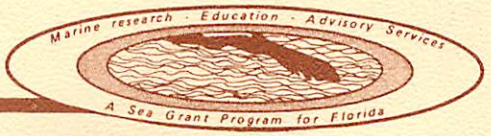
THE SEA GRANT COLLEGE PROGRAM

For January 1 December 31, 1976

STATE UNIVERSITY SYSTEM OF FLORIDA



STATE UNIVERSITY SYSTEM OF FLORIDA
SEA GRANT COLLEGE PROGRAM — 1976

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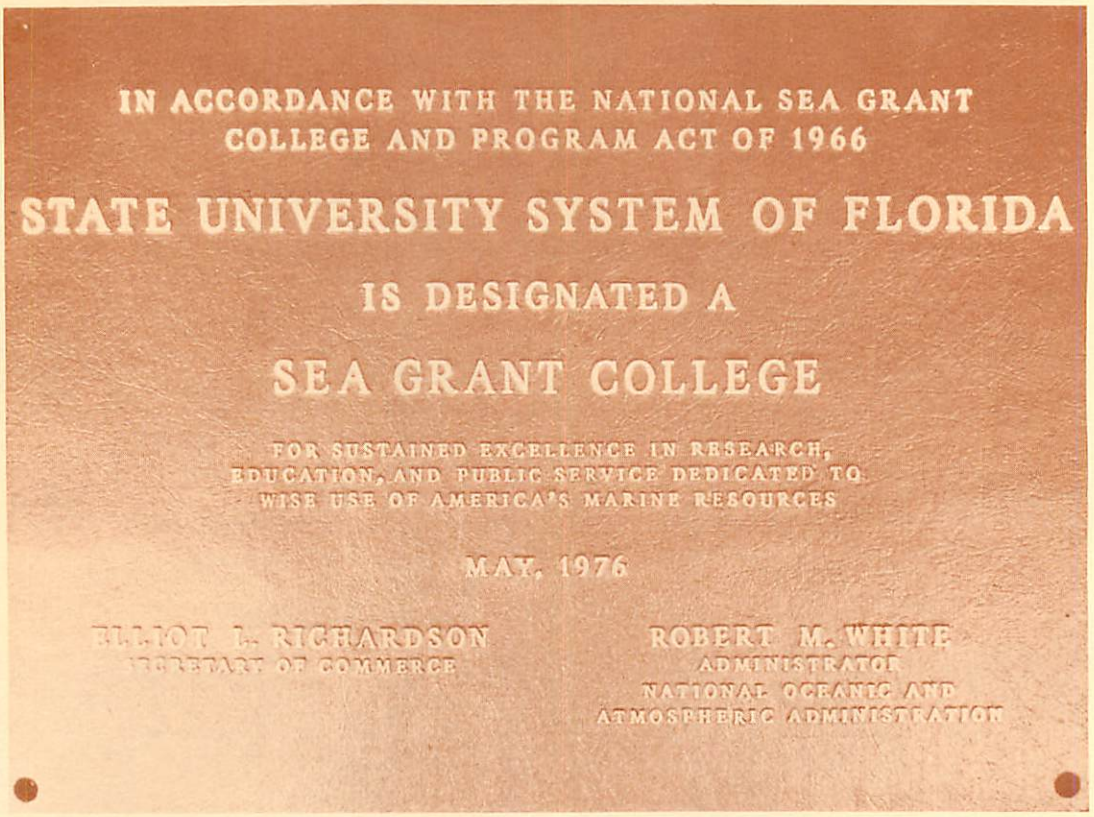
STATE UNIVERSITY SYSTEM OF FLORIDA SEA GRANT COLLEGE PROGRAM 1976

FLORIDA SEA GRANT '76



Director's Statement

While many of our neighbors in the interior of the United States may think of "the sea" as either a harsh enemy to be subdued or else a balmy paradise of unlimited leisure on endless beaches, to Sea Grant the sea and coast are mainly places of vigorous human activity where many persons earn their daily bread. Of course, in the past year our program did deal with nature's fury as unleashed through Hurricane Eloise, and we did initiate what will probably be a growing involvement in coastal recreation. However, much of the college and university talent assembled in the Florida Sea Grant Program was quite busy with practical everyday issues such as coastal policy and management of wetlands, engineering studies of erosion and shore construction, and harvesting the sea's food resources.

At the heart of all the issues are the people who live near or on the sea and who depend upon it for all or part of their way of life. And the role of Sea Grant is to assist those people in realizing a more productive way of life from the sea.

Florida is America's fastest growing coastal state. Not surprisingly, 75% of our new residents choose the coastal zone to live, and many of them want to live in a select number of counties, preferably on the water. It is for this reason that one major Sea Grant effort has been to look at waterfront development design and planning. Work on a canal design handbook is nearing completion, while in the Apalachicola Bay area results from another project have found immediate application in regional land management.

With so many new residents, Florida seeks to

balance their needs and those of the state's long-time citizens and businesses. Hence an increasing share of Florida's 10,000 or so commercial fishermen are receiving business tips through such activities as Sea Grant tax workshops. Florida's fisheries rank fifth in value nationally, and her leading fisheries such as shrimp and spiny lobster have been the subject of economic and biological studies by Sea Grant faculty.

Although research commands the largest share of our budget, the areas of advisory services and education are just as essential to an effective Sea Grant program. We feel this year some strong ties with industrial and commercial employers have been forged through technologist training curricula at the associate degree level. At the same time, that nebulous phenomenon called "public awareness" was pinpointed through an effective 4-H effort with coastal youth.

The Sea Grant Marine Advisory Program achieved the first phase of a long-range strategy by at last getting its field network of marine advisory agents in place. Joining established positions in the Panhandle, Keys, and Southwest, new positions serving the upper and lower Atlantic coast and the Tampa Bay area were established. The next phase of program development calls for involving the agents and the campus-based specialists, in actually formulating research and advisory projects in collaboration with faculty throughout the State University System of Florida.

In 1976 a modest amount of money was set aside for marine agent pilot and demonstration projects. The earliest efforts in this direction have included a demonstration project for floating breakwaters, and redesign of trawling gear. The more established process of funding exploratory and "immediate response" projects undertaken by faculty continued, thereby enabling a medical team to rush to the site of a mass stranding of killer whales last summer. About a dozen such projects were started in 1976. Whereas some may lead to more extensive Sea Grant studies, other seed projects result in sponsorship from various sources such as the National Institutes of Health, the Coastal Plains Regional Commission, or the U. S. Environmental Protection Agency.

Research of a larger nature (usually two or three years) was undertaken in 17 other projects. Among them, one defined a markedly new pattern of long-range blue crab migration in the Gulf of Mexico, and another developed gear to recover smaller, harbor-sized oil spills. Somewhat unexpectedly, previous economic research found a ready application in the ultimate provision of financial assistance to fishermen displaced from closed foreign fishing grounds.

As part of a national network, Florida Sea Grant benefits from Sea Grant programs in other states. We gratefully acknowledge the help marine experts from places such as Mississippi, Georgia, and North Carolina provided last year in the fields of fishing gear technology and seafood science. Also, I am particularly privileged to have just completed a term as chairman of the Council of Sea Grant Directors, and now will serve as president of The Sea Grant Association in 1977.

As you will read on the following pages, Florida Sea Grant has focused its resources on a limited number of subject areas. Each is periodically reviewed, with one result being that "Coastal Policy" was formed to give the "human element" its proper place in the program. In early 1977, Aquaculture will be reassessed as we seek to insure the best university response to Florida needs.

Finally, a good many of our readers will require follow-up information on the subjects in this report. Last year we noted the so-called lag-time in getting technical reports published, and as anticipated 1976 saw an explosion in reports and papers. At our headquarters alone, about 300 letters per month arrive requesting various documents.

And that is what Sea Grant is all about. People helping people satisfy their economic and daily needs from the sea, as well as just plain satisfying their curiosity. The strength of Sea Grant lies in a close union of the research, education, and advisory service elements of America's colleges and universities. The lifeblood of Sea Grant continues to be a covenant between those institutions and the men, women, and children who live, work, play and dream on "the sea."

Hugh Popenoe

Hugh Popenoe
Director

RESEARCH

Dr. David A. Hessinger, University of South Florida, examines sea anemone which produces a venom similar to that of the Portuguese Man-of-War (page 30). In photo on facing page, Dave Peery, University of South Florida, applies burette absorption test on a foam sample being tested for possible use with oil spill recovery unit (page 16).

Estuarine Management

The proper balance of the use, conservation and preservation of Florida's estuaries and coastal lands continues to be of primary importance in light of the great population growth of the 1970's. Three out of every four new Floridians settle in the state's coastal zone, with just 16 counties receiving most of the growth.

From an administrative point of view, it has been important to keep a statewide perspective on estuarine research which can require vast investments. A workshop in March convened state, federal and local agency personnel, scientists, and others to focus on key avenues for Sea Grant involvement. Pilot funds supported a Sea Grant estuarine data team to unify and serve the projects.

During this grant year, research in four selected areas was carried out in close cooperation with state and local organizations. One project concerning environmental parameters essential to estuarine management in Choctawhatchee Bay in the Panhandle was scheduled to conclude in 1975 but was carried over a year. Three other projects continued into the second year at Apalachicola Bay, Hillsborough Bay, and the St. Johns River Estuary. Paramount in all of these studies is the need to understand and interpret the natural environmental processes so as to be able to make rational management decisions concerning their use and development, both in the state's great urban systems and in key rural areas.

Ocean Engineering

"Critical erosion" is the way experts characterize long stretches of Florida's sandy coast, which economists say still serves as the prime attraction for a large share of the state's multi-billion dollar tourist trade.

In addition to the long-term study on littoral drift and the sand budget aimed at preserving Florida's valuable beach sand, research continued on developing environmental canal design criteria to provide for the efficient flushing of canal and borrow lakes in the coastal areas and the examination of seawater corrosion of steel reinforced structures. With the State Department of Transportation estimating that anticipated replacement of the Florida Key bridges the next ten years could cost as much as 250 million dollars, the determination of the best and most economical materials with which to construct the new bridges is most important. A fourth project in the area concerns the development of a prototype oil spill

recovery boat which uses a patented ferromagnetic polyfoam to clean up oil spills. With such spills a continuing environmental problem, an effective and economical method for rapid oil recovery is a necessity.

Fisheries Resources

The Florida Sea Grant Program continued its "partnership" with the state's fishing industry during this grant year. Economic analysis of commercial fishing and seafood marketing continued with reports being published on Florida commercial marine fisheries, the shrimp processing industry, and the spiny lobster fishery. Biological studies of the spiny lobster, the state's second most valuable fishery, continued as did the study to develop a synthetic chemical bait to attract the lobsters which would be cheaper and more convenient than conventional baits now used in lobster pots. To locate source areas for the state's valuable blue crab fishery, research continued on blue crab migration patterns along with the Atlantic and Gulf coasts. A new project which followed logically from previous research on the hydrodynamic evaluation of nets and crawls concerned the implementation of fishing gear design using the model approach.

In line with its philosophy of addressing major economic species and industry-wide concerns, Florida Sea Grant invested "pilot funds" in studies of redfish spawning on the Atlantic coast and electronic tracking of fishes.

Coastal Policy

Coastal areas traditionally have played a vital role in this nation's development. Small colonies which clustered around natural harbors have blossomed into huge metropolitan cities. Throughout our history the coastal shoreline has been considered an unlimited resource. Only recently an awareness has evolved that a great deal of the natural, historic, scenic, cultural, aesthetic, and recreational value of our coastal environment is lost forever as a result of private development. During this grant year, research in this area was concerned with developing model ordinances based on the types of coastal beaches, wetlands, and dunes for which protection has been attempted at state, county, or local level.

Previously, policy studies in law and community development were conducted by Sea Grant as isolated projects. The program area of "Coastal Policy" was set up last year to give research in that field recognition equal to that conducted in the established fields of science and engineering.

ESTUARINE MANAGEMENT

Apalachicola Bay (R/EM-4)

The overall aim of this project was to develop the scientific basis for a management program for the Apalachicola Drainage System. This would be a broad approach, combining scientific and economic data, local input, and management concepts to determine the form of development which would be compatible with this important ecosystem. Specific goals involved a preliminary determination of the principal energy components of the bay system with an emphasis on the relative input of inorganic plant nutrients, particulate matter, and dissolved organic carbon from the Apalachicola River and the contributions of phytoplankton and detrital components to the energy budget of the bay system. The source and role of detritus of terrestrial origin was studied, including the role of microorganisms in detrital breakdown and energy transfer. A sub-project was undertaken to determine the potential impact of clearcutting and storm-water runoff on the biological functions of the bay. Both the impact and productivity analysis were carried out as an extension of the total data base which dated back to March, 1972.

Studies carried out since 1972 concerning monthly changes of phytoplankton, standing crop and productivity, nutrient concentrations, and environmental factors such as light, temperature, turbidity and salinity, which affect phytoplankton productivity, indicate that the Apalachicola Bay System has a comparatively high level of phytoplankton productivity. Temperature and light were found to be the primary limiting factors to phytoplankton growth during winter and spring months with turbidity, nutrients, grazing, and flushing rates seen as additional controlling factors. Reduced river discharge during summer months was associated with reductions in nutrient concentrations. Temporal and spatial nutrient limitation studies showed that phosphate-phosphorus was the primary nutrient limiting phytoplankton productivity in East Bay during the summer while nitrate-nitrogen was the primary limiting factor in Apalachicola Bay at this time. This indicated that during periods of increased productivity in the summer and fall, phytoplankton growth is controlled by nutrients washed into the bay by the Apalachicola River. Since East Bay is a major nursery for various species during summer and fall months, and since phytoplankton productivity is phosphate-limited at this time, restrictions in nutrient flow could have a direct or indirect influence on the productivity of the bay.

Peak levels of leaf and wood matter occurred during late winter and spring river flooding and were traced largely to tree associations in upriver areas. Although the exact levels remain unquantified due to inexact method of sampling, there are indications that bay areas associated with river flow are affected by such input.

Various forms of sampling (otter trawling, seines, trammel nets, etc.) have been carried out since 1972 to determine the biological components in the bay. This has been accompanied by concurrent measurement of important physic-chemical functions such as temperature, salinity, dissolved oxygen, ph, turbidity, color, river flow, rainfall, wind and tidal fluctuations, etc. Peaks of abundance of dominant fishes are relatively evenly distributed through a given 12-month period whereas dominant invertebrates usually show peak abundance during the summer and fall. These relatively regular variations of estuarine productivity and faunal activity are now being used with regard to the development of various management policies. Based on a series of scientific publications, methods have been developed to translate the scientific data into local and system-wide planning and management programs.

In response to the **Franklin County Board of Commissioners** and commercial fishing interests in the area, a project was initiated to determine the impact on the bay of upland clearcutting and draining practices in Tate's Hell Swamp. The combined field and laboratory program, supported by the **Board of Franklin County Commissioners,** the **Buckeye Cellulose Corporation,** and the **Florida Department of Environmental Regulation,** in cludes day/night field collections of infauna and epifauna, physico-chemical monitoring, and field experiments in areas of interest. This has developed into a full Sea Grant project which is a joint effort by Florida Sea Grant investigators, federal, state, and county agencies, and private pulp mill interests. The primary aim is to determine the feasibility of management practices for upland runoff due to clearcutting practices.

During the past year, project personnel have continued to work with the Florida Department of Natural Resources with regard to the purchase of sensitive wetlands areas of the lower Apalachicola River as part of the state's Environmentally Endangered Lands Plan. A total of more than 28,000 acres at a cost exceeding 8 million dollars has now been purchased. This purchase was defined and qualified by scientific data generated by the Apalachicola Sea Grant project. Further involvement of this project in the proposed management of such lands is anticipated.

The Sea Grant project has generated interest in the development of a basin-wide management plan through the coordinated action of a number of state and federal agencies, county commissions, and private interests in the Apalachicola Valley. The principal investigator, together with the Florida Department of Natural Resources, has generated a published compendium of knowledge concerning scientific, economic, legal, and managerial considerations in the Apalachicola Drainage System. This includes papers written by 28 experts in various fields and is now serving as a multi-disciplinary base of information to be used in future planning and management decisions. This has provided the impetus for various related activities, and is viewed as an important step in promoting an objective translation of scientific data for use in planned development.

The principal investigator has served as an advisor to the **Franklin County Board of Commissioners** with regard to zoning regulations, local planning programs for St. George Island, water hyacinth control in the lower Apalachicola Drainage, and the development of efficient decision-making processes at the local level. Through a series of lectures and briefings, this project has contributed scientific input to the Florida Division of State Planning with respect to the development and coordination of a resource management and plannig program for the entire Apalachicola Drainage System.

There has been close coordination of this Sea Grant project with researchers of the Fish and Wildlife Service in their ongoing and proposed studies of the Apalachicola wetlands. Data from the Sea Grant project has been used to initiate preliminary efforts of the Environmental Protection Agency and the National Aeronautics and Space Administration to develop remote sensing as a management tool in this area. Information has also been used by the Florida Department of Environmental Regulation and the U.S. Army Corps of Engineers in their activities in the Apalachicola Drainage System. Data from the Apalachicola Sea Grant project provided the impetus for the possible designation of the Apalachicola Bay System as the first National Estuarine Sanctuary in the Gulf of Mexico under the Coastal Zone Management Act of 1972. This represents, if successful, the direct application of Sea Grant research data to the implementation of coastal zone management on a national scale. Pursuant to this activity, The Conservation Foundation of Washington, D.C. has initiated a series of meetings among local, state, and federal agencies to develop an organized setting for coordinated research and management processes in the Apalachicola Valley. In short, the Apalachicola Bay Sea Grant research is now serving as a nucleus for what could eventually become a national model for the integration of research and planning techniques in important natural drainage systems.

Hillsborough Bay (R/EM-7)

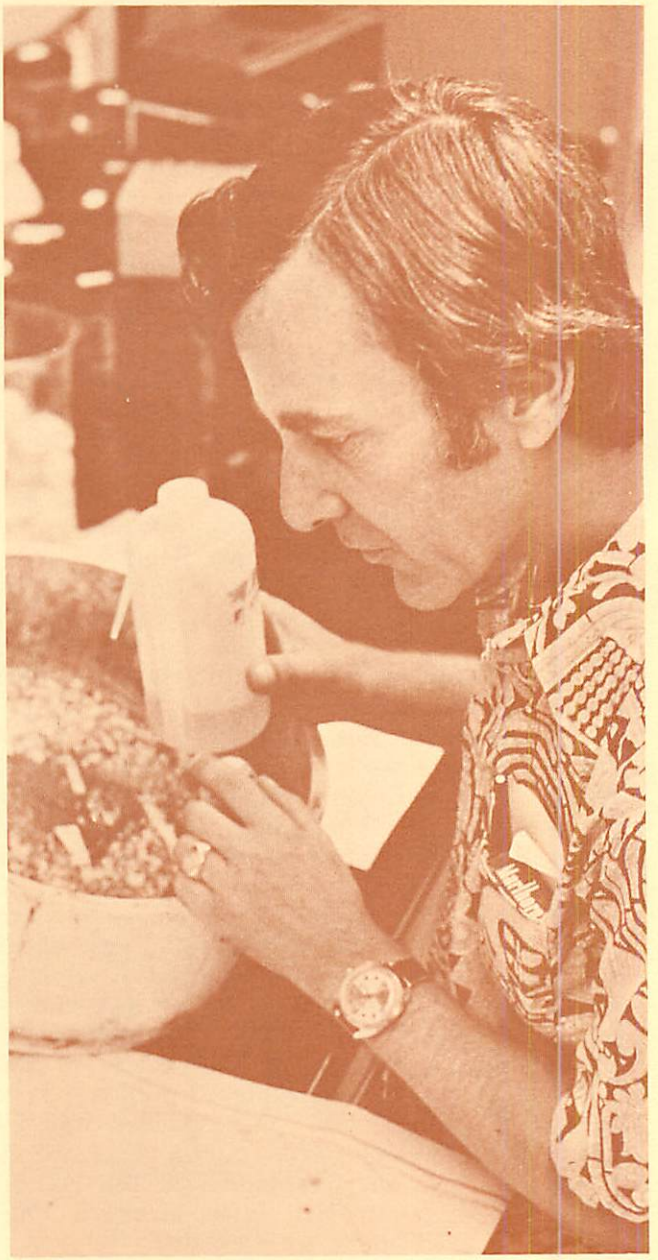
Construction of the City of Tampa advanced (tertiary) waste water treatment (AWT) plant affords a unique opportunity to study the effects of removal of a major point source of pollution in the estuarine environment of Hillsborough Bay. The objectives of the second year of study were to provide continuous pre-AWT data on water quality, sediments and sediment chemistry, and groups of bottom-dwelling invertebrates, and to document the initial changes accompanying the anticipated start up of the AWT plant. Although the AWT plant was to have been completed and gone on-line during 1976, construction delays have put off completion until mid-to-late 1977. It has thus been possible to gather several years of pre-AWT data which will be helpful in assessing AWT plant effects from "normal" variations within the Bay.

The **City of Tampa** and the **Hillsborough County Environmental Protection Commission** have provided matching funds, data, and personnel for the project. Preliminary data has been provided to the Tampa Port Authority and the Army Corps of Engineers to aid them in assessing potential effects of the Tampa Harbor Deepening Project. Additional cooperation has been given to Tampa Electric Company and other agencies involved in pollution effects in Tampa Bay.

