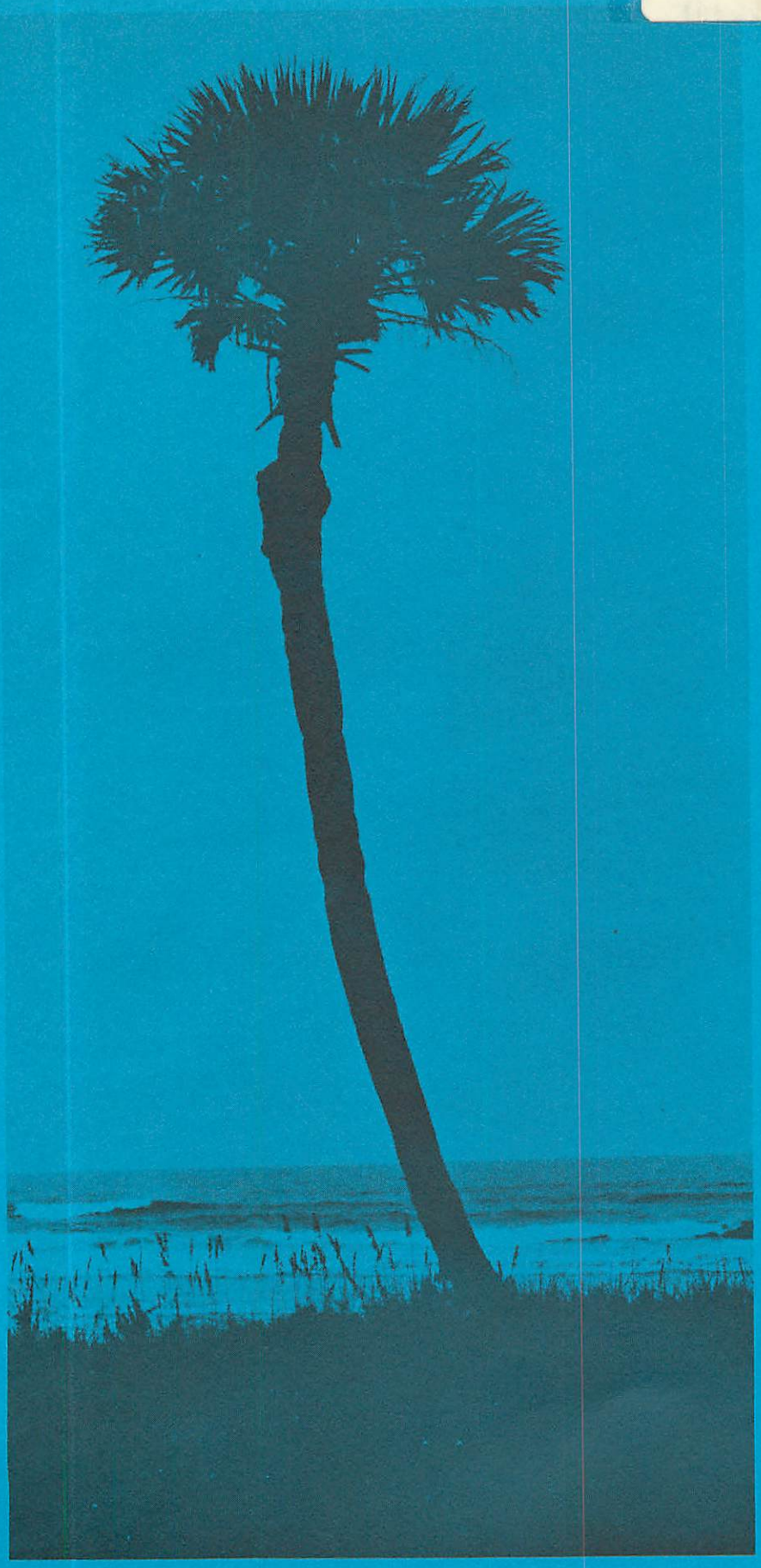
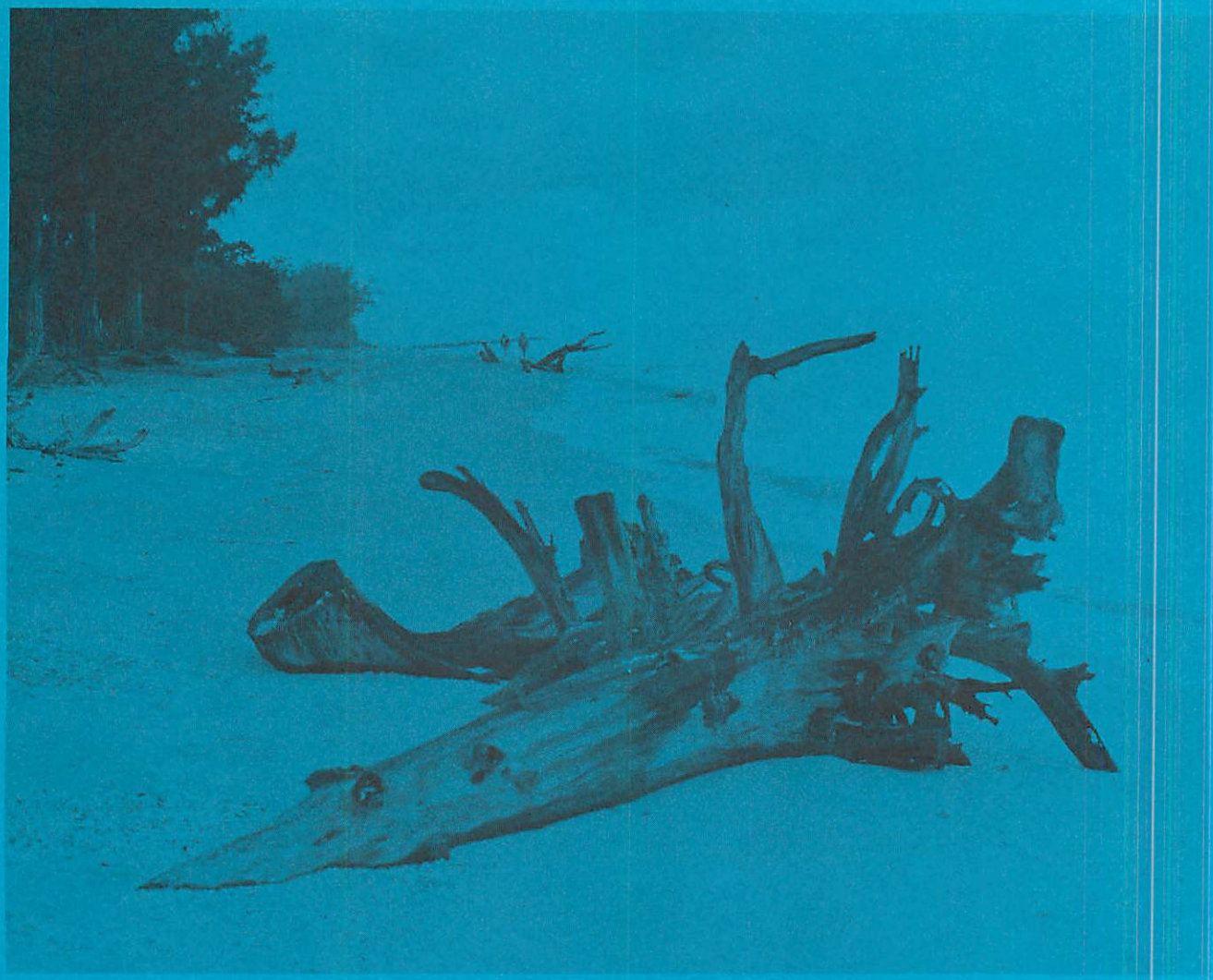


THE SEA GRANT COLLEGE PROGRAM

January 1/December 31, 1978

STATE UNIVERSITY SYSTEM OF FLORIDA

Marine research Education Advisory Services
A Sea Grant Program for Florida



STATE UNIVERSITY SYSTEM OF FLORIDA SEA GRANT COLLEGE PROGRAM—1978

ANNUAL REPORT

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". . .Patience, patience, patience, is what the sea teaches. Patience and faith. One should lie empty, open and choiceless as a beach—waiting for a gift from the sea."

– Anne Morrow Lindbergh, "Gift From the Sea."

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FLORIDA SEA GRANT '78

DIRECTOR'S STATEMENT

In her book, "Gift From the Sea," Anne Morrow Lindbergh discusses how she found the direction for her life in the shells picked up from the beach — the channeled welk which emphasized the need for simplicity, the moon shell for solitude, the double sunrise shell which symbolizes the early days of marriage, the oyster shell of the middle years, and the argonauta when one has outgrown the oyster shell. In the sea, and in the shells on the beach, the author found patience, faith, openness, simplicity, and solitude. These were her own special and private gifts from the sea.

The sea holds something for everyone, yet each finds in the sea or takes from the sea something different, whether it be the material things like shells, fish, minerals, or simply the pure enjoyment of waves breaking off the beach, white swirling foam among the rocks, the sound of breakers, or the feel of bare feet on the soft wet sand.

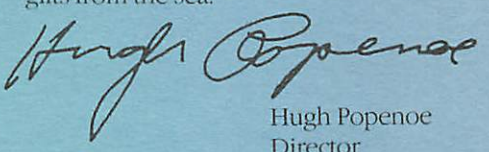
The attraction of people to the sea is well known and as we have pointed out in the past, Florida, like the rest of the country, is feeling the pressures of the ever increasing migration to areas near the oceans and Great Lakes. In fact, the pressures may be even greater here because of the much more extensive coastline. Florida's 1350 mile coastline, for example, nearly equals the 1500 miles of coastline along the rest of the 13 Atlantic states. Florida's coastline is also longer than the 1300 miles of Pacific coastline shared by the three western states, and much longer than the 850 miles of Gulf coast bordering Texas, Louisiana, Mississippi, and Alabama.

Since 1972 Florida Sea Grant College has worked with the federal, state, and local governments and various federal and state agencies in trying to maintain the balance between the extremes of development and conservation. As the state's burgeoning coastal population has grown so has the Sea Grant Program. Over 100 Statements of Interest received from prospective researchers with suggested projects for calendar year 1980 indicate the wealth of talent available in the state's public and private institutions. This is also evident in the reports on Sea Grant research for the past year wherein Sea Grant researchers have continued to work for solutions to realistic, every day problems. Environmental studies in estuaries continued with emphasis on sewage pollution abatement, runoff from forestry operations, and culture and transplant of seagrass on estuarine bottoms. Coastal problems being investigated included corrosion, beach erosion, storm water runoff, and the onshore impact of offshore energy facilities. Commercial fisheries, the initial focus for Sea Grant, continue to merit attention from researchers and advisory personnel with sport fishing and marine recreation becoming more important in view of their importance to Florida's economy.

Also expanding rapidly is Florida Sea Grant College's link with the coastal consumers — the Marine Advisory Program — which added two new advisory agents and a seafood advisory specialist. MAP also expanded its operation into the area of disaster preparedness with the addition of a specialist whose job is to implement a comprehensive educational program for natural hazard awareness in coastal areas.

Florida Sea Grant College also funded two significant thesis projects of marine interest, and continues to encourage the utilization of graduate students for work on Sea Grant funded research. We have also made funds available for the assignment of a 4-H marine education specialist to implement the Florida 4-H Marine Education Program which now has the largest enrollment in the southeast and possibly the largest nationally as well.

Looking back on the past year, we at Florida Sea Grant College are proud to be a part of the large and growing network of Sea Grant Colleges and Institutions. We continue to have as our goal the charge given to us several years ago — the wise use and development of the state's coastal and marine resources. Which, of course, is another way of saying that we are working to insure that, to the greatest extent possible, we all receive and use wisely our own particular "gifts from the sea."



Hugh Popenoe
Director

RESEARCH

ESTUARIES

They may appear to be nothing but muck and swamp, mosquitoes and sandflies, but in those marsh creeks, and in the shallow bays, canals, and estuaries, dominated by mangroves and smelling heavily of salt air and decaying vegetation, fish come to feed, spawn, and seek protection. Literally hundreds of species of fish and shellfish depend upon this seemingly uninhabitable region for their gift of life and for their very survival. And this natural food factory which so lavishly provides protein for the teeming marine inhabitants, in turn provides protein for man, for man lives on top of the food chain.

Over the years natural forces work to create a system of incredible productivity. Plants die and decay—broken down by bacteria and fungi which are eaten by small crustaceans which in turn are eaten by fish—a cycle which, in addition to other nutrient-driven food webs, forms the basis for thriving seafood industries—the backbone of the economy and way of life for many thousands of people who live in these areas.

But there are pressures on these areas. Expanding municipalities, perhaps some distance away, attract industries which discharge waste into the rivers upstream, materials which eventually find their way into the bays and estuaries. Impact of these developing human pressures have become an area of great concern.

Florida Sea Grant has been aware of such pressures and the deteriorating quality of many of the state's more than 50 estuaries, and from its inception has channeled research funds into environmental studies of certain key state waterways where rapid development poses a serious threat to freshwater resources and also to adjacent coastal waters.

Water transported pollutants generated in the upstream drainage basins enter the estuarine systems that serve as breeding grounds for numerous species of flora and fauna of vital direct or indirect importance to the human community. While point source pollution caused by residential, commercial, and industrial developments today is being controlled to a wide extent by modern waste water treatment in the industrialized countries, it is the non-point source pollution caused by such activities as agricultural, mining, forestry, and other operations that is one of the most serious pollution problems of the present time. For example, clear-cutting of forested areas will increase the rate of flow, reduce the time to peak and decrease the pH of the runoff resulting in upset ecosystems in the receiving wetlands and coastal waters. Likewise surface mining of phosphates as practiced in Florida will overturn the aquatic biological balance if excess phosphates are not removed from the runoff by retention and sedimentation.

The oldest project sequence of estuarine research is located in Apalachicola Bay. Based on results of Sea Grant studies in the Apalachicola region of Florida's Panhandle, the state has purchased nearly 30,000 acres of "endangered lands." A six-county group, the Apalachicola River and Bay Association, has been formed to coordinate land planning at the county levels, primarily based on Sea Grant research.

