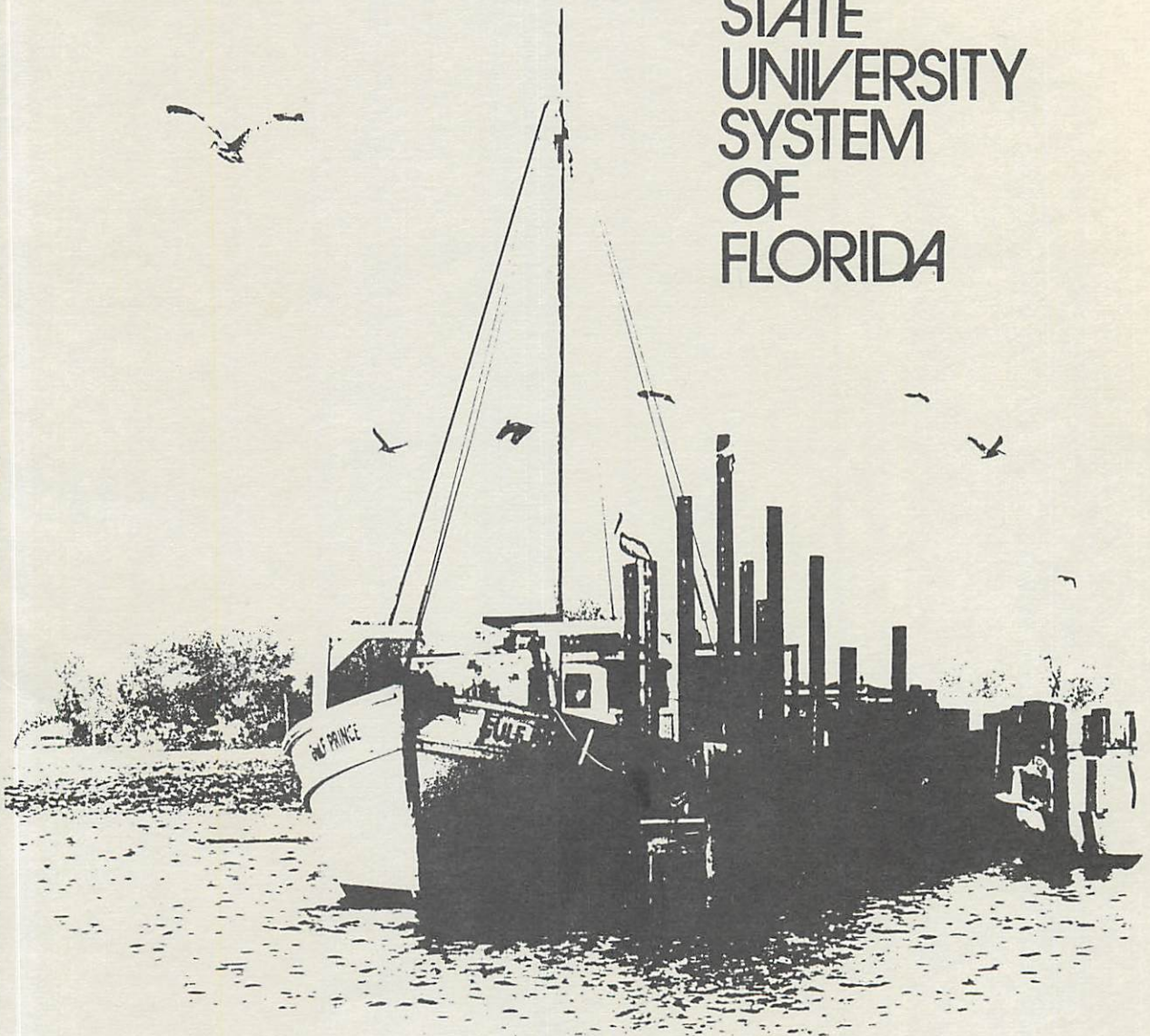


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# THE SEA GRANT COLLEGE PROGRAM

January 1/December 31, 1977

## STATE UNIVERSITY SYSTEM OF FLORIDA



**STATE UNIVERSITY SYSTEM OF FLORIDA  
SEA GRANT COLLEGE PROGRAM—1977**

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This public document was promulgated at a cost of \$1655.90 or \$.552 per copy, to provide an annual report of the Florida Sea Grant College Program.

*"I must down to the seas again. . ."*



## **STATE UNIVERSITY SYSTEM OF FLORIDA SEA GRANT COLLEGE PROGRAM 1977**

### **ANNUAL REPORT**

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# FLORIDA SEA GRANT '77



*“...to the lonely sea and the sky.”*

## DIRECTOR'S STATEMENT

The sea—eternal, always present; always changing; quiet and unassuming at times; more demanding at others; reflecting life itself—has, since the beginning, lured man almost irresistibly to its shores.

With the first boat, man's horizons expanded for he was no longer confined on the land, but could explore beyond it, out into the sea, to expand his fishing ground, to seek new worlds, until today he moves over and under the sea almost as easily as he drives to work.

In larger numbers he has migrated to coastal areas until, in the United States, more than half the population lives in areas bordering the oceans and Great Lakes. In just 25

years, according to one prediction, as many as 200 million Americans may live in this relatively small strip near the water.

In Florida, as in the rest of the country, the coastal strip is a fragile area harboring not only large urban centers with extensive industrial development, but also breeding grounds for various species of marine life. Assisting in the maintenance of the delicate balance between these two extremes and promoting the wise use and development of the state's valuable coastal and marine resources is the goal of the Florida Sea Grant College.

Just who goes down to the Florida sea? To begin with, a goodly number of the state's 30,000,000 yearly visitors, who rank beaches and fishing as prime attractions. Also, nearly 75% of the state's new residents settle in coastal



areas. Statistics associated with America's fastest-growing coastal state include: over 10,000 commercial fishermen, 1,000 marinas, and about 500,000 registered boats. Geographically, the state's coastline is as long as the rest of the U.S. Atlantic states combined.

Since it began in 1972, Florida Sea Grant has worked to insure that public and private decisions about economic and natural resources are as informed as possible. On a practical basis, Sea Grant works in the land grant tradition of research, education, and advisory services. In 1977, 100 university-based faculty and professionals, about 60 graduate and undergraduate students, and over 30 technical and support personnel were involved in Florida Sea Grant.

In return, literally thousands of so-called "users" were involved, not only through participation in workshops on beach erosion, seafood preparation or fishing gear improvements, but also in assisting such projects as canal design or oil spill gear development. Divers trained by Sea Grant went down to the sea to find good jobs in the industrial sector. Marine technologists have found a solid job outlook in northeast Florida. From zero enrollment three years ago, the Florida 4-H marine program now exceeds 7,000. In all, over 50 universities and sponsors collaborated in Sea Grant.

Transcending the major program areas described in this report are common themes such as the restoration of marine resources. Practically, this translates into work on canal design, seagrass revegetation, and uncovering buried natural reefs. Just as foresters can reforest upland acreage, Sea Grant has looked at ways of restoring production of marine and coastal waters.

Along these lines, in 1977, we also looked at ways to enhance natural production. For example, the mid-year conference on artificial reefs led to formation of a statewide advisory team to assist placement of fishing reefs.

Water, its quality and quantity, concerned more of the public in 1977. Sea Grant continued long-term involvement in such issues through support of coastal forest research, while starting new work on saltwater tolerance of ornamental plants. A conference on the role of freshwater in estuaries was held.

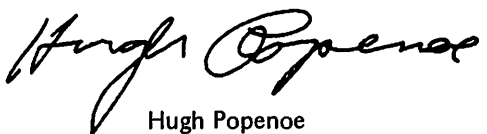
The Extension Service delivery system—longstanding in its effective service to agriculture—has made important contributions to a host of new marine audiences while working on behalf of the universities assembled under the Sea Grant umbrella. With an advisory position for the Big Bend planned for early 1978, all coastal counties will have at least part-time coverage from a marine advisory agent. Local counties supplement Sea Grant and state funds so that individual counties may obtain full-time advisory coverage.

Marine advisory efforts helped residents and tourists alike, through such projects as business management workshops or the handling of thousands of information requests. At other times marine advisory personnel assist in the conduct of research or actually demonstrate research findings.

We continue to encourage Sea Grant as a springboard to other activities. For example, a team coordinated by Florida Sea Grant was awarded funds to draft a management plan for the Gulf of Mexico reef fishery. Other researchers began new projects supported by such sponsors as the petroleum industry.

In looking ahead, we see the generous provision of matching funds provided by sponsors as a key to growth of Sea Grant. As president of the national Sea Grant Association in 1977, I had first-hand experience with the federal deliberations over cost-of-living increases in the Sea Grant budget. In a state with the enormous potential of Florida, we must encourage attention to marine and coastal issues that will move us to the forefront of the ocean world.

Sea Grant, then, responds not just to the call of the sea but also to the needs of persons and groups who depend upon the sea and coast for business and pleasure. That is why our universities go "down to the sea."



Hugh Popenoe  
Director

# RESEARCH

*Sixth in the value of its fisheries...*

*A shoreline that would stretch from Miami to Boston...*

*Nearly 300 million visitors a year...*

*Over 50 tidal inlets...*

*Nearly 300 miles of beaches in a critical state of erosion...*

*Florida...a state truly married to the sea, in a unique geographical position as a peninsula that extends into the South Atlantic and Gulf of Mexico...is a natural priority for the Sea Grant Program.*

*Sea Grant research, following the Sea Grant philosophy, is practical research aimed at solving real problems. These problems are often defined by scientists and laymen alike. Both, too, often collaborate on seeking answers.*

*This approach is sharply pointed up in a number of projects during the past year, including the continuing studies of Hillsborough Bay and the Apalachicola and St. John's estuaries. The five-year study on littoral drift and the sand budget which addressed the problem of erosion of much of Florida's shoreline was concluded this past year. Other engineering research involved the problem of proper flushing of finger canals which lace the Florida coast in many areas, and corrosion of concrete structures—a serious problem in connection with bridges from the mainland to Key West as well as in many other coastal areas. Development of a prototype oil spill recovery unit using magnetic retrieval of oil soaked ferrofoam was also completed with the first tests completed successfully in Tampa Bay. In the area of fisheries, studies of the spiny lobster were completed and the economic analysis of Florida commercial fishing and seafood marketing continued.*

*Florida figures prominently in the nation's rich store of marine resources, and the Florida Sea Grant College is working to insure the wise development and use of these resources through conservation, proper management, and optimum social and economic utilization.*



*“And a gray mist on the sea's face and a gray dawn breaking.”*



## THE ST. JOHNS RIVER ESTUARY [R/EM-6]

The St. Johns River supports major sports and commercial fisheries for bass, shad, eel, mullet, blue crab and two species of shrimp. It provides nursery areas for many important marine and freshwater species and exports nutrients to enrich offshore fisheries areas. Despite the importance of the St. Johns, very little biological information was available and no systematic research had been conducted on the biological systems of the river. This study began in 1975 in response to requests for information from local fisheries groups, the Jacksonville Area Planning Board, and the Southeastern Fisheries Association.

Twenty-three sampling sites were established along the St. Johns and its major tributaries from Mayport to Lake George. Studies have included: 1) monthly sampling of phytoplankton and zooplankton standing crops and productivity; 2) light, temperature, and salinity profiles; 3) nutrient concentrations; and 4) periodic studies of benthic respiration, diurnal oxygen profiles, sediment analysis and total organic carbon in the water column.

Initial statistical analyses indicate positive, non-seasonal correlations between primary productivity and phosphate concentrations, pH, and temperature. Negative, non-seasonal correlations were indicated with nitrate and iron concentrations. Seasonal correlations exist between primary productivity and light, salinity, turbidity, and dissolved oxygen.

Since the growth conditions for different phytoplankton species may vary widely, attempts to correlate environmental parameters with total primary productivity often prove discouraging. A broad peak in productivity often represents a rapid succession of species associations replacing each other as the environmental conditions change. In general, primary productivity increases in the St. Johns with distance from the mouth. This correlation is lowest during fall and winter months and highest during the spring. The wedge of highest productivity tends to move back downstream during the late summer and fall and upstream beginning in January and February. We are presently attempting to correlate this movement with environmental changes.

The principal investigator has served on several advisory committees to the Jacksonville Area Planning Board and the Coastal Zone Planning Committee for Northeast Florida. Several seminars have been arranged by the Marine Advisory Program for local fisheries groups explaining the research project and the role of the river system in offshore fisheries and inshore productivity. Data derived from this project have been used to evaluate several development projects within the river drainage system. The research team is also cooperating with the St. Johns Water Management District in setting up a river monitoring program.

Matching funds were supplied by the Florida Department of Environmental Regulation and the City of Jacksonville.

## ESTUARINE MANAGEMENT

From the beginning, research in estuarine management by the Florida Sea Grant College focused on potentially major estuarine changes likely to be significant beyond a local site, and those involving organizations charged with management decisions for which the research information would be pertinent. The logic of this approach is increasingly apparent not only because 75 percent of Florida's new residents now settle in the coastal zone, but also because fully 70 percent settle in just 16 out of 38 coastal counties. A number of coastal areas in Florida rank as the fastest growing metropolitan areas in the nation.

This last year, as has been the case in previous years, interest in this research by management and planning agencies has been evident in the commitment of funds to match those provided by Sea Grant in 1977, projects involved research on the St. Johns Estuary, effects of pollution abatement on Hillsborough Bay, stormwater runoff in the Apalachicola Estuary, and seagrass transplantation studies. A major concern associated with all of these investigations is the desire to provide decision makers with the data necessary to make intelligent management decisions in key coastal areas.



## HILLSBOROUGH BAY [R/EM-7]

Construction of the City of Tampa advanced tertiary wastewater treatment (AWT) plant has afforded a unique opportunity for study of the effects of removal of the major point source of pollution in the estuarine environment of Hillsborough Bay. Objectives of the third year of study were to provide continuous pre-AWT data on water quality and bottom-dwelling infaunal invertebrates, to document the initial changes accompanying the anticipated start up of the AWT plant and to carry out a detailed analysis of pre-AWT biotic, sedimentary and water quality data.