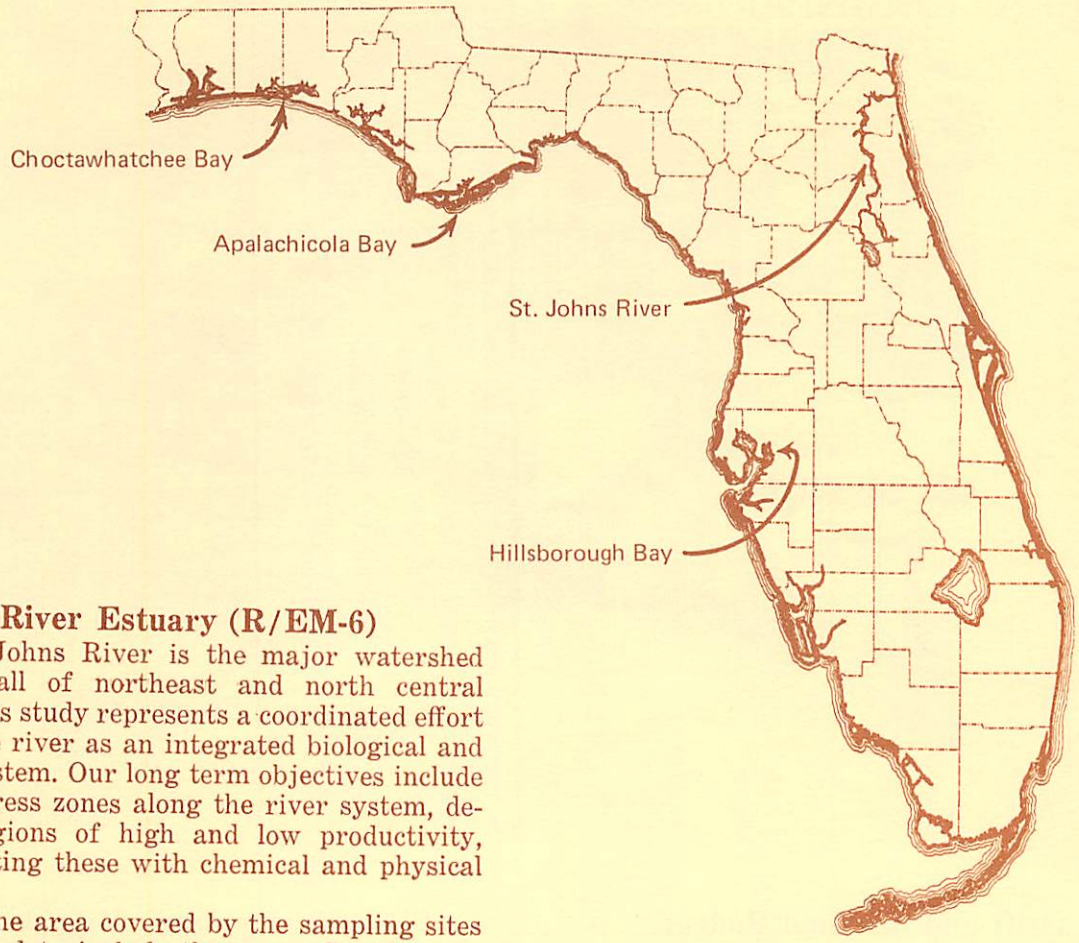
Monthly during 1976, twelve sampling sites running from near the sewage plant outfall to the mouth of Hillsborough Bay have been sampled for water quality and benthic invertebrates. Geological samples were taken quarterly. Analysis of year II data confirm the results found year I, indicating that the upper one-half of Hillsborough Bay is a highly stressed environment, with poor water quality, organically rich sediments, and highly variable invertebrate populations. The lower portion of the Bay is characterized by better water quality and more diverse and stable bottom-dwelling populations.

Marked variations in species numbers, species composition and densities of individuals continued to occur on a month to month basis at the stressed stations, with patterns differing from those seen during year I. A complete die-off of the bottom-dwelling animals occurred at the stressed stations during July and continued through September, 1976, and a one month die-off was seen in September, 1975. Recovery of the animals during both years was seen in a few months.

It is fortunate that the environmental parameters during year II (warmer water temperatures during the winter, etc.) differed markedly from those during year I, and led to different responses by the invertebrates. The yearly variations in the groups noted will aid in a clearer interpretation of any changes accompanying AWT plant start up and operations during late 1977 and 1978.



Dr. Joseph L. Simon, University of South Florida, sorts small animals from sediment samples screened from the bottom of Hillsborough Bay.



St. Johns River Estuary (R/EM-6)

The St. Johns River is the major watershed basin for all of northeast and north central Florida. This study represents a coordinated effort to study the river as an integrated biological and chemical system. Our long term objectives include mapping stress zones along the river system, delimiting regions of high and low productivity, and correlating these with chemical and physical parameters.

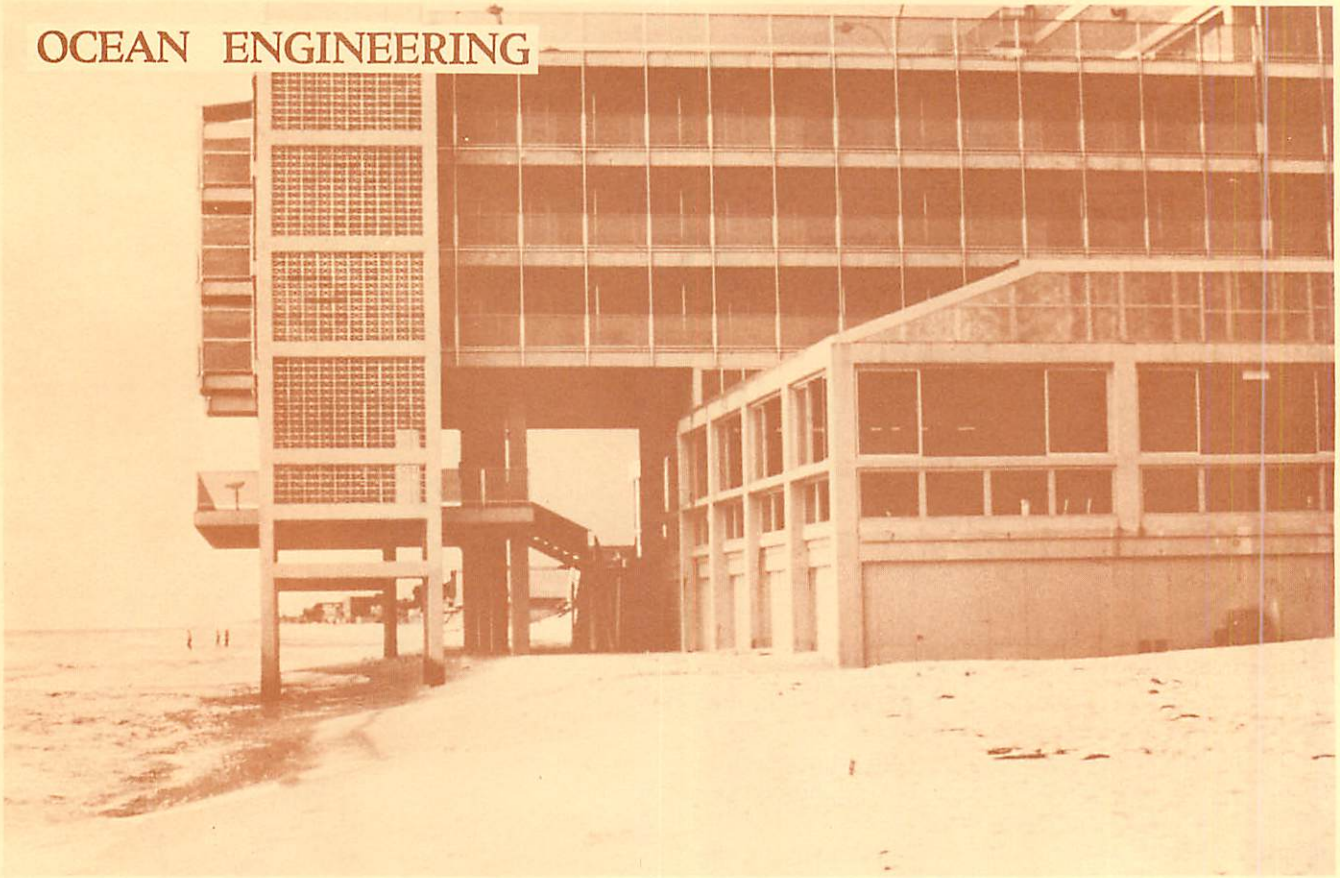
In 1976 the area covered by the sampling sites was expanded to include the upper St. Johns to Lake George. Presently 23 sites are collected monthly. Two tributaries, Julington Creek and Cedar River, are being studied intensively to determine the relative impact of a non-stressed subsystem (Julington Creek) and a highly stressed one (Cedar River).

Cedar River appears to be the most overworked subsystem in the sampling area. The system showed high ammonia levels and large numbers of coliform bacteria in addition to very low dissolved concentrations. The area contained large numbers of Blue Green algae with a very low species diversity. Rice Creek is another highly stressed area with low dissolved oxygen and high turbidity. Cedar River is receiving an excess of domestic sewage pollution and Rice Creek is receiving an excess of industrial wastes.

Based on the data thus far analyzed, primary productivity increases with distance from the mouth. The upstream areas including Dunns Creek and Lake George averaged two and one half times greater primary productivity than downstream areas within 13 miles of the mouth. The effect of Jacksonville on primary productivity of the main stream of the St. Johns as it flows past the city does not seem to alter this general trend. The city does not appear to affect the plankton species composition or diversity within the river itself. The effects of pollution on some of the tributaries have already been described, however, these effects appear to be quickly modified as the tributaries empty into the main river.

These data have been interpreted for the Jacksonville Area Planning Board (JAPB) for use in the Northeast Florida Coastal Zone Management Plan. During the past year several JAPB members have requested information on specific areas of the river for use in zoning and management studies and recommendations.

Two estuarine technical workshops have been given for the Northeast Florida Shrimpers Association members. These workshops were held in August and September and were organized through Mr. Joseph Halusky, marine extension agent for northeast Florida. We have been attempting to work closely with the shrimpers in relating the results of this study to their problems with shrimp productivity and other fisheries problems they have encountered.



Littoral Drift and the Sand Budget (R/OE-1)

In the past 100 years there has been a continuous rise in sea level that has caused a steady erosion of Florida's beaches. In that same period, rivers and estuaries north of Florida ceased being significant sources of sand to her beaches. The improvement of inlets for commercial and recreational purposes has introduced barriers in the normal sand flow. Man has frequently caused accelerated erosion by building too close to the sea, destroying dunes, and converting beach areas into parking lots.

The objective of this research project is to examine the movement of sand in the littoral zone off of Florida's coasts. In 1976 primary attention was given to inlet studies, groin construction at Panama City for measuring littoral drift, and establishing the Archives.

At this point in time, the long-range strategy for beach preservation is to nourish eroded beaches periodically by pumping sand from offshore locations back to the beaches. A knowledge of the amount and direction of sand movement is required to determine the lifetime of a nourished beach and the important cost-benefit ratio.

Glossaries of inlets providing histories, physical parameters and hydrographic analyses were prepared on Sebastian Inlet, John's Pass and Blind Pass, and Matanzas Inlet. The first two have been published and the glossary of Matanzas Inlet is scheduled for early 1977.

Matanzas Inlet deserves special attention because it is the last unimproved inlet on Florida's Atlantic Coast, and thus man's last outdoor laboratory to learn how nature intends for such inlets to behave.

The glossary of the Matanzas Inlet describes it as a hydraulically stable entrance although the main channel and outer bar configurations exhibit significant seasonal variations. Hurricane Dora in 1964 caused a significant change in its character by breaching Rattlesnake Island and altering the bay dimensions. As a result nearly a half million cubic yards of sand accumulated in an inner shoal area. Other calculations show that Matanzas Inlet "captures" only a small portion of the littoral drift along the outer coast, probably about 10 percent of the gross drift. This is an important piece of information needed in understanding the sand budget of Florida.

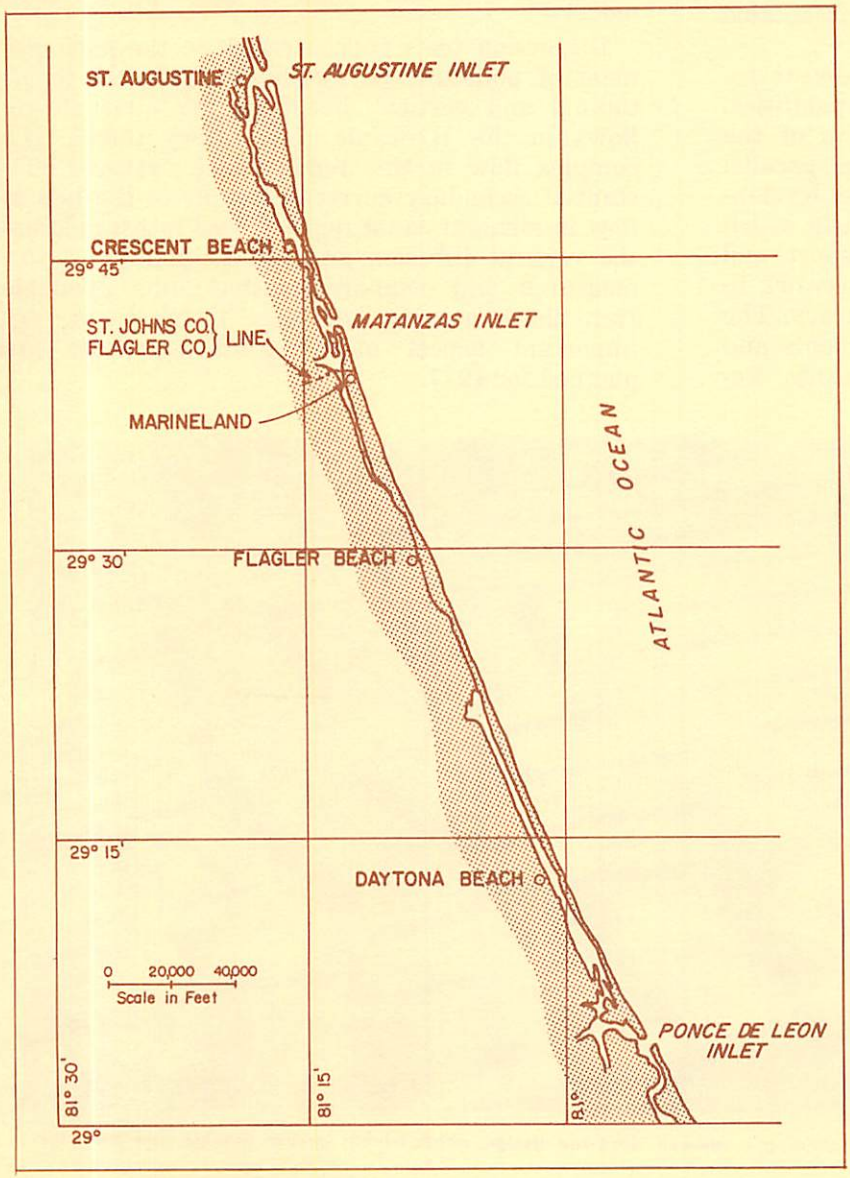
In August 1975 the Coastal and Oceanographic Engineering Laboratory constructed a nylon-bag

groin near Phillips Inlet on Florida's panhandle. The purpose of the groin was to intercept the movement of sand offshore and determine the net amount of sand moving east and west. About three weeks later Hurricane Eloise completely destroyed the installation and measuring devices.

With Sea Grant support the groin was reconstructed in 1976 and is now in use. The volume of sand trapped per unit time has been much larger than anticipated in the first two months of operation and alterations will be needed to raise and lengthen the groin. These early results have shown that the actual sand movement may be a more important factor than originally anticipated.

Both the Matanzas study and the Panama Beach study have been carried out in cooperation with the Corps of Engineers. The State Department of Natural Resources is providing substantial financial support at Panama City and the Engineering and Industrial Experiment Station is supporting research at Matanzas Inlet.

The Coastal Engineering Archives made steady progress in 1976 in spite of budget cutbacks, and experienced a dramatic increase both in the number of items borrowed and in room use. Users from outside the university included students at all levels, professors from other universities, employees of government agencies, civil engineers, representatives from oil companies, lawyers, architects, planners, property owners, city officials, environmentalists—a broad spectrum of individuals and organizations involved with the Florida coast. All of these people found information in the Archives—a unique collection devoted to the Florida coast and to coastal engineering in general.



Matanzas Inlet, between St. Augustine and Daytona Beach, is the last unimproved inlet on Florida's Atlantic Coast, and thus man's outdoor laboratory to learn how nature intends for such inlets to behave.

12 Coastal Canals and Borrow Lakes (R/OE-4)

Thousands of private homes and scores of condominiums line man-made canals and lakes which have been dredged out along the coastline of Florida. The land, now dominated by residences, has a high natural resource value with its bays and rivers providing food and protective breeding grounds for hundreds of species of marine fish and shellfish. But the burgeoning population is upsetting the ecological balance, thereby threatening the marine life.

The objective of this project is to develop a rational procedure for the design and evaluation of tidal finger canal systems and borrow lakes which are compatible with the environment. The results will be incorporated into a design and evaluation manual which can be used by state and federal agencies and consulting engineering firms for the design of environmentally acceptable tidal canal systems.

During this second year of the three-year research, development of information, capabilities, and techniques required for preparation of the design manual proceeded along three parallel paths. The principal path comprises the development of one or more mathematical models which can simulate tidal flows, pollutant transport, and environmental parameters in a canal network to the necessary degree of detail and accuracy. The other two paths comprise field measurments and dispersion measurements in the laboratory. Research in each of these areas is progressing satisfactorily, although a large percentage of the effort during the second year was concentrated on the mathematical modeling portion since this is fundamental to the entire project. In addition to hydrodynamics, sediment transport, freshwater runoff, and groundwater flow, the project will integrate ecological factors into the evaluation capability.

In 1975 and 1976 a number of numerical solution techniques for the one-dimensional convective-dispersion equation were investigated and proved to be unsatisfactory. However, two highly promising numerical methods were developed and tested toward the end of 1976, both of which probably can be extended to two-dimensional networks. Both are considered accurate in describing pollution transport, and both are inexpensive to run for many tidal cycles compared with previous models.

Dispersion tests concentrated on the measurement of pollutant (dye) spreading in the longitudinal and vertical directions for quasi-steady flows in the Hydraulic Laboratory flume. The complex flow in the flume, which features substantial secondary currents similar to the helical flow in straight canal reaches, was measured, and the vertical diffusion under these conditions was measured and compared with results available from the literature. Additional tests on this very important aspect of pollutant transport are planned for 1977.

A partly inhabited canal system in South Florida showing a common dead-end design which inhibits proper flushing and promotes buildup of pollutants.

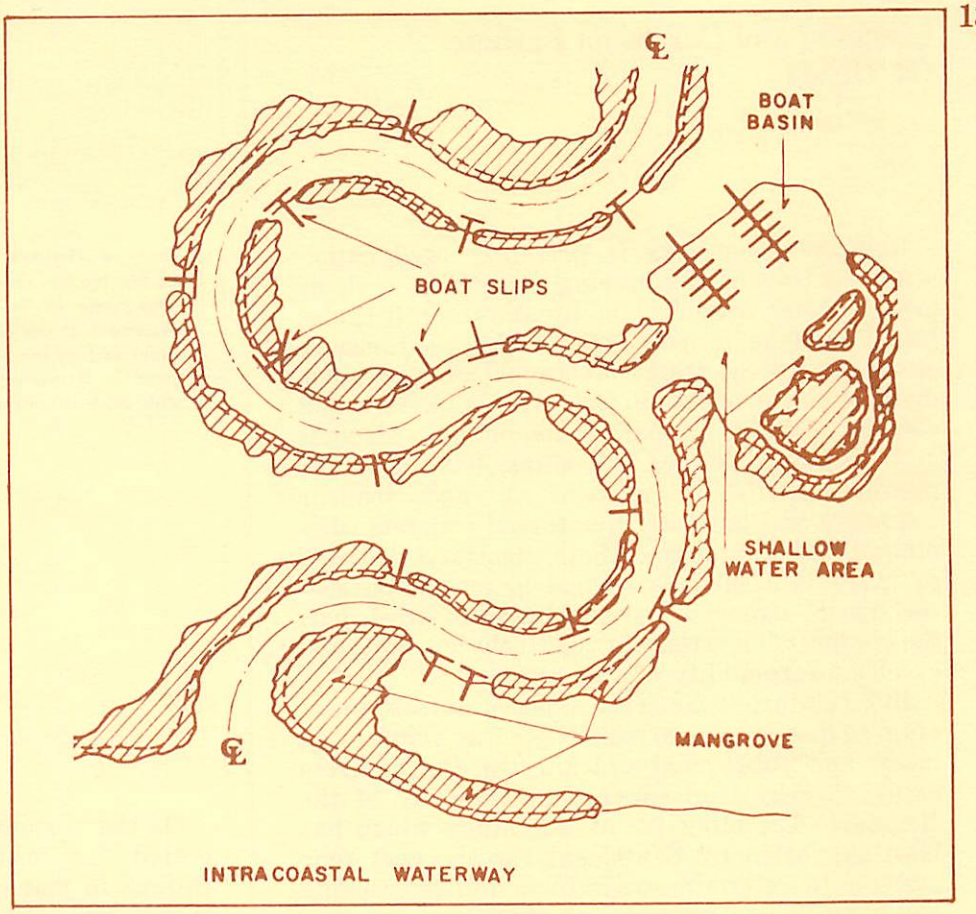


Diagram of recommended meandering residential canal design to provide adequate tidal and estuarine flushing.