"The sea has always challenged the minds and imaginations of men and even today it remains the last great frontier of Earth. It is a realm so vast and so difficult of access that with all our efforts we have explored only a small fraction of its area."

— Rachel Carson,
"The Sea Around Us."

St. Johns River (R/EM-6)

Those variables which often correlate with individual plankton species abundance are salinity, dissolved oxygen, turbidity, phosphate concentration and pH. The variables which often correlate with chlorophyll concentration are temperature, salinity, phosphate concentration and sometimes pH, nitrate concentration and copper concentration.

A secondary aim of the statistical analysis was to group sampling sites together according to physical/chemical and biological criteria respectively. On an annual average basis, the sites which were shown to be similar were usually proximate geographically. For example, two sites near the mouth of the river were grouped with each other but were separate from sites in Trout River and Dunn Creek. Sites near downtown Jacksonville were grouped together but were separate from those further north or south. All the Cedar River sites grouped together as did most of the Julington Creek sites east of the US 13 bridge. Sites south of Julington Creek (Black Creek, Rice Creek, Oklawaha River, Lake George) usually did not group together.

On a month by month basis, some large variations in biological conditions occurred and stations close together geographically turned out to be dissimilar.

Some of the information derived from the statistical analyses of the data has been interpreted for the St. Johns River Water Management District and Jacksonville Bio-Environmental Services as well as the National Inventory of Estuaries.

In 1978, the St. Johns River Estuary project focused on the first stages of data analysis. Data collection activities, begun in January 1975, drew to a close in the spring of 1978 with the completion of the last diurnal oxygen measurements and benthic respiration studies.

To attempt to discover what physical and chemical conditions are likely to affect the productivity of the estuary, biological parameters such as plankton abundance and chlorophyll concentration were related to physical and chemical conditions (e.g., salinity, temperature, turbidity).

Hillsborough Bay (R/EM-7)

The advanced (tertiary) wastewater treatment (AWT) plant in Tampa has provided an opportunity to study the effects of removal of a major point source of pollution on the estuarine environment of Hillsborough Bay. Objectives of the fourth year of study were to provide continuous pre-AWT data on water quality and bottom-dwelling infaunal invertebrates and to follow any changes associated with AWT plant start up. The plant started phasing in its AWT process and achieved secondary treatment standards in May, 1978. By September, 1978, full tertiary (AWT) operation was in effect.

Matching funds, data and personnel for the project have continued to be provided by the **City of Tampa** and the **Hillsborough County Environmental Protection Commission**. Information has been provided to the Tampa Port Authority and the Army Corps of Engineers to aid them in assessing the effects of the Tampa Harbor Deepening Dredging Project, and the Southwest Florida Water Management District has been informed on potential effects of restricting flow of the Alafia River. Information has also been forwarded to the Tampa Bay Regional Planning Council relative to potential dredging plans for Port Manatee.

During the past year of study, continuous monthly samples of bottom dwelling invertebrates, sediments, and water quality were taken in Hillsborough Bay. The variations in species numbers and density patterns seen over the past years continued at the stressed stations. The now familiar summer die-off of organisms again occurred and continued during a much longer period of time than in the past. Experimental *in situ* studies were initiated just prior to the summer die off in attempts to understand the processes of recolonization better. Data on the life histories of amphipod crustaceans in Hillsborough Bay have been analysed in detail and constitute a shortly to be completed Ph.D. dis-

sertation.

During routine sampling in July 1978, small quantities of muck were found at Station 5, over two miles away from the present Corps of Engineers dredging for the Tampa Harbor Deepening Project. This information formed the basis of several emergency meetings with the Corps to evaluate various suggested mitigation and clean-up procedures. During November's sampling, up to two feet of accumulated sediments were recorded at Station 5, resulting in mass mortalities of animals. These findings resulted in another series of meetings with the Corps. By mid-December 1978, the Corps had begun a clean-up operation to remove the accumulated muck and had revised the dredging schedule in attempts to avoid reoccurrence of the problem. Thus, the Hillsborough Bay project has had a marked impact on the decisions of the Army Corps in modifying their dredging plan for the Harbor Deepening Project.

During early November 1978, a 40,000 gallon oil spill occurred in Hillsborough Bay. Sampling information was provided to the Tampa Port Authority to aid in assessing the biological impact of the spill.

Additionally, the **U.S. Environmental Protection Agency** presently is in the process of preparing an Environmental Report in conjunction with their "Facilities Planning" Process on the City of Tampa and Hillsborough County's wastewater disposal problems. That agency was notified of this study and it is anticipated that the data will form a major part of their report.

Culture and Transplant Studies of the Seagrass *Ruppia maritima* (R/EM-10)

Land use management of terrestrial ecosystems such as forests has been practiced during much of the 20th century to insure maintenance of the renewable resource. Similar management practices were recently initiated for the estuarine ecosystem, another renewable resource which has shown signs of decline.

In the estuarine ecosystem, seagrasses play a role similar to that of trees in forests because they oxygenate the water, serve as a food source, provide shelter and a nursery site for economically important animals and stabilize the sediments thus providing erosion control and contributing to water clarity.

Seagrass transplants can be used to manage estuaries in the same way that forest management involves transplanting trees. However, while agricultural techniques were applied directly to formulating methods for transplanting trees, seagrass transplant requires some new techniques designed to overcome problems created by the underwater environment.

The major objectives of this study on seagrass are to test methods for transplanting the seagrass *Ruppia maritima*, determine the time of year most suitable for *Ruppia* transplant, correlate physical and chemical environmental factors with transplant results, determine the growth rate of natural *Ruppia* beds and the physical and chemical environment of these beds and develop some culture techniques.

Studies designed to achieve all five major objectives have been initiated, and monthly data have been accumulated.

From the data accumulated to date, it can be concluded that *Ruppia* can be transplanted using the 'bag method' under certain environmental conditions; that transplants should be made in March, April and May, and that the addition of nutrient pellets to the substrate below transplants does not increase growth or improve the success rate of the transplant. It is also known that at least 25% of the leaves on *Ruppia* plants from natural beds are dead throughout the year; that when growth is measured by tabulating node number, the fastest growth rate in natural beds is during the spring and when *Ruppia* flowers and fruits; and that *Ruppia*, compared to other seagrasses, is easily cultured in laboratory aquaria and in outdoor, closed-system ponds.

The development of transplant techniques for *Ruppia* coupled with information about the necessary environmental conditions for success and the best time of year for transplant will enable managers to more precisely predict, in cases where there is a need for deliberate disturbance, which areas can be disturbed and reclaimed, the time of year when such disturbances will cause the least lasting damage, and the time of year when the damage can be effectively repaired.

The principal investigator and some of the students connected with this project have assisted the Army Corps of Engineers, Mobile Office, in determining the acreage, species composition and relative health of the seagrass beds in a 3-mile long area of Santa Rosa Sound.

Also, members of the **Bream Fishermen Association of Pensacola** periodically survey local estuaries reporting on new and existing beds and are participating in transplant of some plots. The **City of Pensacola** and **Escambia County** also contributed funds to their project, the results of which will be applied by agencies managing the estuarine ecosystem.

Apalachicola Bay (R/EM-12, 13)

This project deals with the problems of working out a general strategy for the development and management of coastal drainage basins with minimum or no adverse effect on the surrounding aquatic ecosystem. This past year, field studies have been completed concerning the potential impact of forestry operations on East Bay.

The data base now includes benthic macrophyte associations, benthic infauna, detritus organisms, and benthic epifauna along with appropriate physico-chemical determinations. The most extensive portion of the data base includes four years of continuous sampling of the physico-chemical environment, benthic infauna, and epibenthic organisms of East Bay. This, together with four years of experimental data concerning detritus-associated materials has been placed in computer files and is being analyzed. The field data will be used in conjunction with modeling efforts and will also serve as the basis for current laboratory work.

Effects of various levels of pH on the activity behavior and adenylate nucleotide pool of the gulf killifish has been examined with the response entered into the computer for analysis.

The combined microbiological/macrobiological studies concerning the response of microcosms of detritus materials are well underway. Marine laboratory facilities have been completed to include dilution systems, banks of test aquaria under controlled conditions, and the means to bring runoff from upland stream systems (together with the available sea water system) into our laboratory. Leaf baskets placed in the Gulf of Mexico have been brought into the lab and the first experiments are now underway concerning the potential impact of upland runoff on coastal assemblages.

Numerical modeling of hydrological events in major drainage basins and of the hydrodynamics in estuarine systems has reached such a degree of reliability today that it seemed natural to apply this methodology in this project. Due to its relatively few and simple pollution sources and low degree of industrial and residential development the Apalachicola River basin stretching south from Atlanta, Georgia, to Florida's Gulf Coast was chosen together with the Apalachicola Bay estuary which has been thoroughly monitored for water quality and biological activities since 1970. Satellite (LANDSAT) pictures are available for the same period of time.

Besides the interaction between drainage basin and estuary the consequential influence of development on biosystem and economy is considered. The method is made interactive by letting the output from the economical analysis serve as input to the planning process and the enforcing political system which again provides the input to the river basin model through land use.

Selection, modification and interfacing of the basin model and the estuary model are considered together with the utilization of the existing biological data base relating biosystem and water quality. Results of the reported research, although based on a specific system are of a general nature and may be applied in most basin/estuary systems in the southeastern United States.

The **Engineering and Industrial Experiment Station**, University of Florida, provided matching funds for this project.

St. Lucie Estuary Conference

The St. Lucie Estuary continues to be a primary habitat for a wide range of marine life, as well as providing economic welfare to the fishing and boating industry. Because of this, the need to become aware of the health of the waterway is an important and urgent issue and in August 1978, the Florida Sea Grant College provided funds for a conference to consider its condition.

At the conference, biological, engineering, and economic aspects of the estuary were considered along with development within the geographical area. As a result of the conference, two significant factors within the estuary have been proposed for further study. One is the sedimentation and transfer of suspended solids throughout the system to determine the amount emanating from the St. Lucie Locks and the effect of the material on the productivity of the system. In conjunction with this, sampling for the distribution and fluctuation of the plankton as an indication of primary productivity would be done. The second factor is siltation which has been a major problem in the estuary and both the local population and the Army Corps of Engineers is interested in learning its effects.

Phthalic Acid Esters

Phthalic acid esters have been used as plasticizers for over four decades to soften resins without chemically reacting with them. In such cases the weight of the plasticizer may be quite significant, perhaps account for up to about 40 percent of the final weight. Also, since plasticizers are very popular over a billion pounds are produced annually. Because of this and the ubiquitous nature of the phthalic esters, the potential for their release into the environment is disturbing. The extent to which they may constitute a danger to public health is a matter of judgement but as far as is known, they perform no desirable metabolic function in man.

This report was undertaken to attempt to understand the mechanisms of entry of phthalic acid esters into a significant estuary. The estuary chosen was Peace- River/Charlotte Harbor on the lower west coast of Florida. Samples were collected at four different locations from bridges over the Peace River which extended northeast from the river mouth at Punta Gorda in Charlotte County for a distance of approximately 96 miles. Samples were taken in the approximate center of the stream flow, between 10 and 30 centimeters below the water surface, and were taken for both phthalic acid ester analysis and for analysis of other organic constituents — orthophosphate, total organic and inorganic-carbon concentration, and iron.

Although additional information is needed concerning the fate and mode of transport of DEHP and other phthalic acid esters and more data must be obtained concerning the concentrations of phthalic acid esters in Charlotte Harbor, results of the analysis of the Peace River samples indicate several points of interest. The modes of input of phthalic acid esters vis-a-vis iron and phosphorus are different. The possibility of natural input of phthalic acid esters seems remote. Also, the concentration of DEHP is considerably greater than had been anticipated at the start of the project so its input into Charlotte Harbor could be a matter of concern.

Additional studies are needed and any results of this project are regarded as progress rather than final. □

COASTAL ZONE

It isn't just the sandy white ribbon between land proper and the sea; it isn't just the estuaries and marshes and mangroves that cradle infant sea creatures; and it isn't just the 200-mile-limit set to perpetuate and conserve our nation's fishery resources; it is all of these things and more—much more.

It is waterbirds, erosion, tidal inlets, people, storms, rust, oil spills, reefs, energy, bridges, economics, barnacles, seagrasses, setback lines, waves, islands, laws, plams—the list is dynamic, vital, endless and in Florida, the coastal zone affects everyone one way or another.

Reciprocal relationships abound and are well-described in many of the coastal-ocean research projects such as intrusion of salt into fresh water; infusion of storm-water into salt water; repercussions onshore of offshore energy development; effects of sea water on man-made structures and the effects of storms, tides, and human development on beaches and dunes.

These are some of the things probed and pondered by Sea Grant researchers in their search for answers or, at least, a better understanding of the forces at play.

Beach and Dune Erosion by Storm Tides and Waves (R/OE-8)

Every year beaches and dunes along the Florida coastline suffer erosion during storms, but methods for predicting or estimating just how far the beach-dune line might recede during a specific storm are lacking.

In establishing the Coastal Construction Control Line along the shorelines, the predictable erosion distance occurring from storm surges is an important factor in locating a proper line. Present methods for predicting such conditions are based on highly simplified assumptions.

The objective of this study is to improve the capability of determining beach-dune erosion distance under storm conditions by examining the main dynamic factors involved. Included in this list are increased water level, wave activities during a storm, and existing topographic factors such as beach-dune elevation, foreshore and offshore slopes and beach width. Development of a formula for computing beach-dune erosion distance is expected to result from examination of the main factors.

Laboratory experiments will be carried out to obtain qualitatively the relative importance of each main factor and the shape of nearshore and beach-dune profile after the storm. Using the Coastal Construction Setback Line study as a point of departure, field measurements will be made after each storm.

Publications resulting from this study include technical report No. 039, "The Variations in Beach Profile When Approximated by a Theoretical Curve" which has been distributed to governmental agencies, universities and laboratories in this country and abroad. Also, a thesis, "Dune Erosion Model Study" will be distributed similarly when completed.