Although the plant was due to come online during 1977, additional delays have caused a postponement until early 1978. The AWT plant switched from primary to secondary treatment on January 29, 1978. Full tertiary treatment, involving both nitrogen and phosphorus removal will be phased into operation during the spring, 1978.

The City of Tampa and the Hillsborough County Environmental Protection Commission have continued to provide matching funds, data and personnel for the project. Preliminary information was provided to the Tampa Port Authority and the Army Corps of Engineers to aid them in assessing possible effects of the Tampa Harbor Deepening Project. Additional information was provided to the Southwest Florida Water Management District on potential effects on the bay environment of restricting specific stream flows.

During 1977, the third year of study, continuous monthly samples of bottom-dwelling species were taken in Hillsborough Bay. Marked variations in species numbers and density patterns noted earlier at the stressed stations continued. The die-off of the bottom-dwelling species seen in 1975 and 1976 happened again in 1977, but commenced in July and continued until at least November at the stressed stations. During the same months, for the first time in this study, a depression of species numbers and densities occurred at the unstressed stations. Lowered dissolved oxygen levels on the bottom appear to be the implicated factor in depressing the stressed fauna. No obvious explanation is available for the lower abundances at unstressed stations.

Data obtained from the project have been provided to the Tampa Port Authority and the Army Corps of Engineers to aid them in assessing the potential effects of the Tampa Harbor Deepening Project. The Corps commenced channel dredging in Hillsborough Bay during November 1977, and will continue for approximately 22 months.

At the same time, the Tampa Port Authority funded a companion project entitled, "Tampa Harbor Deepening Project Sensitive Areas and Benthic Monitoring."

This new project extends the scope of the Sea Grant project, and will allow an evaluation of Sea Grant data with an eye toward determining any effects due to channel dredging.

## SEAGRASSES [R/EM-10]

Because they are primary producers, seagrasses are important benthic plants which provide shelter and food for animals and stabilize the substrate. The number of seagrass beds in estuaries along the coast of Florida seems to be decreasing and in some cases, have completely disappeared—a situation which can be linked to a decline in water quality attributed to the activities of man. Regulatory agencies and public awareness combined have in recent years made some headway in restoring water quality which makes it possible for seagrasses to grow again. Natural revegetation is a slow process, however, restoration can be hastened by using transplant techniques.

Methods were developed for transplanting the seagrass *Ruppia maritima* L. in a low salinity estuary in Northwest Florida. Plant fragments were placed in a tubular net bag which was layed against the substrate and held in position with stakes. The plants sent branches through the holes in the netting and eventually grew beyond the edges of the net bag.

Using these methods, transplants were made monthly at two sites to test for seasonal effects on transplant initiation. This experiment was begun in August 1977, and is still in progress.

Measurements of growth rates of plants in natural and transplanted beds were begun. The natural beds grew rapidly during the spring and fall, declining during the winter and summer. More data must be accumulated before comparisons can be made between natural and transplanted beds.

Measurement of the physico-chemical parameters of transplanted and natural seagrass beds in East Bay showed that this estuary had low nutrient levels. Although transplant sites were separated by as far as five miles, the sediment nutrient levels were very similar. The major difference between the sites seemed to be the rate of decline in water temperature during the fall.

Culture techniques were established for growing *Ruppia* in natural seawater and Instant Ocean and the effects of varying nitrate-nitrogen and phosphate-phosphorus concentrations were tested. Supplementing the culture medium with phosphorus resulted in a faster growth rate while increased nitrogen levels did not affect the growth rate.

Seed germination experiments were initiated but these met with little success.

Matching funds were supplied by Escambia County and the City of Pensacola, and the facilities of the Environmental Protection Agency (EPA) laboratory were used.

## ESTUARINE PRODUCTIVITY—APALACHICOLA BAY [R/EM-11]

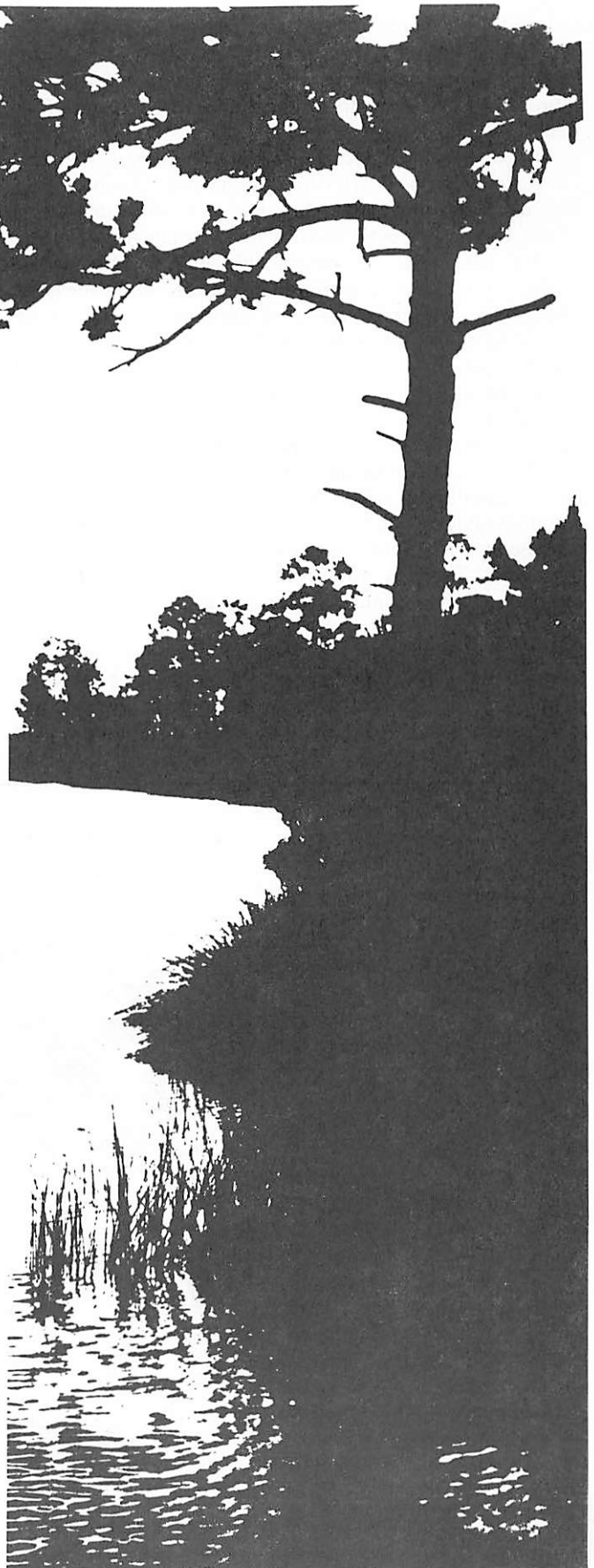
The importance of the Apalachicola Bay System as a highly productive and unpolluted sports and commercial fishery has been well documented in previous studies. Five years of accumulated physico-chemical and biological data are being used in management decisions in the Apalachicola Drainage System. Investigators have realized, during the course of the earlier studies that changes were occurring in the East Bay area seemingly due to upland clear-cutting operations in the Tate's Hell Swamp by various pulp mill interests. Using matching funds and cooperative support from the Franklin County Board of County Commissioners, the Buckeye Cellulose Corporation, and the Florida Department of Environmental Regulation, a preliminary study was initiated to determine the necessity for further action.

This work indicates that during periods of high productivity in the bay, there is a periodic influx of low quality water from upland areas which could have an adverse impact on key populations of commercial importance at a time when such organisms utilize Apalachicola Bay as a nursery. By diverting and channeling the upland flow into the bay, this action (together, possibly, with the clearcutting itself) could be detrimental to the productivity of the bay.

This one-year study was initiated to attempt to define the impact of upland runoff on water quality and key populations associated with the Apalachicola estuary, including integration of field and laboratory studies to determine the potential short and long-term impact of clearcutting and timbering operations on biotic assemblages in the Apalachicola Bay System. Also to be determined was the feasibility of a modeling approach to a water management program in the Tate's Hell area of the Apalachicola drainage based on field and laboratory information.

### Detoxification Process

The major objective of this portion of the study was to use the detrital microfloran and primary detritivores as a





test system to study factors affecting the postulated "detoxification" process of storm water runoff that occurs naturally. The detrital microflora and primary detritivores form the basis of a significant portion of the estuarine food web.

The development of a reproducible assay system for acute stress to the detrital microflora proved much more difficult than anticipated. It was easy to show depression of the respiratory activity with full-strength runoff water, but the data were not reproducible and the effects were at the 8-10% level of inhibition. A more subtle measure, which was a better integrator of stress over a long period, proved to be the metabolism of the endogenous storage material poly-B-hydroxybutyric acid (PHB)—the bacterial equivalent of fat. A quantitative and reproducible assay for PHB was developed from environmental samples showing that when stresses like low pH, high salinity or toxic runoff water impinged upon the detrital microflora under growth conditions where they normally could grow at doubling rates of one to two days, there was a reproducible increase in PHB formation and a rapid decrease in PHB utilization. This has now been verified, and for the first time provides the method necessary to follow the natural detoxification process.

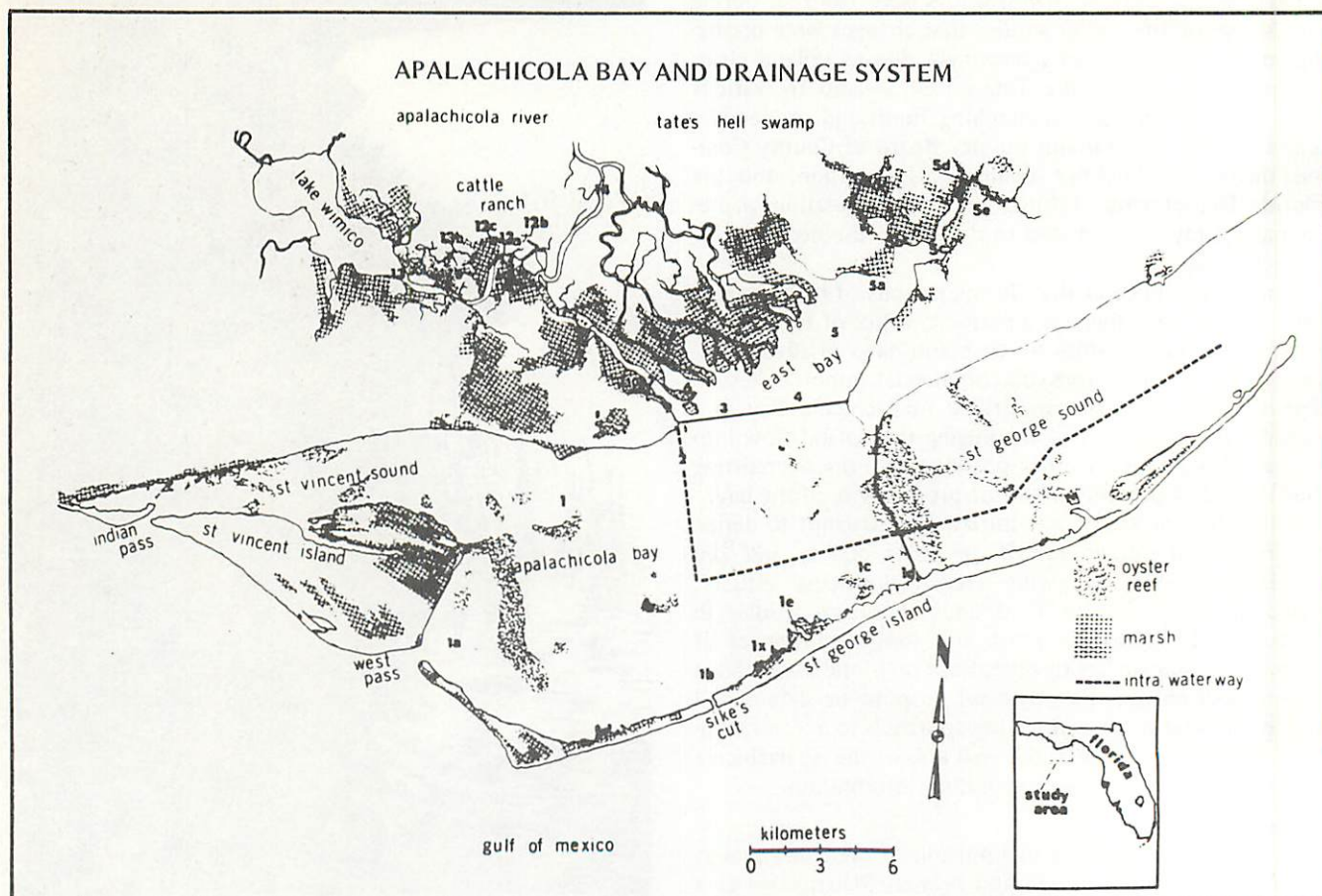
In parallel experiments, one of the most effective methods of rapidly raising the pH and lowering the color of toxic runoff water proved to be slow percolation (one week or so) through the estuarine muds. Any assay system

is now available which will be ready soon. It will be applied to microcosms where the integrated effects in the estuarine food webs from the microbes through the top predator fish can be examined and the data utilized to develop the parameters which will maximize the rate of bio-purification of the storm runoff water.

### Field Monitoring Program

The field monitoring program included analyses of changes in grassbed functions, benthic infauna, litter-associated organisms, juvenile (epibenthic) fishes and invertebrates, and larger fishes. The physico-chemical functions of the Apalachicola Estuary were reviewed, with detailed descriptions of the major habitats in the bay system. Apalachicola River flow as studied with the rain flow determined to be a major cause of seasonal salinity fluctuations. Summer-fall changes in the salinity regime were ascribed to runoff from local rainfall (more pronounced in East Bay than Apalachicola Bay).