Field measurements were somewhat restricted since a better understanding of the relative importance of secondary flows and diffusion, and a more precise definition of the kinds of parameters which will be required from the field for the numerical models, were needed. An extensive field measurement program is being planned for the spring and summer of 1977 which will provide the data required for validation of the models. A test of a new method of rapid measurement of discharges was successfully conducted.

As an ancillary project to R/OE-4, finger canal and borrow lake flushing, immediate response funds were made available to the Florida Hydraulic Laboratory for a joint project with the Computational Sciences Department of Martin Marietta Aerospace, Orlando Division, to investigate the feasibility of hybrid computer approaches for the solution of a mathematical model describing the dispersion of pollutants in the Florida canals. Major emphasis of the project was devoted to developing both analog and digital simulations and performing various comparative runs in order to evaluate the accuracy of the hybrid solution. The overall purpose was to investigate the feasibility of hybrid computation to solve the types of problems currently encountered by the University of Florida Hydraulics Laboratory with a more immediate purpose of comparing hybrid results with digital programs currently running at the University of Florida.

Various tests were performed on the simulation of the model of the dispersion of pollutants in an oscillatory flow in order to demonstrate the feasibility of hybrid computer approaches. By utilizing the parallel computation of the analog, hybrid computation was proven to be fast, accurate, and cost effective for the solution of this diffusion equation. It was determined that for hybrid computation to be efficient the analog model needs to be in a fixed form, and since this project is in the model formulation and research stage of development, it is felt that hybrid computation does not fit the needs of the Hydraulics Laboratory. Instead, digital computation is recommended due to its ease of modification, although for production runs hybrid computation is very efficient and economical. It is felt that emphasis should be placed on methods to solve more complicated and bigger models on the hybrid, and research in this area has been recommended as a follow-on to the feasibility study just completed.

14 Cracking and Corrosion Fatigue (R/OE-5)

Reinforced concrete is presently used extensively in coastal engineering structures such as bridges, piers, seawalls, and breakwaters. It is also being used or proposed for widespread use in ocean structures such as offshore oil storage tanks, drilling and production platforms, pipelines and outfalls, offshore nuclear plants, offshore airports and terminals, barges and ships, floating stable platforms, offshore expositions, and seafloor chambers and habitats. Reinforced concrete combines the advantages of both steel and concrete to make it a universal construction material—the tensile strength and toughness of steel, plus the compression strength, relatively low cost, and excellent formability of concrete.

But reinforced concrete exposed to sea water often experiences corrosion of the reinforcing metal and subsequent cracking of the concrete cover, thereby jeopardizing the integrity of the structure. The objective of this study which has been supported by Sea Grant for the past four years is to determine ways to minimize cracking and corrosion fatigue of such structures.

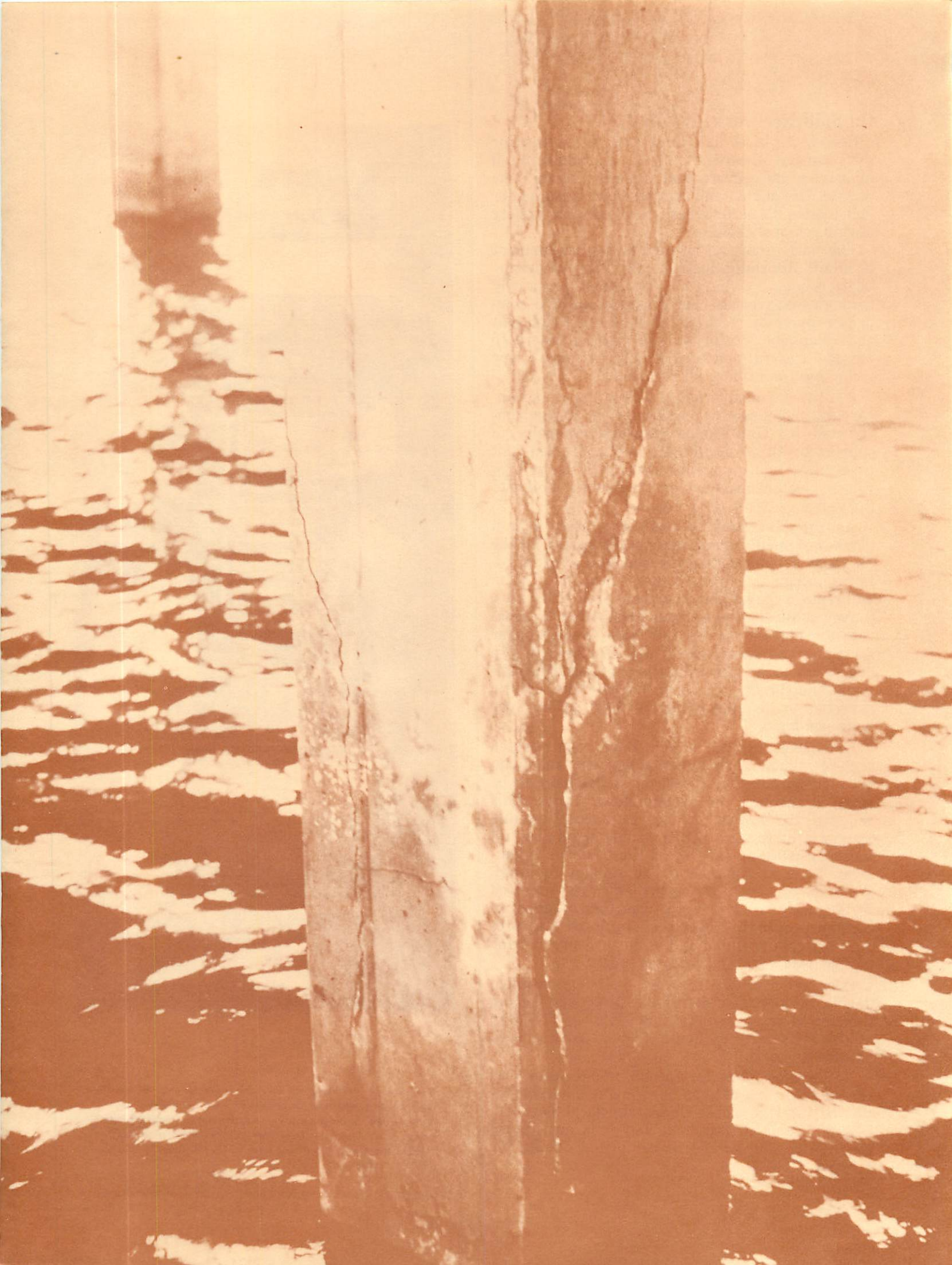
Experiments continued actively through this year with emphasis upon corrosion tendencies of various metals in concrete. Experiments also continued on the influence of cathodic polarization upon fatigue properties of structural steel in sea water.

To determine what might be a suitable metallic coating for steel reinforcement in concrete exposed to a marine environment and possibly to stray current, concrete specimens were embedded with steel, aluminum, cadium, copper, molybdenum, nickel, and galvanized steel and exposed to sea water. Direct current was impressed on these to accelerate corrosion of the reinforcement so that cracking of the concrete could be observed within the time limit of the investigation. Aluminum, cadmium, copper, and nickel were found to have no beneficial effect on concrete cracking as compared to steel. In addition, no correlation between oxide-metal volume ratio and concrete time-to-cracking could be observed. It was found that corrosion of molybdenum has little or no tendency to crack concrete and its corrosion potential and active behavior approximates that of steel, indicating it may be an excellent coating. But further research on the effects of molybdenum on concrete exposed to seawater is needed.

Many of Florida's 4000 reinforced concrete bridges are in hostile coastal zone areas or even the open sea. The State Department of Transportation estimates that anticipated replacement of the Florida Key Bridges over the next 10 years could cost as much as 250 million dollars so they are interested in discovering the best and most economical materials with which to construct the new bridges.

Of the various techniques that have been suggested for mitigating cracking and corrosion fatigue in marine structures, cathodic protection may be the most effective, realistic, and practical, at least for submerged offshore applications, but the following questions which have been raised by other research studies with regard to the endurance limits established by such cathodic polarization need to be answered: 1) How does endurance limit vary with potential? 2) What is the upper limit for endurance limit that can be realized by cathodic polarization? 3) What is the mechanism for this strengthening? The purpose of this investigation was to develop a better understanding of the above points.

The benefits from this corrosion study are already being realized with a patent authorization having been applied for through the Sea Grant office. Also, at a meeting with the American Petroleum Institute Offshore Safety and Antipollution Research Committee, Florida Atlantic University was requested to present a proposal with regard to a two-year seawater fatigue project to be sponsored by the committee. Establishment of this rapport with the API Committee is largely because of research conducted under this present Sea Grant Project. Finally, a paper describing the phenomenon of endurance limit enhancement from cathodic protection, based primarily on results of this study, was presented to the National Association of Corrosion Engineers.



Oil Spill Recovery (R/OE-6)

Search for new and improved techniques for the recovery of marine oil spills continues by oil industries and government agencies around the world. The many and varied conditions under which oil spills occur create the need for a variety of spill removal devices.

The purpose of this project is the development of an oil absorbing, magnetically retrievable sorbent product which can be used repeatedly through many cycles and construction of a companion magnetic recovery unit which is efficient and relatively free of complicated machinery to provide a useful and economically attractive new technique for rapid spill recovery.

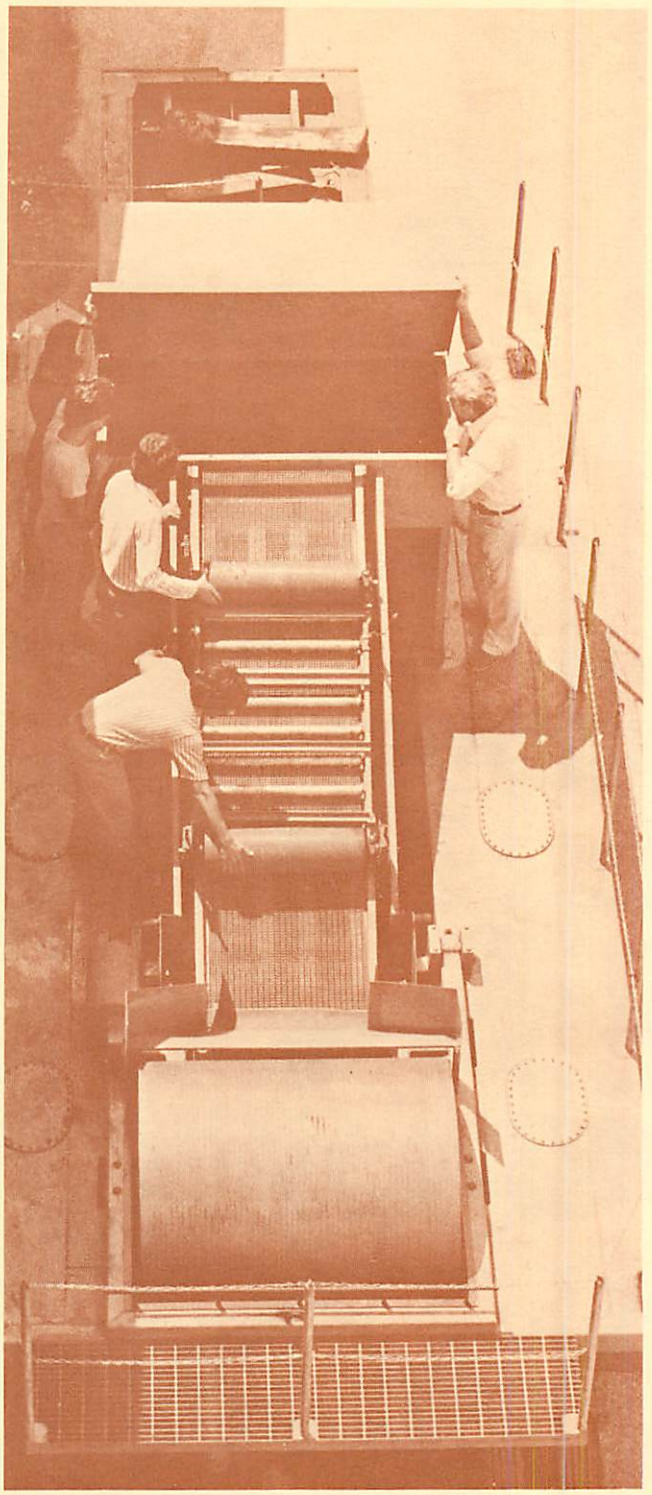
A 24-foot portable oil spill recovery vessel incorporating magnetic principles is being constructed by **Gulf-Tampa Drydock Company** in support of this concept. The self-contained unit consists of twin pontoons which will use a high velocity water spray system to direct the oil into the region between the pontoons.

As the oil passes beneath the boat, a thin blanket of small ferrofoam cubes is spread on the oil from a storage hopper near the bow. A rotating magnetic drum located near the sterm will remove the oil soaked sorbent from the water, convey it through a wringer mechanism to separate the oil, and return the foam to the hopper for reuse.The separated oil will be stored in two 500-gallon tanks located in the pontoons. The estimated maximum recovery rate for the unit is expected to be approximately 2400 gallons per hour per knot.

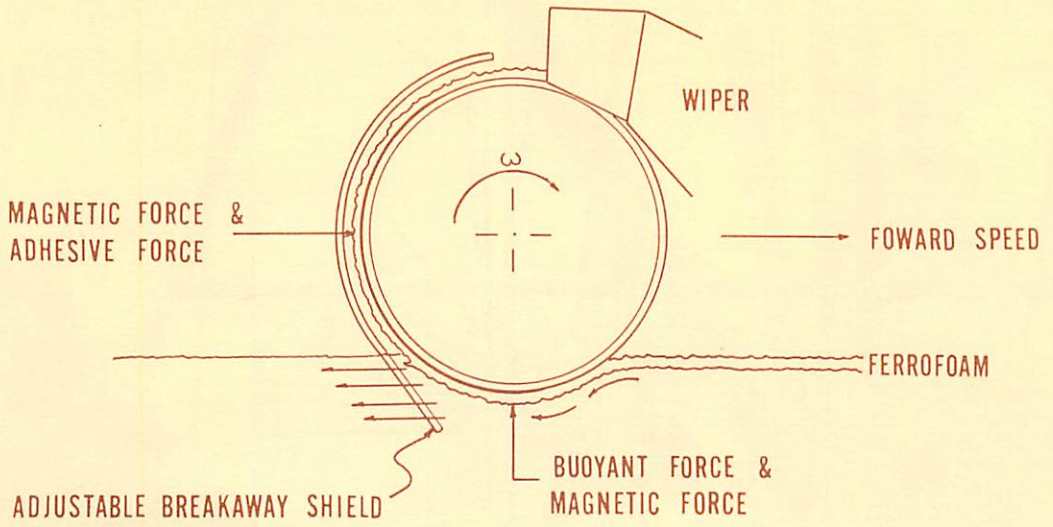
Extensive research efforts have been devoted to development of a magnetically retrievable foam product, suitable for diesel oil spills that can be recycled through the system many times. This requires the proper balance of absorption and magnetic attraction which enable maximum oil recovery without sinking of the foam or breakaway from the magnetic drum upon retrieval. Work on this part of the project was completed in August 1976 and work was then started on construction of the necessary equipment to produce suitable amounts of the finished product for use in tests with the recovery unit.

Completion of the recovery vessel is expected during the first few months of 1977, and during this period ferromagnetic foam is to be produced at the University of South Florida on a limited production basis.

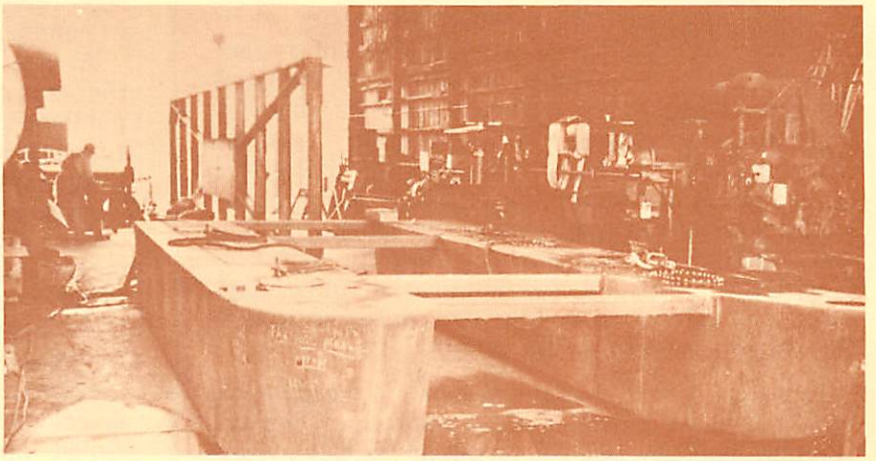
No detailed plans for formal on-site tests with the recovery vessel have been made, but cooperation of the U.S. Coast Guard and local Port Authority people is expected, and it is anticipated that the testing should be completed during the summer of 1977.



Top view of prototype of oil spill recovery unit. Bottom to top: rotating magnetic drum which picks up oil-soaked ferrofoam, the wringer-conveyor which moves foam up and wrings it out, and the ferrofoam hopper where new and reuseable foam are stored and from which the foam is dropped into the water.



The rotating magnetic drum will remove the oil-soaked ferrofoam from the water, convey it through a wringer mechanism to separate the oil, and return the foam to the hopper for reuse. The above diagram shows the mechanical principles of magnetic recovery. In the photo on the left, the designer of the unit, Joseph Turbeville, left, University of South Florida, and graduate students Jeff Back and Terrell Wilson, place magnets on the rotating drum.



Front view of prototype of oil spill recovery unit. After being wrung from the foam, the separated oil is stored in two 500 gallon tanks located in the pontoons.

FISHERIES RESOURCES

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

This five-year project which began in 1974 has two major divisions: 1) production economics and supply analysis and 2) market analysis. Research accomplishments are reported under these two divisions and under a third division titled "Industry Analysis". The latter includes research on a broader industry basis and includes items such as public policy and economic impact studies.

During this report year, in the market analysis area, two publications developed from the study of the Florida shrimp processing industry were completed and published. One Sea Grant report presented research results pertaining to industry characteristics; entry and exit analysis; market concentration; product differentation; market coordination; margins and pricing behavior; product sales strategies; productivity and trends; and emerging changes. The other journal article was published in the *Fishery Bulletin* and presented the results of the application of market chain analysis to entry and exit patterns within the shrimp processing industry.

Prices and marketing margins in the Florida king mackerel industry were analyzed with respect to quantity landed, terminal market prices, market structure and cost of marketing services. Additional primary price data from New York terminal market has been acquired for further analysis for completion of the study. An in depth review and analysis of current and past research in the areas of demand for and consumption of seafood products and the market structure, conduct, and performance of the industry was undertaken. In the area of production and supply analysis, an article was published in a trade magazine reporting the cost of porpoise interference in commercial fishery operations.

A cost and returns analysis of production in the spiny lobster industry was completed and published for four different size firms based on vessel size. Continuous production relationships were developed and are reported in a Ph.D. dissertation completed in December, 1976.

Cost and returns data for red snapper-grouper vessels were collected for firms based along the lower west coast of Florida. These data were incorporated with analysis previously completed for vessels based in northwest Florida to provide a statistical and budgetary analysis of red snaper-grouper operations in the Gulf of Mexico. Area fished and vessel size were principal factors

studied in a journal article which is in review. Initial literature review and problem statements have been developed for a masters thesis which will be an in-depth analysis of the Gulf of Mexico red snapper-grouper industry. Management considerations will be the focal point of the research.

Data collected in a 1975 survey of Florida commercial fishermen were analyzed during 1976. Major factors analyzed were age; education and location of fishermen; quantity and value of landings; investments in gear and vessels; loan sources; fuel requirements; and income and employment levels. A research report is being published.

Industry analysis includes studies which incorporate basic demand and production data and studies to address broader questions of concern to the industry. Currently, public policy pertaining to fisheries' management, economic impacts, and descriptions of trends are three types of research projects underway.

A bioeconomic model was developed and was used to determine maximum economic yield and optimum resource allocation for the spiny lobster industry in Florida. A journal article has been accepted for presentation at the Southern Agricultural Economics Association meetings in 1977. The model was also adapted to analyze the potential impact of over-fishing in the industry due to the entry of lobstermen displaced from the Bahamian fishery. The results of this analysis were published as a paper presented at the Tropical and Subtropical Fisheries Technological Conference held in Corpus Christi, Texas.

Economic trends in output, resources employed and economic importance of major species landed in Florida have been analyzed and published in two research reports. One report covered all species in the state. The second report was concerned only with the spiny lobster fishery.