Matching funds for this project have been provided by the **Bureau of Beaches and Shores, Florida Department of Natural Resources.**

Fatigue of Welded Structural Steel in SeaWater (R/OE-9)

Sea water is well-known to have an adverse effect, over a period of time, on the steel used in offshore construction. Referred to as "corrosion fatigue," numerous failures in marine structures have been attributed to this cause. Structural damage results from wave loadings which is particularly severe at welded joints where stresses are concentrated.

Of special interest to ocean engineers and the offshore petroleum industry, corrosion fatigue is projected to be the most significant factor related to offshore structural soundness.

With the petroleum industry looking to the sea, integrity of offshore structures — petroleum platforms in particular — is a highly significant technological problem that will become increasingly important.

During the past year, Florida Sea Grant scientists have obtained special equipment for integration into a testing system. With companion funding from the **American Petroleum Institute (API)** this has amounted to six machines, each capable of testing two specimens.

The specified tests involve fatigue of 1" x 6" butt welded specimens which are either cathodically protected or not protected. The water velocity is 0.5 feet per second past the specimens and the temperature is either ambient or 4° C. Because of the low cyclic test speed, some of the tests are scheduled to run for as long as a year which is sufficient to accumulate 100 million cycles — approximately equivalent to a twenty-year wave action exposure.

Because freely corroding specimens have failed relatively quickly, more data has been obtained sooner than was initially expected. On the other hand, cathodically protected specimens are much more resistant to fatigue.

During the past year, three meetings of the API Technical Advisory Committee on Corrosion Fatigue were held at Florida Atlantic University. These meet-

ings permitted the group to view the experiments first hand and to discuss the significances of the data with regard to present and future marine standards.

Sikes Cut (R/OE-10)

Sikes Cut is a man-made inlet across St. George Island, a barrier island separating the Gulf of Mexico from Apalachicola Bay in the Florida Panhandle. The Apalachicola River discharges into Apalachicola Bay five miles north of Sikes Cut.

This bay is a highly productive biological region that produces approximately 90 percent of the commercial oyster harvest in Florida. According to recent data, the salinity level of the bay has been gradually increasing. Scientists believe that Sikes Cut has affected the salinity level of the bay in two ways: (1) by diverting fresh water from the Apalachicola River away from the oyster reefs, and (2) by introducing salt water into the bay which causes an increase in the oyster predator population. In general, oysters need fresh water because fresh water keeps predators such as the southern oyster drill and crown conch from approaching the reefs.

The objective of this investigation is to determine the role of Sikes Cut in the flow dynamics of Apalachicola Bay. Flow mixing, salt water intrusion and inlet hydraulic constants are factors considered in this determination. Results will also be used in connection with a mathematical model of Apalachicola Bay which is being developed to study the water quality degradation of the bay.

The Sikes Cut field study was performed during August of 1978. Tides were monitored, velocities in the inlet and bay were measured, flow rates and salinity profiles of the inlet and bay were obtained, and a hydrographic survey of the bay area was carried out.

Matching funds for this project were provided by the **Florida State Legislature.**

Glossaries of Tidal Inlets in Florida (R/OE-11)

Located at intervals around the 1350 mile coastline of Florida are 60 tidal inlets — 17 on the Atlantic Coast and 43 on the Gulf Coast. These inlets handle almost all of the coastal commercial trade, particularly the fishing industry which is worth hundreds of millions of dollars each year. Since much of Florida's shoreline is sandy, one of the typical problems associated with inlets is the shoaling of the navigable channel, another is hazardous currents. Because inlets are vital links to the sea, attention to periodic improvements becomes necessary. Common engineering solutions have been to construct one or two jetties and/or dredge the channel. In fact, all but one inlet on Florida's Atlantic Coast have been improved through jetty construction and many on the Gulf Coast.

Problems of hydraulic and sedimentary stability currently exist at a number of tidal inlets along the sandy Florida shoreline but in order to determine necessary corrective measures, much diverse information is needed. Records of history, engineering works, geological and morphological characteristics, economic benefits and climate pertaining to many of the inlets exist, but are scattered among various institutions and agencies.

Glossaries of six inlets have already been published and include: St. Lucie Inlet, Fort Pierce Inlet, Sebastian Inlet, John's Pass and Blind Pass, and Matanzas. Glossaries currently being completed include: Canaveral Harbor Entrance, Sikes Cut, Fort George and Big Hickory Pass.

Matching funds for this project have been provided by the **Florida State Legislature.**

Marine-Related Recreation Businesses, Facilities, and Services in Coastal Bay County, Florida (R/CP-1)

A very large chunk of the Florida economy is derived from the marine-related recreational sector. The purpose of this project was to inventory, locate and categorize the various marine-related activities of Bay County, Florida in terms of size, function and interrelationships.

These activities include public and private business services and facilities such as fishing supplies, marinas, charter boats, fishing piers, and boat ramps. Additionally, this investigation provides an understanding of the overabundance or lack of certain activities and facilities in each part of the Bay County coastal zone.

According to the report the marine industry is highly fragmented. Consequently most of the problems remain unarticulated to local decision makers. Researchers recommend organization of the marine industry in order to alert public decision makers to the industry's special needs and problems and to promote future development of the marine recreation industry.

Results of this study will be used to help the marine advisory agent guide the growth of these activities; the Bay County Chamber of Commerce and other public agencies develop an economic program in this area; and recreation organizations direct organizational efforts.

Stormwater Runoff and the Coastal Zone (R/CP-2)

As a result of pollution caused by stormwater runoff, a number of legal questions have arisen related to modification of current land use plans and drainage practices. Legal solutions to these problems are being studied by the Eastern Water Law Center of the University of Florida College of Law whose aim is to draft appropriate model ordinances.

During this second year of a two-year project, the Center expanded its original review of federal and state statutes and regulations that are applicable to problems associated with stormwater runoff, especially as it threatens the environmental quality of Florida's coastal areas. The common law related to drainage and water use was also examined in greater detail with emphasis placed on the use of these legal principles in the context of stormwater pollution abatement.

The core of the Center's research centered around the development of two model ordinances, 1) a Model Surface Water Runoff Control Ordinance, and 2) a Model Individual Sewage Disposal Facility Control Ordinance. Both grew out of an exhaustive review of articles, ordinances and model legislation in these areas. The first drafts were a synthesis of the best components of existing and proposed legislation from cities and counties throughout the country and the best ideas from innumerable articles and technical reports concerning stormwater runoff and septic tank controls.

Drafts of the two model ordinances have been circulated for review and critique around the State of Florida and to other local, regional and state agencies throughout the United States. Responses are closely examined and suggestions are being incorporated into the drafts where appropriate. Revisions of the model ordinances continue to be circulated for further comments and critique.

A report, "Legal Alternatives for Effective Management of Stormwater Runoff and Related Pollution Problems," was submitted to the Southwest Florida Regional Planning Council in August 1978, for their use in developing water quality management plans as required by the Clean Water Act, PL 92-500.

Matching funds for this project have been provided by the **Southwest Florida Regional Planning Council.**

Onshore Impact of Offshore Energy Facilities: A Legal Analysis (R/CP-3)

Offshore oil and gas development, deepwater ports, shipping of petroleum products, and floating power plants are energy activities which could have great environmental, economic, and social impacts on Florida's coastal communities. The most obvious danger is the potential for oil spills through either the drilling for or transportation of oil. A large oil spill could be particularly devastating for Florida because of the fragile environment and the tourist based economy.

However, there are many other repercussions which, although not quite as spectacular as an oil spill, can have an equally profound effect on a local community. While energy development occurs offshore, a great deal of onshore development is generated. This onshore development, in turn, is accompanied by additional environmental, economic, and social impacts which are either beneficial or detrimental to a local community. Consequently, local governments must be aware of the positive and negative influences that accompany these energy activities in order to respond effectively to development proposals.

Decisions affecting offshore activity are made at the federal and state level while local governments are often left with the problem of coping with the onshore impact. The purpose of this study was to analyze the conflict and to give local officials an idea of the range of options available to them in reacting to or planning for the effects of offshore activity.

In 1978, the Florida Legislature adopted the Florida Coastal Zone Management Act. Rather than enacting a comprehensive coastal policy, the legislature has chosen to rely on existing state and local laws to implement the coastal program. There are many existing state programs which can be used to encourage, discourage, or control offshore energy development and the corresponding onshore energy activity. Under the new state act, local governments will have the primary responsibility of dealing with onshore impact within their jurisdiction.

The investigators of this project have prepared several publications to provide local governments with information concerning the alternatives available to them in reacting to or planning for the effect offshore activity will have. These publications have been reviewed and recommendations made by the staff of the Bureau of Coastal Zone Planning and the Department of Environmental Regulation. Staff members of the Division of State Planning in the Department of Administration were also contacted by the investigators.

Representatives of both the Florida League of Cities and the Florida Association of County Commissioners have reviewed and are enthusiastic about the report. Also, an article has been accepted for publication by the University of Florida Law Review.

Matching funds have been provided by the **Center for Governmental Responsibility.**

Salt Tolerance of Common Ornamental Plants and Turfgrass (R/CP-4)

Industrial consumption of large quantities of water and population density in coastal urban areas have altered the fresh/saline balance within the Florida aquifer. The problem was first apparent and is most acute in certain coastal cities, and it is possible that within the next decade, other areas may also be affected.

Research has shown that most plants are sensitive to irrigation with poor quality water, and it is known that plants grown with saline water exhibit reduced growth rates as well as a higher incidence of leaf tip burn. Not only that, but high salt levels may eventually kill plants altogether.

As the water supply in some Florida comunities has become more saline, plants in these areas are beginning to show signs of saline toxicity. The $500 million turfgrass industry and the $300 million commercial foliage and flowering pot plant industry are particularly affected. Consumers are also experiencing similar problems, expecially with regard to lawn and landscape plant maintenance.

The purpose of this project was to identify the salt tolerance of the most commonly used Florida turfgrasses and foliage plants. Using solution culture techniques, plants were suspended and grown in a modified nutrient solution supplemented with various quantities of sodium chloride or artificial sea salts. Reductions in plant growth rates were then related to increased salt solutions.

Initially, this procedure was used for turfgrass and foliage plant studies. Bahia grass and centipede grass, however, developed severe disease problems and the procedure proved unsatisfactory. An alternative procedure, sand culture, was then established. Initial results indicate that St. Augustine and Bermuda grasses are more salt tolerant than either centipede or bahia. However, exact water quality criteria are yet to be established. Using solution culture techniques, a study determining the most salt tolerant

bermuda grass cultivars has been completed and analysis of the final results is underway.

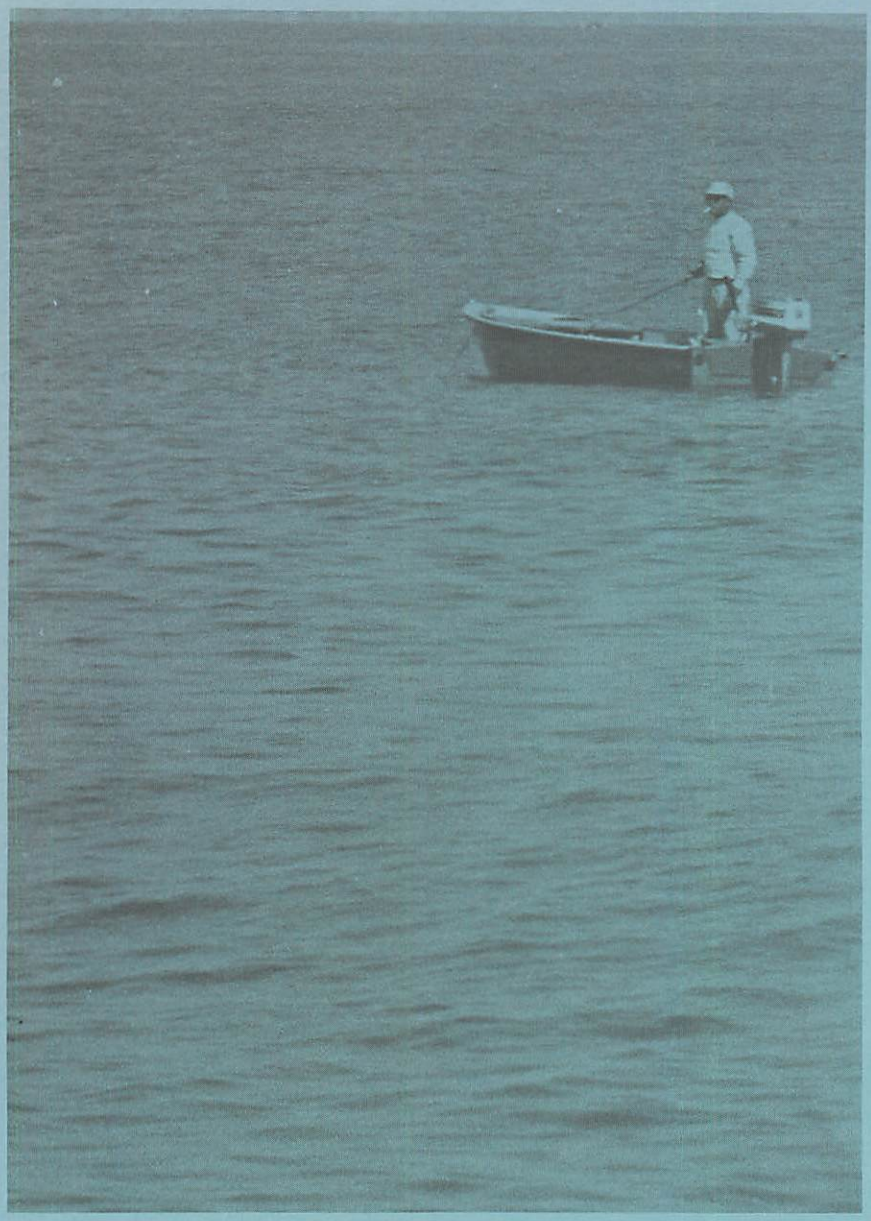
Solution culture studies have been concluded in parlor palm while Schefflera, Norfolk Island Pine, and Weeping Fig are currently being evaluated at varying salt levels. Relative salt tolerance of additional foliage plants will be investigated during the next year.