Various water quality trends were noted with water color tending to decline with time in outer bay areas (following long-term river flow fluctuations), and portions of East Bay significantly increasing levels of color over the study period with peaks apparent during spring and late summer months and were directly attributable to local rainfall and upland runoff. Although turbidity generally declined during the period, being highly correlated with river flow,





peaks of turbidity were noted in benthic areas of East Bay during periods of high runoff. Such functions remained temporally stable in Apalachicola Bay indicating proximity to local runoff as a determinant of water quality in the bay.

Changes in the eastern portions of East Bay (high color, low pH) were associated with runoff from the Tate's Hell Swamp during periods of local rainfall. Preliminary observations and results associated these changes with clearcutting, ditching, and draining activities. Upland studies indicated that clearcutting was only part of the problem, and that the establishment of drainage ditches contributed to a channelization of the water flow from upland swamps to the bay. This was particularly evident during periods of rainfall. Thus, the water quality changes observed in the bay were postulated as a result of complex interactions between the clearcutting and drainage activities in upland areas and local rainfall patterns.

A combined field and laboratory study was conducted to determine the avoidance reactions of blue crabs (*Callinectes sapidus*) to the highly colored (acidic) runoff from clearcut areas in upper portions of East Bay. Blue crabs of two age groups showed marked laboratory avoidance of runoff and of control water with experimentally reduced pH. Small crabs were abundant in areas characterized by pH levels openly avoided under laboratory conditions. The larger crabs, however, apparently avoided such areas in the field. Factors other than pH were thought to be functional in the field distribution of the crabs.

Studies were also carried out concerning the potential impact of storm water runoff from clearcut areas on short- and long-term functions of epibenthic fishes and invertebrates in the Apalachicola Estuary. The summer-fall period in the East Bay areas was considered important since a variety of organisms nursery in this part of the bay during this period. This includes penaeid shrimp, blue crabs, and various finfishes. At this time, productivity tends to peak in various portions of the system including species richness and diversity in addition to the presence of considerable numbers within given populations.

Various biological functions were monitored in East Bay where short-term changes in the physical environment were noted during periods of upland runoff. The biological situation was considered complex since the distribution of organisms in such areas depends to a degree on a complex of physical requirements. Some species were actually drawn to the runoff areas (perhaps as a trophic response) only to leave as water quality conditions became intolerable.

## Numerical Modeling

Available numerical models were reviewed in order to determine if available technology could address the problem. In addition flow, tidal, climatic, hydrologic, and biological data were collected and reviewed. It was concluded that a real-time hydrological model (based on the Stanford Watershed Model) and a vertically-averaged two-dimensional salinity and hydrodynamic model could be linked to simulate the system. Some fieldwork was undertaken, data requirements were assessed, and scheduling was outlined. Preliminary analysis of biological data was made.

Concurrently a more general study was made on the status and needs of water quality modeling for the Florida coastal zone. A review of model types and technology understandable to planners and managers was written and disseminated. Reviews of several Florida EPA "208" plans were made to determine the state-of-the-art. It was concluded that the major constraints in model usage are: 1) inability to route basin effluents to the estuarine zone, 2) inability to handle nonpoint effluents, and 3) inadequate verification.

On the basis of these conclusions, a numerical simulation of the Apalachicola can be seen to have several significant generic applications such as: 1) testing the available technology to simulate a rather simple system, 2) developing a method of predicting nonpoint source loads, especially for silviculture, 3) developing a method to predict land use change effects upon the receiving estuary, 4) ascertaining appropriate verification criteria for water-quality management models.

One very interesting novel discovery was that landsat photos should be processed to display both land uses overtime and selected instantaneous water quality throughout the Bay. Through coordination with the EPA Remote Sensing Laboratory in Las Vegas, Nevada, this information will be used for model calibration and input to provide both a high degree of predictive reliability and generic capacity.

To conclude, a schedule for application of existing engineering technology to simulate the effects of silvicultural activities upon estuarine water quality was proposed. Results of the review process were widely disseminated. It was concluded, on the basis of a general review of Florida coastal water-quality needs, that the Apalachicola simulation would serve as a needed prototype for analysis of land use effects, verification and nonpoint source technology.



## DATA MANAGEMENT FOR ESTUARINE PROJECTS

Estuarine studies produce similar data. In addition, results of the studies pinpoint interaction of variables that either coincide with other investigations, differ with like investigations and/or provide justification for future study. To date, there have been few coordinated efforts to bank all of this information for statistical and retrieval purposes.

In order to determine the feasibility of a data management and statistical analysis service for Florida Sea Grant, a study was made to establish: 1) the size, status and structure of current data bases, 2) the type of investigator data base interactions desired, and 3) the type and degree of statistical services to be supplied to the investigators.

The principal investigators of estuarine research projects were contacted and each was studied as to possible application of a data management system. Also, initial contact was made with some of the many outside data bases to determine overlap, possible interactions and various data base design criteria being used by sources useful to Sea Grant users.

According to the study report, all the investigators contacted felt that the system proposed by Data Management and Statistical Analysis Service would be advantageous. Many felt they were being buried by their data rather than enlightened by it, because each spends a great deal of time working up individual program schemes, storage formats and mechanics of the data base—time that could be used to better advantage in the analysis procedures. A final report is in preparation.

### TURKEY CREEK

The Palm Bay-Melbourne-Tillman Drainage District (MTDD) of East Central Florida has been subject to extensive diversion of water from a wetland into the Indian River Estuary for more than 50 years. A preliminary study, supported by Florida Sea Grant, investigated the effects of drainage on productivity, the hydrologic cycle and land use in the Palm Bay region. The study revealed (1) a lack of water quality data for the creek, (2) differences in rainfall patterns which could affect plans for flood control and future water supply, and (3) insufficient up-to-date information on stage and flow from the drainage district and the creek.

Since several agencies are engaged in new plans for the rapidly developing region, the present investigation was designed to provide information to decision-makers and local citizens for the formulation and analysis of these plans. In addition, methodologies employed in this study could be used as a basis for similar land use and energy cost/benefit analysis.

Objectives of the present MTDD Palm Bay study were: (1) to generate yearly water quality data for Turkey Creek necessary for coastal zone planning and evaluation of runoff patterns, (2) to investigate the energy cost/benefit of the proposed lock and dam on Turkey Creek for local decision-makers and determine the applicability of the method to

engineering projects, (3) to document regional rainfall distribution in South Brevard County and the yearly flow from the Main outlet canal of the MTDD, and (4) to extend the systems model of the MTDD Palm Bay region.

Water quality data were collected bi-monthly on Turkey Creek from January 1977 through December 1977. Twenty-two parameters were tested. The data is currently being analyzed for presentation in the project final report.

During the investigation of the energy cost to benefit of the lock and dam, the MTDD area was mapped using facilities at NASA, Cape Kennedy. LANDSAT information from multispectral infra red imagery was used to designate land use. Final maps were planimetered using NASA facilities. In addition analysis was undertaken to determine the accuracy of two methods of LANDSAT imagery interpretations.

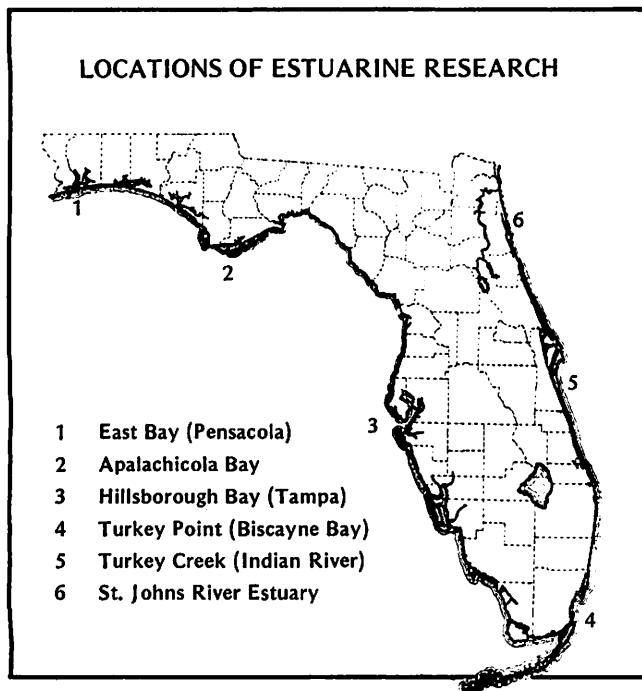
Rainfall gauges were distributed throughout the study area and were incorporated into a network of gauges placed by the St. John's Water Management District and Brevard County. These agencies met, established sites and exchanged data during the year. Region patterns of rainfall can be established over a ten-year period as this cooperative effort is extended.

A digital recording staff gauge was installed and maintained on the MTDD main canal by the St. John's River Water Management District. Personnel from Brevard County and the MTDD study helped in developing rating curves necessary for calculation flow as compared to staff gauge information. A non-recording staff gauge was donated to the project by U.S. Geological Survey personnel and surveyed by the Florida Department of Transportation. Daily records are being kept on water levels at the mouth of Turkey Creek near the Indian River.

The MTDD-Palm Bay study has served as a unifying force in hydrologic and environmental studies regionally. The rain gauge network and staff gauges will continue to operate beyond the end of the project. Information obtained will be used by the MTDD, St. John's WMD, Brevard County and various planning agencies. The Department of Transportation has included Turkey Creek area in a comprehensive study of the effect of causeway construction on estuarine systems. The water quality parameters of that study and the 208 Water Management Program have been co-ordinated with that of the MTDD Study and will be available to agencies making planning decisions on a local, county and state level.

The MTDD study has also served as the center of public information on environmental and water resources in the area. Presentations have been made before elected officials. State permitting agencies have used data, maps and background gathered during the study in permit application review.

Matching funds were supplied by a number of interested agencies and private businesses. Major contributors were St. Johns River Water Management District, and NASA.



## SEAGRASS ANIMAL COMMUNITIES

One of the factors causing seagrass beds in Florida estuaries to recede is the thermal pollution produced by certain industries located adjacent to the estuaries. Since seagrass beds provide a habitat for some organisms, a place of refuge for others and a food source for still others, restoration of this coastal vegetation is vital.

Four years ago, the Turkey Point region of Biscayne Bay, which had been subject to thermal effluents from a nearby power plant, was selected as a *Thalassia testudinum* restoration site. This study assesses and compares epibenthic and infaunal animal communities in the restored or replanted areas of Turkey Point with the unrestored and should enable investigators to predict the type of recolonization that may be expected to accompany such restoration programs.

The sampling was done on a quarterly basis beginning in late July. Initially ten sampling stations were proposed, and all of these were sampled with the infaunal ("grab") sampler during the first and second (October) sampling periods. Trawl sampling during the July period covered some of the unrestored, restored and control stations, but technical difficulties prevented a complete series from being taken. The second quarter's samples, however, included all trawl stations.

Dense algal mats, common at the control station and some of the restored stations, made testing of the samples both difficult and time-consuming. Although the initial proposal called for the sampling of restored and unrestored stations in and adjacent to both replanted locations, there was no reason to believe that one transect would be recolonized differently from the other. Consequently, it was decided to reduce the number of sampling stations. Only six stations were sampled during the third quarter.

Results to date are only preliminary as only approximately 20 percent of the samples have been sorted. Complete identifications and analyses have not been made, however, certain trends already are apparent.

The commercially important pink shrimp, *Penaeus duorarum* Burkenroad, and several species of caridean grass and bait shrimp found in the control and restored areas greatly exceeded the numbers found in the unrestored areas. Similar results were found among groups of primary consumers such as the Amphipods and Isopods. Fishes in the sampling area were represented by only a few species, and these were primarily larval or juvenile age classes. Again, the numbers of individuals collected in the control and restored areas were much greater than in the unrestored areas.

Much greater species diversity has been found in the mollusks than in the other 42 species identified to date. Here again, the control station and restored stations yielded much greater numbers, both in terms of individuals and in species diversity. The rather larger collection of marine worms (annelids) has not as yet been identified, virtually all of the penaeid shrimp, and many of the caridean shrimp have been juveniles, which suggests that the restored and control areas serve as an effective nursery ground.

Perhaps the most surprising result to date, is the virtual absence of species of crabs. Less than 50 specimens of any brachyuran crab have been taken. The latter have been juvenile specimens of *Callinectes sapidus* Rathbun. These results contrast markedly from those of Thorhaug and Roessler (1977), who reported hermit and brachyuran crab among the dominant species in the area. Another noticeable difference has been the complete absence of red algae in the sampling area. No appreciable difference in temperature or salinities have been observed from those of previous years, and as yet there can be no explanation for these observed changes.

Matching funds for this project were supplied by Applied Marine Ecological Services. The work is done in cooperation with the University of Miami.



THE SOUTH FLORIDA COAST



THE SOUTH FLORIDA COAST  
A STUDY OF THE COASTAL  
PLANT COMMUNITY  
AND THE BEACH  
PLANT COMMUNITY  
IN THE SOUTH FLORIDA COAST  
AREA





## LITTORAL DRIFT AND THE SAND BUDGET [R/OE-1]

Beaches change constantly—rise and fall, move and flow. Florida's sandy beaches, among the state's most valuable resources because they attract millions of tourists annually, are no exception. However, nearly 300 miles of this shoreline are in a critical state of erosion. This study, in its fifth and final year, consists of several subprojects whose common thread is the need to determine the influence of various factors on the movement of sand in the coastal areas.

It is recognized that too often in the past, attempts had been made to solve local isolated beach problems without proper recognition of the system as a whole. This study of beaches, inlets and wave climate at various locations was undertaken with the hope of providing a better understanding of the sand budget.