A masters thesis was initiated which addresses the question of the economic impact of fisheries on the Florida economy. Gross sales, income and employment are being analyzed for the fishing and seafood processing sectors.

Spiny Lobster Biology (R/FR-5)

In recent years, the commercial fishery for spiny lobster (*Panulirus argus*) in Florida has ranked second only to the shrimp fishery in economic importance. With increased fishing pressure, the catch per unit of effort has declined, causing significant profit losses to lobster fishermen.

This study was designed to address management-related questions based upon the biology of the spiny lobster. Seasonal movements, growth rates, reproductive biology, abundance, distribution and population structure of lobsters in the lower Keys have been studied since late 1974. Management questions include the possibility of a reduction in the minimum size limit, implementation of new restrictions on the fishery (possibly including various forms of limited entry), and appropriate allocation of the resource between commercial and recreational interests.

Preliminary results from 6,362 tagged and released (791 recovered) lobsters showed that lobsters in the Gulf of Mexico moved an average 40 km (22 n.mi) generally west-southwesterly from the Key West area toward Dry Tortugas, into deeper waters, stronger currents, and reef-environments. Movements of Atlantic lobsters were not as uni-directional as those of Gulf lobsters, and averaged only 17 km (9 n.mi). Maximum movements, observed to date, was 107 km (58 n.mi) by one Gulf lobster, and 37 km (20 n.mi) by one Atlantic lobster. One Atlantic lobster was recovered after nearly one year only 3 km from the original tag-release location.

Growth rates averaged 5.4 mm per molt in 45 animals studied in the laboratory during 1975.

The reef environment has been shown, as expected, to represent the primary zone of reproductive activity. No egg-bearing female lobsters were observed among about 1,250 females sampled in the Gulf during 1975 and 1976. In the Atlantic, primarily in deeper reef waters near the Gulf Stream, nearly 15 percent of approximately 1,600 females sampled showed signs of reproductive activity, indicated by the presence of eggs and/or a spermatophore (the latter deposited by a male).

Preliminary analyses have indicated significant differences in ratios of males to females in two of four sample areas studied. Differences in average size were also observed among different areas. Atlantic lobsters generally exceeded the legal size limit of 76.2 mm (3 in) in carapace length, whereas Gulf lobsters were generally sub-legal in size (called "shorts").

The sex ratio among 309 lobsters from the mid-depth (7-9 m) Gulf study site, was nearly 50:50; in this sample the females were predominantly legal-sized, but the males were short. In the shallow (4-6 m) Gulf study site, males were slightly more numerous than females (58:42) in a sample of 320 lobsters, but average size of both sexes was sub-legal.

In the Atlantic, the average size of males and females was identical (81.5 mm carapace length) in both study areas, but sex ratios differed. In the shallow (5-6 m) study site, a 50:50 sex ratio was observed among 281 lobsters. On the reef (7-12 m depth), males were slightly less numerous than females (43:57) among a sample of 301 lobsters.

These preliminary findings have been reported by the investigators to meetings of the Commercial Fishermen's Association of Monroe County (Marathon), the Lower Keys Chapter (Sugarloaf Key) of the Organized Fishermen of Florida, the Marathon Rotary Club, the American Institute of Biological Sciences, the Gulf and Caribbean Fisheries Institute, and the Spiny Lobster Research Review Conference convened at Key West in December for fishermen, industry leaders, and scientists.

A preliminary report is scheduled for publication in the 1976 Proceedings of the Gulf and Caribbean Fisheries Institute, and several final reports concerning specific subject areas will be prepared in 1977.

Attractants of the Spiny Lobster (R/FR-6)

One way to offset the economic effects of the reduced catch-effort experienced by South Florida spiny lobstermen is to introduce more efficient, convenient methodology to the fishery. Towards this end, work continued on a project designed to survey the biological feasibility of developing an efficient, economical chemical attractant for the South Florida spiny lobster fishery.

Continued behavioral assays, done in cooperation with the National Marine Fisheries Service Laboratory, Miami, support the preliminary finding that citric acid is one of the most effective single-chemical attractants for this organism. Citric acid at concentrations of 0.001 gm/liter attracts as many lobsters as does a natural complete feeding stimulant like shrimp extract at comparable concentrations (0.001 gm wt. weight muscle tissue/liter).

Field testing, the primary focus of this year's effort, required definition of an effective release vehicle for the attractant. Agar gels proved unsuitable for use under field conditions, so attention was focused on a manufactured laminate release system (Herculite Protective Fabrics Corporation, N.Y., N.Y.), originally developed for controlled-release of insect natural products in aerial environments. Formulations of this product tested to date, however, have caught less effectively than control traps baited with standard cowhide strips. Final field tests are planned for August, 1977, to evaluate improved versions of this release system.

Economic considerations appear positive with company estimates of approximately 10 cents to laminate one pound (454 gm) of dry chemical. The attractant's potential impact on the fishery will be developed in reference to Prochaska and William's recent economic analysis of the fishery (Florida Sea Grant Report No. 12, *The Florida Spiny Lobster Fishery: Landings, Prices, and Resource Productivity*).

Blue Crab Migrations (R/FR-7)

The blue crab, *Callinectes sapidus* Rathbun, is common in all nearshore estuarine environments of the western Atlantic seaboard and the Gulf of Mexico, and in the Gulf the blue crab fishery ranks third in value of all food fisheries. The abundance of blue crabs in Florida waters is reflected in state-wide commercial landings of over 17.5 millions pounds for 1974. Besides supporting a large commercial fishery, the relative ease with which it may be captured makes the blue crab a major recreational fishing species.

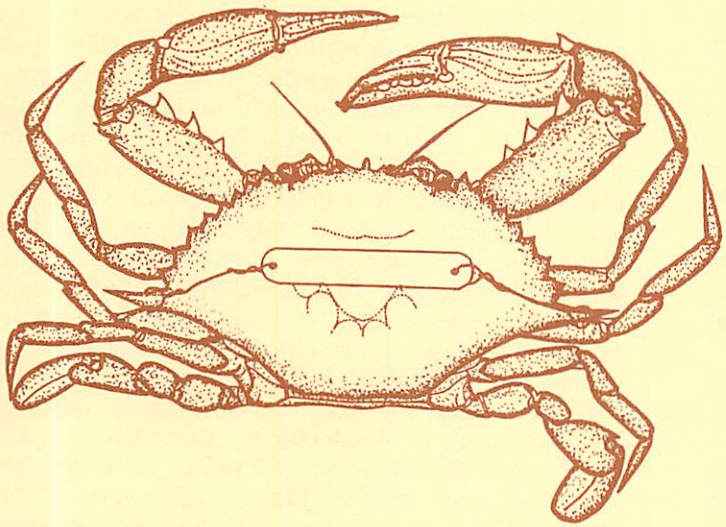
As with other important commercial species, the life history and fishery for the blue crab have been extensively investigated in other areas, but although the Florida blue crab fishery (sport and commercial) represents a multi-million dollar industry, relatively few studies have been conducted on the blue crab's life history in Florida waters. Previous studies on blue crab migrations have indicated they are related to phases in the life cycle, particularly those of the female, with the net result of the female blue crab's migrations being described as an onshore/offshore movement, tending to keep crabs from one estuarine system from mixing with those of adjacent systems.

However, evidence from a previous Florida study suggested a contradictory migration pattern for Florida blue crabs, at least along the Gulf coast. For that reason this tag-recapture study had as its main objectives the mapping of migrational patterns of marketable-size crabs using data compiled from tag returns; determining the source areas for the blue crab fisheries throughout Florida, and providing population dynamics data which would be needed should future management and regulation be required to ensure sustained yields.

This project, which began in May, 1974, with Immediate Response funding and ended in December, 1976, resulted in 25 blue crab taggings at 14 different sites along the Florida Atlantic and Gulf coasts. From these, 10,040 crabs were tagged and released, 5,321 males (53%) and 4,719 females (47%). There have been 1,059 total reported returns, for a return rate of 10.55%. Fifty-four percent of the recaptures were females (573) and the remaining 46% (486) males. There were several notable returns and return trends.

By and large, females traveled the greatest distances. Approximately 20.1% of recaptured females moved distances greater than 30 miles. The extensive range of female movement is evidenced by the 18 crabs (3% of female recaptures) which traveled over 200 miles and the two individuals which went as far as 310 miles.

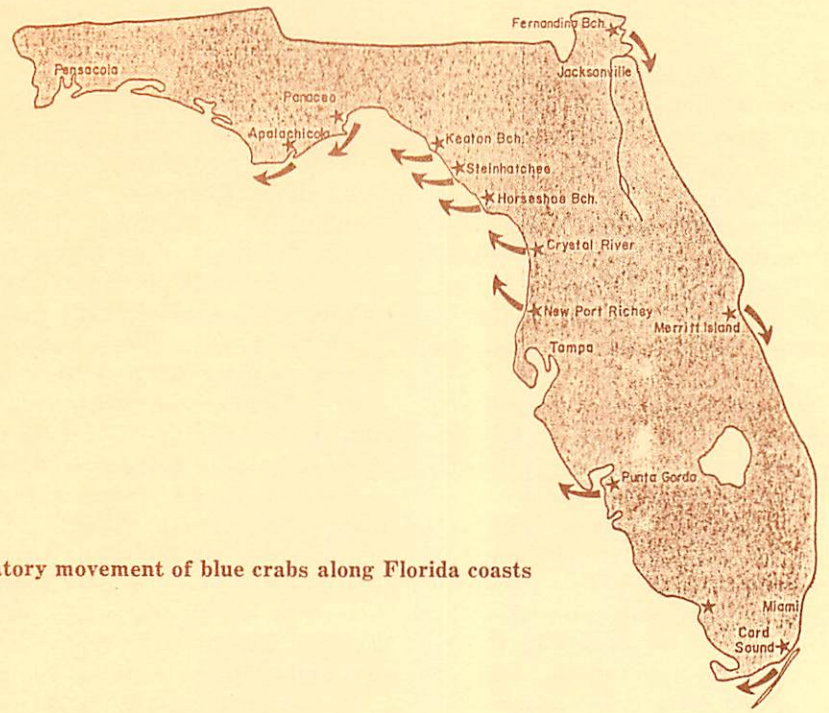
In contrast, 92.4% (499) of males recaptured were returned from within 10 miles (16 km) of the release site. The limited movement of male crabs was further substantiated by 2 males which were recaptured 205 and 245 days after release but less than 4 miles from their release site. Statistical treatment of return data indicated a highly significant difference in distance traveled by males and females. Male crabs exhibited no real trend in their movements, remaining in their "home territory". As noted, when they did travel, it was not



Tag placement on a blue crab. Tag is actual tag size and has information on both sides. Tag color is orange with black lettering.

IFAS-BLDG. 737
UNIV. OF FLA.
GAINESVILLE 32611
00001

PLEASE CALL COLLECT (904) 392-2451
REPORT CAPTURE SITE
DATE & TAG NUMBER



Trends in migratory movement of blue crabs along Florida coasts

as dramatic as the females. Generally there was a tendency to disperse back into the surrounding marshes and creeks.

For the Atlantic coast releases, the direction of any appreciable movement was southerly or westerly, while on the Gulf coast, movements were directed northerly and westerly. These directional trends have been hypothesized to be the result of female blus crabs migrating toward a spawning area. The Apalachicola Bay system (Panacea to Cape San Blas area) appears to be the major spawning area (source are) for the entire Florida Gulf coast blue crab fishery. Source areas for the Florida Atlantic coast have been tentatively identified at the northeastern corner of Florida/southeastern corner of Georgia, and the lower portions of the Indian River (Sebastian Inlet, St. Lucie Inlet, and Stuart Inlet), with the possibility of another minor spawning area at the peninsular tip of Florida.

For calendar year 1976, taggings were to continue along the Atlantic coast of Florida, however, during the course of the study, the blue crab fishery experienced an unpredicted, violent decrease in the abundance of commercial-size stocks (and probably juvenile forms). Immediate effects of this dramatic decline in abundance were a reduction of commercial personnel (crabbers and support), product shortages, and a hesitancy of producers to supply crabs for research purposes. The latter effect was reflected in the poor showing of tagging for 1976—only one trip resulting in 550 crabs being tagged. For this reason 1976 was spent in preparation of manuscripts, "advisory" capacities, and development of hypotheses from previous data.

That information resulting from this project will be of direct interest to the commercial crabbing communities of both coasts was very evident when a return was reported. The crabbers were very interested in the project when they reported recaptures and asked for information concerning the project and/or general biology of the blue crab. For this reason, a Marine Advisory Program publication was generated dealing with the growth, reproduction and migration of blue crabs along Florida's Gulf coast. It was written in nontechnical language for distribution to the commercial interests. The National Marine Fisheries Service has cited this publication in their impact evaluation of Gulf of Mexico oil exploration and drilling, using the data on migration patterns and spawning in Apalachicola Bay. Additionally, conclusions of the migration study have resulted in the Florida Power Corporation agreeing to make a 300 foot break in the dike structure at their Crystal River plant on the Gulf coast to permit crabs to follow their migration pathway and help to ease some of the entrainment and impingement.

Fishing Gear Design (R/FR-8)

This project is the outgrowth of a three-year project completed in 1975 concerning the hydrodynamic model and prototype evaluation of nets and trawls. The successful development of model laws and the study of their potential use in the design of new trawls under that project aroused a strong interest among the fishing industry in and outside of Florida.

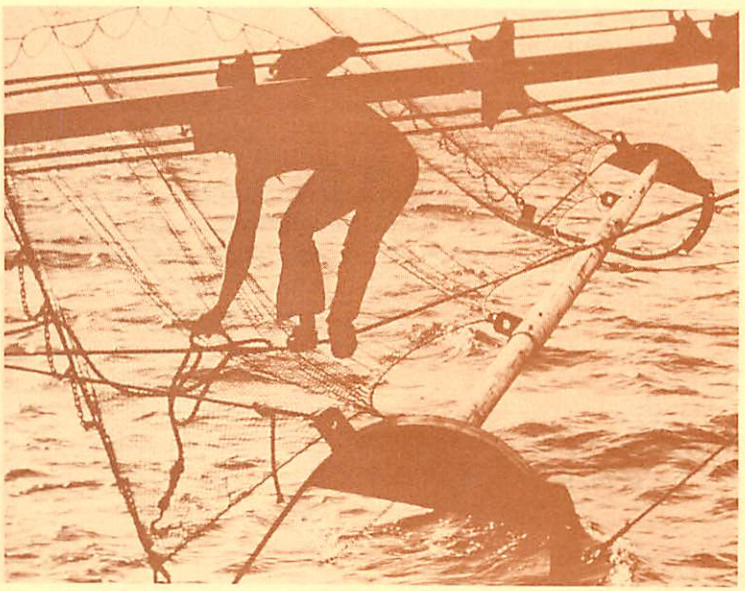
Contacts among the fishermen of Florida indicated that it was imperative to reevaluate the performance of nets widely used in Florida waters, and to redesign for the least possible hydrodynamic drag. Additionally, it was realized that new types of otter doors should be designed for fishing on hard and deep bottoms so that the doors will not be dragged straight on the bottom but provide the necessary force to keep the trawl open. Also, discussion with the National Marine Fisheries Service at Pascagoula, Mississippi, explored their needs for model evaluation and modification of new net types such as the separator trawl.

To address such problems and shift efforts in this area from research to combined research-advisory, this project was initiated in 1976. The objective of the project was the implementation of commercial fishing gear design by hydrodynamic models in hydraulic research flumes. The analytical tool for the project was already available, having been developed in the previous Sea Grant project on nets and trawls, and the physical tool, a major hydraulic flume, was available at the University of Florida.

Hydrodynamic modeling is a method for rational design of structures or devices interacting with flowing water (or air). It is based on the idea that observations made in a small and inexpensive model may be transferred quantitatively to the corresponding prototype in which such observations would not be possible or prohibitively expensive to make. This method is and has been used widely in design of boats, tankers, aircraft, spillways, intakes, etc. However, the design of efficient nets and trawls by means of models is of fairly recent origin in the United States.

While investigators have developed basic equations for modeling flow around fish nets by considering the inertia and gravity forces as primary forces, they assume that the elastic deformations of twines and ropes in the net are negligible. But the shape of a net and therefore the forces acting on it are affected by the elongation of twines and ropes under load. In order to allow the correct numerical transfer of model observations to the prototype, it is therefore necessary to establish special hydrodynamic model laws which take the stress-strain characteristics of the model and prototype net materials into consideration.

As a result of this project, a user's manual has been produced which outlines the establishment of such model laws and their verification by full scale ocean and laboratory tests. The manual also shows how distortion of mesh and twine size may prevent a relatively too high influence of viscous forces in the models. Use of this method is illustrated in the manual by a numerical example showing the step by step preparation of a trawl model and the transfer of observed dimensions and other quantities to the prototype.



This prototype beam trawl being tested off Fernandina Beach is one example of the kind of gear being improved by this project.

Model Coastal Ordinances (R/L-2)

There are many coastal areas in Florida where although the public has the right to use the shore between the mean high and mean low water lines, and in some cases the adjacent soft sand areas, they often have no real means of access to these areas. Additionally, the coastal dune, wetland, and estuarine beach areas are not always adequately protected by present legislation. In these circumstances it appears to be advantageous for individual counties to establish a more appropriate construction setback line to prevent destruction of dunes, wetlands, and coastal and estuarine beaches.

To assist local coastal communities in dealing with these problems, the Florida Coastal Coordinating Council, now the Florida Bureau of Coastal Zone Planning, suggested a project aimed at developing model ordinances providing for public beach access and coastal construction setback and permitting requirements.

During this one-year project all coastal states were surveyed to determine what type of coastal beach, estuarine beach, coastal wetlands, and coastal dune protection had been attempted. Numerous coastal communities throughout Florida were also contacted. The copies of ordinances obtained during the survey proved very helpful in developing the model ordinances which incorporate and expand upon the best elements of existing laws.

Valuable input was received from officials in Hillsborough and Manatee counties, as well as from representatives of the Florida Department of Natural Resources, the Southwest Florida Regional Planning Council, and various other state and federal agencies.

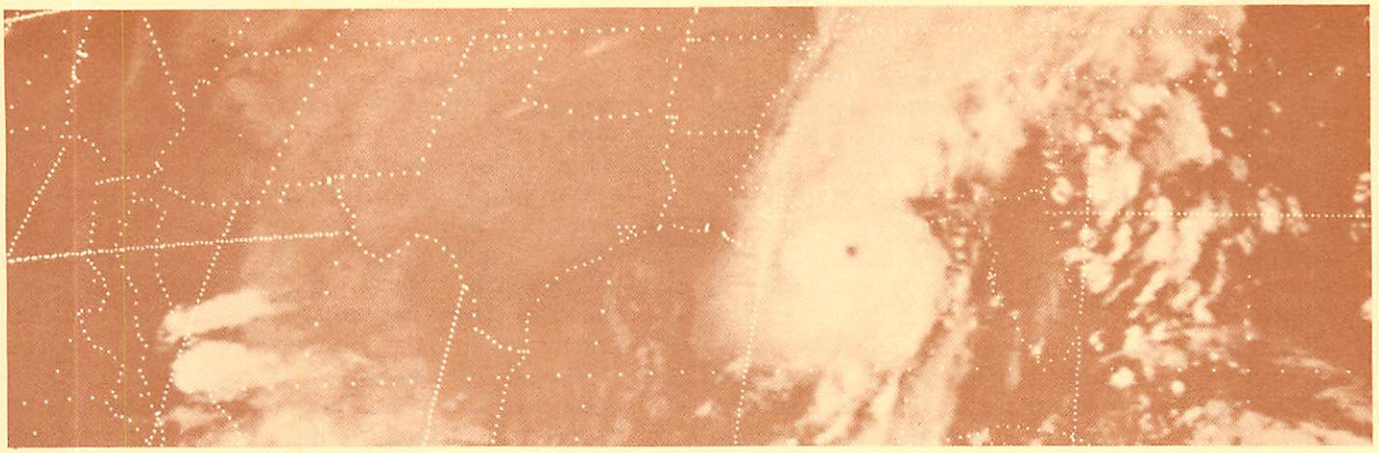
The packet of county ordinances includes a beach access ordinance and a coastal construction setback line ordinance, including provisions for protection and preservation of dunes, coastal estuarine beaches, and tidal wetlands.

SHORT TERM AND PILOT STUDIES

(M/PM-2)

Again during this grant year Florida Sea Grant used discretionary funds to meet immediate needs that could not await for funding through the normal annual review process. Additionally, "seed" money was provided to certain projects as pilot studies in new areas or to support work already underway in one of the program's major research areas. The social impact studies of hurricane Eloise and support of studies of the whales and dolphins involved in mass mammal strandings are examples of some of the immediate response support provided during the year. Money for pilot studies was provided for a number of projects including consideration of an artificial reef system as a permanent local government function in Pinellas County, for location of spawning areas of the red drum fish, and study of certain seagrasses for use in revegetation projects. Also a study on lobster genetics was founded as a companion study to major research on the biology of the Florida spiny lobster.

Hurricane Eloise approaching the Florida coast at 1 a.m., September 23, 1975. This infra-red image in a photo from NESS (National Environmental Satellite Service, NOAA) was taken by SMS 1 (Synchronous Meteorological Satellite) jointly operated by NASA and NESS.