The first year of the research period has been fruitful in refining test procedures, establishing field plots and providing preliminary data. Identification of the salt tolerance of plant materials will enable home owners, commercial producers and state Extension personnel to select plants appropriate for use in areas with poor quality water. These findings, the most reliable data yet available in Florida, should aid researchers to adapt cultural techniques for the possible use of saline irrigation water in the production of ornamental crops.

Navigational Channels and Coastal Structures

The Governor's Task Force on inlet erosion and beach maintenance was involved in evaluating the effects that coastal structures and deep navigation entrance channels have on shorelines. Sea Grant provided funds for the collection and analysis of additional data for preliminary evaluation of the effect of channels and structures on adjacent shorelines as well as to estimate qualitatively the same effects from historical charts.

The work, when finished will be incorporated into the recommendations to the governor contained in the task force report and all data, reports, and maps purchased as a result of the project will be housed in the Coastal Engineering Archives. □



FOOD FROM THE SEA

Commercial Fishing and Seafood Marketing (R/FR-4)

The commercial fisherman pulling in a net bulging with struggling flapping fish knows only too well that the sea which seems so bountiful and generous at that moment can also withhold its largesse and that those seeking its treasure will experience at times the feeling of emptiness and defeat. His life of 16 to 18 hour days may seem harsh to some and the hazards of the sea too risky, yet men continue to fish and to become fishermen and the sea, over the years, has continued to yield its gift of fish.

Today, even with inflationary impacts, the price of many species of fish has reached the luxury category and moved out of the economic reach of many consumers. Yields of certain sought-after species are down and recently enacted management plans as a result of the 200-mile limit seek to set regulations to assure an optimum yield. The fisherman needs money to buy and maintain his boat, to sustain him over the lean periods, and to know how to manage his business in a profitable manner.

From its inception Florida Sea Grant has worked with the commercial fisherman and seafood processor. The first identifiable audiences were from these groups and over the last six years economic studies have provided valuable information on costs and returns to specific fisheries, more efficient nets and trawls have been developed, and biological studies of certain species completed.

"He was an old man who fished alone in a skiff in the Gulf Stream and he had gone eighty-four days now without taking a fish."

– Ernest Hemingway, "Old Man and The Sea."

Economic research linked both to biological studies and advisory services has been rapidly disseminated over the past several years with some significant accomplishments during the past year.

Three articles and reports were published during the year which were based on economic analyses completed during 1977 which quantified the economic relationship between the commercial fishing industry and support industries.

Reports were published on costs and earnings studies of both Spanish mackerel net boats and hook-and-line king mackerel fishermen. Surveys as of 1976 showed an average net return of $14,867 for king mackerel boats after deducting costs for fuel, gear, repairs, and depreciation, and an average net profit of $15,943 for the boats of Spanish mackerel fishermen. These reports are available from the Florida Marine Advisory Program.

A seafood port study, done in conjunction with the Agricultural Market Research Center and co-sponsored by the **Gulf and South Atlantic Fishery Development Foundation, Inc.**, identified specific port needs and associated costs for development of these ports for seven major counties in North Florida. Construction of an entire seafood port was not recommended, however, specific improvements which were needed were listed and the appropriateness of public versus private funding was analyzed.

Under contract to the **Gulf of Mexico Fishery Management Council**, a Reef Fish Management Plan was developed for Gulf of Mexico reef fish with economic, legal, biological, and social factors included in the analyses. Research findings were reviewed by industry members and were the basis for optimum yield and management regulations adapted by the Management Council.

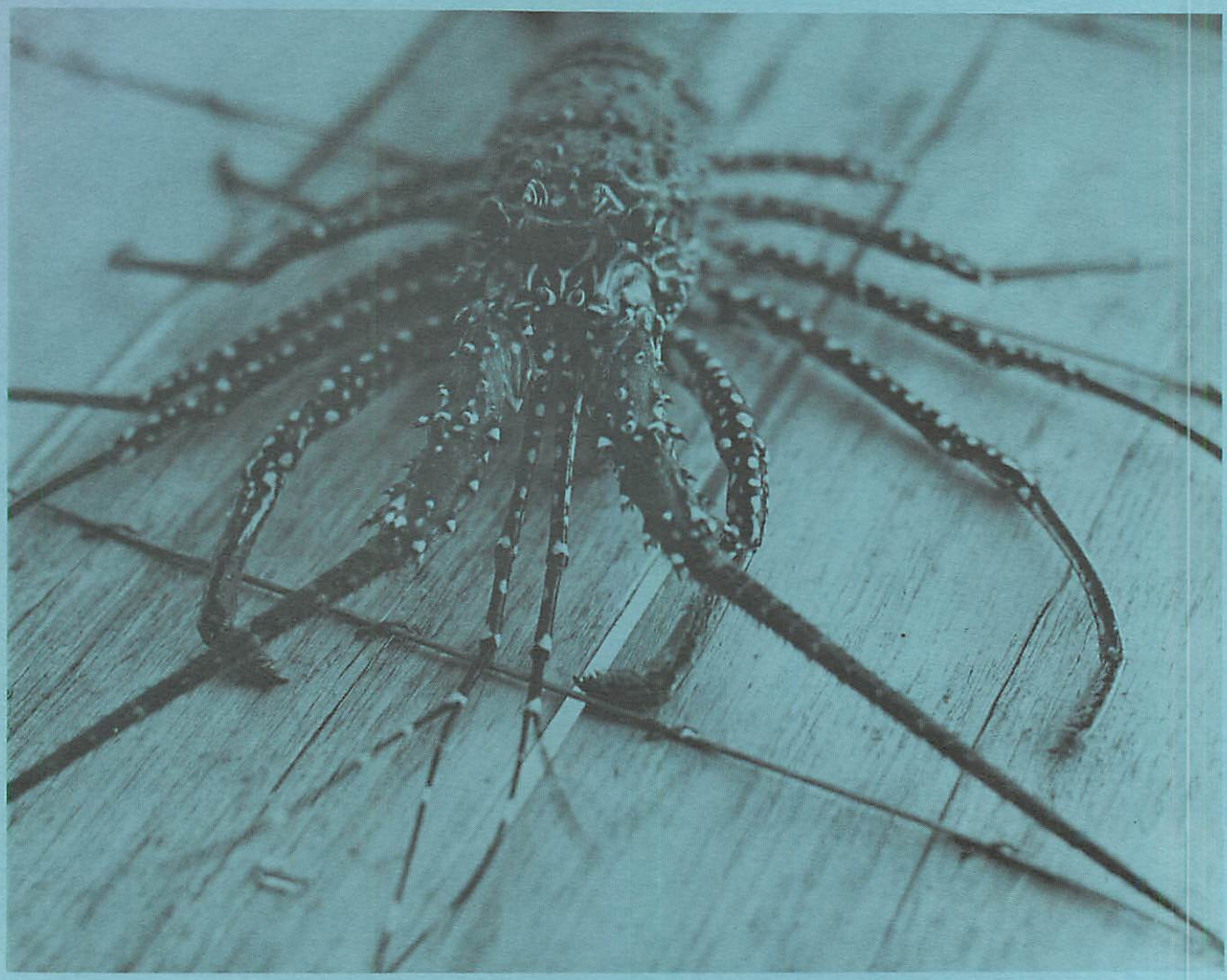
Soft Crab Fishery in Florida

The "soft crab" is not a separate crab species, but rather the result of the hard shell shedding process, or molting, which is required for the growth of most crustaceans. Traditionally, soft-shelled blue crab fisheries have small volume because the shedding operation is considered a labor intensive art. Consumer demand has always exceeded supply thus increasing the value of the fishery. This supply-demand problem resulted in a unanimous recommendation from the 1977 meeting of the National Blue Crab Industry Workshop for introduction of soft-shelled blue crab shedding operations where they are not utilized but show potential.

Florida is presently an underutilized site because of the annual large supply of hard crabs available and the prolonged growing seasons which result in more molts. The general objective of this project was to determine the potential for development of a soft-shelled blue crab fishery in the upper reaches of the St. Johns River.

Since it requires special training and experience to recognize the special signs that indicate pre-molt conditions, consulting services of an experienced soft-crab fisherman were obtained. By being able to identify crabs that are coming into the molting stage they can be separated, kept a short time until the molt, and then sold as soft shell crabs for four to five times the price of a hard shell crab.

This project is not scheduled for completion until early in 1979 but already there is a definite indication that the potential exists for success of a soft shell blue crab fishery in Florida.



Lobster Workshop

A Sea Grant sponsored Spiny Lobster Workshop held during January was well attended and served to facilitate spiny lobster research by interchange of data between those working in this field. Most projects are of fairly long-term duration and the workshop served to provide interim information to others working in this field, long before the final reports are published. It also provided a contact for others interested in Florida's spiny lobster research such as the Perry Oceanographics and the Caribbean Fishery Management Council. Subjects discussed included movement patterns of the spiny lobster in South Florida, certain biological aspects and management considerations.

Lobster Biology (R/FR-5)

Biological studies of the spiny lobster, the state's second largest fishery in terms of dollars, which included an extensive tag and recapture program off the Florida Keys, officially terminated in 1977. However, an extension was granted in order to provide time for preparation of reports and specific publications concerning the project. With computer printouts on movement data now available, it should be possible to determine if the directional movements of the lobsters are real or a result of sea-bottom topography.

During the tag and recapture part of the program a total of 6,223 lobsters were captured in wooden slat-traps, tagged and released from two Gulf habitats and three on the Atlantic side of the Keys. Reliable movement statistics were obtained from 479 out of 820 of these tagged lobsters that were returned by commercial fishermen. The directional movements from the five release sites were significantly non-uniform and generally favored eastward or westward directions.

Lobster Recruitment (F/FR-10)

An allied spiny lobster project in its second year focused on ascertaining dispersal patterns of planktonic phyllosome larvae of the spiny lobster to determine if lobsters commercially harvested in Florida waters are part of a self-sustaining "closed loop" type system of recruitment or constitute a non-self-sustaining "open system."

The question the project is attempting to answer is what contribution foreign larvae make to repopulation of the Florida region and what contribution do larvae released by Florida lobsters make to the repopulation of Florida and other regions.

At present the project is far short of being able to clearly delineate the genetic affinities and larval recruitment patterns for the many populations of spiny lobster. However, with the few facts available, it is possible to make some speculations concerning recruitment of larvae to Florida. It appears unlikely that British Honduras lobsters are a significant contributor to Florida recruitment. Further, if it is assumed that those lobsters are representative of other Caribbean stocks whose larvae might be carried through the Yucatan Channel, then there is little or no contribution from these sources. On the other hand, water circulation directly off British Honduras may be part of a local gyre mixing little with the main Caribbean water flow passing through the Jamaica and Cayman Islands area. The latter may be more representative of flow from the Lesser Antilles, portions of the Venezuelan coast and further east as well as the southern coasts of the Greater Antilles. It is essential to the project to obtain animals from such locales as Jamaica, the Caymans, Trinidad, selected areas in the Lesser Antilles, and possibly the Venezuelan coast.

Populations to the north of the Greater Antilles (e.g. Florida and the Bahamas) and the Virgin Islands show a different pattern of relationship. In ex-

amining which populations are different at some locations (e.g. Virgin Islands vs most Florida populations) and which show no difference at any locations (e.g. various Bahama populations), it is tempting to speculate a westerly flow of larvae. Although it is unlikely that many larvae are directly transported from the Virgin Islands to Florida, intermediate populations might be. Thus larval flow from an area such as the north coast of Cuba to both Florida and the western Bahamas might lead to similar genetic structure.

At this point in the research, although definite larval recruitment patterns have not yet been fully established, the feasibility of the biochemical population genetic approach has, and as the project progresses it is anticipated that it will be possible to predict probable sources of larvae for not only Florida populations but others as well.

Seafood Patties (R/FR-12)

With the prices of so-called "conventional" or "acceptable" fish species becoming more expensive and the supply of these species diminishing, it appears prudent to examine ways in which underutilized species of fish may be marketed so as to be acceptable to the consuming public.

Many finfish species landed in Florida are underutilized such as mullet, blue runner, crevalle, croaker, black drum, sea bass and others. In addition, filleting finfish leaves a considerable quantity of edible flesh remaining on the frame. The purpose of this project was to examine ways in which flesh from the underutilized species and the edible remains of the more marketable varieties left after filleting can be exploited as an acceptable fish product.

The objectives of the study were to develop seafood patties from these underutilized species in combination with other ingredients; determine possible optimum combination with other ingredients; determine the effects of chemicals, antioxidants and other processing factors on acceptability of the final product, to study the shelf life and the effect of various processing techniques on the storage stability of these products, and to work with interested Florida seafood processors in developing acceptable economical and nutritious seafood products.

Two separate studies are being conducted, the first using various combinations of mullet, sheepshead or croaker mixed with certain other chemicals. Processing conditions were altered for the different combinations by varying the time and/or temperature of deep fat frying and oven cooking. Sensory evaluations have not yet been completed.

In the second study minced croaker was mixed with various combinations of chemicals to determine viscosity, breaking force, and sensory evaluation. The processing factors remained constant for deep fat frying and oven cooking. Sensory tests have not yet been completed.

Singleton Packing Corporation of Tampa is cooperating in the project and initial findings have been distributed to them for application. For those products found to be acceptable as well as economically feasible, studies on shelf life and the effects of various processing techniques on storage stability will be conducted.

Solar Smoker

In another study, in an effort to develop a solar-assisted smoking process which can produce an acceptable smoked fish product with a low-expenditure of energy, a prototype solar-assisted smoker was constructed at the University of Florida. Smoked fish enjoys wide public acceptance and represents a good market but there is a possible hazard related to preparation. As a result, in 1970 the Food and Drug Administration (FDA) recommended a Good Manufacturing Practice for smoked fish which specified minimum temperature requirements depending upon the salt level of the fish.

With the FDA expected to revise the 1970 standards and require even higher temperatures and longer smoking times, it is anticipated that federal legislation will most likely make adequate safety assurance programs mandatory for all food processors. This will require smoked fish processors to install electric or fuel heating units which are expensive and consume a large amount of energy.