The tidal inlets on the Florida coastline interfere with the outercoast littoral processes in that they act either as sand traps (or sinks) or as sources of sediment. The long-term ability of a particular inlet to supply or remove sediment from the outer coast is contingent upon the hydraulic regime of the inlet. The objective of this portion of the project was to obtain hydraulic and sedimentary data at selected problematic inlets in order to better understand the physical processes occurring at these inlets, thus improving the understanding of navigation and beach erosion problems occurring in their vicinity.

Glossaries have been prepared on six inlets to date, the last two being Matanzas and Ponce de Leon Inlets. These two glossaries have provided useful baseline information to the Corps of Engineers for major modification projects in the vicinity of these two inlets. Reconnaissance of Matanzas Inlet has yielded basic information concerning erosion/accretion of shorelines adjacent to real estate properties owned by concerned individuals.

In another area of this research, an experimental sand-bag groin was constructed near Panama City Beach to trap a large percentage of the littoral drift moving along the coast. Accretion and erosion on both sides of the groin are measured by surveys. Waves and currents in that region are measured daily. The energy input by waves into the surf zone is correlated to the sand movements and the generalized functional relationship is determined for application in the Florida Panhandle area. It is considered that the results will be directly applicable to the design of a beach nourishment project for the Panama City beaches.

In another study of sand transport, an array of pressure transducers that can measure both the energy spectrum and direction were employed at Clearwater Beach. It is necessary to know both the energy and direction of waves over a statistically significant time (months or years) in order to understand the causes of sand transport to and from a beach area. Human observations of wave height and average direction are not sufficiently precise, cannot be effective during hours of darkness or storm, and are costly. The wave data gathered at Clearwater Beach should allow for a recommendation on how best to enhance the stability of the beach and stabilize the navigation channel in the inlet.

## OCEAN ENGINEERING

Both information and "hardware" are matters of concern to the Ocean Engineering program, which originally was established to guide the planning and protection of shores and shoreline development. The attractiveness of Florida's sandy beaches is often cited as prime motivation for a majority of the state's 25,000,000 annual visitors who support a \$6 billion tourist industry. Critical erosion affecting much of the shoreline, however, constitutes a threat to existing coastal development. At the same time, new development seeks to avoid existing patterns of costly ill-advised construction.

This year marked the conclusion of several investigations including a five-year project on the Florida sand budget. As by-products of this research a detailed report was published on the use of littoral drift roses to evaluate alongshore sand transport and a nationally unique facility, the Coastal Engineering Archives, was established as a source of valuable coastal data. Studies on a number of Florida's 50 inlets have been completed with glossaries published on six of them.

Florida Sea Grant researchers have also worked closely with the marine industry in projects involving corrosion and oil spill control, and a fourth project, completed this year, addressed the hydrodynamic factors involved in finger canal and borrow lake flushing. With thousands of private homes and scores of condominiums lining man-made canals and lakes which have been dredged out along the coastline of Florida, this is a particularly significant study.

## FINGER CANAL AND BORROW LAKE FLUSHING [R/OE-4]

Often residential canal networks in Florida have not been designed to fit in with the natural characteristics of a site, or to work with the forces and natural systems provided by nature. This has resulted in many acres of destroyed wetlands and many miles of waterways which cannot be effectively flushed by the limited extent of tidal action and the light, variable winds characteristic of Florida's coastal zone.

The purposes of the canal design research project were to review the characteristics of Florida canal sites; to develop an overall approach to canal system design, with appropriate guidelines; to develop a numerical model which would adequately simulate the hydrodynamics, transport and dispersion of pollutants in tidal canal networks; to develop appropriate field measurement techniques and guidelines; and to demonstrate the overall approach to an optimal canal design with the use of the numerical model.

Researchers analyzed the need for various kinds of data, developed appropriate measurement procedures and guidelines, and created and verified a numerical model which can be used to simulate tide, wind induced circulation, and density currents in canal networks. In addition, design guidelines and variability relationships which aid in the synthesis of new canal networks and the modification of existing designs were developed and the use of such design guidelines was demonstrated.

As a result, a capability has been developed for analyzing pollutant transport characteristics in existing tidal canal

network design before it has been constructed. With this procedure, description of the natural variables at a particular site, and relationships obtained from numerical models for the variability of pollutant concentration as a function of tide, wind, canal geometry, and patterns of pollutant inflow, an engineer can synthesize a canal network which is based on sound hydrodynamic principles and can test the ability of the design to meet a specified level of water quality.

The results have been applied to specific test cases developed during several field surveys by the Hydraulic Laboratory, University of Florida. It is expected that, once the design methods have been distributed, the model will be used widely by consulting firms and regulating agencies on state and federal levels throughout the southeastern part of the country for evaluating both improvements to existing designs and new canal systems.

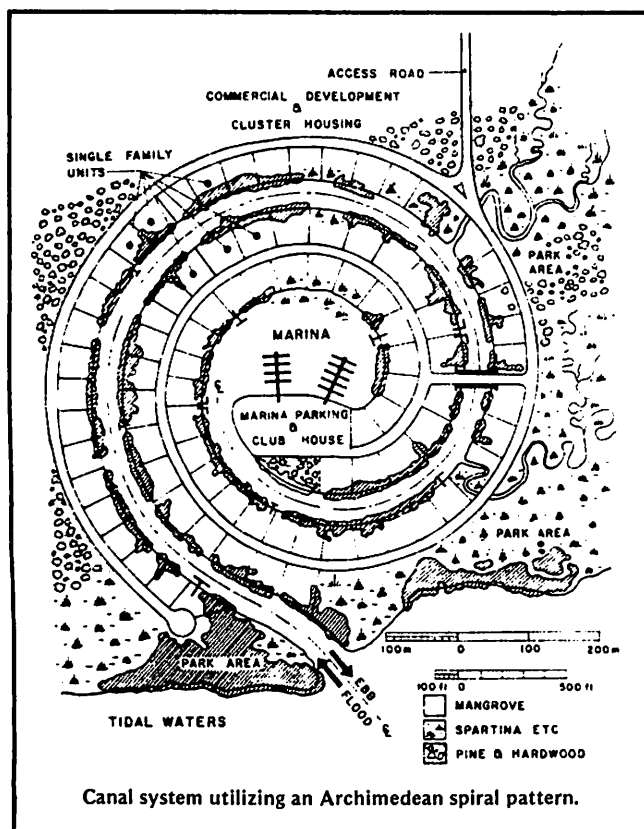
Interim concepts and results have been reviewed with local planning agencies, the County Commissioners of Palm Beach County in February 1976, and the County Commissioners of Indian River County in July 1977. A seminar is planned for May 1978. The design procedures and use of the model will be presented to the Florida Departments of Environmental Regulation and Natural Resources in Tallahassee in June 1978.

A canal design manual is being prepared which is oriented toward the practical application of the results of the canal design research project.

Matching funds were supplied by the Palm Beach County Board of Commissioners and the State of Florida.

## CRACKING AND CORROSION FATIGUE [R/OE-5]

Reinforced concrete, used extensively in coastal structures, has the advantages of both steel and concrete to make it a universal construction material. But when exposed to sea water it is subject to corrosion of the reinforcing metal and subsequent cracking of the concrete. The objective of this study has been to determine ways to minimize cracking and corrosion fatigue of such structures.





This final year of the project focused largely upon additives to reinforced concrete which might enhance corrosion resistance of an embedded metal. In the past, such additives have fallen into the inhibitor category, and as a general rule have not been successful. Results from experiments conducted during the first year of this project suggested however, that additives which enhance corrosion product solubility may inhibit cracking, and, project efforts during the past

year have been directed toward determining if this is the case.

For the additive under investigation to be effective, it must satisfy the following criteria: 1) Enhancement of metal ion or corrosion product solubility must be realized; 2) Corrosion rate of the embedded metal must not be accelerated; 3) Mechanical and physical properties of the concrete must not be compromised; 4) Mitigation or prolongment of concrete cracking must be realized. Research effort during the past year involved selection of additives which were tested as to the requirements noted in category 1 above. Attractive additives were then incorporated into concrete specimens to determine strength (category 2). Subsequently, tests in categories 3 and 4 have been initiated; and these are presently in progress. If a particular additive is able to perform adequately in all four of the above categories, then this technique will be applied to actual reinforced concrete structures in sea water.

Matching funds were supplied by the Florida Department of Transportation.



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## SEA WATER CORROSION FATIGUE

It is generally recognized that corrosion fatigue is an important cause of cracking and failure in marine structures and components, and for this reason increased research is being directed toward this topic. Of the various techniques that have been suggested to relieve such damage, cathodic protection may be the most effective, realistic, and practical, at least for submerged offshore applications.

The purpose of this project was to contribute to the understanding of corrosion fatigue of structural steel in sea water. The need existed because steel is the most widely used tensile load bearing material in marine use and because all materials tend to fracture when subjected to cyclical stresses and a corrosive environment.

Researchers conducted reverse bend fatigue tests upon

notched 1018 steel specimens in sea water as a function of constant cathodic potential. As had been reported by other scientists, cathodic polarization was found to restore an endurance limit. Interestingly, the maximum endurance limit for specimens cathodically polarized in sea water was approximately 100 percent greater than for fatigue in air. A possible conclusion was that calcareous deposits, which commonly occur upon cathodically polarized surfaces in sea water, are either directly or indirectly responsible.

Based upon the corrosion fatigue research performed thus far at Florida Atlantic University under Florida Sea Grant College sponsorship, a major research project fund has been initiated by the American Petroleum Institute Committee on Offshore Safety and Antipollution Research.

It is anticipated that results of this study will contribute to the integrity and safety of welded structures and components in sea water.

## OIL SPILL RECOVERY UNIT [R/OE-6]

The need for a variety of oil spill removal devices has been recognized by oil industries and government agencies worldwide. Because marine oil spills occur under varied conditions, the search for new and improved techniques for recovery is a continuous one.

The original proposal for this project, submitted in 1975, was based on results of experimental research at the University of South Florida into the use of magnetically retrievable sorbents for oil spill recovery and control. The proposal called for development of an oil-absorbing magnetically retrievable sorbent product which could be used repeatedly through many cycles and a companion magnetic recovery unit which would be efficient and relatively free of complicated machinery.

This project resulted in the development of the oil-absorbing, magnetically retrievable sorbent product described and a prototype magnetic recovery vessel which functioned as theorized in the proposal.

The 24-foot portable oil spill recovery vessel, incorporating magnetic principles, was constructed by Gulf-Tampa Drydock Company. The self-contained unit consists of twin pontoons which uses a high velocity water spray system to direct the oil into the region between the pontoons.

The twin-hull prototype design is intended for use in the recovery of thin-film oil (or chemical) spills which might occur on inland rivers and protected harbors.

As the vessel moves through a spill, it sweeps into the five-foot wide region between the pontoons. As oil passes beneath the 100-cubic foot hopper near the bow, a thin blanket of ferrofoam pads or chips is laid down from the rotary feeder mechanism which spans the space between

the hulls. A variable speed control on the feeder allows the operator to select the optimum rate of flow required for any given type of oil.

As the oil-soaked sorbent moves between the hulls and under the rotating magnetic drum, which is slightly immersed, the buoyant forces on the oily sorbent combine with the magnetic forces to cause a strong attachment to the drum surface at the interface. As the oil sorbent is lifted from the water on the afterside of the drum, adhesive forces and magnetic forces continue to hold the sorbent firmly to the drum allowing water to quickly drain away.

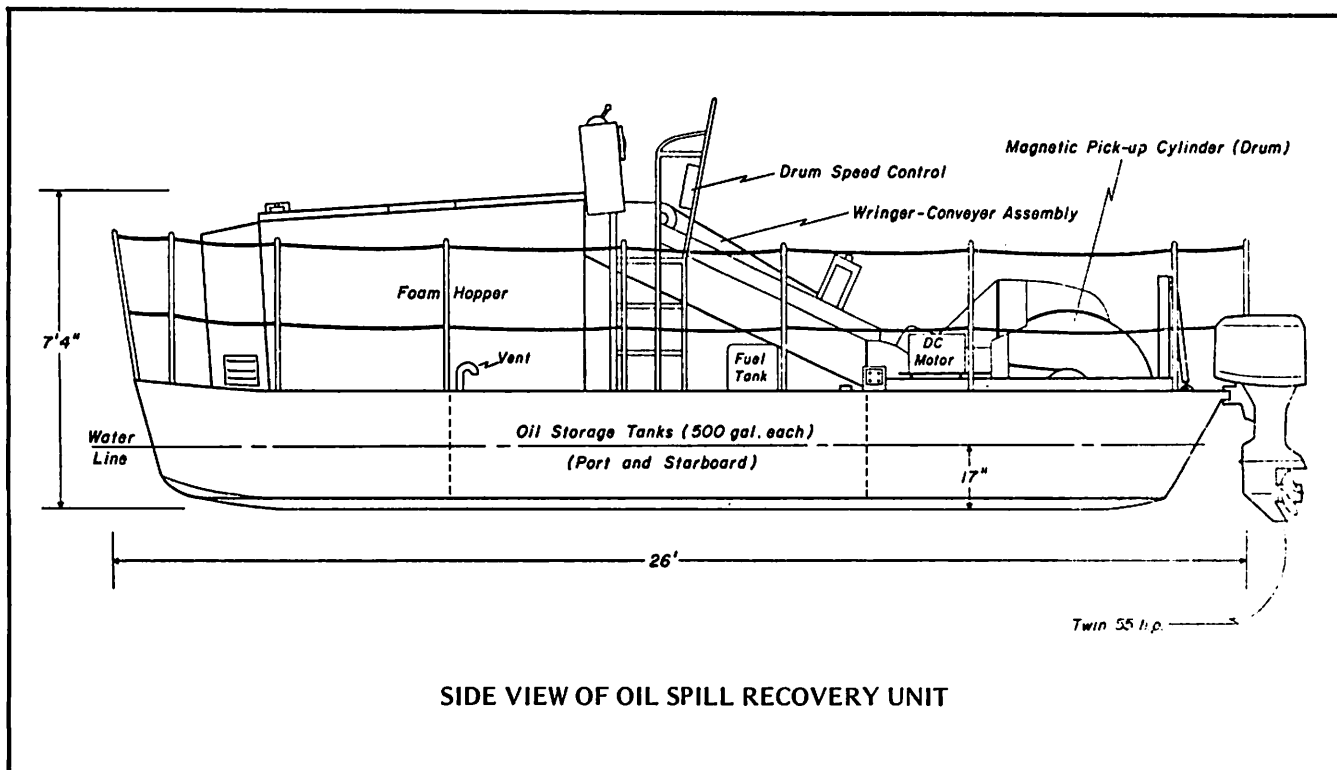
After the oil sorbent is carried over the top of the cylinder, it is removed by a notched neoprene wiper assembly attached to a slanted chute.