Hurricane Eloise—Social Impact and Public Attitudes

On September 22, 1975, Hurricane Eloise hit the northwest Florida panhandle with winds up to 136 miles per hour, causing damages in the millions of dollars. In a few hours, the 40-mile strip from Fort Walton Beach to Panama City became a scene of devastation.

In the aftermath of the hurricane, with immediate response funds from the Florida Sea Grant Program, two studies were conducted, one concerning the social impact of the hurricane on Panama City and the other a study of public attitudes toward hazard zone land use controls.

In investigating the social impact of the hurricane three major areas of investigation were developed: 1) factors affecting individual decisions to evacuate, and selection of routes, means, and destinations; 2) beliefs, attitudes, and knowledge of hurricane forecasting; and 3) attitudes about the performance of the news media before and after the storm and its impact on the local economy with particular reference to tourism; and 4) perceptions about the impact of the storm itself on community life.

Different sectors of the Panama City area which might have been affected differently by the hurricane were identified—the beach area, bay area, and inland area.

Investigators interviewed 205 people—49 in the beach sector, 75 in the bay sector, and 81 inland.

A majority of those questioned reported making some preparations for the hurricane, but it was in the beach area where more people said they made no advance preparations at all such as securing their homes and putting in supplies of food.

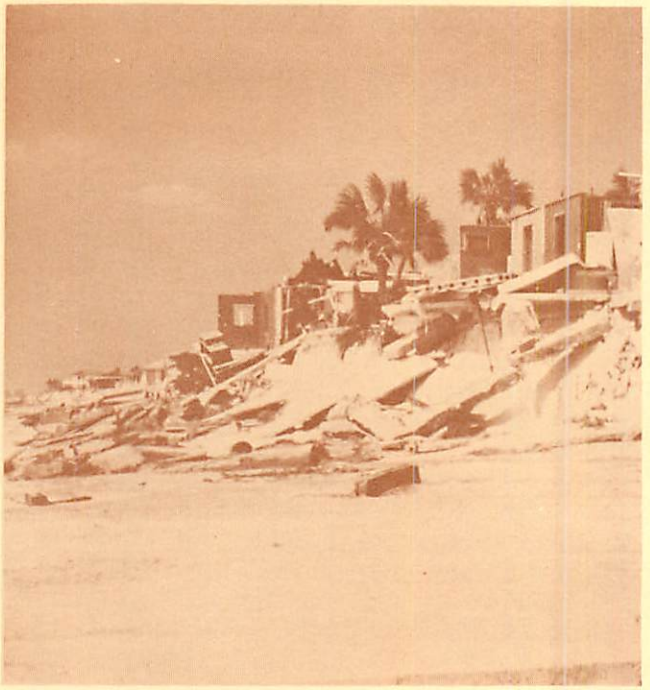
Because they still thought that there was almost no chance of the hurricane hitting Panama City, nearly everyone interviewed went to bed before midnight on September 22. However, by this time those living on the beach were becoming more concerned and a few more of them stayed up to learn the storm was headed their way.

When they were finally convinced that Eloise would come their way, 76 percent of the beach residents evacuated. However, based on the research sampling, three-fourths of the estimated total of 10,000 evacuees left their homes between 2 and 4:30 a.m. As a result, many of them reported trouble in reaching their destination because of heavy traffic congestion.

Although the death and injury tolls were quite low, investigators felt there is no justification for complacency about the existing warning system. Data from the survey reveals that approximately 40 percent of the people did not relocate to safer quarters and one out of seven did not evacuate from beach areas. There remains a question as to why so few did evacuate although the low loss of life may indicate that they did not need too. But other factors were probably present such as the fact that 57 percent of the people didn't learn until after midnight that the storm was to hit Panama City despite National Weather Service (NWS) advice at 9:45 p.m. to relocate from low-lying areas.

Results of the study suggest that the public may quite possibly be depending too heavily on NWS advisories and warnings, especially several hours before the expected landfall and recommends that broadcasts stress the fact that 24 hour forecasts of landfall and even 12 hour forecasts are subject to error and that residents throughout the entire warning area should make preparations for possible relocation. The report further suggests that there may be more public confidence in hurricane forecasting than is merited.

The news media received generally high marks for its part in keeping the public informed of Eloise's approach. The great majority of people sampled indicated that they received most of their information about the hurricane from radio and television with almost everyone checking weather reports at least once or twice the night before the storm hit and 71 percent checking almost every hour. Despite this, the 9:45 NWS report concerning the storm and advising relocation was apparently either unheard, not remembered, or not given much weight.

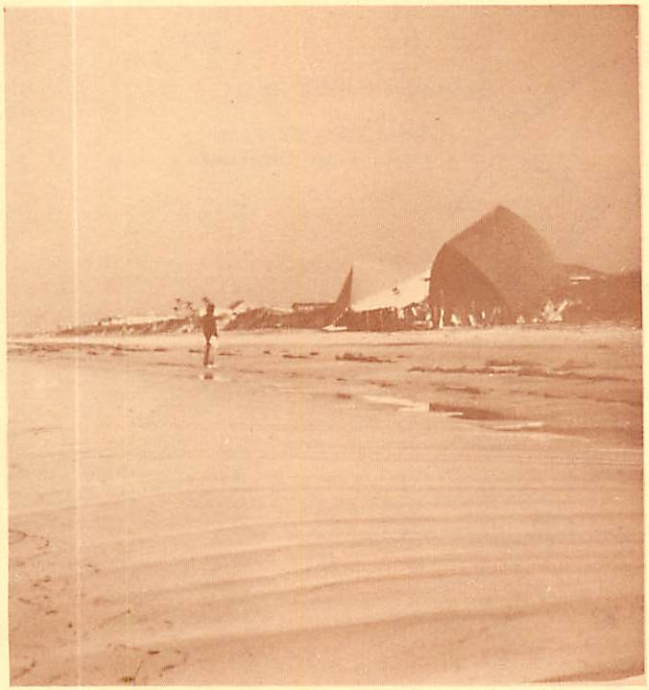


Panama City Beach . . .

Two points emerge from the data: 1) some information is not reaching listeners and viewers which suggests that significant messages should be repeated several times and explained each time. 2) the presumption should not be made that everyone is monitoring the storm closely.

Almost 75 percent of the sample interviewed had heard about the hurricane several days before its arrival, although only a few actually believed it would hit Panama City. Many of those who heard that Eloise had turned toward Panama City learned of it through friends, relatives, and neighbors, pointing up the fact that even in this day of mass communications personal contact plays a very important role in times of disaster. Much publicity had been given to location of public shelters in Panama City, yet many evacuees headed out of town, most of them heading north directly in the path of the storm instead of to the east and out of its way.

A fair number of people did not see Eloise as being all that bad. Less than half those queried specified any negative effects at all, only one third believed tourism would be hurt, and a fifth of the respondents felt the hurricane would ac-



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tually have a positive economic or political effect.

The investigators stressed that not too much should be made of this, because different phrasing of the questions could have elicited different responses, but they felt that what may be quite significant is the point that if public perception of the hazard is not so negative, public concern with it over the long run may be less and there may be less support in the community for hurricane-coping and planning.

Results of the study sugest that in general the people of Panama City responded well to Hurricane Eloise and that they were generally satisfied with official and media response to the disaster.

The purpose of the study on public attitudes was to investigate a generally held but undocumented belief that as time passes after a disaster, individual's concern with the risk imposed by living in a hazardous area diminishes. A similar phenomenon was believed to exist with respect to public attitudes toward legislation which would restrict the use of hazardous areas, i.e. that support for legal measures to control land use would be favorable soon after a disaster but would diminish as time passes and memory fades.

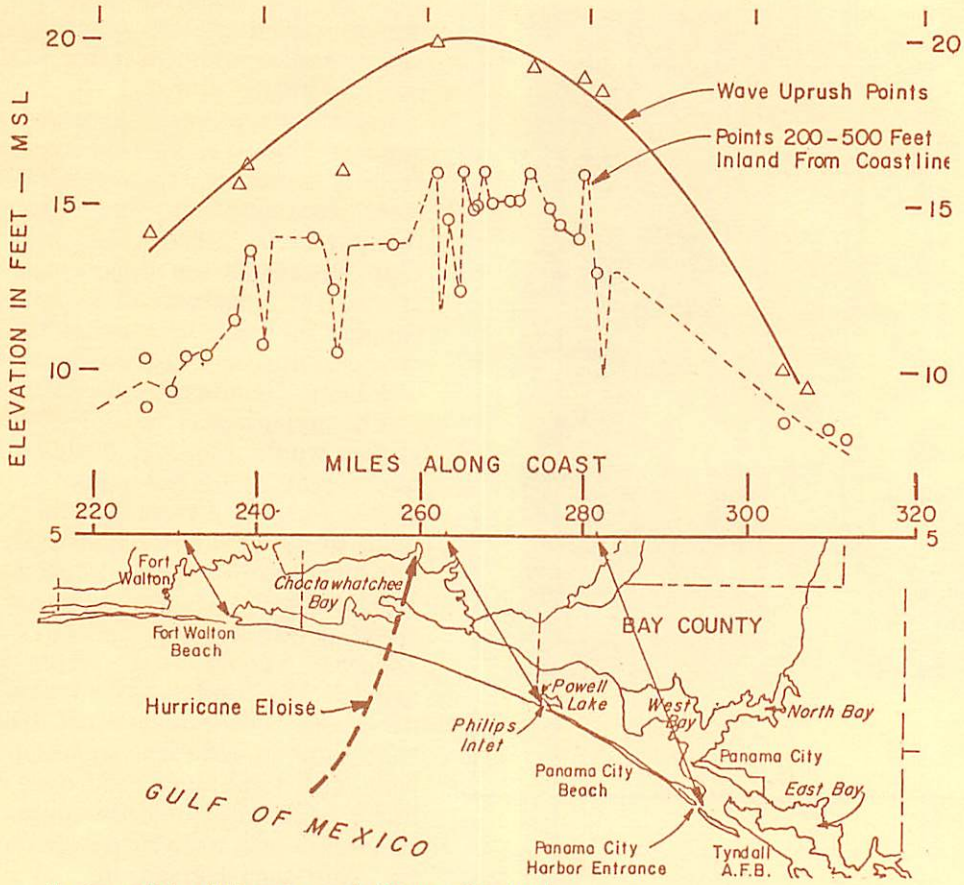
Panama City Beach and the Dons Bayou-Cinco Bayou area of Fort Walton Beach was chosen as sites for the investigation with most interviewing being conducted within a few blocks of the water's edge. Six months after the original interviews attempts were made to contact the same respondents again, and six months after that a third contact was attempted.

Investigators were surprised at the degree of support found for all four types of land use controls. The setback line, generally expected to be most controversial was favored or strongly favored by 91 percent, although it is noteworthy that very few of the respondents would be directly affected by a setback line. There was also strong support for flood zone restrictions, building codes designed to cope with hurricane winds, and mobile home tie-down requirements.

The hypothesis had predicted that the hurricane would increase such support, but subsequent polling of the same individuals was expected to show a return to the situation as it was prior to the hurricane. However, six months after the hurricane, public support was stronger than it had been two weeks after the storm. This trend continued six months later as well with almost 95 percent of the respondents favoring the setback line and over 86 percent in favor of flood zone restrictions. Most dramatic increase at that point in time was in support of the building code with total support at over 87 percent. Popularity of mobile home tie-down requirements also increased with over 97 percent of the respondents favoring such legislation.

There was a drop-out rate of 25 percent from the first to the second poll and 32 percent from the first to the third. If a substantial majority not included in subsequent samples had expressed negative attitudes initially, the apparent change in attitude on the part of the remaining sample would not be real. In fact, however, the drop-out rate was the same for supporters and opposers. Computations were performed to deal only with people included in both the first and second or first and third samples. Changes were not attributable to changes in sample composition. Most people either had no change in attitude or had a small positive shift.

While investigators point out that a number of cautions are in order, the investigation revealed substantially more public support for governmental restrictions on the use of hazardous areas in the two communities studied than had been expected before the survey. This attitude-change process, the investigators feel, is probably generalizable to other populations. It is important to officials seeking public support for initiation of such regulations after a disaster to know that favorable public opinion does not necessarily diminish quickly, that, in fact, support may even increase if the community's experiences with the hazard are similar to those in the places included in this investigation.



Hurricane Eloise high water mark, Panama City beaches.

Hurricane Eloise—Its Effects On The Beach

Hurricane Eloise struck the Florida northwest coast in the early morning of September 23, 1975, its center crossing the coastline about midway between Fort Walton Beach in Walton County and Panama City Beach in Bay County (Figure 1) at a forward speed of better than 20 knots. The maximum sustained surface winds were estimated to be 110 knots at landfall. Hurricane tides of 12 to 16 ft. above mean sea level (MSL) were produced by Eloise (based on highwater marks surveyed by the U.S. Army Corps of Engineers, Mobile District).

The first 17 miles of coast to the right of the hurricane center at landfall is relatively undeveloped with white sand beach backed by some magnificent dunes of 15 to 40 ft. in height (Walton County). The next 17 miles of coast is one of Florida's most developed resort areas with motels and hotels concentrated on the beach front (Bay County). It was here in this area the highest hurricane tides took place, resulting in extensive structural damage and beach-dune erosion. In the undeveloped area in Walton County, the damage was almost entirely in the form of beach-dune sand losses. These two contrasting segments of coast provided an excellent opportunity for studying the beach-dune response to hurricane tides and waves under varying coastal development conditions.

Under the Florida Coastal Construction Setback Line (SBL) program, the study area was surveyed before Hurricane Eloise with beach-dune profiles at approximately every 1,000 ft. and offshore soundings every 3,000 ft. Immediately after Hurricane Eloise, the same area was resurveyed. Altogether, there are more than 220 sets of beach-dune profiles and over 70 sets of offshore soundings. Controlled stereo aerial plan photographs of the primarily affected area before and after the hurricane are also available.

With the above surveying data, aerial plan photographs and pictures taken immediately after Eloise, the damages and effects on the coast of Bay, Walton and Okaloosa Counties (about 68 miles) as a result of the hurricane are being studied.

Matching funds for this study were supplied by the Florida Department of Natural Resources. Results, including conclusions and any recommendations, are expected to be completed in the spring of 1977.

Lobster Genetics

Management of the lobster fishery depends in part on knowledge of location of breeding stocks giving rise to each year's recruits. Present views include the following extremes: (1) all larvae go out to sea eventually contributing to repopulation of geographically distant areas and never to parental stocks or (2) when they go out to sea they travel in current loops or gyres that eventually return them to the general area of their parents. Since this study proposes to use biochemical-genetic markers to identify breeding populations, the first phase involved identification of several enzyme systems that might be useful as genetic markers. A preliminary population comparison study was done to indicate the feasibility of the approach. Thus far we have identified at least 8 esterase loci.

Population comparisons show all Florida populations not to be different at this locus where as all were different from one Central American population (Belize). Thus the overall approach appears feasible. A plan has been developed incorporating the above information for a two-year study. Results from that study should lead to more precise identification of breeding stocks which contribute to Florida populations.

Information obtained will be disseminated in the form of scientific publications and presentations, and will also be summarized in lay language for direct and indirect dissemination to fishermen.

Macrobrachium Shrimps

The culture of fresh-water prawns, particularly *Macrobrachium rosenbergii,* has become a successful industry in some places. Shrimp farmers in Puerto Rico and Hawaii appear to have made a financial success of the rearing of this species, and those in Central America and southern Florida are approaching that level. The principal goal of this research was the production of a superior strain of *Macrobrachium* by the joint mechanisms of selective breeding and hybridization, and particularly the production of faster-growing shrimps. Much of this work has already been described in Annual Reports for 1973, 1974, and three published papers (Dobkin *et al.*, 1974, 1975, in press).

Only a limited amount of work could be accomplished in 1976 because of the small amount of money available. Two broods of *Macrobrachium rosenbergii* were reared. The first of these was raised for 251 days (from hatching), from March through November. Excellent growth was achieved, and the 331 animals remaining at the end of the experiment (of an original 700) averaged 13.6 cm. in length and 31.0 gms. in weight. Those in the second brood, hatched at the beginning of July and placed in ponds in late August, were growing equally well in November, but were almost totally killed by unusually cold weather in mid-January. Mass mortality occurred when the temperature in the small ponds reached the low 50's (Fahrenheit).

The other aspect of the work, hybridization, proceeded slowly. The aim was to acquire specimens of several "varieties" of *M. rosenbergii* in order to carry out these experiments, but unfortunately this was not achieved until late in the year when it was no longer possible to raise larvae. The so-called Malaysian (Hawaiian), Thai, and Palauan varieties are now being held in the laboratory, and preparations are being made to mate members of different strains, in order to see if their offspring have better growth or survival qualities than the Malaysian variety itself.

Rookery Bay Soils

The value of Florida's wetlands and their importance to marine organisms and thus to the south Florida sport and commercial fisheries has been well documented. These swamps are also valuable as shoreline stabilizers. However, the soils of these mangrove swamps have received little study. The purpose of this project was to examine, sample, and analyze the inter-tidal soils of Rookery Bay in order to classify them and establish and define mappable soil units.

Results indicated that most soils were covered with mangroves and consisted of a thin layer of organic material over sand or sandy clay loam. "Drowned" sandy soils with an "organic hardpan" were found at higher elevations in the swamp indicating the subsidence of the area relative to sea level. These soils are poorly drained, saline, saturated with bases, and have a low capacity to bear loads. Also, most soils contain high levels of sulfur which would cause toxic levels of acidity if these wetlands were to be drained.

Information revealed by this project is being provided to soil scientists in the Soil Conservation Service to assist them in classifying, mapping, and making management recommendations in similar sites, and will also be made available to the Collier County Conservancy and the Bureau of Coastal Zone Planning (DNR).

30 Portuguese Man-O-War

Although the sting from the Portuguese Man-of-War (*Physalia*) is rarely fatal, it can be excruciatingly painful and for this reason these innocent looking jellyfish-like organisms can be a disruptive influence among Florida beach-going tourists as well as individuals who work in waters where the *Physilia* are present.

This study was undertaken with the goal of contributing to development of methods to protect against toxic effects of the venom. The stinging potency of the *Physalia* and related species of jellyfish is due to the occurrence of numerous minute stinging capsules or nematocysts each containing a powerful venom along the surface of the tentacles.

In this project, venom from the sea anemone and the man-of-war is used to produce antibodies to the venom in rabbits. Antibodies produced in the rabbits will be capable of reacting with the active toxin and inactivating it, thus producing an active immunity to the venom in rabbits and with continued research to be able to desensitize humans to the stings.

The greatest problem encountered in studying nematocyst venoms is the difficulty of obtaining pure venom while still retaining the biological potency of the original venom.

A gentle extraction procedure was developed which allowed the removal of all detectable adhering cytoplasmic materials from the nematocysts while also preventing the more fragile and functional nematocysts from prematurely discharging and thereby losing their venom.

The toxicity of the *Physalia* venoms was determined in mice by intravenous injections. It was found that the intermediate range of lethality (i.e., the range between the maximum non-lethal dose and the minimum lethal dose) is quite narrow. Such a narrow mortality curve contrasts with the broad curves for various snake and microbial toxins. Broad mortality curves are characteristic of toxins which act on very generalized and widely distributed target tissues such as skeletal muscle. On the other hand, a narrow lethality range is suggestive of a toxin which acts at very specialized and limited target sites within the body.

In the toxin tests it was found that if a mouse could survive the first 60 minutes of a *Physalia* venom dose it would generally survive altogether. This, if extended to human cases, would point to the need for either rapid remedial action or else the development of a prophylactic program.

Although an experimental antiserum against *Physalia* venom has not yet been produced, it is reasonably certain that it will be developed in the near future using techniques already successfully employed in this project to produce such an antiserum against the nematocyst venom of the sea anemone. With the availability of a potent and stable venom the major obstacle to producing an experimental serum to *Physalia* venom in rabbits has been removed.

Oyster Season

In 1974 and 1975 sharp debate developed over the wisdom of opening Apalachicola Bay to oystering the year-around, instead of confining the legal season to September through May as has been the case for almost a decade now. This study considered three economic issues central to the debate: (1) the effect of a summer season on income and production of other area fisheries, (2) the effect of a summer season on area oyster quality, and (3) the effect of a summer season on oyster prices and landings. In each case the analysis was largely unfavorable to the case for an open season during the summer.

The trade-off between summer oyster production and the harvest of other species was found to be substantial. The volume of oyster harvest per unit of harvesting effort is greater during the winter months where oysters are in fatter condition. But, for other area fisheries (finfish and crab) this is not the case.

The existence of an open summer season in the past also was shown to have had an adverse effect on the year-around average quality of oysters produced in the Bay. Using yield of oysters to the Florida barrel as a measure of oyster quality, a significant improvement in quality was found after the Bay was closed to summer harvesting.

The effect of a summer season on oyster prices and perhaps on landings also appeared to be unfavorable. This conclusion must be a little tentative because of the generally complicated nature of the analysis, and especially because the dealer price variable was not deflated. Deflated price did not work well in the demand equations tested.

Thus, the factors tested in reviewing the case for and against a summer oyster season in Apalachicola Bay seem to indicate a closed summer season is the more desirable fisheries management, unless the conditions of harvest greatly changed from those that have existed in the past.