The prototype solar-assisted smoker uses a rectangular collector covered with transparent fiberglass sheets. Air is blown into the smoker from the collector using a two-inch galvanized pipe and one-half horsepower motor. A portable metal rack holds the sawdust trays above the chamber floor. The fish are hung from hooks anchored to the top of the smoker. The sawdust is ignited conventionally with a match or burning paper, then the hot air pumped in from the collector heats the fish and circulates the smoke evenly. In addition to developing an acceptable smoked fish product an objective of this study was to determine factors affecting product quality during processing and storage and also to investigate the economic feasibility of a solar-oriented smoking process.

Cedar Key Oyster Relocation Project

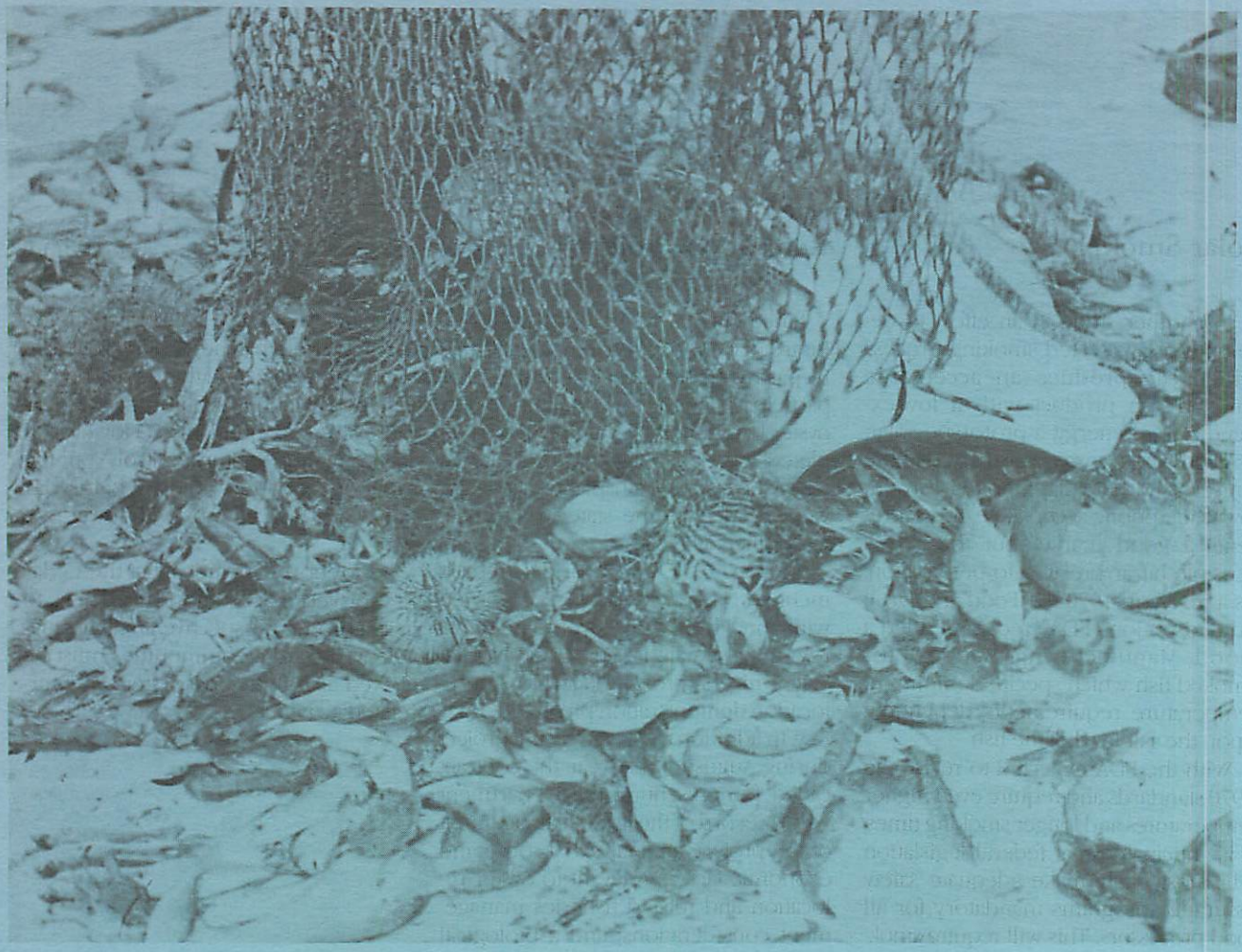
Since the early 1930s the Florida Board of Conservation, now the Florida Department of Natural Resources has participated in the construction of new oyster beds and the rehabilitation of depleted oyster bars around the state. At Cedar Key, oyster transplanting projects were funded by the state in alternate years since 1971.

During 1977, the Florida Department of Natural Resources contracted with the Florida Resources and Environmental Analysis Center at Florida State University to conduct an oyster relocation demonstration project at Cedar Key. In addition to managing the project during August of that year, the contract called for presenting the Department with a record of the actual management of the project; an analysis of social and economic factors relevant to oyster relocation and related fisheries management considerations; and a biological assessment of the condition of oysters relayed in past projects, current areas used for relocation, and recommendations for improvement of the technique. Observations, suggestions and recommendations regarding the relaying technique, its use in any future state-supported projects, or its adoption into the private sector were also to be included. In 1978 the Florida Sea Grant College provided immediate response funds for preparation of the final report.

According to the report, from a social point of view, the overall community response to the project was determined to be both positive and negative with more people citing the negative aspects of the project. Of these aspects, the most frequently mentioned criticism was that there were not as many oysters being moved as was claimed and that project workers were taking advantage of the state, having as their main object making good money. On the positive side, people viewed the project as beneficial in an economic sense and only secondarily as a benefit to subsequent harvests.

From a biological standpoint, the report indicated that the planting has been highly successful and there is no reason why the plantings would not be commercially successful also. However, it recommends tighter controls on the numbers of oysters planted, better dispersal and also clumps with fewer oysters.

The report concludes that the Cedar Key project has demonstrated that to gain a proper perspective, small fishing-oriented coastal communities must be viewed as a functional system of interrelated activities.



Snapper-Grouper Fishery (R/FR-9)

Declining yield of the snapper-grouper fishery in Florida indicated a pressing need for substantial additional data in order to make effective management decisions. This study has been directed at obtaining basic life history data on the 35 species which comprise this fishery.

Several phases of this project have been completed. These include determining snapper age by means of otoliths and vertebrae, a cluster analysis of stomach contents, and determination of daily growth patterns. A 2000 reference bibliography on snapper and grouper biology is in preparation and life history data has been integrated into the fishery management plan.

This study will continue to deal with filling in the gaps in the present data base and answering critical questions concerning stock size and distribution.

"The whole street rumbles and groans and screams and rattles while the silver rivers of fish pour in out of the boats and the boats rise higher and higher in the water until they are empty. The canneries rumble and rattle and squeak until the last fish is cleaned and cut and cooked and canned. . ."

– John Steinbeck, "Cannery Row."

Sharks

Two projects were undertaken during the past year under immediate response and pilot project funding.

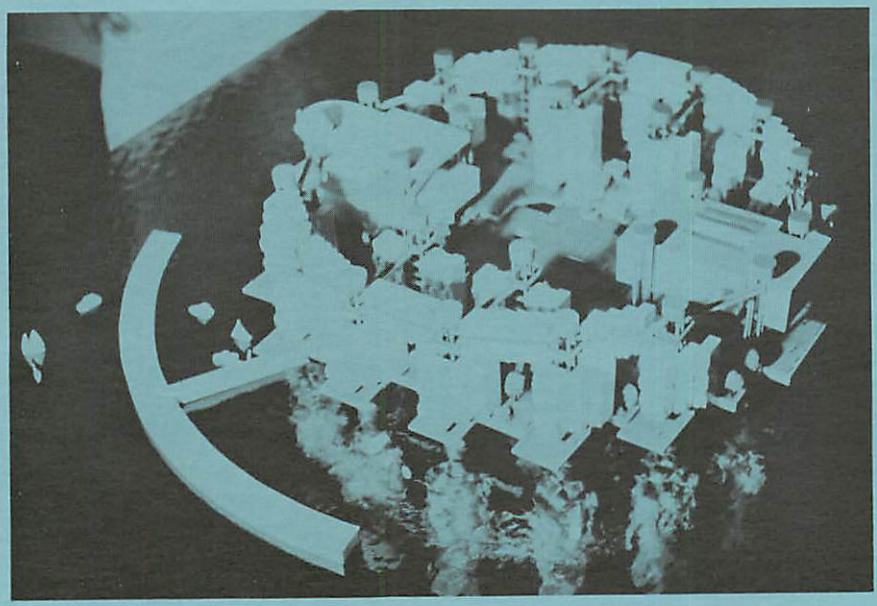
One, a pilot project aimed at assessing the shark resources of inshore northeastern Gulf of Mexico waters was completed following shark "rodeos" at Pensacola, Destin, and Panama City, Florida, and Dauphin Island and Orange Beach, Alabama.

These "rodeos" were intensive fishing tournaments and as the sharks were brought in they were weighed, identified, and measured.

Records were kept as to where each shark was caught, the time of day, depth of water, distance from shore, size and type of hook used, bait, the kinds and numbers of other fishes caught at that location, and the number of people fishing. Biological data collected included age and growth studies, sex, and reproductive information as well as specimens of vital organs and teeth from each shark. It is anticipated that when compilation of data is complete it will be published for interested users.

The second shark project which is nearing completion is attempting to determine the levels of heavy metals in sharks. Shark meat, acknowledged to be nutritious and pleasant tasting when properly processed, has been slowly gaining acceptance among restaurants and school lunch programs. But the quantities of mercury, lead and cadmium which may be present in sharks has remained an unanswered question which the results of this project may answer. □

EDUCATION



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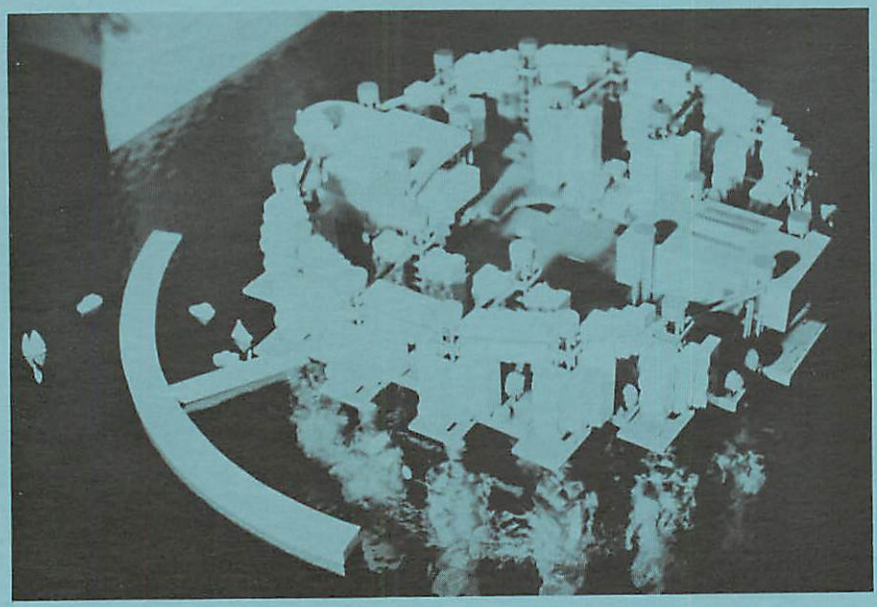


The lure of the sea for man, pulling him irresistibly to the shore almost as the sounds of the Sirens lured the ship of Ulysses to the perilous rocks off their island, is a coin with another side. That side is education—Marine education, for if Americans are going to continue to live by the sea in ever increasing numbers, if the state of our marine environment is to remain healthy, if its health is directly or even indirectly related to the health of our country, then our very future as a nation requires that the oceans receive their proper place in American educational process.

Theodore Roosevelt is reputed to have remarked that, "A nation behaves well if the natural resources and assets which one generation must turn over to the next generation are increased and not impaired in value." The ideal situation then, would be to treat the sea as a self-replenishing source so that as one generation receives its own unique gifts, forces would be set in motion so that the following generation would not go away empty handed.

Recognizing the importance of continually enlarging our knowledge of the sea and the proper utilization of its vast resources, Florida Sea Grant has, from the beginning, encouraged the participation of graduate students in Sea Grant Funded projects, supported wholly or in part certain graduate thesis projects, has provided seed money for start-up of technology classes at colleges and universities, and has supported a vital and rapidly expanding 4-H marine education program.

Graduate Student Theses

In addition to 24 graduate students who were supported as part of research projects, two were supported strictly on the basis of their graduate thesis topics.

FLOATING CITY

The first involved the work of A. Lee Martin, a student in the College of Architecture at the University of Florida and produced something that looked as if it might have been lifted from the novels of Jules Verne. It was a modern, up-to-date idea for a floating city accommodating 1500 people and containing its own facilities — commercial shops, schools, library, hospital, gardens and open spaces.

The city was designed as a working laboratory for 100 scientists and their families plus approximately three research support workers per scientist and two additional non-technical workers per scientist including doctors, nurses, clerks, cooks, barbers, and those necessary to support the utilitarian needs of the floating complex. The scientists would be engaged in some form of marine research, which Martin believes should be in mariculture because "of a need for food sources to feed the masses at present and in the future, and because the energy needs of our civilization are not being met, there is a substantiated need for facilities to carry on research in this area."

Martin didn't overlook the aesthetics of the situation. He designed the city to offer opportunities for normal family living, provide for basic physical needs, and to give the occupants variety, diversity, flexibility, and motivation in their everyday lives.

The floating complex is circular in shape with a diameter of 735 feet and contains housing modules, commercial area with pedestrian walkway, skywalk, central plaza and neighborhood plazas. One housing area is garden oriented to permit residents to enjoy a non-ocean setting and the other is oriented seaward. A helicopter pad permits access from the air while ships bringing supplies may unload underneath the center of the floating platform through large access ports. A floating breakwater rotates independently of the platform to meet waves from any direction, thus providing a secure harbor for research vessels and supply ships.