From here it is moved by a conveyer-type wringer mechanism to the distribution hopper for reuse. The separated oil is gravity fed into two 500-gallon storage tanks located in the pontoons.

Preliminary performance tests conducted during fair weather no-oil conditions in Tampa harbor in April and May of 1977, demonstrated the advantages to be gained by the addition of magnetic principles to free-floating sorbent systems of oil spill recovery.

As a result of this development effort, a collaborative program of research into magnetic materials and collection systems, with the Foundation for Scientific and Industrial Research in Trondheim, Norway, has been formed and the principal investigator for this project is now working in Norway with others who share his belief in the magnetic method.

Matching funds were supplied by the Gulf-Tampa Drydock Company.





## BEACH RESTORATION [R/OE-7]

Beach restoration projects usually involve dredging of sand from offshore deposits with that sand then pumped onto the beach through a series of pipes. These operations have become increasingly common along Florida's coasts in recent years and will probably expand in the future. Although there is extensive information on the environmental effects of dredging and filling, most reports have focused on bays and estuaries. Much less information is available on the consequences of offshore dredging for beach nourishment.

Of several studies which have been done, one investigated the fish populations before and after a restoration project at Lido Key, Florida, where investigators reported at least a temporary increase in fishes along the beach and near the borrow area. Conversely, another study of an offshore borrow area created three years previously near Treasure Island, Florida, revealed a decrease in the diversity and abundance of benthic invertebrates within the pit compared to the adjacent undisturbed bottom. Last year, Sea Grant researchers surveyed the fishes and nearshore reef communities following beach nourishment in Broward County, Florida, and although no adverse effects were reported in the area of Pompano to Lauderdale-by-the-Sea, substantial physical damage to the reefs was found farther south at Hallandale.

Since no quantitative studies on the environmental impact of beach nourishments in southeastern Florida had been initiated, this project was designed to assess the density and diversity of benthic invertebrate populations in a borrow area created off Hillsboro Beach, Broward County, Florida, in 1972, and to compare these findings with those from nearby undisturbed bottoms.

Six sampling stations were established in order to compare the benthic fauna within the borrow area with that of nearby undisturbed bottom. Three control stations were located at intervals along a line directly north of the borrow area, and three were located within the excavated trough. Samples were obtained by SCUBA divers using a hand driven PVC coring tube. Later, in the laboratory, organisms in the samples were separated from the sediments, identified to species if possible, and counted.

Preliminary results presented a striking contrast to those found in the study of borrow pits on the west coast of Florida in which a low diversity and a low abundance of macrofauna was found within the pit compared to that in adjacent undisturbed areas.

In the nearly five-year interval between the completion of the Hillsboro Beach restoration project and the initiation of this study, the borrow area was not only repopulated by macrobenthos, but it now supports a fauna which is conspicuously diverse and more abundant than in the adjacent undisturbed areas. The rubble created by the dredging operation provides a habitat for numerous sessile and boring organisms which further adds to the productivity of these areas. A great variety of reef fishes were found in the vicinity of the rubble slopes.

Additional support for this project was furnished by the Joint FAU-FIU Center for Urban and Environmental Problems.

## FLOATING TIRE BREAKWATERS

Since the beginning of man's development of the coastal zone, the problem of shoreline erosion has plagued those who build along the coast. This problem exists, not only along the open coast, but also in more sheltered waters. Some areas along many of Florida's lagoons, bays and marine waterways have long-term recession rates of more than six feet per year. And where high ground borders larger expanses of open water, bluff recession can be extremely severe.

Conventional structures used to alleviate this condition such as bulkheads, groins, jetties and rock revetments are quite expensive, discouraging many shoreline landowners from protecting their property. Since the floating tire breakwater has the potential to reduce shoreline erosion in protected waters at moderate cost and with minimal damaging side effects, it was the purpose of this study to design, construct, place and monitor such a structure in order to demonstrate its effectiveness to the community and interested professionals.

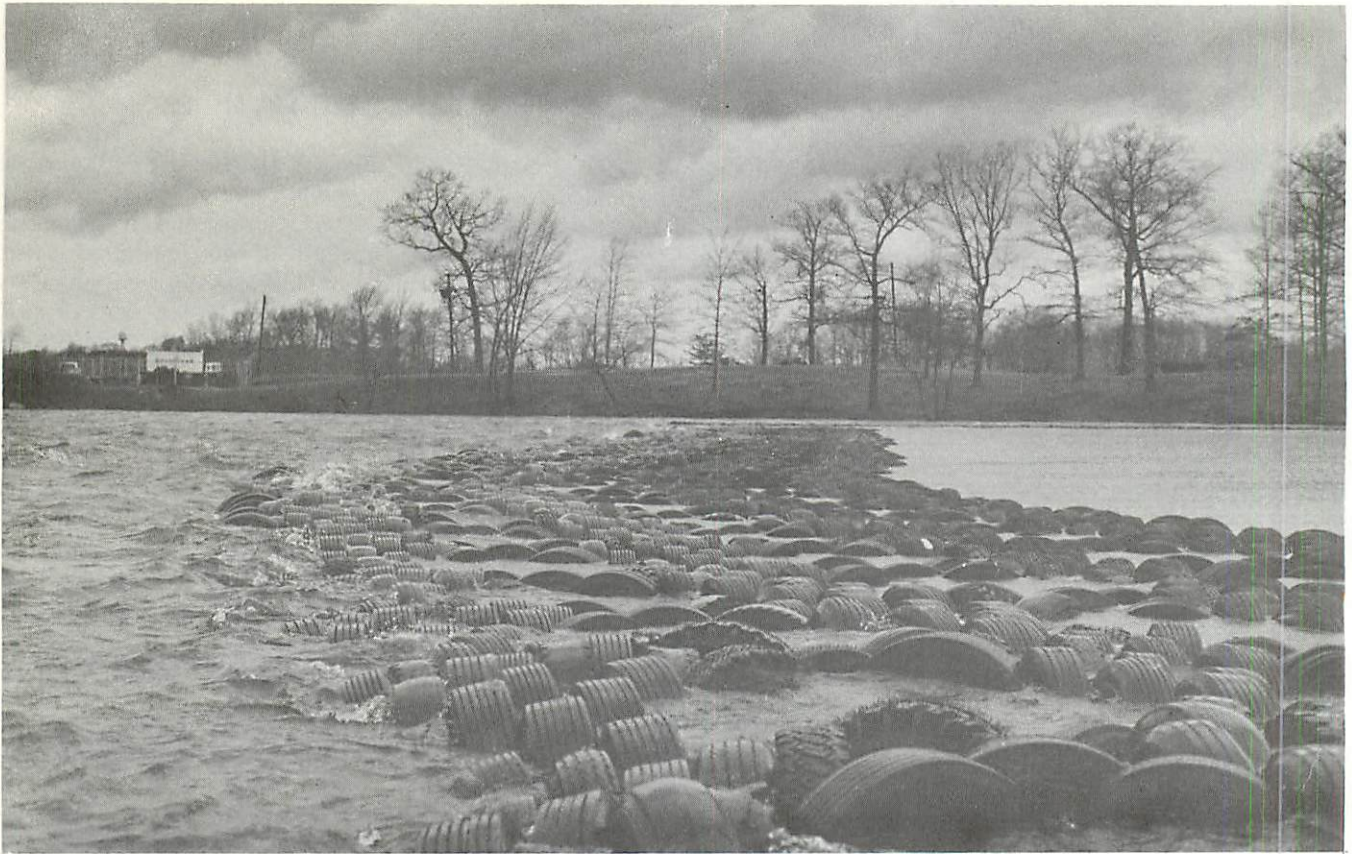
According to the study, a floating tire breakwater is easy to build and repair and can be easily disassembled and moved to another site. Construction materials are relatively inexpensive and include scrap tires, strips of dacron or nylon cord and lag screws. The tires are bound together vertically, resulting in a structure that will float, supported by air trapped in each tire crown. To moor the breakwater, Danforth type anchors are used.

The first scrap tire breakwaters were built by the University of Rhode Island Sea Grant Program in September 1974. Others, some several hundred feet in length, have been installed at many locations along the eastern seaboard and in the Great Lakes. The first one in Florida, the one discussed in this report, was constructed on the south shore of Santa Rosa Sound in August 1977. This site exhibited traits common to many eroding shorelines in Florida's coastal bays. It has a broad shallow shelf extending about 300 feet from shore before reaching a mean low water depth of 3 feet and then drops off quickly into deep water.

Because the effectiveness of a breakwater depends on a number of factors such as its length, its distance from shore and the range of approach angles of incident waves, it was found that modifications would have to be made on the Rhode Island design in order to adapt the breakwater to the conditions existing at the Florida site. Since breakwater length was limited by permit to 100 feet, and exposure to damaging waves ranged from WNW to ENE about 150°, it was necessary to place the breakwater as close to shore as possible—on the shallow flats.

Breaking waves in shallow water exert great horizontal as well as vertical force—stresses not encountered in deep water. Consequently, stronger internal ties and heavier ground tackle were needed. Depending on its draft and the depth of the water, the breakwater can either be pounded violently on the bottom or become permanently stranded if the bottoms of the tires become filled with sand.





To release trapped sand, the researchers punched one or two 1½ inch holes in each tire and assembled the module in such a way that the holes would be on the bottom when the module was tipped into the water. Each tire was inspected, marked and placed so that all holes would be under water, and the part of the tire above the waterline would be airtight to insure flotation.

Configuration of the module was also designed differently from that of the Rhode Island breakwater. Modules were connected by using a large truck tire as the main connector with two smaller tires placed concentrically on either side. Where needed, additional small tires were placed at either end of the truck tire, between it and the two modules being connected.

This modification affects two major changes in breakwater structure and function. As the breakwater begins to strand, the large truck tires hit bottom first. This, plus the greatly increased stiffness of the intermodule connection, prevents stranding and filling with sand.

The dacron or nylon cord strips used to tie the breakwater together has a breaking strength of about 10,000 lbs./sq. in., and at the time of construction, was available for about \$30/ton plus freight. Although it is easy to cut with a hacksaw or sharp knife, the material is highly resistant to abrasion and does not stretch, corrode or deteriorate in sea water.

Instead of fastening the ties with nylon bolts, as was done in Rhode Island, the ties were fastened by tying them in square knots. After about 10 percent of the knots worked loose during severe storms, investigators decided

to pin the ends of the ties beyond the knots to the tires with lag screws. This stopped both knot failure and tire rotation.

Anchor lines were initially attached to the tires projecting from the edges of the breakwater. After several knot failures in the unpinned connector and module ties near the anchor lines attachment, the anchor lines were led through the breakwater in sections of flexible plastic pipe to prevent chafing.

Researchers report this breakwater to be effective in dissipating waves less than three feet high with short wave lengths. One of its advantages is that it can be easily modified if sufficient wave damping does not occur.

A by-product of this breakwater is that it creates an artificial floating reef which encourages the growth of emergent shoreline plants and provides an additional habitat for fish, shrimp, and crabs.

On the negative side, however, these breakwaters are not as durable as the massive stone or concrete structures. They require periodic inspection and maintenance, and could possibly go adrift due to ground tackle failure or become navigational hazards.

Investigators emphasize, however, that no erosion technique, including the floating tire breakwater, should be used without going through the appropriate state and federal permit agencies. Final approval for construction rests with these agencies.

Matching funds were supplied by Charles A. Gifford, Pensacola, Florida.



## HURRICANE ELOISE

The study of the effects of Hurricane Eloise on Northwest Florida beaches was concluded this year with a comparative study between the Coastal Construction Setback Line established by the Florida Department of Natural Resources and the erosion line left in the wake of the storm. Results of the study indicate that the factors and criteria used in determining the setback line are valid.

It was found that the setback line and erosion line generally followed the same trend in their variations in distance from the mean sea level line.

Ground elevation in relation to historical storm and hurricane tides, erosion trends and fluctuations of the beach profile were among the factors coastal engineers considered in locating the setback line. Other considerations were beach and offshore slopes, dune height, upland development and vegetation line.

Classified three on a scale of five by the National Hurricane Center, the landfall maximum winds produced by Eloise were estimated at 110 knots and sustained winds near 80 knots with gusts of 135 knots. Tides of 12 to 16 feet above mean sea level were measured by the U.S. Army Corps of Engineers.

Although Eloise, which hit the northeast Florida coast on September 23, 1975, was a very severe storm, its high water and wave activity passed rapidly, lessening the damage to the beach-dune system. Field observations and survey data clearly indicate that some of the eroded material had been returned to the beach by wave activity shortly after the storm.

To determine beach-dune response to hurricane tides and waves under varying coastal development conditions,

contrasting segments of coast were studied. The first 17 miles of coast to the right of the hurricane center at landfall, Walton County, was relatively undeveloped with white sand beach backed by dunes 15 to 40 feet high. In this area, the erosion line stayed at the seawall side of the setback line.