The extent to which an open summer season would be economically harmful to the local industry and economy would depend upon the volume of summer harvesting. However, the effect of the summer season does not seem economically helpful, whatever the level.

Red Tide

The term "red tide" is a general one that describes the sudden growth of microorganisms in the marine environment that gives rise to discolored water and other phenomena including mass deaths of marine animals, paralytic shellfish poisoning, severe economic losses, and respiratory and contact irritation.

As any red tide organism dies, biochemical decomposition occurs and oxygen levels can be come rapidly depleted. Approximately 100 species of marine animals are known to have been killed by the Florida red tide organism, *Gymnodinium breve,* and a considerable number were due to the oxygen-depletion-effect. Mass mortalities of fish and marine animals has also occurred because of a toxin that is associated with the red tide organism. Shellfish (oysters, clams, mussels) may ingest a toxin-containing red tide organism and entrap the poison. Persons who consume the contaminated shellfish become afflicted with paralytic shellfish poisoning and death may result, depending upon the number of shellfish, the degree of contamination, the species of the red tide, and the recency and intensity of red tide.

In Florida coastal waters, *G. breve* is destroyed in the surf and it appears that the resulting aerosols contain irritating substances that cause respiratory problems for persons up to 30-40 miles from the red tide bloom. Economic loss to the tourist industry in Florida during an outbreak of red tide is considerable.

Research prior to 1975 revealed a blue green alga, *Gomphosphaeria aponina,* that elaborated a plant substance (provisionally called "aponin") that destroys the red tide cells (*G. breve*) in the laboratory. This study was a follow-up of research project R/EM-9 which examined the growth requirements and characteristics of aponin, and was aimed at determining the advantages and disadvantages of biocontrol as a means of limited control of the Florida red tide.

Since conclusion of research project R/EM-0 in 1975, progress has been made in several major areas of investigation. These include further investigation of isolation and purification schemes for aponin, studies concerning the biological interaction of aponin with *G. breve,* development of a method of continuous mass culture of *G. aponina* under nutritional and physico-environmental conditions favorable for rapid growth, and continued characterization of aspects of organism culture and growth including effects of select trace metals, presence of a "growth factor", kinetics of iron uptake, and rate of aponin synthesis as a function of nutrition.

Considerable progress was made in characterizing the nutrient requirements of *G. aponina* and the mode of action of aponin. The inorganic nutrient requirements have been characterized adequately, as have the variation of growth with salinity, light, and temperature. In addition, the isolation of aponin has been improved, and much progress has been made in characterizing the chemical properties of aponin and affecting purification. The environmental degradation of aponin appears to be favorable.

On the basis of this and future studies it is hoped that the environmental acceptability of aponin can be demonstrated. It is also possible that the availability of structural information will permit modifications that would enhance the suitability of management of *G. breve* blooms on a limited, but useful basis.

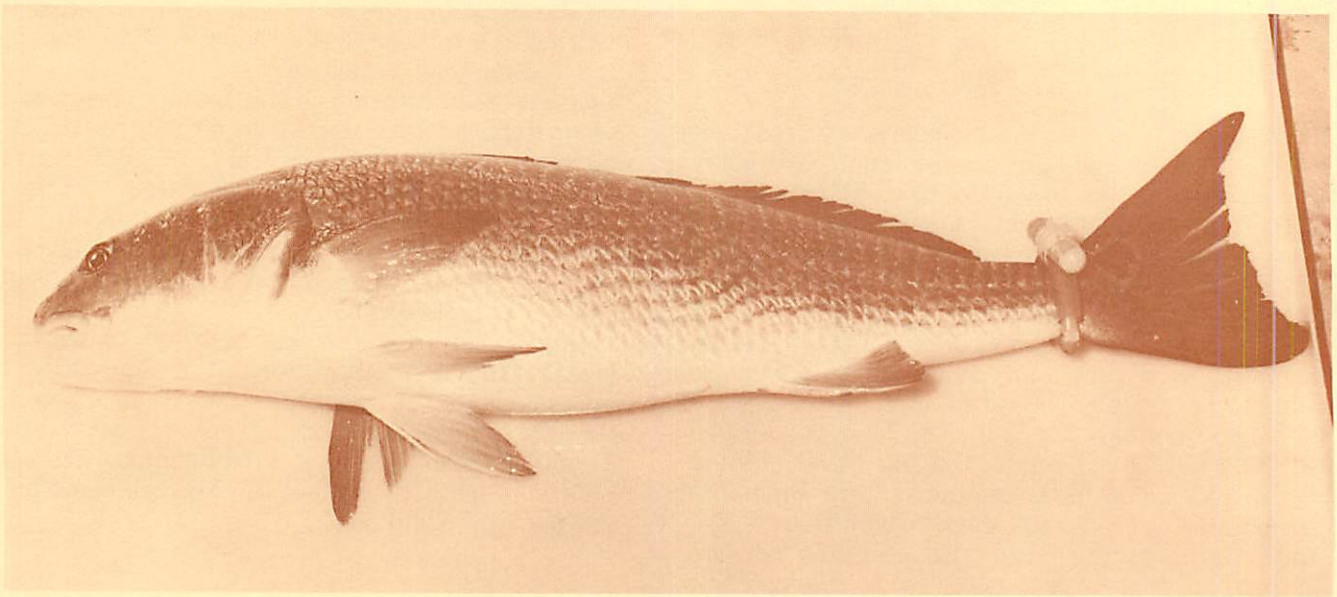
Bay Scallops

Bay Scallops, *Argopecten irradians concentricus,* once a plentiful natural resource in Tampa Bay, have all but disappeared. Since it is an extremely sensitive species to all forms of environmental disturbances it was felt that the increase in human population and the accompanying environmental pressures may have been the cause of the decline of the scallops.

Preliminary research data indicated that adult scallops spawned elsewhere may grow well in environments classified as "polluted" due to overpopulation and other causes. To explore this concept, Florida Sea Grant provided "seed" money from immediate response funds to investigate the feasibility of transplanting scallops to areas of Tampa Bay.

In June 1976, scallops were transplanted from near Tarpon Springs to six locations in Tampa Bay and maintained in specially constructed cages suspended off the bottom. Information on the growth, mortality, reproduction, and general health of these caged scallops was collected every three weeks throughout the summer or until no scallops remained. An attempt was made to correlate this information with hydrographic conditions in the area. Results indicate that although growth was comparable to that in other areas, the scallops were unable to survive and reproduce in Tampa Bay waters during the summer months.

However, although this project proved to be unsuccessful, it is felt that additional studies should be undertaken during other seasons when conditions might be more favorable.



Red drum (7 lbs) with harness and transmitter attached.

Red Drum

The red drum, *Sciaenops ocellata*, is one of Florida's most popular food and game fish, and although much is known about this species, the sites of spawning are unknown. This study was stimulated by reports from commercial fishermen that schools of large roe-bearing red drum migrate annually into an estuarine area, the Mosquito Lagoon, north of Cape Canaveral, during the months of September and October, the known spawning period of this species. Verification of spawning in this area would provide the first documentation of a spawning site for red drum and also the first evidence that at least a portion of the population spawns in an estuarine habitat.

During September and October, four workers were taken to the Mosquito Lagoon on a houseboat owned by the Whitney Marine Laboratory. With help from local fishermen, 5 large red drum (12 to 34 lbs.) were caught, tagged with ultrasonic transmitters, and released unharmed. This tagging method permits movements of the fish to be detected and recorded with sonic tracking equipment. Detailed data were obtained on movements of two tagged specimens for periods of 16 and 30 days. Both fish moved into small clearly defined "territories" of ca. 0.26 km^2 and "milled around" in these territories for minimum periods of 11 and 26 days. Other mature red drum occupied these territories as evidenced by the proximity of other catches by fishermen. A third tagged fish, "lost" shortly after its release, was recaptured in January, 1977, by a commercial fisherman within one mile of its original release point in the Lagoon. This fish, a male, was full of roe when tagged, but contained no roe when recaptured. Hence it had spawned in the interim period.

During the time the two tagged red drum occupied the territories described above, local fishermen provided researchers with roe obtained from other freshly-caught specimens. With assistance from workers at the Department of Natural Resources Marine Research Laboratory, each roe was examined to determine the maturity of developing egg cells (oocytes). Beginning on October 5, females contained mature oocytes such as have been shown in other studies to be capable of developing on to the spawning stage within 48 hours. Two of our tagged fish remained in the Lagoon for minimum periods of 4 to 19 days after the appearance of mature oocytes in the specimen of October 5.

Larvae hatched from eggs collected with plankton nets in the Lagoon included many larvae identified as belonging to the drum family (Scianidae). However, these larvae have not yet been positively identified as those of red drum.

Since spawning was not actually observed, additional studies are required to completely document this phenomenon. However, the evidence collected provides strong support for the contention that the Mosquito Lagoon does serve as a spawning site for the red drum. Definite proof of the latter may show that the Lagoon and possibly the adjacent Indian River and Banana River are unique ecological habitats in which certain man-made structures, e.g., mosquito control dikes, are having marked deleterious effects.

Neuroscientists from the University of Florida medical center who had previously been involved in the study of neuropathology of whales and dolphins under Florida Sea Grant immediate response funds were again assisted during this grant year in the investigation of the deaths of marine mammals involved in three mysterious mass strandings off the southwest coast of Florida and the Florida Keys.

Examination of the brain tissue of the 25 spinner dolphins involved in the first stranding incident revealed nothing to explain the strange occurrence. Necropsies performed ruled out brain disease, parasites and tumors, as well as bacterial, fungal or viral infections. The scientists also completed brain necropsies on three false killer whales that died after beaching themselves near the same area. Immediate cause of death was determined to be bacteria in the blood which was apparently not related to the stranding.

At the third stranding, off Loggerhead Key in the Dry Tortugas, funds were made available immediately by Sea Grant to provide for a chartered plane. This made it possible for the neuroscientists to secure the brain of the dead false killer whale within two hours after death. An on-the-spot examination of the brain revealed a heavy infestation of parasites in the middle ear, but this condition has not yet been correlated with the stranding. The vestibular system of the whale is also being examined but is not complete. It is expected to determine whether or not the parasites caused the animal to become disoriented, perhaps by disturbing his echo-sounding apparatus so that he lost sense of direction and landed on shore or became dizzy and sought support of the sandy beach to regain equilibrium.

Although no definite cause of the strandings has been found, the scientists feel that more than one factor could sufficiently distress a sea mammal to cause panic and a search for land to avoid the immediate threat of drowning and that the social aggregation of whales and dolphins lends credence to the theory that when one or more leaders in a pod become sick or distressed enough to lose sense of direction, others may follow the leaders to dangerously shallow territory and possibly death.

Aquatic Preserves

The objective of this project was to provide the Board of Trustees of the Internal Improvement Trust Fund with the information, recommendations and guidelines needed to draft rules for the management of Florida's aquatic preserves.

The preserve management policies of seven coastal states were discussed, focusing on the components of the various management systems that relate to the Florida problem. The aspects addressed included the monitoring and inventory processes, public involvement, permitting, educational and scientific use, and recreation policy.

A bibliography of recent socio-economic studies and planning and documents relating to preserve management has been compiled and although further study of demand for recreational uses and support services is recommended, it is evident that immediate consideration must be given to the accommodation of existing industrial, shoreline, and transportation or oriented uses.

The Aquatic Preserve Act of 1975 makes provision for continuation of "traditional riparian uses", subject to permitting by designated state authorities. In order to guide these agencies in coordinating preserves, clearly stated goals, policies, and objectives for the system as a whole must be developed.

A bibliography of physical science studies has been compiled. This survey indicates that further scientific study is advisable, following the development of system goals and management priorities. Impacts resulting from alterations affecting water quality on a basin-wide area could be addressed.

Legislation relating to aquatic preserves was surveyed as part of this project and a bibliography of selected federal and state legislation presented.

Special consideration was given in the report to the relationship of aquatic preserve management of the state coastal zone management program. Recommendations were made relating to the proposed designation of the aquatic preserves as "geographic areas of particular concern" (under the Federal Coastal Zone Management Act of 1972) and coordination with other state resource management programs.

An attempt has been made to demonstrate that the effectiveness of management rules and regulations will depend upon formulation of clearly articulated goals, policies and objectives which can accommodate the competing interests associated with these sites. In order to provide for the greatest public benefit, the aquatic preserves must be viewed in relationship to the broad state resource management framework and integrated into the state coastal management program.

Seagrass beds support important bottom-dwelling communities in estuaries along the Gulf coast from Texas to the Florida Keys. They serve as sediment traps, bottom stabilizers, a place of refuge for some organisms and a habitat for others, a source of primary production and a direct food source for a few plant-eating mammals. In estuaries receiving increased siltation, thermal pollution, and increased industrial pollutants, the seagrass beds have receded. In the Pensacola area, seagrass beds have completely disappeared in Escambia Bay which receives industrial pollutants. As efforts are made to improve water quality of the estuaries, there will be a need for reliable revegetation techniques.

In this project, the seagrasses *Ruppia maritima* Linnaeus and *Halodule wrightii* Aschers were studied in laboratory culture to ascertain if they were suitable for such revegetation projects in low salinity estuaries. Initial studies showed that both species produced new shoots from plant fragments consisting either of single intercalary nodes or apical nodes. This growth response has not been described previously for seagrasses. During an 8 week period about 40 percent of the *R. maritima* fragments rooted firmly in a sand substrate, however, none of the *H. wrightii* fragments rooted. These preliminary studies suggested *R. maritima* might be a suitable seagrass for revegetation projects.

Since initial studies showed that nodes produced new shoots in both species and rooted in one species, an experiment was designed to quantify the amount of growth and to measure the effects of some physical and chemical factors such as, substrate type, salinity, transplant method and nutrient concentration, on growth. Growth was measured as an increase in leaf number, node number, leaf length and weight gain. Observed differences in the growth of plant fragments over the 8 week experimental period were expressed as percent change.

Overall, intercalary nodes grown on a suspended net in an aquarium having a sand substrate demonstrated the largest increase in leaf number, 120 percent. However, plant fragments grown in a silty sand substrate showed the largest weight gain. Since coverage is probably more important than weight gain in the function of a seagrass bed as a sediment trap and a habitat for other organisms, conditions favoring increased coverage such as a sand substrate will be selected for transplant experiments in the field.

Only *R. maritima* rooted consistently. However, its rooting frequency of between 20 and 40 percent may be too small for satisfactory seagrass revegetation. Pretreatment of the plant fragments with Indol Acetic Acid, a growth hormone which induces adventitious root formation, may increase the rooting frequency.

In general, *R. maritima* proved to be a more satisfactory plant for laboratory culture than *H. wrightii*. Probably, *R. maritima* will prove to be a better species for revegetation in the field, too.

The ability of these seagrasses to produce new plants from fragments containing single intercalary nodes should lead to the development of entirely new transplant methods and, hopefully, less expensive methods than those currently in use.

Artificial Reefs

Fishermen have known since ancient times that fish tend to congregate around submarine (reef) prominences in shallow water. Thus, artificial reefs have existed as long as human activities have placed objects in marine waters. In the United States, use of structures such as shipwrecks for fishing purposes has been reported as long ago as the 1830's, however, systematic efforts to construct submarine reefs did not come about until the middle of this century. Since then hundreds of artificial reefs have been built.

Artificial reefs are attractive to coastal communities because they enhance fish productivity while providing a disposal outlet for bulky waste materials such as tires, culvert, junk boats and bridges. Particular ingenuity has been exercised in the use of scrap tires in various configurations, ranging from single tire units to pyramids, triangles, high-profile multi-tire units, and chains of tires linked together with tire bead. A new, non-weighted aggregate of split tires was devised as a part of the Pinellas County reef system which is the subject of this study.

With its long coastline and emphasis on marine sports fishing as a recreation and key industry, Florida has a strong history of interest and activity in artificial reefs.

Some quantitative information useful for assessing the value of artificial reefs to coastal communities is available. However, in general, information on the economic value and cost of offshore reefs to local and regional communities is very scarce, notwithstanding the widespread interest in this type of development.

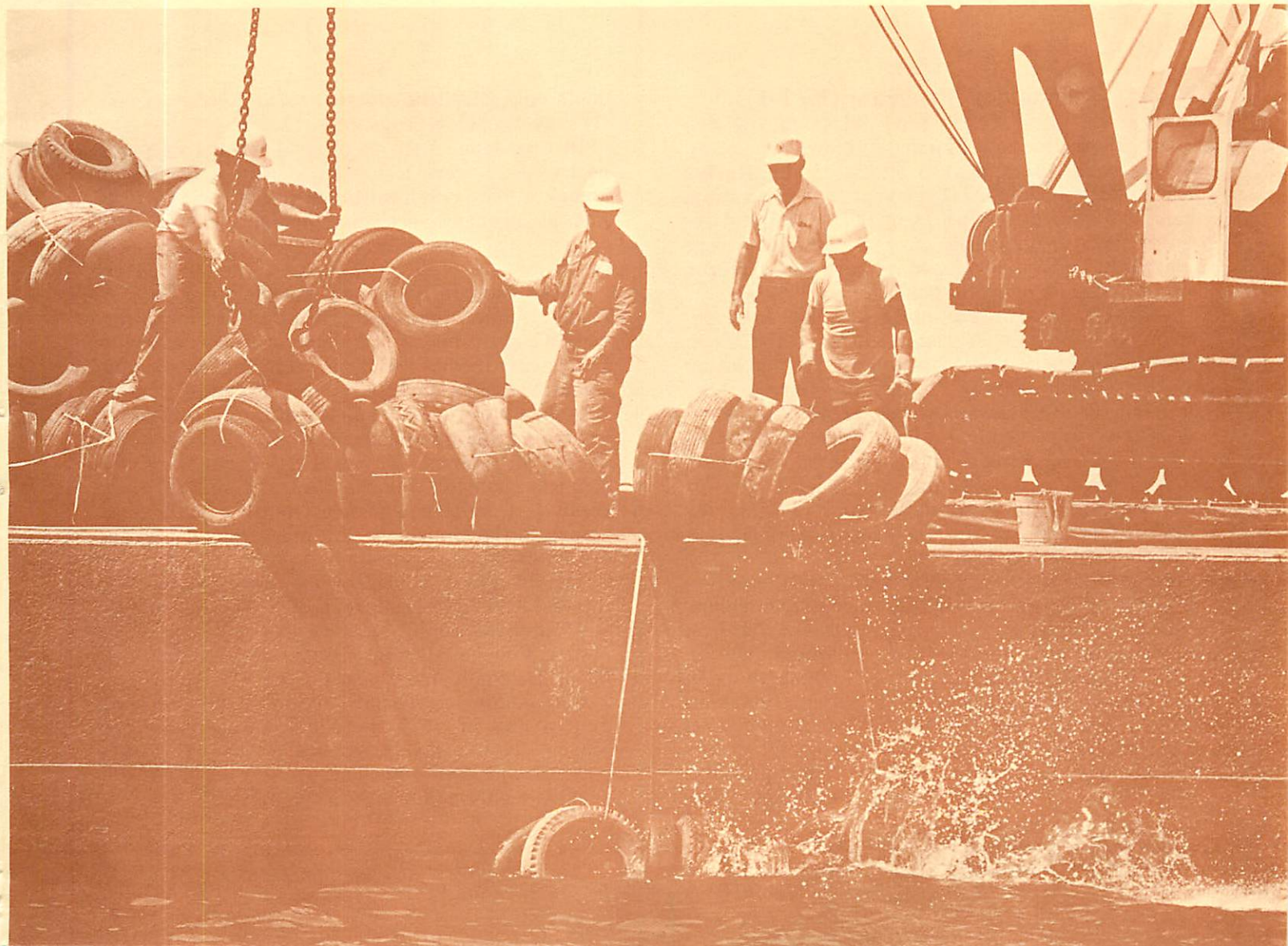
This study is an attempt to analyze the interrelationship of a well-developed artificial reef system as a permanent local government function in Pinellas County on the central western (Gulf) coast of Florida.

Objectives of this study are to draw on current information being prepared for a preliminary

descriptive account of the development of the Pinellas artificial reef program, including principles of design, location, construction, maintenance, and monitoring, as well as the socio-political factors involved in gaining public support and regulatory approval for the program; to evaluate productivity and cost/benefit ratio of the artificial reefs insofar as possible, with special emphasis on the Clearwater reefs; and to develop an inventory of the unanswered biological, technical, and economic questions related to artificial reef operation and significance, and response to questions raised by public officials.

The first objective has been attained—apart from writing an account of the socio-political factors involved. Evaluation of potential benefit cost ratios at varying degrees of utilization has been accomplished. The study presents all pertinent information on the fixed and variable costs of reef construction by Pinellas County to date and estimates construction costs through 1982/83. The figures include not only the budgeted costs, but also the imputed costs incurred by other county departments who have donated their services or materials or sold them below cost.

A comparison of the costs of burying tires—the principal raw material of artificial reefs—in landfills revealed that a tire in place at a reef costs a great deal more than the two cents it takes to bury one in a landfill. But tires buried in landfills cause land values to deteriorate and total land-fill expenditures yield benefit cost ratios of less than 10 percent. Given the observed fish productivities, if anywhere near full utilization of the artificial reefs by Sunday anglers comes about, however, benefit cost ratios of nearly 1.5 will result. It is highly desirable that a reef built of tires and culvert serve exclusively Sunday anglers daytime, perhaps accompanied by shark anglers at night. Other users of relatively expensive reefs like these, such as trolling sports anglers and divers, fail to produce benefit cost ratios in excess of one. Because of the unusually severe weather in the area, interviews with reef users have fallen short of the desired and will be continued through March, 1977.