In designing the flotation system for this city, Martin used the concept developed by the University of Hawaii Sea Grant Program in their project concerned with construction of large offshore platforms in the ocean environment — the feasibility of which was verified through computerized mathematical analysis.

Martin believes people can live at sea for extended periods of time and that permanent communities can be built and inhabited in the open ocean because man has a need to inhabit the ocean in order to search for energy resources and possible sources of food.

PREGNANT SCUBA DIVERS

The second graduate research project was by Margie Bolton, graduate student in nursing and a senior advanced scuba diver who set out to determine if it is safe for women to scuba dive during pregnancy.

Bolton, who completed the research under the direction of Dr. Molly C. Dougherty, associate professor of nursing, found that the frequency of complications was not related to the extent of diving during pregnancy; however, three out of 24 pregnant women who dived at depths greater than 100 feet had malformed infants.

Of the 208 women sampled, 136 had dived at some time during one or more pregnancies. Comparisons were made between frequencies of complications among pregnancies during which women dived and the frequency of complications among pregnancies during which women dived before, but not during pregnancy.

Although the risk of harmful effects to the fetus from scuba diving during pregnancy appears to be real, there appears to be no justification for abortion or undue alarm among women who have dived while pregnant since much more evidence is needed before the findings are conclusive.

Based on the report, pregnant divers are advised to use a sensible approach by limiting dives to 60 feet, limiting duration to one-half the United States Navy decompression tables, and avoiding strenuous dives, hypoventilation and chilling.

Bolton reports that in the United States alone, 10 percent to 20 percent of the 3 million certified scuba divers are women in the childbearing years. Additionally, an increasing number are engaged in scientific and commercial diving. Many of these women will dive during the crucial first trimester when the infant is developing and often before pregnancy is confirmed.

4-H Marine Education (E/Y-2)

The Florida 4-H marine education program evolved from a demonstrated need by Florida 4-H youth for a comprehensive educational program in the area of marine science and has grown rapidly until it now boasts an enrollment of 7,393, first in the southeast region and first or second nationally.

Florida Sea Grant College continues its support of this important program by providing funds for a 4-H Marine Education Specialist for two years. The new specialist has assumed leadership in the management of the total 4-H Marine program which involves development, acquisition, and utilization of specialized literature, scheduling of activities and events, and working with members of the state 4-H staff, county 4-H agents, the marine advisory program and Sea Grant and other selected governmental and private organizations.

Participation of 4-H members presenting marine demonstrations at the annual state-wide 4-H Congress has increased yearly as has the enrollment at 4-H Marine camps. Last year there were four marine camps in different locations with a total enrollment of over 200.

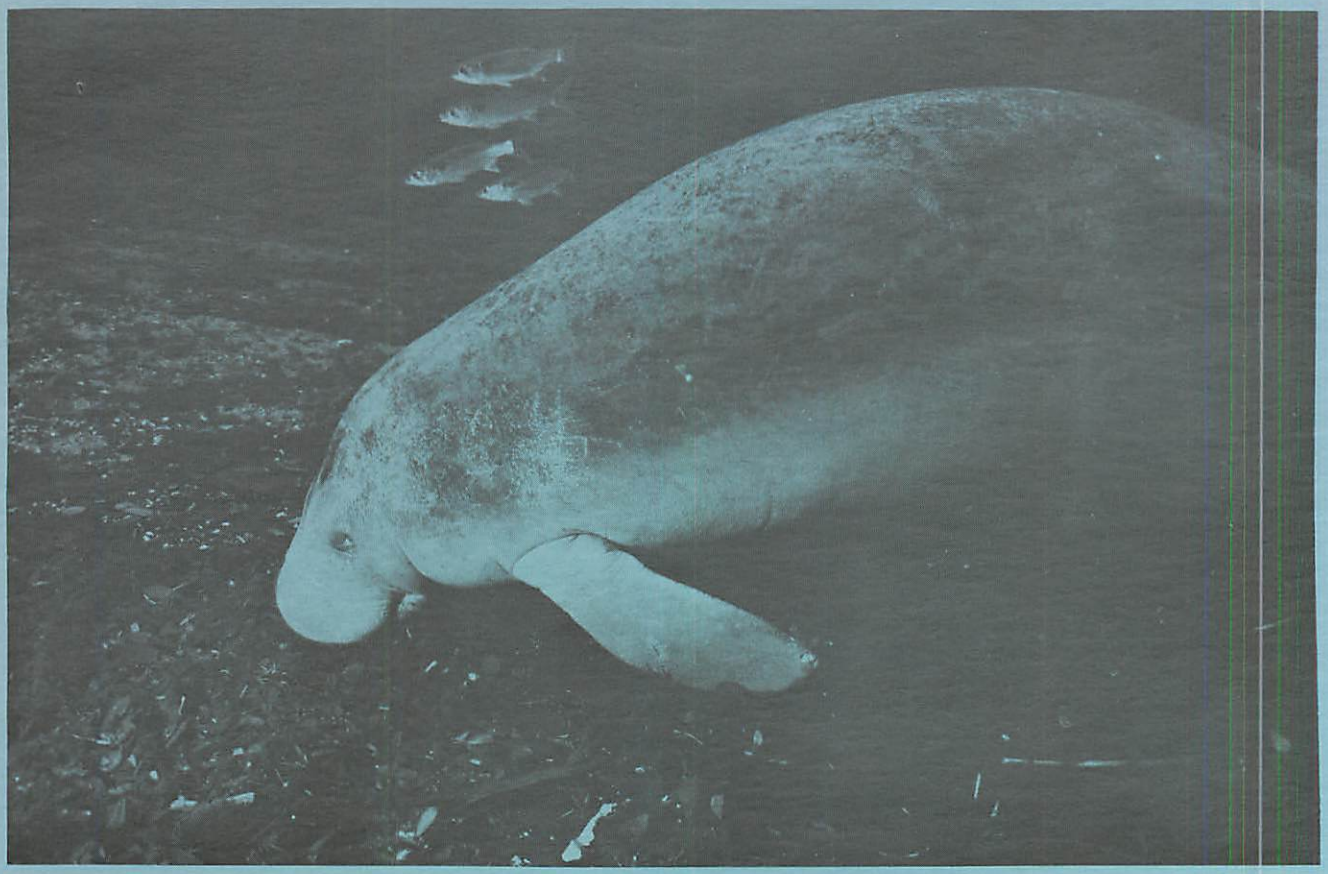
These camps, organized by marine advisory agents and staffed by 4-H adult leaders and personnel from county extension offices, featured such diverse marine activities as snorkeling, netmaking, marine specimen collecting and marine crafts. Classes were held on such subjects as sealife communities, marine technology, seafood, marine careers, dolphins, sharks, manatees, blue crabs, and other sea creatures as well as dangerous marine animals.

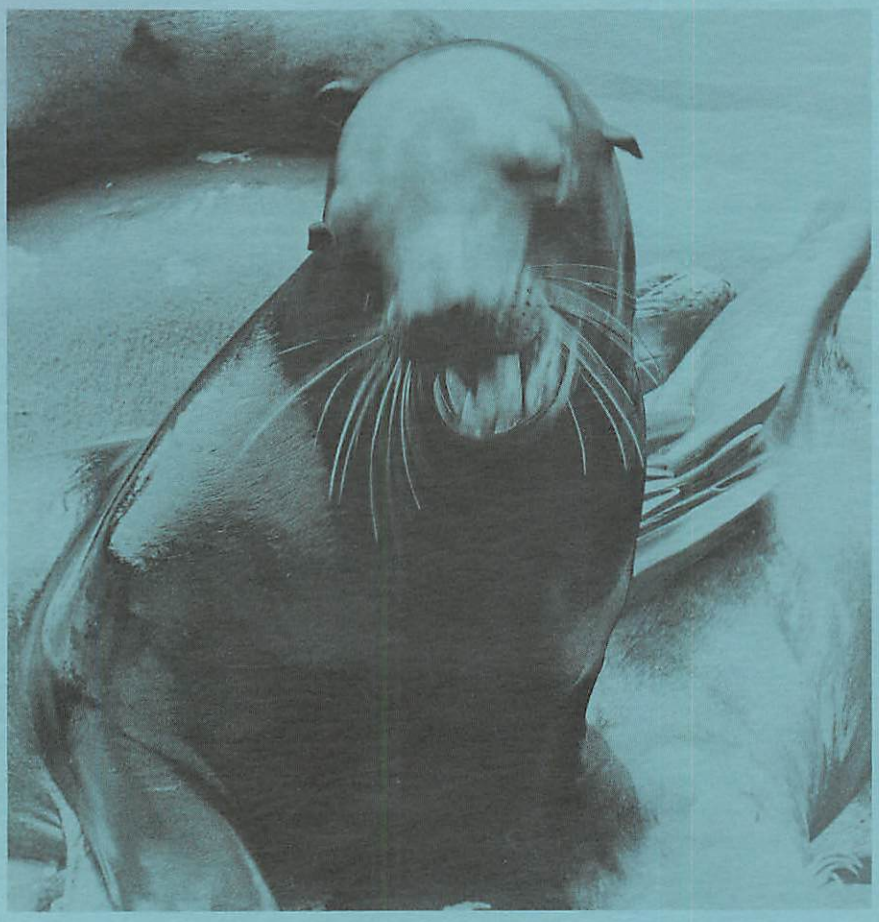
Student Paper Award

Months of work with the Florida Sea Grant Spiny Lobster project paid off for Douglas Gregory, Jr., graduate student in the School of Forest Resources and Conservation at the University of Florida.

At the annual meeting of the American Fisheries Society at the University of Rhode Island, Gregory won the Student Paper Award for his presentation of a paper entitled, "Reproductive Biology of the Spiny Lobster in South Florida."

The paper, which detailed significant findings from the three-year Sea Grant project, was co-authored by Dr. R. F. Labisky, principal investigator of the project and professor in the School of Forestry and Christopher Combs, assistant researcher on the project and currently a doctoral candidate at Texas A & M University. □





Preventive Medicine for Captive Marine Mammals

Multitudes of people love animals and seem to be especially drawn to the aquatic mammals seen in oceanariums and zoos. These attractions, in addition to offering millions of visitors an opportunity to study and observe all types of marine life, also contribute substantially to knowledge about marine animals. Along with this interest and the increasing number of marine mammals held in captivity is a growing concern related to their health care. Besides humanitarian considerations passage of the Federal Marine Mammal Protection Act in 1972 made it far more difficult and costly for an attraction to replace an animal. Consequently, the industry is becoming more aware of the necessity for breeding and sustaining these animals in captivity.

"We need another and a wiser and perhaps a more mystical concept of animals. Remote from universal nature, and living by complicated artifice, man in civilization surveys the creatures through the glass of his knowledge and sees thereby a feather magnified and the whole image in distortion. We patronize them for their incompleteness, for their tragic fate of having taken form so far below ourselves. And therein we err, and greatly err. For the animal shall not be measured by man. In a world older and more complete than ours, they move finished and complete, gifted with extensions of the senses we have lost or never attained, living by voices we shall never hear. They are not brethren; they are not underlings; they are other nations, caught with ourselves in the net of life and time, fellow prisoners of the splendor and travail of the earth."

– Henry Beston,
"The Outermost House."

Recognizing this need, a Sea Grant researcher has established normal clinical values to aid in checking organ functions and spotting physical problems before they begin in the Pacific pilot whale, *Globicephala scammoni*; the Atlantic bottlenosed dolphin, *Tursiops truncatus*; and the Florida manatee, *Trichechus manatus* latirostris Harland.

From an examination of records and case histories of several marine attractions, the most serious health problems and the most frequent causes of death were determined for the three species.

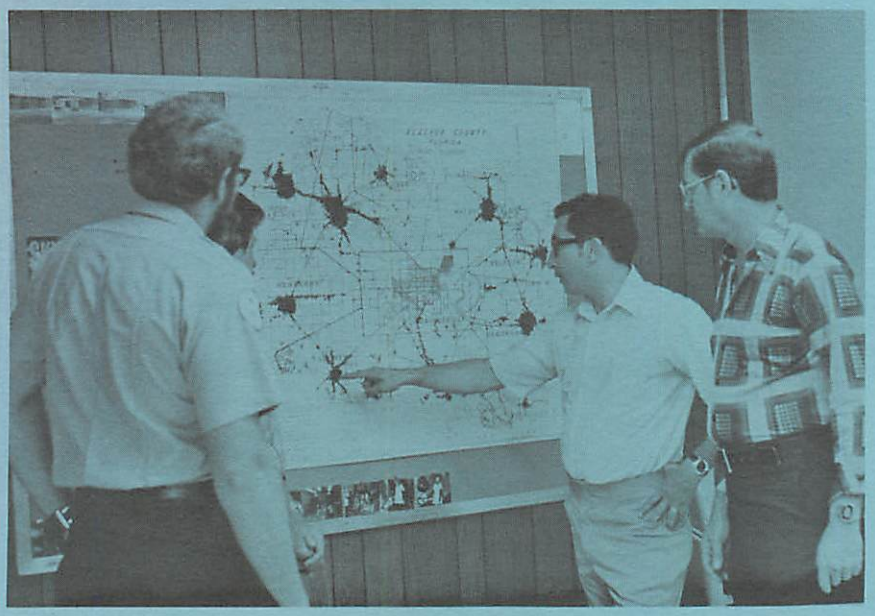
Results of the study revealed that in the pilot whale, problems associated with capture and adjustment immediately following capture resulted in liver damage. A second problem contributing to death was the aggressive behavior shown by males in mating season. The major problem, however, was found to be gastroenteritis and the researcher states that early detection, treatment and management of this digestive disorder is essential for extending the life-span of these animals.

Because of their inclination for swallowing foreign objects, bottlenosed dolphins have been known to suffer illness, sometimes even death, from ingesting such things as bird nests and large sharp objects. And, according to the study, erysipelas, which has been controlled by immunization, and seasonal respiratory infections are continuing problems of the dolphin; but the most serious threat to the life of these animals at Marineland of Florida has been hepatitis. In 1968, an outbreak of this disease killed almost all of the captive dolphins. Since the specific cause was not established a plan for monitoring, preventing, and managing hepatitis in dolphins is crucial.

