout the reporting period to generate public awareness. News articles and information are submitted to the local newspapers as appropriate.

A slide-set describing "Recreational Opportunities on the Alabama Gulf Coast", slated for use in the five state-operated Welcome Centers, was another type of media focus conceived and implemented. The narrative and photography for this set are complete and presently being processed for statewide use.

OTHER ACTIVITIES

Work continued on the development of an Industrial Fishing Port for the Mobile Area resulting in the production and distribution of a proposal/prospectus. The prospectus was distributed to members of the Chamber Executive Committee and to various individuals in the Mobile County and City government. The result has been an application by the Mobile's Economic Development Group for funding through the Alabama Development Office and the Economic Development Agency.

Two "Marine Fishing Workshops" were held in conjunction with the University of Alabama Southwest Regional Office. This is the second year that the two organizations have jointly sponsored this workshop.

Progress was made in beginning the operation of a satellite field office in Bayou La Batre, Alabama's most productive fishing port. This location will greatly aid in making Advisory Service personnel more accessible to members of the fishing community. Improved relationships with several groups within the fishing industry should result.

MISSISSIPPI ADVISORY SERVICES PROGRAM: SPECIALISTS SUPPORT, UNIVERSITY OF SOUTHERN MISSISSIPPI 73(1)

David J. Etzold — University of Southern Mississippi
D.C. Williams, Jr. — University of Southern Mississippi

SUMMARY: THIS PROJECT PROVIDES ASSISTANCE TO MISSISSIPPI SEA GRANT ADVISORY SERVICE PERSONNEL IN SEVERAL WAYS: (1) LONG-TERM PROGRAMS SUCH AS THE CONTROLLED FRESH WATER PROJECT, (2) SHORT-TERM ECONOMIC AND MARKET ANALYSES, AND (3) PROVIDING EXPERTISE IN THE AREAS OF MANAGEMENT AND ECONOMICS TO ADVISORY PERSONNEL.

The two major subdivisions of this project are: (1) to continue to seek ways and means for introducing controlled fresh water flows into the marine estuaries of Mississippi to enhance seafood productivity, and (2) to make preliminary short term investigations into economic and market analyses of seafood and related products in the crab, foodfish, oyster, and charter boat industries.

CONTROLLED FRESH WATER PROJECT

The Controlled Fresh Water Project began in 1973 with Mississippi-Alabama Sea Grant sponsorship. Preliminary efforts included coordinating efforts of industry, Mississippi and Louisiana governmental agencies, LSU Sea Grant, and the U.S. Army Corp of Engineers. Briefly, these efforts supported the conclusion that fresh water discharged into estuarine areas enhances fish and wildlife productivity. Recognition of this has resulted in a $30,000 appropriation by the U.S. House of Representatives for the first year of a feasibility study. This funding to the New Orleans District Army Corp of Engineers is part of the Federal Public Works Appropriations Law. The Advisory Service continues to support this idea by reporting to various groups the basic ideas of fresh water input.

ECONOMIC AND MARKETING ANALYSES

Little effort has been expended on economic and market analyses as they relate to Mississippi and Alabama seafood products. Efforts to increase the use of these resources are becoming vital as the need for protein increases. An example of short-term market and economic analysis is the ongoing Mississippi Charter Boat Industry Study. Tabulated preliminary sample data obtained previously, and modified questionnaires, served as input data for this project. Final analysis of these data are designed to increase the accuracy of catch predictions, to determine the basic economic impact of the industry, and to obtain a market profile of the customers. Thus, this study will aid the industry and the community as well as aiding marine biologists. In addition to this study, a sampling plan for the shrimping industry was developed. Finally, an article was written on seafood products.

PUBLICATIONS

Etzold, D.J., N.O. Murray, and C.D. Veal. 1977. Charter boat fishing on the Mississippi Gulf Coast. MASGP-77-021.

1977. Progress report on Controlled Fresh Water Project. Gulf States Marine Fisheries Commission.

COOPERATING ORGANIZATIONS

U.S. Army Corp of Engineers
Mississippi Cooperative Extension Services
Louisiana Sea Grant Program

MANAGEMENT

ACTIVITY BUDGET

	NOAA Grant Funds	Matching Funds
MARINE RESOURCES DEVELOPMENT		
Living Resources Other than Aquaculture	$ 31,500	$ 14,612
SOCIO-ECONOMIC & LEGAL STUDIES		
Marine Economics	38,000	15,003
Ocean Law	28,355	12,207
MARINE TECHNOLOGY RESEARCH & DEVELOPMENT		
Resources Recovery & Utilization	61,956	43,099
MARINE ENVIRONMENTAL RESEARCH		
Ecosystems Research	52,716	44,911
Pollution Studies	24,500	16,892
Applied Oceanography	21,214	30,364
ADVISORY SERVICES		
Extension Programs	128,857	112,257
Other Advisory Services	13,500	5,500
PROGRAM MANAGEMENT & DEVELOPMENT	99,402	51,192
TOTAL	$500,000	$346,037

Partial funding from Sea Grant #04-6-158-44060 as follows:

	NOAA	Matching
Living Resources, other than Aquaculture	$ 14,975	$ 15,279
Ecosystems Research	8,951	5,184
Other Education	3,000	8,027
Total	$ 26,926	$ 28,490

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

MISSISSIPPI-ALABAMA SEA GRANT CONSORTIUM ADMINISTRATIVE COUNCIL

Dr. Robert P. Glaze
Assistant to the President and
Dean of Administration
University of Alabama in Birmingham

Dr. J. Chester McKee, Jr.
Vice President for Research and Dean
of the Graduate School
Mississippi State University

Dr. Howard M. Phillips
Vice President for Academic Affairs
University of South Alabama

Dr. Harold D. Howse
Director
Gulf Coast Research Laboratory

Dr. E. Roger Sayers
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Dr. Courtney J. Smith
Department of Chemistry
Tuskegee Institute

Dr. Donald Walsh
Associate Director of University
Research
Graduate School
University of Mississippi

MISSISSIPPI-ALABAMA SEA GRANT CONSORTIUM ADVISORY PANEL

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Director
Mississippi Cooperative Extension Service
Mississippi State University

Mr. Charles M. Lyles
Executive Director
Gulf States Marine Fisheries Commission

Mr. J.E. Thomas
Executive Director
Mississippi Marine Resources Council

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Director
Marine Resources Division
Alabama Department of Conservation and Natural Resources

Dr. Richard L. Leard
Director
Mississippi Marine Conservation Commission

Dr. J. Michael Sprott
Director
Alabama Cooperative Extension Service


BIG MOE
OCEAN SPRINGS, MISS.

Cover: "Vertical Soaring Pelican" (actual size 14" X 32") - wood carving, block print by Walter Anderson, Ocean Springs naturalist-artist. Life-long resident of the Gulf Coast, Walter Anderson's life and work are the subject of the award winning PBS documentary "The Islander" as well as two books "The Horn Island Logs of Walter Inglis Anderson" and "A Painter's Psalm: The Walter Anderson's Cottage." Permission for use of the print was graciously provided by his widow, Agnes Grinstead Anderson.

EDITING AND LAYOUT:
David F. Werschkul, Ph.D.

EDITORAL ASSISTANT:
William A. Johnson
University of Southern Mississippi