EDUCATION

Three formal projects were supported in 1976. In each case, Sea Grant funds were provided as "start-up" support to activities that will become self-sustaining in a short time.

A number of graduate students were supported as research assistants in the investigations covered in this annual report. Also, as listed in the Publications Section, a number of theses and dissertations were completed. Graduates of the Sea Grant "apprenticeship" in Florida are now employed by such organizations as the Nuclear Regulatory Commission, Florida Department of Environmental Regulation, University of Maryland, and Virginia Polytecnic Institute & State University.

Marine Technology Program (E/T-1)

As a result of funds received from the Sea Grant Program and Florida Junior College, an Associate in Arts degree speciality in Marine Technology is being established at that institution. Essential equipment has been purchased and receives year round use, and all program core courses have been developed and are being offered on a regular, sequential basis.

User interest in this program has been increasing and includes regular use of the Navy Specal Service vessel, **Wacamaw**; free printing of the Florida Junior College brochure by the **Jacksonville Shipyards Incorporated**; cash donations from the Florida Junior College Foundation via a local consulting firm; requests for classroom space from city, state, county and federal agencies for upgrading employee skills; and requests for lectures, interviews and specimen analysis for various community sources.

Graduates of the program will have the option of entering the job market as marine technicians with two year skills or continuing their education at an upper division university on an articulation basis. A substantial number of upper division institutions have entered into articulation contracts with Florida Junior College. Articulation contracts are necessary in today's complex curricula to insure maximum student transferability. Florida Junior College Marine Technology students only enroll in courses which actively transfer into bachelor programs.

In this connection, an impressive list of prospective employers has been identified, including among others, one local industry and two governmental agencies actively participating in the cooperative education of Marine Technology students.

These cooperative programs allow students to receive valuable work experience while completing degree requirements. One employer, Jacksonville Shipyards Incorporated, is entering into additional contracts with selected students to further subsidize the students' education for an additional two years, permitting them to attain a Bachelor's degree in Marine Engineering Technology. In compensation for this the Jacksonville Shipyards receives a written contract from the student to return to the shipyards as a mid-management coordinator for four years.

The Program is generating large amounts of interest and industrial support with some industrial interests already planning to rely on Florida Junior College Marine Technology graduates to fill future employment needs.

Core courses have continued to be fully enrolled and by fall of 1977 the Florida Junior College Marine Technology Program should be a self-perpetuating, self-sufficient working asset to the academic curriculum and community.

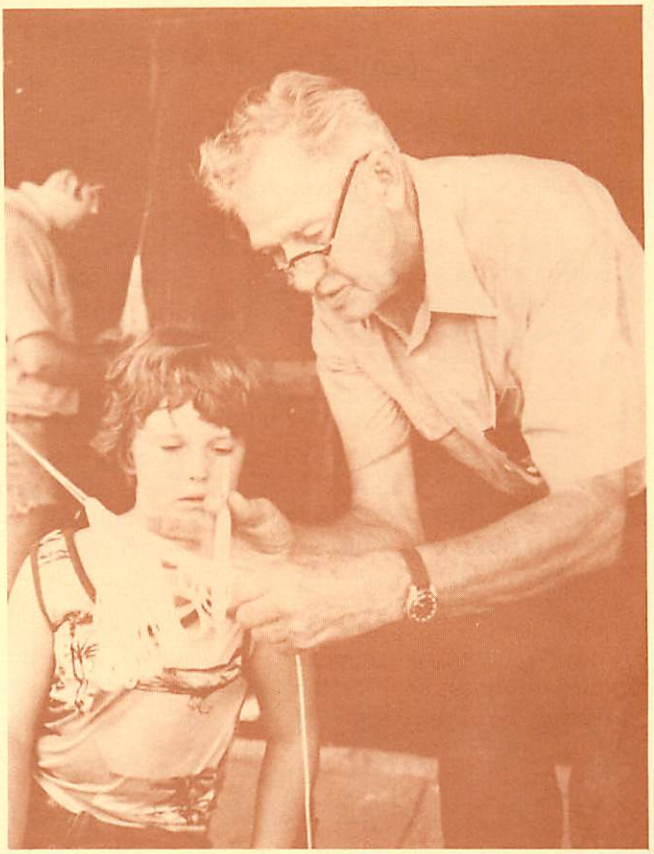
4-H Program (E/Y-1)

At the request of the office of Sea Grant, the Florida 4-H Department, University of Florida, in cooperation with the Florida Sea Grant Program and the Florida Extension Marine Advisory Program, designed and conducted a National 4-H Marine Education Survey to obtain and analyze selected 4-H marine education data. The Survey enabled states with operational 4-H marine education programs to further assess their relative growth while states without programs could view existing programs as an aid to, and possible guide for, future developments in the area of 4-H marine education.

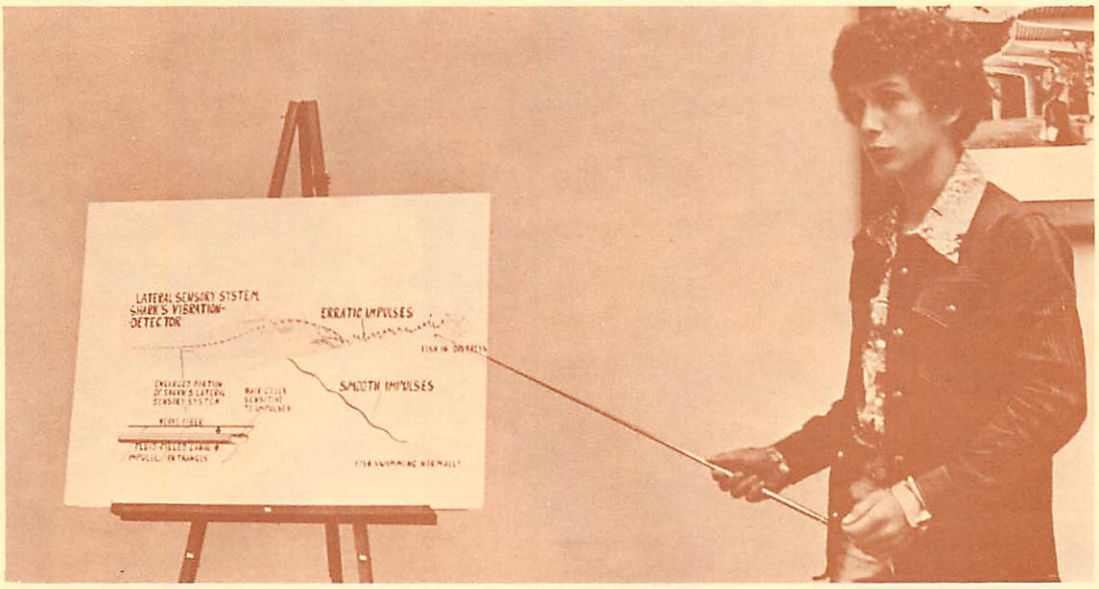
The first Marine Education 4-H Camp was held in July with a program designed to create an increased awareness among the 100 participating youth, ages 13-18, of science, ecology, economics, recreation, nutrition, and careers—all in a marine context. As a result of the success of this camp, a one-week Marine 4-H Institute is being planned for 100 senior 4-H boys and girls at Marineland of Florida during August, 1977.

During the year, five new marine special interest 4-H publications for leaders and members were developed and distributed. These publications included information on sponges, sea shells, beachcombing, marine aquarium, and birdwatching. Eleven 4-H marine special interest units have been developed so far. This amounts to over 110,000 member's pieces and 11,000 leader's guides distributed for county use.

A popularized Florida 4-H Marine Program emblem was designed and converted into peel-and-stick seals and shoulder patches for use by agents, volunteers, 4-H'ers and others in providing greater marine program visibility and increased program participation.



Net-making was one of the marine skills taught by volunteers at the 4-H marine camp. Below, Florida 4-H'er Don Cronin, explains the shark's navigational system during his project demonstration at the state 4-H Congress in July.



Underwater Technology (E/T-2)

The first year of this new Associate of Science degree program in Underwater Technology at Florida Institute of Technology was successfully completed. Most of the second year manpower has been obtained, facility modifications are approximately 75 percent complete, and approximately 90 percent of the necessary equipment for the second year has been received. During the first year the medical capability of the new triple lock chamber was verified and two diving manuals were published: "FIT, JBC Recompression Chamber Operations," and "FIT, JBC Diving Operations Manual." The LCM diving boat, although behind schedule, will be reviewed for final acceptance testing the latter part of April, 1977.

The second year class which began in January, 1977, consists of 34 returning sophomores and 110 new freshmen. The 1978 class is full and applications are well underway for 1979, so it is evident that the entire new class load that can be handled in any one year, 99 freshmen, will be met.

The long-range objective of this program is to provide industry with trained underwater technicians who have completed a two-year Associate of Science Degree in Underwater Technology, and it is hoped that the program will serve as a model for other institutions considering entrance into this field. Industry's response to the curriculum has been strongly positive, and a substantial contribution of equipment has been made.

Students in Underwater Technology Program at Florida Institute of Technology, Jensen Beach campus.

ADVISORY SERVICES

Don Sweat, right, marine advisory agent for Pinellas and Hillsborough counties, checks trynet doors on shrimp boat with Captain Harrison Hurlston.

While 1976 was the Bicentennial year for the United States, it represented the fifth birthday for Florida's Marine Advisory Program (MAP). From its inception in 1972, with a staff limited to one full-time professional, it has developed into a working force of Principal Investigator (Dean, Florida Cooperative Extension Service), a Program Coordinator who serves as program administrator, four campus-based specialists (marine economics, seafood technology, coastal engineering and communications) and six marine agents, strategically located along Florida's coast. The agents are now housed in identifiable field offices with secretarial support, and the specialists are housed on the campus in their respective subject matter departments where they have ready access to their professional personnel and research resources. The MAP effort was supported by the research and educational resources of the State University System of Florida, the Florida Cooperative Extension Service, and public and private contractors.

Marine Advisory Program (A/MAP-1)

Due to the immensity of Florida's coastline, 1,350 linear miles and 8,426 shoreline miles, with 60% of the state's population, it obviously was impractical within the allowable budget to attempt to service all marine interests. Therefore, it was decided to concentrate on the commercial fishing industry, persons or organizations from the public and private sectors responsible for coastal development and beach preservation and restoration, youth education groups such as 4-H, and public decision makers. Local advisory committees have helped to order priorities. This community involvement was instrumental in the initiation of many Sea Grant research projects, both short and long range.

Publications

Since public awareness is an essential component of an effective advisory program, concerted effort was directed toward newsletters, publications, group workshops, seminars, and conferences. The MAP Newsletter reaches 7,000 persons bimonthly; the field offices routinely issue individual newsletters to local mailing lists ranging from 150 to 700; and public and commercial TV and radio channels expand this printed coverage. These frequently feature agents and specialists along with marine-involved persons from the public and private sectors.

Supplementing these efforts was the issuance of Marine Publications on such diverse subjects as electronic fish scanning, blue crab migrations, economic analyses of Florida's valuable spiny lobster fishery, hurricane-resistant contsruction for beach-fronting homes, and beach dune walkover structures. About 15,000 of these have been printed and distributed to date. Each month about 300 persons write the central office for publications.

Marine Economics

Economic factors have always been a prime consideration and problem to Florida's important commercial fishing industry, and 1976 seemed to exceed the previous years' vexations in several respects. The Tax Reform Act of 1976 posed unusual problems for commercial fishermen not only due to the many technical changes in the law, but also because of the year to year change in fishermen's operational costs and earnings. MAP addressed its economic resources to this challenge by preparing a series of Tax Tips on such pertinent subjects as boat selling, income averaging, investment tax audit, business losses, depreciation methods. Tax workshops were held throughout the state wherein fishermen not only were made aware of tax preparation but also worked on actual problems. The Tax Tips were distributed statewide by the field agents and were also explained at the workshops.

Major presentations were made at the annual conventions of the two major Florida commercial fishery associations on market margins, market prices, volume marketed and marketing services on a principal species, king mackerel.

Another major and growing fishery, that for groupers and snappers, was the subject of a workshop on anticipated net returns using various sized vessels engaged in this fishery.

The curtailment of U.S. spiny lobster fishing operations in Bahamian waters due to that government's closure order, created a panic situation among the Miami-based fleet. The majority of these fishermen have boats of limited range and unique one-fishery functionality. As a result, severe economic losses were experienced. Successful efforts by the Small Business Administration, the National Fisheries Service, and the Florida Departments of Natural Resources and Commerce resulted in funds being made available to hardship cases for boat conversion, alternative gear, and living expenses.

The MAP role was that of liason between the fishermen, largely of Hispanic origin, and the SBA disbursing office by extending technical assistance on vessels and gear conversion and orientation on alternative species, fishing grounds, and fishing methods. Several new boats were constructed through this funding source, and MAP also facilitated sale of outmoded craft to Florida calico scallop fishing interests.

Adequate financing is a constant problem to the commercial fishing industry. MAP personnel served in a catalytic role in alerting the industry to the Production Credit Association procedures with the result that loans from 1972, when commercial fishermen were first eligible, to 1976 amounted to more than 170 in number, totaling $6.5 million. Florida exceeded the combined total of the other three states in this PCA region (North and South Carolina and Georgia) where 140 loans totaled $4.3 million.

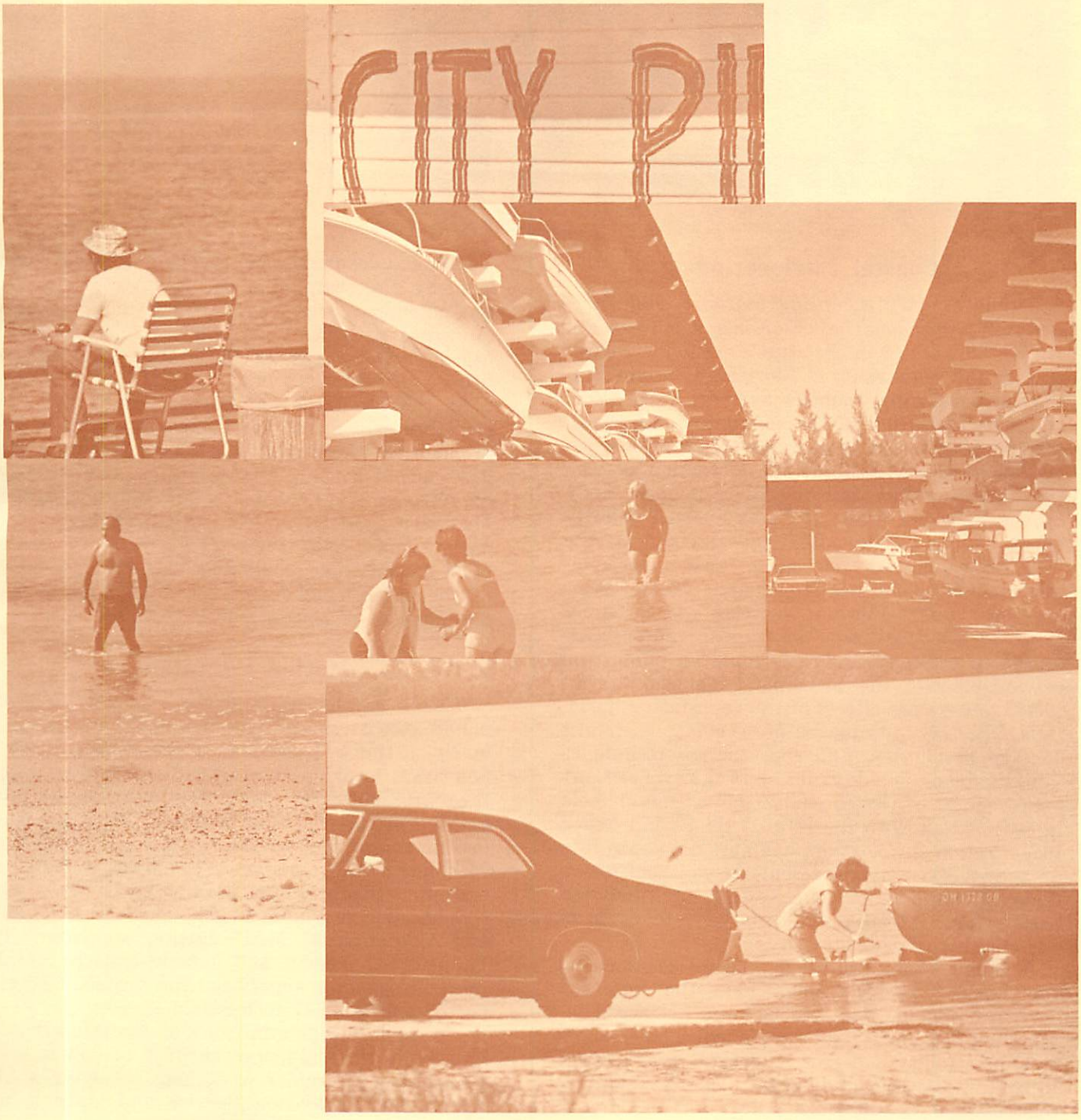
Marine Recreation

The intensity of marine recreational activity, not only in terms of dollar investment, but in number of facilities and recreational users in Florida, has exceeded the MAP capacity for any concentrated involvement. However, there is an acute awareness of the need for such involvement and future staff recruitment and associated research and educational resources will be particularly directed toward this important audience. Peripheral and exploratory work with a few marinas, sport diving groups, surfers, boaters, and fishermen has been undertaken to "test the water", and this leaves no doubt as to the need for this type of MAP effort.

As sport fishing and diving and archeological interests increase, there has been a corresponding demand for increased numbers of artificial reefs for habitat improvements and anglers' satisfaction. This is a statewide matter which includes local, state, and federal government agencies as well as MAP and the private sector. A MAP-sponsored workshop dealing with artificial reefs was held at Sarasota with representatives from reef committees in southwest Florida counties discussing reef requirements and progress made in their areas.

A marine recreation related project in the Florida Keys involving the preparation and erection of pictographic signs was recommended to the county commission and approved. These signs remind visitors that birds, coral, and native plants are protected, that there are size limits on shellfish, that boating safety is important and about other pertinent matters.

Marine Recreation - - A major factor in Florida's economy



Marine agents Doug Coughenower, left, and Jeff Fisher, discuss careers in the marine field with two 4-H campers at the 4-H marine camp.

Coastal Engineering

Estimates vary according to source, but it is generally conceded that Florida's sand beaches are a major factor in the state's economy. Nearly 60% of the registrants at Florida's Welcome Stations listed coastal counties as their destination, and more than 70% of the population and wealth are concentrated in sixteen coastal counties, each of which bases much of its attraction on the availability of Florida's 500 miles of open sandy beaches. Accordingly, MAP has exerted priority efforts to work with public agencies and private interests concerned with beach erosion, reclamation, and development. The Fourth Annual Seminar on Coastal Engineering was sponsored by MAP on the University of Florida campus. Attended by approximately one-hundred public and private officials, the principal emphasis was directed toward the effects of the devastating hurricane, "Eloise," and means of recovery as well as damage prevention, and construction techniques to mitigate similar destruction in the event of any future storm of like intensity. This seminar, held in cooperation with the Florida Shore and Beach Preservation Association, has now developed into an annual event and represents an excellent forum for exchange of knowledge and research between the university and public and private agencies and administrators.

A 3-day short course in coastal engineering topics was held in December at the Rosentiel School of Marine and Atmospheric Science, University of Miami. Topics included open channel flow, probability concepts in coastal engineering, littoral processes, residential canals and the coastal construction setback line.

Personal contacts in coastal counties were made by the coastal engineering advisory specialist and support engineers to aid planning officials concerned with beach erosion and nourishments, beach creation, coastal structures, and marina sitings.