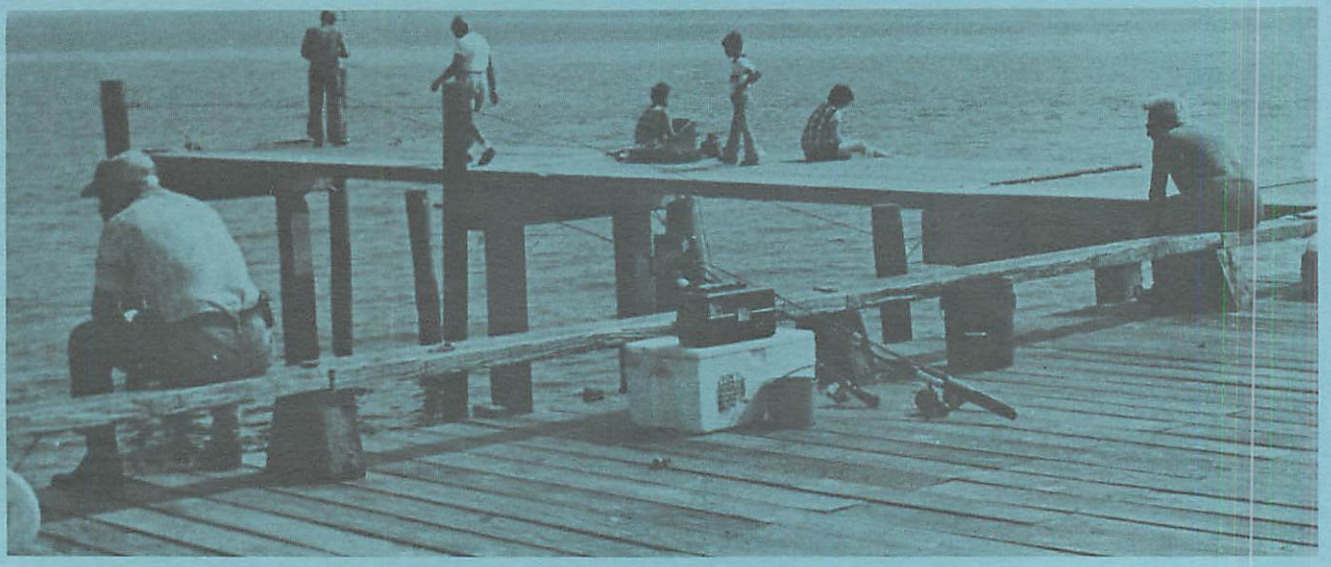
Although there is no record of the death of an adult manatee in captivity, two infants and a two-year-old that had been nourished on formula died from generalized bacterial infections. To combat this situation, it is recommended that antibiotics and colostrum be included in the formula to compensate for the passive immunity usually provided by the mother, and because these animals require warm water for survival, the temperature of the water in the holding tank should be kept at 75°F.

Skin diseases causing ulcers are the major problem for adult manatees. Hair follicles become infected from the build-up of bacteria in the tank.

Although this study established normal clinical values for the three species mentioned, individual characteristics differ somewhat in animals as in humans and it appears that the ideal situation would be to determine the normal values for each individual animal.



ADVISORY SERVICES



MARINE ADVISORY PROGRAM (A/MAP-1)

Some gifts become valuable only after a person learns to use them or to appreciate them and most people, if they have something they need or enjoy, are interested in caring for it so that they may continue to enjoy it. People who love the beach, and who want to continue to swim, picnic, surf, or just walk the deserted stretch during the winter become alarmed when they see it slowly slipping into the sea. Fishermen who have always caught their limit in favorite fishing spots become upset when the fish are no longer there. Retirees with life savings invested in homes on the many coastal canals that lace the state become very disturbed to note a disagreeable odor coming from the unflushed water and garbage collecting at the place where the canal ends.

Where can they go for assistance? Every county is now served at least part of the time by a marine advisory agent who is located in a county Extension office in his area of work. He is a marine educator, serving his vast marine community through educational and informational efforts. Supported by university-based specialists he provides factual data or offers other alternatives for solving problems such as these. He can help. He is a communications link with the Florida Sea Grant College and one of his missions is to identify problems which university researchers can help to solve. Sea Grant research is practical research aimed at solving real problems such as those mentioned above. The marine agent does not just identify problems, he also carries the solution back to the users in the coastal zone. For people who live and work in Florida's coastal communities, the local marine advisory agent offers the possibility for perpetuating the enjoyment of their own unique environment.

1978 was a busy year and a year of rapid expansion for the Florida Marine Advisory Program. The permanent staff was enlarged by four with the addition of two marine advisory agents and specialists in seafood science and emergency preparedness. The staff became increasingly active and influential in identifying research needs, evaluating proposals and assisting with the implementation of approved research projects for the Florida Sea Grant College.

Commercial Fishery Technology and Economics

Commercial fisheries and seafood processing were the initial focus for MAP when it began operations seven years ago. Although the program has since expanded into a number of other areas these sectors remain as strong points of interest. The Marine Economics specialist as well as some of the advisory agents played major roles in the development of fishery management plans for the Fishery Management Councils and have participated in a seafood port study recently completed. In addition, many tax, business management, and gear technology workshops have been held for fishermen throughout the state.

The addition of a Seafood Advisory Specialist to the staff kicked off an extensive program effort to assist seafood processors. Both domestic and foreign sources are being investigated as possible markets for under-utilized species. The midwest is also seen as an expanding market.

MAP continued to encourage Production Credit Association loans for fishermen and expanded this effort by co-sponsoring with the Federal Intermediate Credit Bank of Columbia, S.C. and the Coastal Plains Center in Wilmington, N.C. a three-day conference for PCA bankers from southeastern states.

The purpose of the conference was to help PCA bankers become better informed to pass judgement on loan applications and take advantage of the growing potential in aquatic loan funding. During the conference the bankers were taken to Fernandina Beach where they were led through an on-site survey of a snapper-grouper boat and two shrimp trawlers.

Emergency Preparedness

Newest service from the Marine Advisory Program was instituted early in the year with the addition of a special assistant to the coordinator for the purpose of implementing a comprehensive educational program for natural hazard awareness in coastal areas.

What made this innovation especially noteworthy was the fact that the individual assuming these duties was the first transferee under the Intergovernmental Personnel Act of 1970. Marine advisory agents have become increasingly involved in developing and implementing the programs. The expertise of federal, state, and local agencies is utilized and the entire effort is coordinated with the National Weather Service regional office, the disaster preparedness staff, and the staff of the National Hurricane Center as well as meteorologists in charge of various weather stations. The program is closely coordinated with the state office of Civil Defense and the Office of Education in developing curricula for all levels of the educational system.

During 1978 nearly 6800 persons participated in hurricane and tornado workshops in 20 counties and tornado spotter workshops for law enforcement and Civil Defense officials were conducted at various locations throughout the state.

As a result of work in this program, several advantages have accrued to Florida's agricultural industry. NOAA weather radio now furnishes swine producers in the northern portion of the state a "comfort index" determined from a combination of temperature and dew point readings so that they can more accurately determine when it will be safe to ship their hogs to market. Farmers have been advised to construct mounds of dirt in pastures where cattle can safely retreat on higher ground in the event of flooding; and agronomists on the Hurricane Task Force Committee of the Cooperative Extension Service have developed methods for blanching soil that has experienced salt water intrusion and have determined what plants could best be grown after salt has entered the soil.

The weather service has benefited, too, with the Florida Marine Patrol now sending weather observations directly to local weather offices and private yachts which carry sophisticated weather gear also regularly furnishing up-to-date weather data to weather offices for use in forecasts on NOAA Weather Radio. A MAP Bulletin, "Boating Safety — Thunderstorms" was developed by a port meteorologist under the auspices of the Florida Sea Grant College and is scheduled for publication early in 1979.

Coastal Engineering

The MAP specialist in coastal engineering continued to work through advisory agents in furnishing assistance and information to planning groups in coastal counties. MAP co-sponsored a beach seminar at which the questions of beach erosion and shoreline stabilization were addressed as well as storm effects on barrier islands, rebuilding beaches, use of vegetation on beaches, and building construction along the shoreline.

Publications

This past year was a record year for Marine Advisory and Sea Grant Publications. In addition to publications distributed to constituents by marine advisory agents, nearly 14,000 were distributed from the central office as a result of 2,641 requests received from individuals and organizations in Florida, the U.S., and overseas.

New Sea Grant Reports were issued on such subjects as artificial reefs, impact of commercial fishing, and Ponce de Leon Inlet, and MAP Bulletins were published on the production, costs, and earnings in both the Spanish and king mackerel fisheries. Early in the year a MAP Bulletin listing all MAP and Sea Grant publications to date was printed and distributed to all Newsletter subscribers.

Technical papers were released on such diverse subjects as the spiny lobster, shrimp beam trawls, biology and fishery of sponges and stone crabs, beach erosion and estuarine research.

In cooperation with the Manatee Working Group, MAP published a brochure on the manatee and ways to protect this endangered mammal. Thousands of copies were printed and distributed throughout the state including copies to Welcome Stations. Three other brochures on the shark, scuba diving, and cold water survival were also placed in the Welcome Stations where supplies were quickly exhausted and requests were received to have them reprinted and resupplied.

The MAP bi-monthly Newsletter continued to be sent out to over 7,000 subscribers and Coastal News Reprints, a compilation of articles on marine subjects in the Florida Press continued to be very popular. Each advisory agent also continued to issue a periodic newsletter to his constituents.

MAP agents and specialists continued to use the mass media for dissemination of information by appearing on various radio and TV shows. Twenty-one news releases were prepared and issued to the state newspapers and selected national outlets during the year. In addition, a new weekly column, COASTLINES, was initiated and distributed on a quarterly basis to the state's weekly newspapers.

Marine Recreation

Marine recreation, which had received only limited attention during the first six years of the program, came into its own in 1978 with expanded effort in artifical reef placement and work with marina and boatyard operators.

The artificial reef placement team, funded by Sea Grant, worked closely with marine advisory agents in the areas where reefs were planned. On some occasions the agents initiated the action, then followed through by requesting the reef team to travel to the communities involved to meet with the artificial reef committees.

In April, at Orlando, MAP hosted a meeting of marina and boatyard operators from around the state in response to a recognized need to determine the role of the marinas in coastal regions as the focal point of human activity between land and sea. Information was needed particularly on the value of marinas to the economy, problems faced by existing marina operators, and technological and ecological factors affecting the marine business. With nearly 500,000 boats registered in the state it is evident that the boating industry represents a tremendous economic factor. Recognizing this, the conferees considered the possibility of forming a Florida Marina Association. They also considered closely the proposed Coastal Zone Management Plan which was before the state legislature at the time. Cooperation with the Marine Industries Association of Florida has led to their including, for the first time, a special section for marinas. □

PROGRAM SUMMARY

Publications

MARINE ADVISORY BULLETINS

MAP-2 *Florida Sea Grant Program Directory* - 1978.

MAP-3 *Florida Sea Grant Publications* - Revised January 1978.

MAP-4 *Production, Costs, and Earnings by Boat Size: Florida Spanish Mackerel Fishery.* James C. Cato, R. Allen Morris and Fred J. Prochaska.

BROCHURES AND FACT SHEETS

MAFS-2 *Medical Care For Commercial Fisherman.* Discusses medical services for commercial fishermen available through the U.S. Public Health Service. Includes addresses and phone numbers of Florida outpatient clinics.

MAFS-3 *Protect the Manatee.* Information on the Florida Manatee *(Trichechus manatus),* a Florida endangered species. In addition to a map showing locations of refuges used by manatees in Florida, many interesting facts are included.

MAFS-6 *Land Your Catch Fresh.* Quality control guidelines for proper protection of fish harvest by culling, cleaning and chilling. Includes legal requirements for boats used for harvesting or transporting seafood.

TECHNICAL PAPERS

Tech. Paper #4 *Spiny Lobster Research Review: Proceedings of a Conference Held December 16, 1976 in Key West, Florida.* Richard E. Warner, Ed.

Tech. Paper #5 *Short-And Long-Term Effects of Forestry Operations on Water Quality and the Biota of the Apalachicola Estuary (North Florida, U.S.A.).* Robert J. Livingston.

Tech. Paper #6 *Shrimp Beam Trawl — Design, Construction and Operation.* Bent A Christensen and John Dorman.

Tech. Paper #7 *Papers Presented at Beach Seminar Held October 4-7, 1978 at Captiva Island, Florida.* T. L. Walton, Jr. and T. M. Leahy, Eds.

Tech. Paper #8 *The Biology and Utilization of Florida's Commercial Sponges.* John M. Stevely, Jerome C. Thompson and Richard E. Warner.

Tech. Paper #9 *Biology and Florida Fishery of the Stone Crab, With Emphasis on Southwest Florida.* Theresa M. Bert, Richard E. Warner and Lorin D. Kessler.

Tech. Paper #10 *Chemical Attractants of the Florida Spiny Lobster, Panulirus argus.* Barry W. Ache, Bruce R. Johnson and Edward Clark.

SEA GRANT REPORTS

Report No. 24 *Artificial Reefs in Florida.* Donald Y. Aska, Ed.

Report No. 25 *Primary Economic Impact of the Florida Commercial Fishing Sector.* Fred J. Prochaska and R. Allen Morris.

"When we go down to the low-tide line, we enter a world that is as old as the earth itself—the primeval meeting place of the elements of earth and water, a place of compromise and conflict and eternal change."

— Rachel Carson,
"The Edge of the Sea."

Theses and Dissertations

Eng-Wilmot, David L. 1978. The chemistry of the marine blue-green alga, *Gomphosphaeria aponina*. Growth and production of the bioactive natural product aponin. Ph.D. diss. Univ. of Florida, Gainesville.

Hayter, Earl J. 1977. Verification of the hydrodynamic regime of a tidal waterway network. M.S. thesis. Univ. of Florida, Gainesville.

Jones, Christopher P. 1977. An evaluation of sand by-passing systems at tidal inlets in Florida. M.S. thesis. Univ. of Florida, Gainesville.