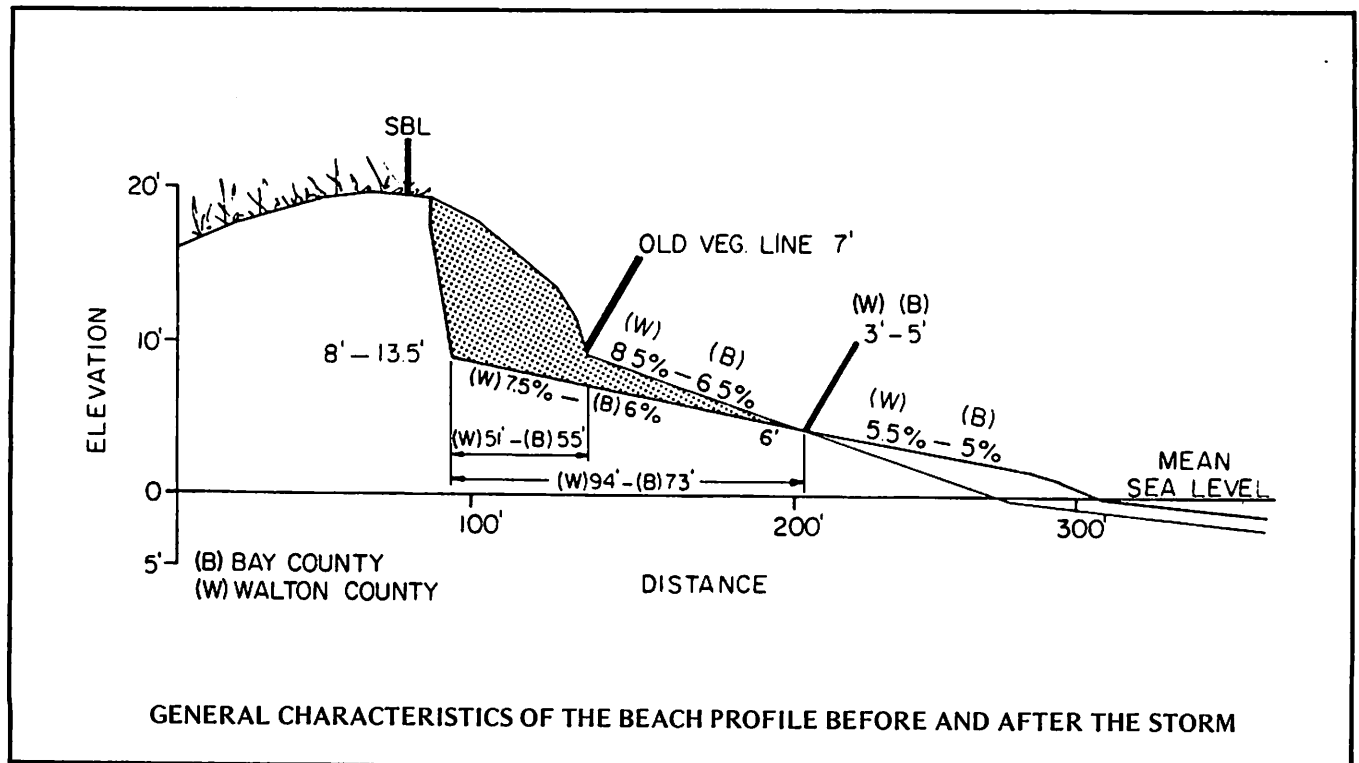
The next 19 miles of coast, Bay County, was one of Florida's most developed resort areas with motels and hotels concentrated on the beach front. Highest hurricane tides took place in this area. It was along here that intensive development had made it impractical to place the setback line as landward as the setback line study had shown it should be, and in the area the landward limit of the erosion line reached beyond the setback line.

Before and after beach profiles compared to before and after aerial photography of the beach disclosed that although 15-to 20-foot high dunes receded 60 feet in areas where erosion was worst, the mean sea level shoreline actually moved seaward in most areas, increasing the plan area of the beach.

Observations also revealed that in areas where the beach was wide with gentle slope, gradually merging into dunes, there was very little erosion. Even though the areas were flooded, the vegetation was left intact.

But, in the neighboring areas, with steeper beach slope and rapid dune rise, severe erosion took place. It was also noted that breakthrough of the dune ridge occurred where the vegetation had been destroyed over the dune ridge by a walking trail or some other cause, emphasizing the fact that vegetation does retard erosion processes.

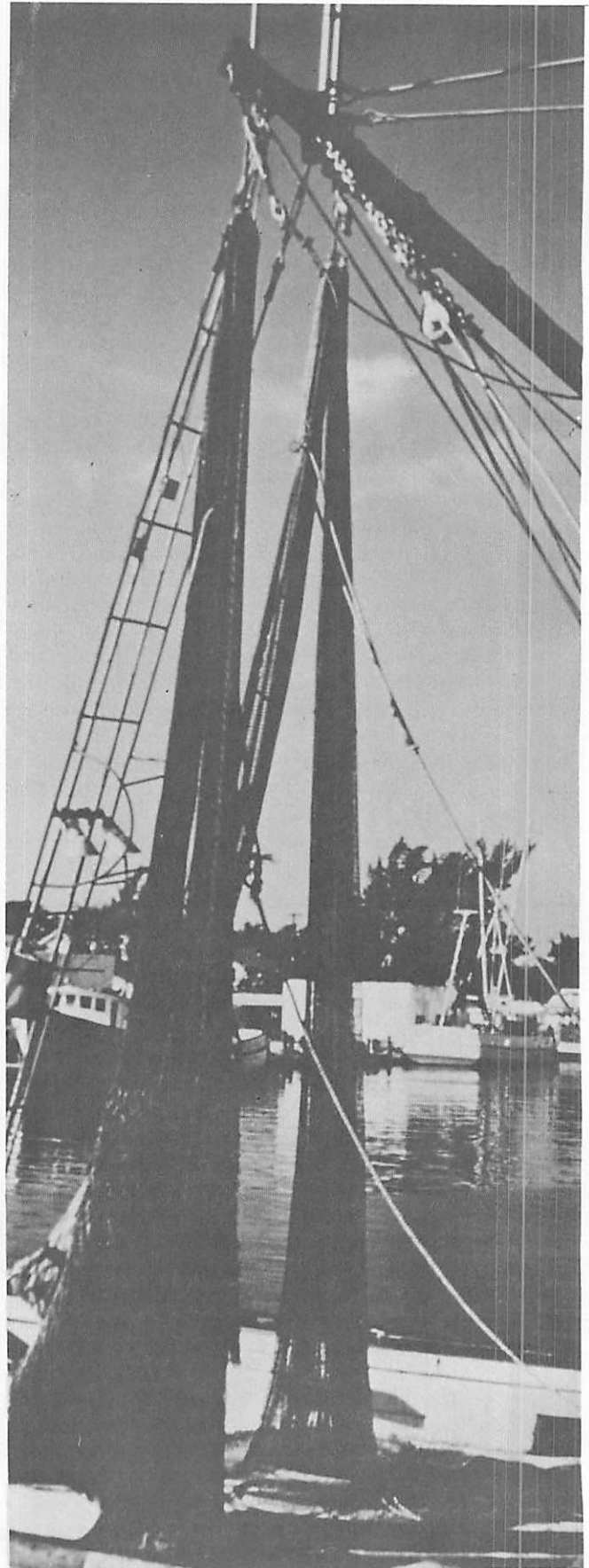
Matching funds for this study were supplied by the Florida Department of Natural Resources, Bureau of Beaches and Shores.



## FISHERIES RESOURCES

This research area follows a general policy of addressing Sea Grant fishery research to the major fisheries—the “Top 10”—with additional research useful to broad segments of the industry. The rationale for this focus was to respond to some of the many needs of an industry that ranks as the fifth most valuable nationally and numbers over 10,000 commercial fishermen. The goals—developing and providing information for the harvest and utilization of living marine resources; fulfilling technical needs of the industry; and providing information for management decisions.

User involvement often begins when a project is suggested or requested by a fisherman or organization. One excellent example of this is the spiny lobster research which evolved from lobster fishery complaints about declining yield for increased effort. While it is intended that emphasis on commercial fisheries research will continue at the same level, Florida Sea Grant is also planning a modest beginning in the area of recreational fisheries which represents an even larger economic impact on the state's economy.





## COMMERCIAL FISHING AND SEAFOOD MARKETING [R/FR-4]

This marine economics program which was established in 1974 has three major divisions: (1) production economics and supply analysis, (2) market analysis, and (3) industry analysis and public policy.

### Production and Supply Analysis

The objectives of the production economics component are to determine the social, cultural and economic characteristics of commercial fishermen with particular emphasis on the factors affecting employment of fishermen in specified fisheries, and to analyze cost and returns to fishermen employing alternative levels of factor inputs in specified fishery enterprises or combinations of fishery enterprises.

A primary survey of Florida Atlantic Coast king mackerel and Spanish mackerel fishermen was taken in 1977. Cost and returns analysis were completed for the hook-and-line king mackerel fishery and for the Spanish mackerel net-boat fishery. Net-boat classes of 20 to 22 and 30 to 55 feet in length were analyzed in the Spanish mackerel fishery.

Statistical data were compiled by county for the Florida East Coast and Florida Northwest Coast. Two publications were prepared which reported analysis of trends, growth rates and relative economic importance of major species within each county and region.

A journal article was developed from research on the spiny lobster fishery. This research determined that in 1974 approximately 795 traps per firm was optimal when the stock of lobsters is at an optimum level. An analysis was made as to the effects of boat size, fishing intensity and area fished on optimum number of traps fished per firm.

A journal article was published which reports research on costs and returns analysis of the Gulf of Mexico snapper-grouper fishery. The statistical analysis focused on variations in costs and returns due to area fished and vessel size. Additional trend research and initial production relationships have been estimated for the fishery of each of the States bordering on the Gulf of Mexico.

A research report analyzing commercial fishermen was published. Findings indicated that the average fisherman is 48 years old, and has an average of 11.3 years of schooling. Approximately 71 percent of Florida commercial boat and vessel owners have only one boat, almost 18 percent own two, six percent own three, and slightly less than five percent own four or more. Sixty-seven percent had one or more loans to finance business operations in 1974. Local banks accounted for 58.6 percent of all loans. Gross sales earned from fishing by Florida commercial fishermen averaged \$28,600 per firm in 1974 for all types of fishing enterprises. Those earning at least part of their income from shrimp sales averaged \$53,100 in 1974 while all other fishing firms earned an average of \$11,400.

### Marketing and Demand Analysis

The primary marketing level for the Florida Atlantic Coast finfish industry was analyzed with data collected in 1976. Marketing channels and market structure were identified and market performance was evaluated by relating relative prices paid and marketing services offered to the degree of market concentration. Price equations were developed which related Florida fishermen prices to terminal market prices and quantity supplied. This information was presented at three industry meetings.

Prices and marketing margins for Atlantic Coast king mackerel were analyzed using monthly observations for a 60-month period. Prices and margins were regressed on terminal market prices, quantity supplied, and costs of marketing services. In addition, shifts in demand brought about by the formation of a marketing cooperative and marketing association and several court cases alleging price collusion in the mackerel industry were analyzed.

### Industry Analysis and Public Policy

The objectives of the industry analysis section of the program are to treat the production and marketing sectors simultaneously while considering questions of economic impacts and management of the fisheries on public policy.

The primary economic impact of Florida's major fisheries was estimated at 346 million with another 73 million in income generated in 1975. The impact analysis was extended to provide analysis for specific industry problems such as the relocation of the Tampa Bay Shrimp Fleet. The primary impact of a professional bass tournament was estimated and published in a trade journal.

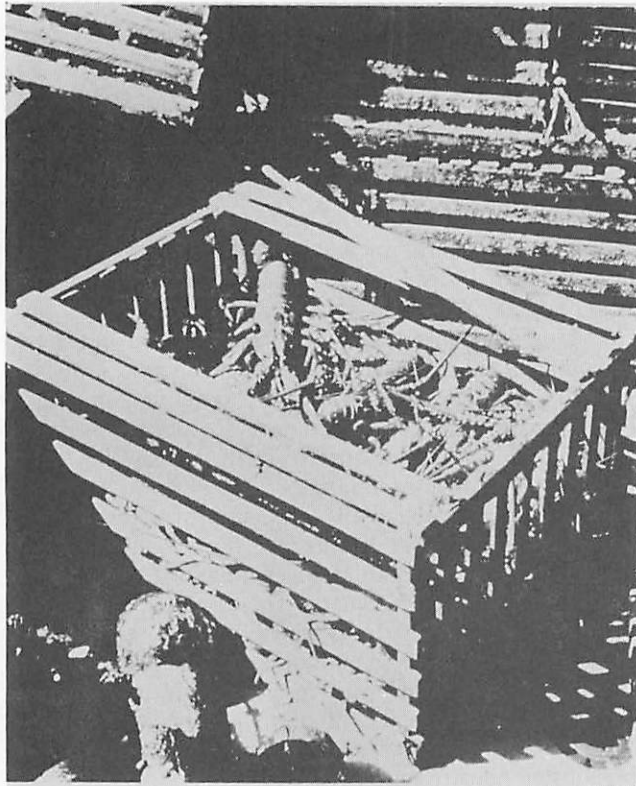
A journal article was published on the subject of management considerations for the spiny lobster fishery. In determining maximum economic yield with respect to traps per firm and the number of firms in the industry, it was found that the present combination of resources differs considerably from optimum levels. In 1973, 399 firms were fishing an average of 429 traps each with a predicted level of landings equal to 5.4 million pounds. The optimum solution suggests a reduction of 186 firms and an increase of 366 traps per firm for the remaining firms. This reorganization would cause industry costs to be \$2,355,407 instead of the present annual estimated cost of \$2,725,549. Savings measured in reduced cost are \$370,142. This savings of approximately 14 percent must be compared to political, social and economic costs of displacing the 186 firms before an "optimum" management program can be determined. Reduction in total industry cost with a relatively small increase in total industry revenue divided among 186 fewer firms, however, will result in a considerable increase in profits for remaining firms. Predicted net profits per firm would increase from \$6,677 to \$18,350 after elimination of the 186 firms presently in the industry. The potential redistribution of income resulting from a maximum economic yield program will require serious consideration by policy makers.