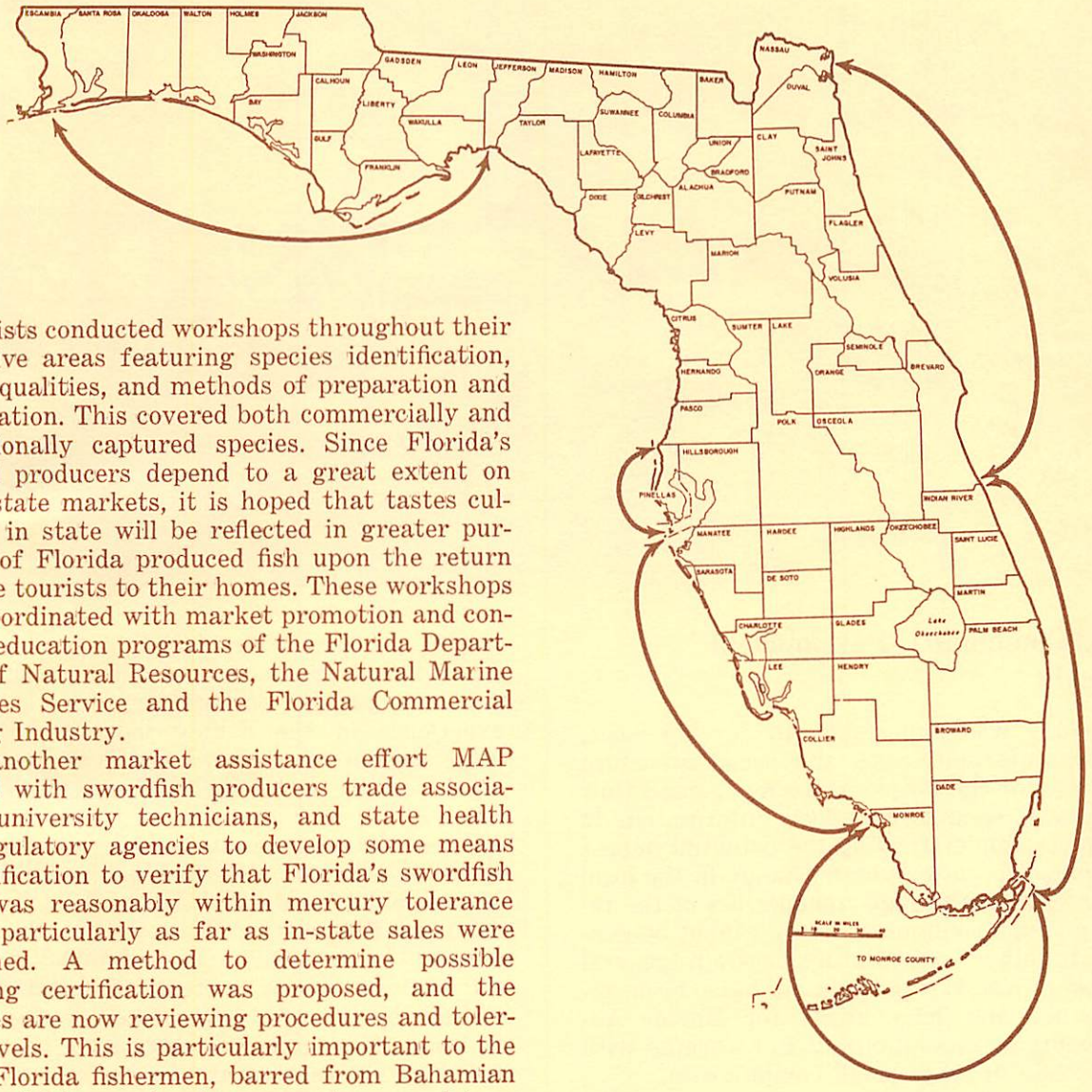
As the Coastal Zone Management (CZM) parameters expand and local impacts become more pronounced, there has been a concomitant MAP involvement with local CZM officials and advisory committees. The two most recent additions to the MAP field staff have strong coastal management backgrounds, and interaction with government CZM officials has resulted in closer involvement of the other members of the MAP staff in the development of coastal policy recommendations.

Marine Education

Visible results were attained in the field of public awareness and resource education, particularly in the 4-H area. As a result of a Florida Sea Grant award several educational and training brochures were especially designed for the 4-H youth. For the first time, a special week-long 4-H marine camp program was conducted with some 74 youths participating. The healthy reaction prompted planning for several such week-long sessions during summer 1977 on both the East and Gulf Coasts. MAP agents, supported by trained 4-H leaders and outside experts, developed the agenda, supervised the project, and reported unusual 4-H enthusiasm.

Many of Florida's millions of tourists are not familiar with local fish or shellfish or how to prepare them. Consumer workshops involving MAP agents and Extension Service and state home

Marine Area Agent Coverage — 1976



Multi-county marine agents provide a point of contact for local residents and provide a liaison with state universities in their area of coverage.

economists conducted workshops throughout their respective areas featuring species identification, unique qualities, and methods of preparation and preservation. This covered both commercially and recreationally captured species. Since Florida's seafood producers depend to a great extent on out-of-state markets, it is hoped that tastes cultivated in state will be reflected in greater purchases of Florida produced fish upon the return of these tourists to their homes. These workshops were coordinated with market promotion and consumer education programs of the Florida Department of Natural Resources, the Natural Marine Fisheries Service and the Florida Commercial Fishing Industry.

In another market assistance effort MAP worked with swordfish producers trade associations, university technicians, and state health and regulatory agencies to develop some means of certification to verify that Florida's swordfish catch was reasonably within mercury tolerance limits, particularly as far as in-state sales were concerned. A method to determine possible sampling certification was proposed, and the agencies are now reviewing procedures and tolerance levels. This is particularly important to the south Florida fishermen, barred from Bahamian lobster fishing only to encounter regulatory agency prohibitions when they resorted to alternative fisheries of which swordfishing is one of the most promising prospects.

Experience gained during the past five years of planning, staffing, program implementation and user contact enabled the Marine Advisory Program to demonstrate its real significance and impact during 1976. Additionally, the increased public awareness of the MAP communication linkage with the university-based research capability has enabled the Florida Sea Grant College Program to provide an ever-expanding public service to the state's coastal areas as visualized in the original 1972 planning.

ADVISORY SERVICES RESEARCH

Fishing Community Development (R/AS-1)

This study was undertaken to develop basic, qualitative information on the social structure and lifeways of the people of a single, small Gulf Coast fishing community. Such information is important for understanding the potential impact of technological and economic change in the local fishing industry. Although the specifics of the results of a single community study cannot be generalized to other communities, certain general principles of social organization have been revealed which may have utility for Marine Advisory agents in understanding and working with their clientele in other small communities.

The primary data for the study consist of the daily fieldnotes of a graduate student who worked in the community during April 1975 to March 1976, spending many hours on board fishing vessels, particpating in community activities, compiling a census of the community, collecting family genealogies, and conducting scores of informal interviews. In addition a structured interview instrument, developed to elicit quantifiable information about perceptions of various occupations, including both fishing-related jobs and occupations not related to fishing, was administered to a sample of thirty-three men. During May, 1976, a questionnaire administered to a sample of 846 junior and senior high school students in the county, produced extensive data on a variety of topics including educational and occupational aspirations, parents' occupations, nad student work experience in the fishing industry. Finally, a large amount of economic and demographic data on the county was compiled from existing public sources.

These data have been compiled in a report of approximately two hundred pages which should be available for distribution within the Marine Advisory Program by Summer 1977. Some of the data will be subjected to more detailed and technical analyses for a doctoral dissertation to be written by the graduate student fieldworker. In addition, data from this study have been utilized for papers presented at two professional society meetings and at a workshop on extended jurisdiction conducted at Woods Hole Oceanographic Institution.

Since 1950 the research community has experienced major changes in its fishing economy. Although still retaining a diversified fishing technology to some extent, the community is best known as the center in the county for the production of a single species. During the early 1950's the county produced less than one percent of the states' total of the species, but by the mid-1970's, the county became the state's leading producer with approximately 30 percent of the total catch of the species. This increase in production may be largely attributed to a single innovation

Fishermen of the small Gulf Coast fishing village pull in a beach seine. Photo to the left shows the village "waterfront" with crab processing house in left background and unused oyster house in right foreground.

in fishing gear. This innovation not only contributed to a major increase in catch, but also had functional consequences in boat design, work organization, and the overall structure of the local community and its economy.

At the present time the county is experiencing major influences from urban areas, but the fishing sector of the research community, in particular, continues to be organized in terms of family and kinship. In addition a local conceptual distinction is made between "natives" and "outsiders" and between "bay people" and "hill people". Family-owned processing houses have played an important role in technological innovations in the fishery and continue to be focal points for the social and economic organization of the local industry, although dependent on predominantly black laborers from outside the community for processing catches.

Many of the social and cultural characteristics of the fishing community tentatively have been interpreted as stemming from a need for flexibility which has been engendered by seasonal and cyclical fluctuations in the availability of the principal species fished.

As a result of this community study, a number of directions for further research are indicated. Long-term, detailed quantitative studies of the activities of small samples of fishermen and seafood workers are needed. Comparative studies of other communities dependent on other fish species should increase understanding of the relationship between the behavior of different species of fish and the organization of human activities. Finally, a comprehensive program of data compilation and analyses aimed at interrelating social and economic indicators with variations in marine landings is suggested.

In the final report the investigators hazard a few practical suggestions for the Marine Advisory Program including the need for adjusting work schedules to match those of fishermen, acknowledging the role of women and children in local fisheries, and recognizing and accommodating local informal modes of social and economic organization. Also considered is the advisability of changing the name of the Marine Advisory Program, since it can have negative and/or conflicting connotative associations with such long established usages as "the Marine Patrol" and "marine advisories" in weather forecasting.

Every effort will continue to be made to protect the privacy and anonymity of the people of the research community, thus neither the community nor the county are identified by actual name in the final report. The investigators are deeply indebted to the people for their patient cooperation in "being studied".

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Marine Advisory Bulletins

SUSF-SG-76-001 *Florida Sea Grant Program Directory*—1976.

SUSF-SG-76-002 *Electronic Fish Scanning—Net Fishing, Florida.* Donald Y. Aska and Thomas M. Leahy.

SUSF-SG-76-003 *Reproduction, Growth, and Migration of Blue Crabs Along Florida's Gulf Coast.* Michael J. Oesterling.

SUSF-SG-76-004 *Economic Analysis of Cost and Returns in the Spiny Lobster Fishery by Boat and Vessel Size.* Fred J. Prochaska and Joel S. Williams.

SUSF-SG-76-005 *Hurricane-Resistant Construction for Homes.* Todd L. Walton, Jr.

SUSF-SG-76-006 *Beach Dune Walkover Structures.* Todd L. Walton, Jr. and Thomas C. Skinner.

Sea Grant Reports

Report No. 8 *An Indexed Bibliography of the Spiny Lobster Family Palinuridae.* P. Kanciruk and W. F. Herrnkind, Editors.

Report No. 9 *Economic Structure of the Florida Shrimp Processing Industry.* Jose Alvarez, Chris O. Andrews, and Fred J. Prochaska.

Report No. 10 *Conference Proceedings: Sharks and Man—A Perspective.* William Seaman, Editor.

Report No. 11 *Florida Commercial Marine Fisheries—Growth, Relative Importance and Input Trends.* Fred J. Prochaska.

Report No. 12 *The Florida Spiny Lobster Fishery: Landings, Prices and Resource Productivity.* Joel S. Williams and Fred J. Prochaska.

Report No. 13 *Littoral Drift Estimates Along the Coastline of Florida.* T. L. Walton, Jr.

Report No. 14 *Sebastian Inlet—Glossary of Inlets Report No. 3.* A. J. Mehta, Wm. D. Adams, and C. P. Jones.

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Report No. 16 *Lugworm Aquaculture.* Charles N. D'Asaro and Henry C. K. Chen.

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PROGRAM SUMMARY

PROJECTS AND INVESTIGATORS

Project	Complete Ttitle	Duration Begin	Duration End	Investigator and Institution
	Estuarine Management			
R/EM-4	Energy relationships and the productivity of Apalachicola Bay	1975	1976	Robert J. Livingston, R. L. Iverson, David C. White, FSU
R/EM-5	Biological, chemical, geological and physical parameters essential to estuarine management in Choctawhatchee Bay	1975	1976	Sneed Collard, UWF
R/EM-6	The St. Johns River estuary: A chemical, physical, and biological study	1975	1977	Carole L. DeMort, R. D. Bowman, UNF
R/EM-7	Effects of sewage pollution abatement on Hillsborough Bay	1975	1978	Joseph L. Simon, Wen H. Huang, USF
	Ocean Engineering			
R/OE-1	Nearshore circulation, littoral drift and the sand budget of Florida	1972	1977	Morton Smutz, James Purpura, T. Y. Chiu, Ashish Mehta, UF
R/OE-4	Hydrodynamic factors involved in finger canal and borrow lake flushing in Florida's coastal zone	1975	1977	B. A. Christensen, H. Rubin, G. Griffin, UF
R/OE-5	Sea water corrosion of reinforcing metals and concrete cracking	1976	1977	William H. Hartt, FAU
R/OE-6	A portable magnetic recovery unit for oil spill control utilizing ferromagnetic sorbents	1976	1977	Joseph E. Turbeville, USF
	Fisheries Resources			
R/FR-4	Economic analysis of commercial fishing and seafood marketing	1974	1978	Fred J. Prochaska, James C. Cato, UF
R/FR-5	Biological studies of the spiny lobster in South Florida	1975	1978	Richard E. Warner, Christopher Combs, William Mendenhall, UF
R/FR-6	Attractants of the spiny lobster in South Florida	1975	1976	Barry W. Ache, FAU
R/FR-7	Blue crab migration patterns along Florida coastlines	1975	1976	Frank J. Maturo, Michael J. Osterling, UF
R/FR-8	Implementation of fishing gear design in hydraulic flumes through the model approach	1976	1976	B. A. Christensen, UF
	Coastal Policy			
R/L-2	County and local ordinances concerning the public interests in Florida's coastal beaches	1976	1976	Frank E. Maloney, Dan Fernandez, UF
	Education			
E/T-1	Associate of Arts in marine technology	1976	1977	Roger M. Lloyd, Jr., FJC
E/T-2	Associate of Science in underwater technology	1976	1977	James Woodberry, Peter Navaretta, FIT
E/Y-1	Florida 4-H marine program development project	1976	1976	Thomas C. Greenawalt, UF

	Advisory Services			
A/MAP-1	Marine Advisory Program	Continuous		John T. Woeste, Marion L. Clarke, UF
	Advisory Services Research			
R/AS-1	Human factors in the economic development of a northwest Florida Gulf coast fishing community	1975	1976	J. Anthony Paredes, James Sabella, FSU
	Short Term, Pilot & Demonstration Projects			
M/PM-2	Florida Sea Grant immediate response projects:	Continuous		
	• Behavioral control of **Tursiops truncatus** by underwater sound	11/74	6/76	David K. Caldwell, Melba C. Caldwell, Harry Hollien, UF
	• Studies on methods to protect against the effects of Portuguese Man-O-War (**Physalia** sp.) stingings	4/75	6/76	David Hessinger, USF
	• Economic consequences of lengthening the oyster season for Apalachicola Bay, Florida	6/75	2/76	Charles Rockwood, FSU
	• Social impact of Hurricane Eloise	9/75	6/76	Earl J. Baker, John C. Brigham, J. A. Paredes, Donald D. Smith, FSU; P. Doughty, UF
	• Selective breeding and hybridization of **Macrobrachium** shrimps	12/75	6/76	Sheldon Dobkin, FAU
	• Experimental manipulation of the bay scallop	1/76	12/76	Norman Blake, USF
	• Assessment of damage from Hurricane Eloise and its effects on the Beach	2/76	12/76	James A. Purpura, UF
	• Characteristics of Aponin	3/76	12/76	D. F. Martin, USF
	• Economic and social significance of artificial reefs off Clearwater	4/76	4/77	Frank Manheim & Eila Manni, USF; H. Matthews, St. Petersburg Community College
	• Genetic relatededness of different geographic populations of spiny lobster (**Panulirus argus**) in Florida	4/76	10/76	Robert Menzies, Nova Univ.
	• Pilot project in use of ultrasonically tagged red snapper as a means of following schools of fish	6/76	9/76	William Carr, UF
	• Estuarine data management	6/76	12/76	James McClave, UF
	• Culture and transplant studies of the seagrass **Ruppia**	6/76	10/76	Peggy Winter, UWF
	• A study of the spawning movements & the spawning site of the red drum, **Sciaenops ocellata**, using ultrasonic transmitters	7/76	12/76	William Carr, UF
	• Guidelines for establishment of rules and regulations for managing Florida's aquatic reserves	7/76	12/76	Edward Fernald, Roy Herndon, FSU
	• Demonstrate in-situ performance of an artificial floating breakwater	9/76	8/77	Jeffrey Fisher, MAP
	• Characterization of the inter-tidal soils of Rookery Bay, Florida	8/76	12/76	C. L. Coultas, FAMU
	• Cathodic protection against sea water	9/76	8/77	William Hartt, FAU
	• Environmental systems analysis of MTDD Dam on Turkey Creek	10/76	10/77	Diane D. Barile, FIT
	Administration			
M/PM-1	Administration of the State University System of Florida Sea Grant College Program	Continuous		Hugh L. Popenoe, William Seaman, Jr., UF

BUDGET, CALENDAR YEAR 1976*

Florida Program Area & Federal Classification	NOAA Sea Grant	University System Guarantees & Sponsors**
ESTUARINE MANAGEMENT RESEARCH		
Support of Coastal Decisions	$ 72,300	$ 51,200
Pollution Studies	61,000	30,600
OCEAN ENGINEERING RESEARCH		
Coastal Engineering	185,300	186,700
FISHERIES RESOURCES RESEARCH		
Living Resources	109,900	56,400
Marine Economics	25,300	29,200
Resources Recovery & Utilization	12,300	8,600
LAW RESEARCH		
Ocean Law	32,800	4,000
EDUCATION		
College, Vocational, & Youth	72,400	331,000
ADVISORY SERVICES		
Extension Programs	302,100	186,600
SHORT TERM & PILOT STUDIES	53,200	22,200
ADMINISTRATION	70,800	31,200
TOTALS	$997,400	$937,700

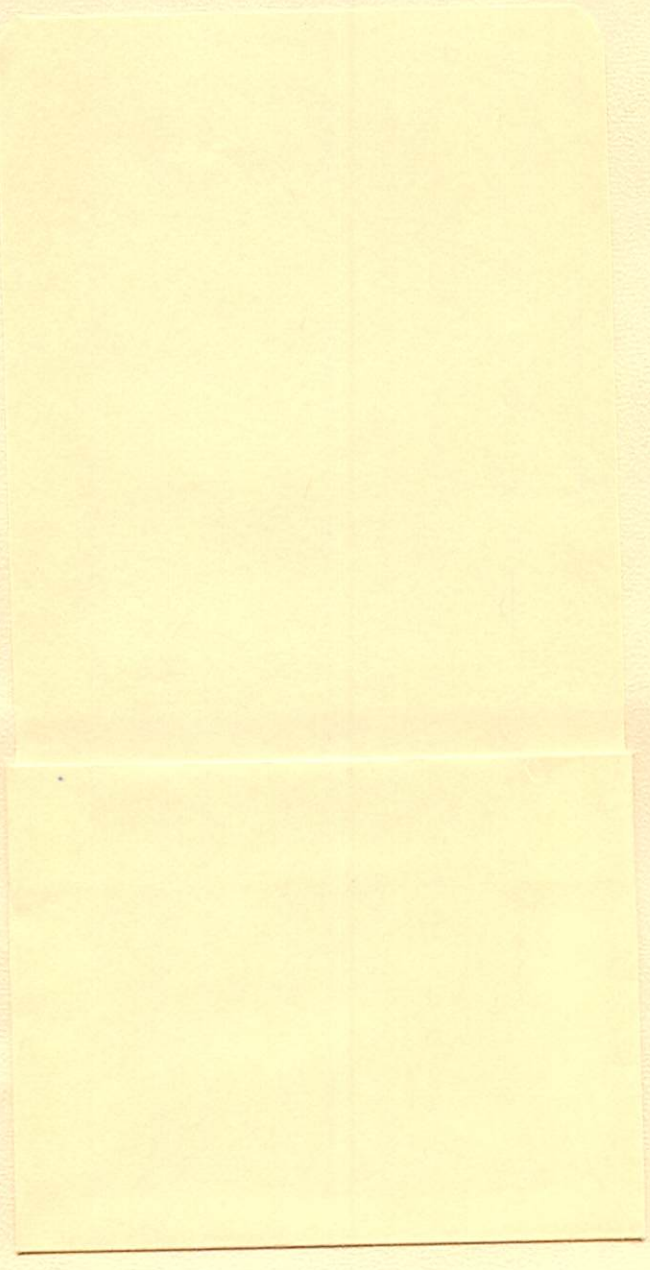
*Approximate figures subject of final audit
**No federal funds included

SPONSORS

Boards of County Commissioners of Various Coastal Counties (advisory services)
Buckeye Cellulose Corporation
Coastal Plains Center for Marine Development Services
Collier County Conservancy
Florida Board of Regents
Florida Department of Environmental Regulation
Florida Department of Natural Resources
Florida Department of Transportation
Florida Keys Community College
Florida Power and Light Corporation
Franklin County Board of Commissioners
Gulf-Tampa Drydock Company
Hillsborough County
Jacksonville (city of) Bioenvironmental Services
Jacksonville Shipyards, Inc.
Martin Marietta Aerospace
Monroe County
Palm Bay (city of)
Palm Beach County
Pinellas County
State University System of Florida Institute of Oceanography
Tampa (city of)
U.S. Corps of Engineers
U.S. Environmental Protection Agency
U.S. National Marine Fisheries Service
U.S. Navy

GRANTEES

Florida Agricultural and Mechanical University, Tallahassee
Florida Atlantic University, Boca Raton
Florida Institute of Technology, Melbourne and Jensen Beach
Florida Junior College, Jacksonville
Florida State University, Tallahassee
Heed University, Hollywood
Nova University, Ft. Lauderdale
University of Florida, Gainesville
University of North Florida, Jacksonville
University of South Florida, Tampa
University of West Florida, Pensacola



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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 Service, John T. Woeste, dean, in conducting Cooperative Extension work in Agriculture, Home Economics, and Marine Scineces, 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.