Lee, Jonathan K. 1977. A one-dimensional finite-difference model of pollutant transport in tidal finger canal networks. M.S. thesis. Univ. of Florida, Gainesville.

McCoy, Leslie F., Jr. 1977. The isolation and some biological properties of the marine natural product "aponin." Ph.D. diss. Univ. of South Florida, Tampa.

Morris, Fred. 1978. Hydraulic measurements, data analysis, and rational design procedures for residential tidal canal networks. Ph.D. diss. Univ. of Florida, Gainesville.

Schug, Donald M. 1978. Political and economic aspects of artificial reefs in Pinellas County, Florida. M.S. thesis. Univ. of South Florida, Tampa.

Turner, Dean H. 1976. Cracking of concrete due to corrosion of various embedded metals. M.S. thesis. Florida Atlantic Univ., Boca Raton.

Walton, Raymond. 1978. Numerical modeling of solute transport in tidal canal networks. Ph.D. diss. Univ. of Florida, Gainesville.

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Johnson, Bruce R. and Barry W. Ache. 1978. Antennular chemosensitivity in the spiny lobster, *Panulirus argus*: Amino acids as feeding stimuli. *Mar. Behav. Physiol. 1978. 5*:145-157.

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Maloney, Frank E., Dan Fernandez, Anthony R. Parrish, Jr., and James M. Reinders. 1977. Public beach access: A guaranteed place to spread your towel. *Univ. of Fla. Law Review XXIX*:853-880.

Maloney, Frank E. and Anthony J. O'Donnell, Jr. 1978. Drawing the line at the oceanfront. The role of coastal construction setback lines in regulating development of the coastal zone. *Univ. of Fla. Law Review XXX*:383-404.

Martin, Dean F. and Marina H. Gonzalez. 1978. Effects of salinity on synthesis of DNA, acidic polysaccharide, and growth in the blue-green alga, *Gomphosphaeria aponina. Water Res. 12*:951-955.

McCoy, Leslie F., Jr. and Dean F. Martin. 1978. Distribution of cytolytic activity in cultures of *Gomphosphaeria aponina. J. Environ. Sci. Health. A13(7)*:517-525.

Meeter, D. A. and R. J. Livingston. 1978. Statistical methods applied to a four-year multivariate study of a Florida estuarine system. *Amer. Soc. for Testing and Materials. Special Tech. Pub. 652.* pp. 53-67.

Mehta, A. J. 1978. Flow dynamics and nearshore transport. 83-161 *in*: Bruun, Per. Stability of tidal inlets. Elsevier Scientific Publishing Co., Amsterdam.

Menzel, Winston. 1978. Selection and hybridization in quahog clams (*Mercenaria* spp.). 507-521 *in*: Avault, James W., Jr., editor. *Proceedings of the Eighth Annual Meeting World Mariculture Society*. January 1977. San Jose, Costa Rica.

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Prochaska, Fred J. 1978. Prices, marketing margins and structural change in the king mackerel marketing system. *Southern J. Agr. Econ.* July 1978. pp. 105-109.

Prochaska, Fred J. and James C. Cato. 1978. Analysis of Florida Atlantic king mackerel monthly dockside prices. 67-69 *in: Proceedings of the Mackerel Colloquim*, March 16, 1978.

Walton, T. L., Jr. 1978. Coastal erosion — some causes and some consequences (with special emphasis on the state of Florida). *Mar. Tech. Soc. J. 12(4)*:28-33

Projects and Investigators

Project	Complete Title	Duration Begin	Duration End	Investigator and Institution
	Estuarine Management			
R/EM-6	The St. Johns River Estuary: A Chemical, Physical and Biological Study	1975	1978	Carole L. DeMort, R. D. Bowman, UNF
R/EM-7	Effects of Sewage Pollution Abatement on Hillsborough Bay	1975	1978	Joseph L. Simon, USF
R/EM-10	Culture and Transplant Studies of the Seagrass *Ruppia maritima*	1977	1979	Peggy A. Winter, UWF
R/EM-12, 13, 14	Coastal Forestry Practices and Estuarine Productivity: A Case Study, The Apalachicola Bay	1978	1979/ 1980	Robert J. Livingston, David C. White, FSU; Bent A. Christensen, UF
	Ocean Engineering			
R/OE-8	Beach & Dune Erosion Caused by Storm Tides and Waves	1978	1980	T. Y. Chiu, UF
R/OE-9	Fatigue of Welded Steel in Sea Water	1978	1979	William H. Hartt; D. S. Wolf, FAU
R/OE-10	The Role of Sikes Cut in the Flow Dynamics of Apalachicola Bay System	1978	1978	A. J. Mehta; D. M. Sheppard, UF
R/OE-11	Glossaries of Tidal Inlets in Florida	1978	1979	A. J. Mehta, UF
	Fisheries Resources			
R/FR-4	Economic Analysis of Commercial Fishing and Seafood Marketing	1974	1979	Fred J. Prochaska, James C. Cato, UF
R/FR-5	Biological Studies of the Spiny Lobster in South Florida	1975	1978	R. E. Labisky, Christopher Combs, William Mendenhall, UF
R/FR-9	Management: Biology of the Northwest Florida Snapper-Grouper Fishery	1977	1979	Stephen A. Bortone, UWF
R/FR-10	Spiny Lobster Larval Recruitment in the Florida Keys	1977	1979	R. A. Menzies, Nova U
R/FR-11	Seafood Patties from Underutilized Fisheries	1978	1979	J. C. Deng, UF
	Coastal Policy			
R/CP-1	Marine-related Recreation Businesses, Facilities and Services in Coastal Bay County, Florida	1978	1978	E. A. Fernald, K. Walby, FSU
R/CP-2	Legal Alternatives for Management of Storm Water Runoff	1977	1978	Frank E. Maloney, Dan Fernandez, UF
R/CP-3	Onshore Impact of Offshore Energy Facilities: A Legal Analysis	1977	1978	Jon L. Mills, R. D. Woodson, UF
R/CP-4	Salt Tolerance of Common Ornamental Horticultural Plants	1978	1979	T. A. Nell, UF
	Education			
E/Y-2	Florida 4-H Marine Education Program	1978	1979	Thomas Greenawalt, UF
	Advisory Services			
A/MAP-1	Marine Advisory Program	Continuous		John T. Woeste, Marion L. Clarke, UF
	Short Term, Pilot & Demonstration Projects			
	Florida Sea Grant Immediate Response Projects:	1/76	4/78	William H. Hartt, FAU
	Cathodic Protection Against Sea Water Corrosion Fatigue	3/77	3/78	P. Cardeilhac, UF
	Preventive Medicine for Captive Marine Mammals	6/77	12/77	W. E. Barrick, UF
	Salt Tolerant Plants for Florida	7/77	3/78	E. A. Fernald, FSU
	Cedar Key Oyster Relocation Project	8/77	8/78	P. A. McLaughlin, FIU
	Animal Communities in Seagrass	10/77	10/78	M. E. Kassouny, FSU
	Heavy Metals in Selected Species of Sharks	10/77	12/77	Barry W. Ache, FAU
	Spiny Lobster Workshop	12/77	3/78	A. K. Craig, FAU
	Pilot Study: Atlas of Florida Marine Resources by County	12/77	11/78	D. E. Martin, USF
	Phthalic Acid Esters in Estuaries	1/78	6/78	J. R. Anderson, Jr., FSU
	Florida Artificial Reef Atlas	1/78	12/78	H. Mathews, SPJC
	Artificial Reef Resource Team	3/78	6/78	T. Walton, UF
	Navigation Channels and Coastal Structures Seafood Port Study	3/78	11/78	K. Mathis, J. C. Cato, R. L. Degner, F. J. Prochaska, & P. Landrum, UF
	Shark Resources of Inshore Northeastern Gulf of Mexico Waters	7/78	12/78	S. B. Collard, UWF
	Development of Soft Crab Fishery in Florida	9/78	1/79	W. S. Otwell, UF
	Administration			
M/PM-1	Administration of the State University System of Florida Sea Grant College	Continuous		Hugh L. Popenoe, William Seaman, Jr., UF

Budget,
Calendar Year
1978*

Florida Program Area & Federal Classification	NOAA Sea Grant	Collegiate Grantees & Sponsors**
ESTUARINE MANAGEMENT RESEARCH		
Support of Coastal Decisions	$ 147,500	$ 75,300
Ecosystem Research	37,700	18,400
Pollution Studies	81,600	82,400
OCEAN ENGINEERING RESEARCH		
Materials and Structures	40,200	52,800
Coastal Engineering	77,300	61,000
FISHERIES RESOURCES RESEARCH		
Living Resources	103,900	53,000
Marine Economics	41,000	43,600
Seafood Science and Technology	39,200	16,600
COASTAL POLICY RESEARCH		
Law	59,800	26,100
Recreation	18,800	9,500
EDUCATION		
Youth	32,000	60,500
ADVISORY SERVICES		
Extension Programs	369,500	379,800
SHORT TERM & PILOT STUDIES	100,500	31,300
ADMINISTRATION	111,100	30,200
Totals	$1,260,100	$940,500

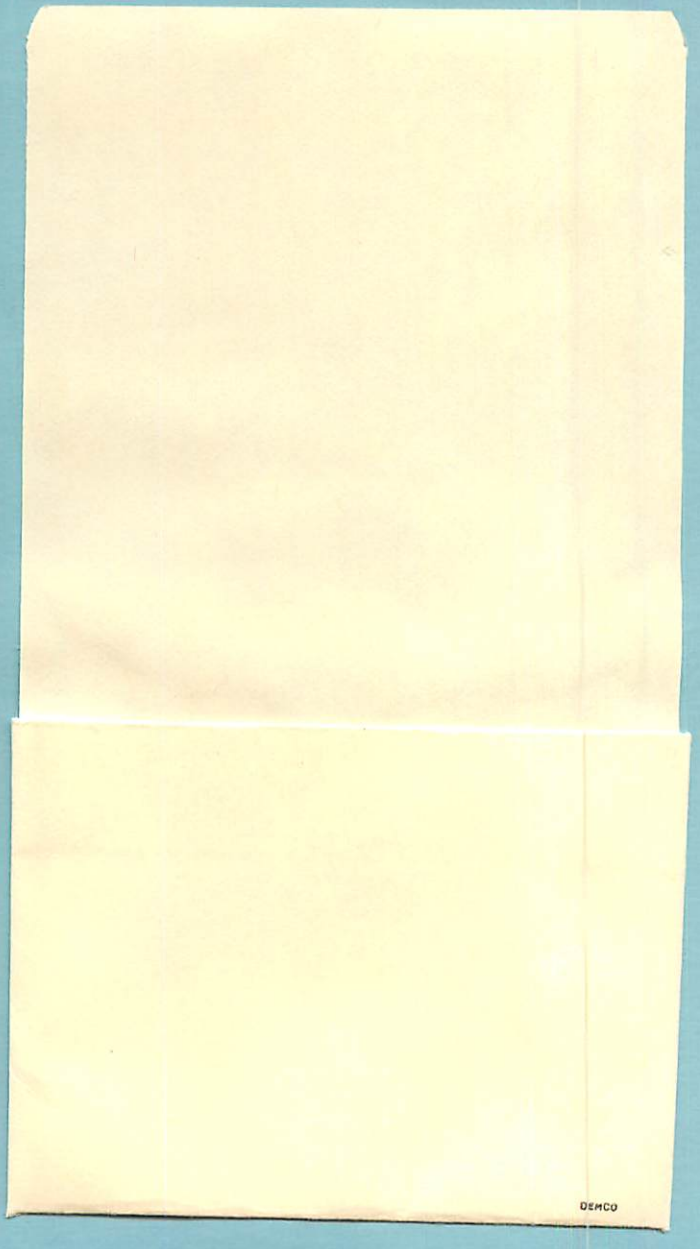
*Approximate figures subject to final audit
**No federal funds included

Sponsors

American Petroleum Institute
Academy of Marine Science, Miami
Applied Marine Ecological Service
Board of County Commissioners of Various Coastal Counties (advisory services)
Bream Fishermen's Association
Center for Governmental Responsibility
Clearwater (city of)
Coastal Plains Center for Marine Development Services, Wilmington, N.C.
Escambia County
Florida Board of Regents
Florida Department of Environmental Regulation
Florida Department of Natural Resources
Florida Department of Transportation
Florida State Legislature
Franklin County Board of County Commissioners
Gulf and South Atlantic Fishery Development Foundation, Inc.
Gulf of Mexico Fishery Management Council
Hillsborough County Environmental Protection Commission
Jones, Bruce (commercial fisherman)
Paschke, Capt. Rusty
Pensacola (city of)
Pensacola Party Boats, Inc.
Singleton Packing Corp., Tampa
Southwest Florida Regional Planning Council
Southwest Florida Water Management District
Tampa (city of)
U.S. Environmental Protection Agency

Grantees

Florida Atlantic University, Boca Raton
Florida International University, Miami
Florida State University, Tallahassee
Nova University, Ft. Lauderdale
St. Petersburg Junior College, St. Petersburg
University of Florida, Gainesville
University of North Florida, Jacksonville
University of South Florida, Tampa
University of West Florida, Pensacola



The Florida Sea Grant Program is supported by award of the Office of Sea Grant, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, grant number 04-8-MOI-76, under provisions of the National Sea Grant College and Programs Act of 1966. The Florida Sea Grant Program was initiated in 1972 with three major components: applied marine research, education, and advisory services.

State University System of Florida Sea Grant Reports are published by the Marine Advisory Program which functions as a component of the Florida Cooperative Extension, John T. Woeste, dean, in conducting Cooperative Extension work in Agriculture, Home Economics, and Marine Sciences, State of Florida, U.S. Department of Agriculture, U.S. Department of Commerce and Boards of County Commissioners, cooperating. Printed and distributed in furtherance of the Acts of Congress of May 8 and June 14, 1914. The Florida Sea Grant College Program is an Equal Employment Opportunity-Affirmative Action Employer authorized to provide research, educational information and other services only to individuals and institutions that function without regard to race, color, sex, or national origin.

This public document was promulgated at a cost of **$1,947.62** or **$.780** per copy, to provide an annual report of the Florida Sea Grant College Program.