A proceedings paper was developed which explained appropriate bio-economic models for management of fisheries. Specific firm and industry models for the Florida spiny lobster industry were presented.

## THE SPINY LOBSTER BIOLOGY [R/FR-5]

Large populations of the spiny lobster *Panulirus argus* in South Florida waters form the basis of the state's second largest commercial fishery and support a large and rapidly growing marine recreational activity. However, steadily increasing commercial and sport fishing efforts have so reduced the adult population that catch per unit of effort now is for many fishermen unsatisfactorily low.

The objective of this study was to investigate the biology of the spiny lobster in South Florida for the purposes of providing information useful to the management of this valuable resource. Aspects of the study included growth, reproduction, population structure, yield, movements, and distribution/abundance, with the anticipation that findings will provide data to aid in the development of alternative management strategies.



Field research, which was terminated this year, revealed some interesting statistics. A total of 3,064 female lobsters, 1,326 from Gulf waters and 1,738 from Atlantic waters, were examined for evidence of overt reproductive activity during the 14-month period, July 1975 to August 1976. None of the Gulf females were egg-bearing and only 1 exhibited a spermatophore. Of the Atlantic females, 259 exhibited eggs or spermatophores, 62 being egg-bearing.

Principal habitat for lobster reproduction was in the deep waters of the Atlantic offshore reef, with the peak month for reproduction being May. Females with carapace lengths less than 80 mm. were essentially reproductively inactive, indicating that the reproductive potential of the lobster resource may not be adequately protected by the present legal size limit of 76.2 mm. In addition, the trap catch of legal-sized lobsters had declined to four percent in Gulf waters and 20 percent in the Atlantic by the end of the fishing seasons in March, indicating a very high rate of harvest exploitation in South Florida.

As a result of this study, six technical papers on the topics of reproduction, growth, population demography, movements, yield, and management strategies are scheduled to be published during 1978. Additionally, project findings have been used to 1) model the experimental design for a similar research project on spiny lobsters to be conducted in the middle and upper keys by the Florida Department of Natural Resources; 2) maintain strong scientific credibility in a traditionally skeptical commercial fishing community; and 3) contribute to the development of potential management strategies being considered by various state and federal agencies and organizations.

Outside matching support for this project was provided by the U.S. Navy and elements of the fishing industry.

## SPINY LOBSTER RECRUITMENT [R/FR-10]

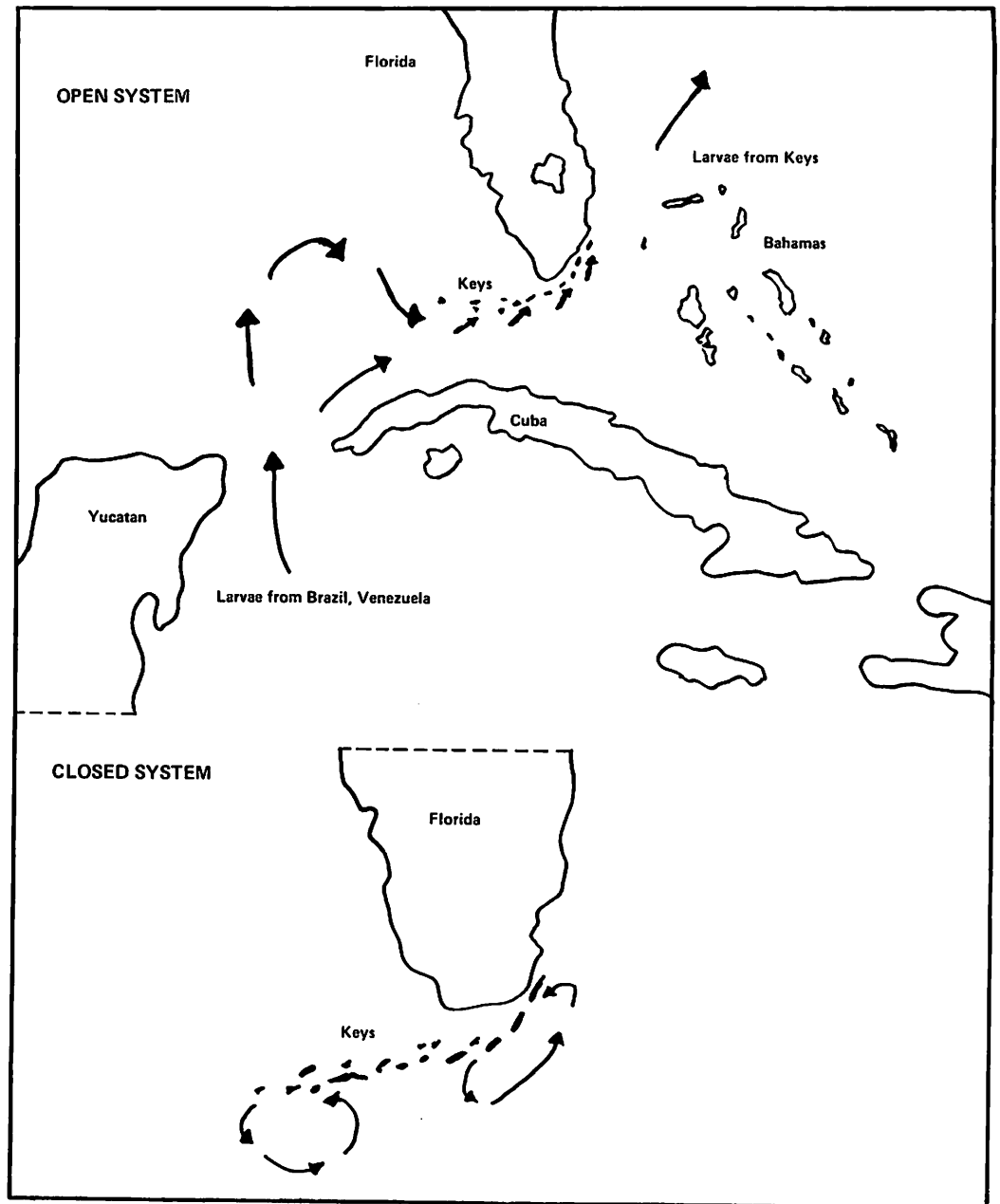
This project, which is closely related to the biological studies of the spiny lobster, has been underway for over a year, however, it has been largely preoccupied with establishing background parameters and has only recently begun to address the direct questions posed below.

The principal objective of the study is to ascertain dispersal patterns of planktonic phyllosome larvae of the spiny lobster, *Panulirus argus* and especially to determine if lobsters commercially harvested in Florida waters



## SPINY LOBSTER RECRUITMENT

Possible dispersal patterns of planktonic phyllosome larvae of the spiny lobster showing self-sustaining closed loop system or non-self-sustaining open system.



are part of a self-sustaining closed loop larval recruitment system, or constitute a non-self-sustaining open system. One of the fundamental problems in understanding the life history of the Caribbean spiny lobster is the influence that the long-lived (over six months) planktonic phyllosome stage has on the larval dispersal and recruitment to various populations.

The principal approach is one of genetics using biochemical markers similar to human blood groups to distinguish foreign populations that might or could not contribute young to the Florida population. This is done first by analysis of the adult population and second by comparing samples of post-larvae entering Florida nursery waters with the various adult populations.

If the distribution of phyllosomes in coastal waters is influenced primarily by local eddy current loops and

behavioral factors which effectively inhibit long-distance movements out of the spawning area, then populations of *Panulirus argus* can be considered essentially self-sustaining. This could be termed a small closed loop recruitment system. However, if phyllosomes are transported en masse by strong uni-directional offshore currents and settle out as bottom dwelling pueruli in distant nursery areas, recruitment in any given area would be dependent upon foreign larval sources. Over short distances, this pattern can be considered an open system, but over the range of *Panulirus argus* the open system may give way to a large closed loop. Fishing management policies would be quite different depending upon which recruitment pattern is in effect.

The Academy of Marine Science in Miami has provided matching funds for this project.

## NORTHWEST FLORIDA SNAPPER-GROUPER FISHERY [R/FR-9]

Evidence has been presented by several investigators that the snapper-grouper fishery in the northwest Florida region has been in a state of decline. The purpose of this project is to obtain biological data on the life histories of the species which comprise the fishery so that intelligent management decisions can be made. The types of life history data obtained in this project will be: age, growth rates, maximum size, age at maturity, and age at recruitment; feeding habits of the species with regard to size, age, sex, area, and competitors; and reproduction, fecundity, potential recruitment and spawning time of the exploited species.

During the past year specimens of snapper and grouper species associated with the northwest Florida Fishery have been collected. Many of these specimens have been obtained by accompanying federal research vessels such as the FRS *Oregon II*. A great many specimens have also been supplied by local commercial and sport fishermen. Because of the large number of specimens collected off the Mississippi Delta area much of the effort has been directed toward assessing the effects of the trawl fishery of the area on the mortality of juvenile red snapper.

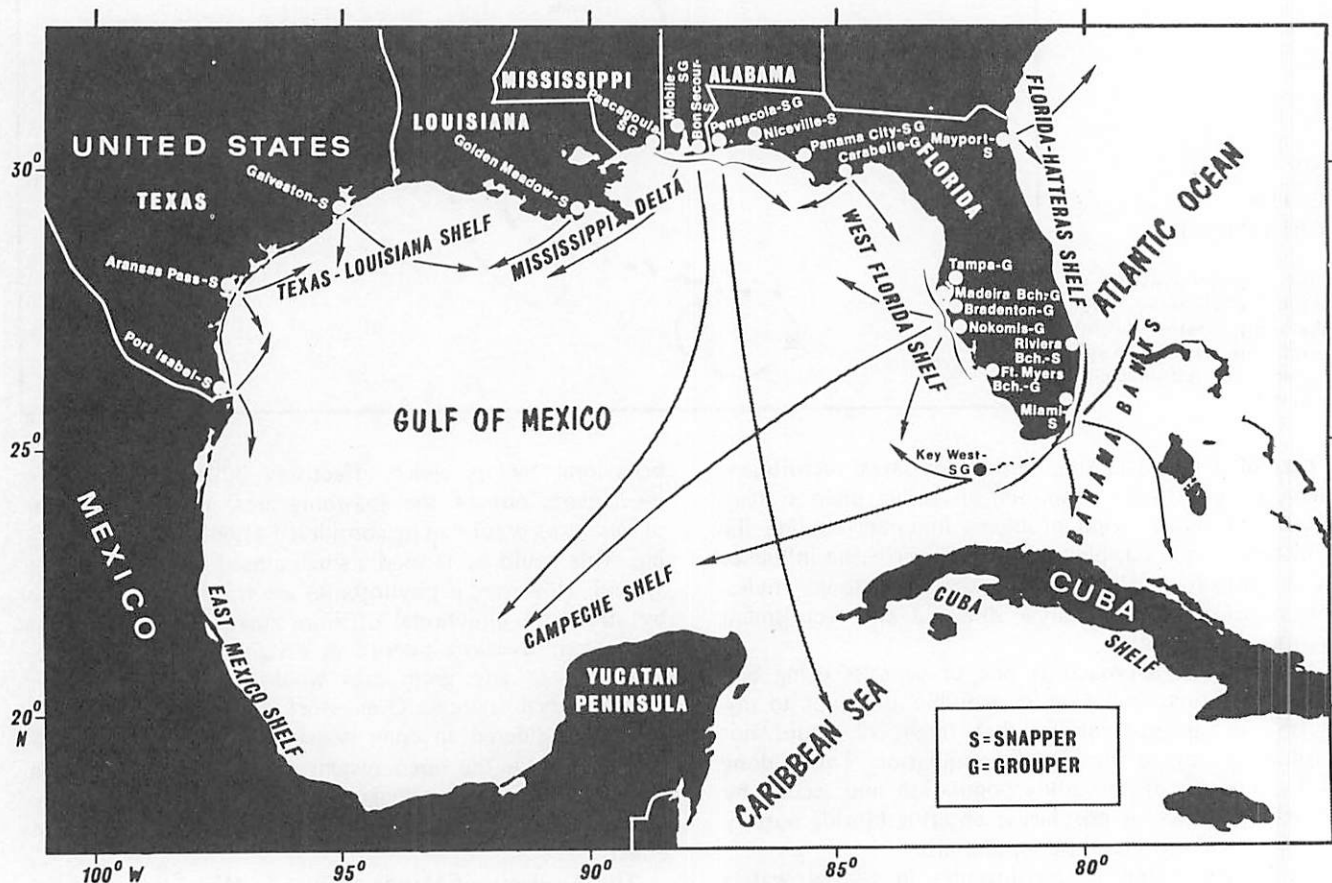
The validity of using otoliths for aging the species comprising the fishery has been established. This was necessary as the northern Gulf offers a temperature regime

of minimal change, and it is important to know the variability in methods for aging by scales, otoliths, or other hard parts.

Also, analyzing food and stomach content data by means of cluster analysis has been tried. The data thus far indicate that clustering stomach content data allows comparison and contrast of species by area, sex, size, and age, and prediction of possible changes in the competitive interactions, if any, of the above parameters change.

Two students are currently working on thesis problems directly associated with this project. Also, a significant interaction with other groups has been the compilation of a 1000 reference bibliography in cooperation with the National Marine Fisheries Service, Gulf region fisheries management plan on reef fishes. The bibliography will add significantly to the development of the fisheries management plan.

Sources of outside matching funds for the project are Pensacola Party Boats, Inc.; Bruce Jones, commercial fisherman; and Captain Rusty Paschke.



U.S. snapper-grouper fishery, port areas and grounds fished.



## ELVERS

Although freshwater eels of the genus *Anguilla* are not a common aquaculture species in the United States, in Europe and Asia they are a multi-million dollar industry. Research in North Carolina, South Carolina and Georgia, however, has led to growing, prosperous commercialization of the long, slimy snake-like fish.

Florida investigators wanted to find out if the same thing couldn't be done here. In studying the methods used by the North Carolinians, researchers found that eel culturists rely upon natural populations of elvers, *Anguilla rostrata*, to replenish their stocks. These are collected annually to assure adequate supplies for culturing.

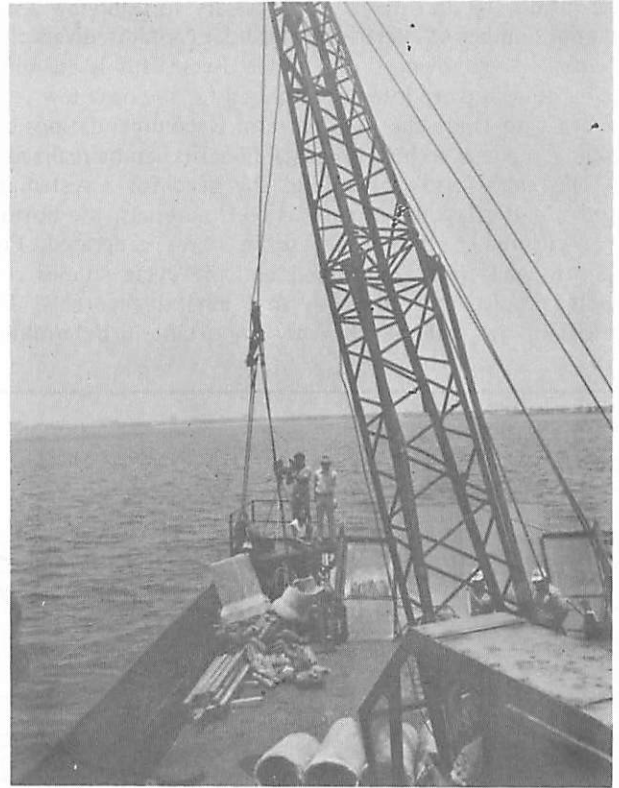
Culture of elvers is complicated because adults spawn in the sea while juveniles return to freshwater to mature. Since eels spawn at great depths, they have never been collected while spawning. Therefore, juveniles entering freshwater are the vital link between natural populations and culture stocks.

As the elvers move into fresh water, they tend to become concentrated at the bases of obstructions in their paths such as waterfalls, manmade dams, weirs and other barriers. Movement is difficult and slow in these places and it is here that elver collection is most successful.

The object of this study was to survey the Nassau, St. Johns and Tolomato Rivers in Northeast Florida to determine if elvers could be found in sufficient numbers for collection.

After locating likely congregation sites, dip nets and traps were used to collect the elvers. At only one site, Guana Dam, were any elvers found and those in very small number. The limited number of *Anguilla* elvers caught was probably the result of several different factors: 1) The elver run may have begun and been completed before sampling was initiated. 2) The elvers may not enter freshwater but remain in brackish areas until larger, and 3) Elvers were not concentrated because structures impeding their migration did not exist. It is possible that even under optimum conditions, the number of elvers caught still may not have been sufficient to warrant collection on a commercial scale, either for culture or direct export.

Results obtained from this project tend to concur with the opinion expressed in the Florida Sea Grant aquaculture outlook that eel aquaculture, although having prospects, at this time should be a low priority species, especially if natural populations of elvers are needed for stocking. Additionally, with information readily available from the successful North Carolina Sea Grant project, a pilot teaching facility for eel culture does not appear to be warranted.



## ARTIFICIAL REEFS

This study was conducted in conjunction with a cooperative investigation of biological, political and socioeconomic aspects of the Clearwater Artificial Reef. A general model was adopted to allow for the estimation of actual and potential benefits and costs even though the outputs of the alternative projects are subject to different pricing policies in the short and long run and vary by the type of project.

Costs and potential benefits of artificial reefs were assessed and compared with other modes of disposing of the primary raw material, tires. The results showed that although tires can be buried quite cheaply in landfills, in the long run they can be used more beneficially in reef construction that yields recreational benefits for centuries to come. It is expected that the reef population will reach its sustained level in about two years but the reef itself will endure an estimated 1,000 years if built with tires and practically forever if built with culvert, provided that annual maintenance of buoys is undertaken.

This interdisciplinary study had to rely heavily on nature's biological technologies in the conversion of tires to catchable fish and thereby suffered from the uneven state of art between the disciplines of economics and biology. But even though an economist does not have the expertise to fill many of the gaps in the biological knowledge, the benefit cost framework developed above points out areas where data are lacking or deficiencies exist and thus requires further research.

All benefits assessed by the study are potential, that is, realizable benefits rather than actual. The next step was to study the actual benefits today and to project them into

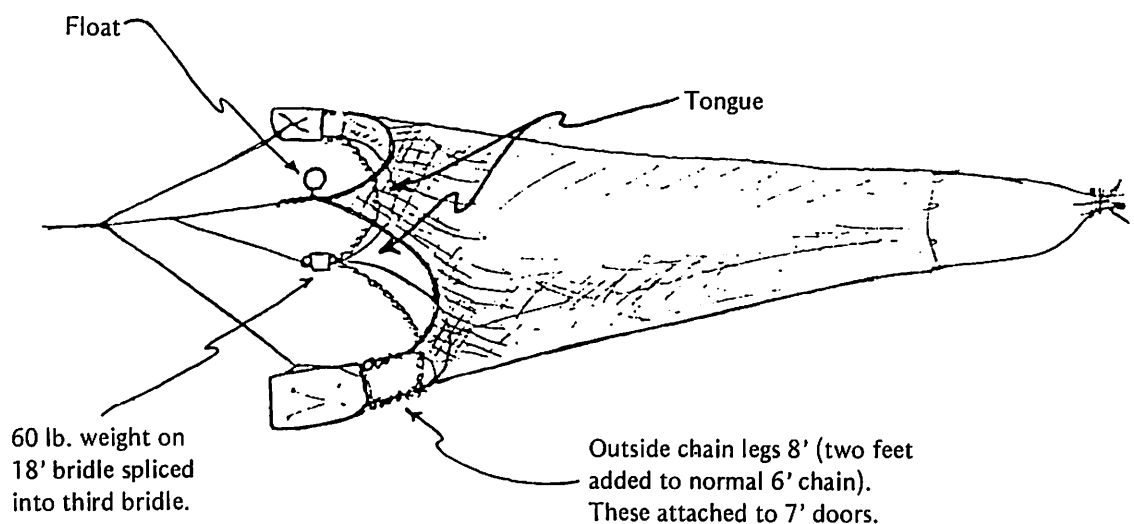
the future. To do this, it was necessary to interview a substantial number of anglers, charter boat captains, divers club members, boat owners, and other users. This is currently being done and needs to be continued for the next few years in order to chart the user pattern. Recommendations can then be made as to how potential benefits can be realized.

This input also pointed up the need for a systematic study of the layouts of various reef materials, the bottom area covered, and the reef surface area generated. Fish counts need to be multiplied and life cycle studies conducted typically of the fish that inhabit the reefs. The height of the reef may be very important in determining

the size of the fish that inhabit it, but no suitable data were available to test that hypothesis.

In summary, cost of reef building are of an entirely different order of magnitude than the costs of burying tires in landfills. Reef construction represents voluntary and postponable expenditures. Results of this study suggest that the merits associated with building reefs should be evaluated in comparison with the merits of other discretionary private and local government expenditures before decisions are made.

Matching funds for this project were supplied by the City of Clearwater and St. Petersburg Junior College.



## TONGUE NET

Improvement of fishing gear for greater efficiency is a high priority item from the standpoint of increased performance as well as energy conservation. Florida fishermen have indicated that a reevaluation of net performance and redesign for the least possible hydrodynamic drag is imperative.

Along this line, Georgia marine advisory agents modified an earlier "Twin Trawl" design used by shrimp fishermen along the Gulf and Atlantic coasts by employing a single net, adding 'tongues' to the trawl's opening, and replacing the sled used on the twin trawl by a single float and weight. These modifications were designed to ease handling by using the single net which requires only one bag while the twin trawl required two. Also, by distributing towing forces more evenly throughout the net and away from otter doors a decrease in fuel consumption was expected.

Florida marine advisory agents cooperated with the Georgia agents in the modified tongue net demonstration. The purpose was to place the tongue net on a commercial shrimping vessel and to show that it could catch more shrimp per drag than a standard 65-foot flat net.

Normally, for a 72-foot net, 9-foot doors are necessary to open the net. However, these were replaced by 7-foot doors since much of the towing force is transmitted through the 'tongues'.

The tongue net was placed on a commercial shrimp vessel and towed for 12 full days or 32 drags. During this same period, a 60-foot flat net was towed from the opposite side of the vessel. The total catch was 2090 pounds of shrimp with heads on. An estimated 1240 pounds was caught by the tongue net, representing an average of 38.8 pounds per drag or 59.3 percent of the catch. The 60-foot flat net caught 850 pounds, an average of 26.6 pound per drag, or 40.6 percent of the catch. The tongue net outfished the flat net by 18.7 percent or 12.2 pounds per drag.

It was noted that the tongue net fished cleaner. Culling out the trash fish took less time because there were fewer trash fish caught. Also, the fish caught were usually smaller than those caught in the 60-foot net.

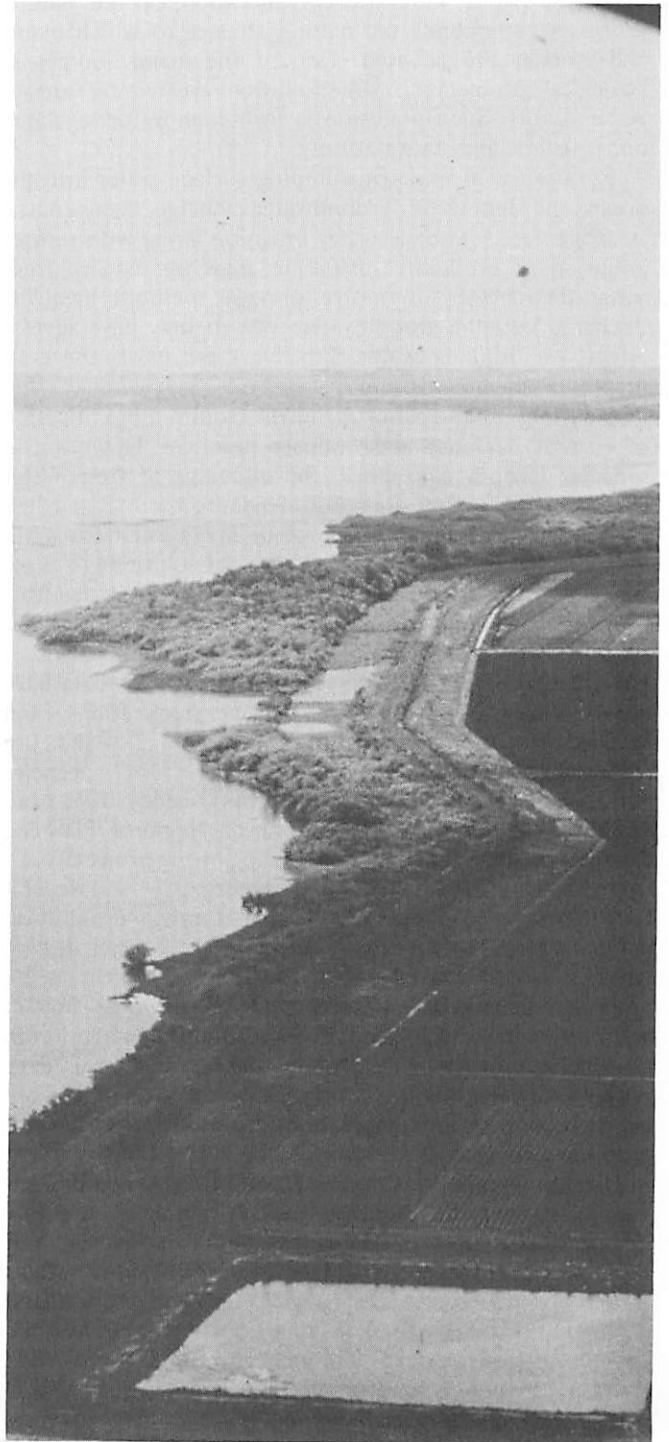
Although handling was simplified, compared with the twin trawl, the weight tangled with the float and door chain legs requiring a deckhand to crawl out on the outrigger to untangle it. Investigators thought the net might be redesigned by shortening the chain legs and modifying the weight to reduce tangling.

Results have not yet been applied by industry, but it is assumed that a fuel savings would be realized by use of the tongue net since the smaller doors reduce drag. However, further tests are needed to show how the increase in catch and probable reduction in fuel consumption would significantly outweigh the handling problems.



## COASTAL POLICY

The coastal policy area of Sea Grant research was established to encompass disciplines dealing with legal, social, economic, and planning aspects of coastal management and development. This program area builds upon earlier projects related to law, coastal planning and recreation. It is intended to complement the Estuarine Management area and to provide a focus for Sea Grant involvement in the social needs of the coastal zone including urbanization and commercialization. During the past year, two projects were funded, one focused on the impact of offshore energy facilities; the other considered the development of legal alternatives for effective management of stormwater runoff. Both of these projects will continue into the next year.





## ONSHORE IMPACT OF OFFSHORE ENERGY FACILITIES: A LEGAL ANALYSIS [R/CP-3]

### STORMWATER RUNOFF AND THE COASTAL ZONE [R/CP-2]

Estuaries are greatly affected by artificial alteration of the runoff patterns, since the estuarine zone is a complex system whose flora and fauna are dependent upon natural rainfall patterns. All the diverse elements of the coastal ecosystem operate as a functioning unit because of the natural flow of water. Man's alteration of the natural processes compounds the natural stresses to which plants and animals are adapted. One of the major sources of ecological problems is the pollution created by surface water runoff. Such pollution is forbidden by or regulated under federal and state statutes.

Further, as a result of dumping surface water into the ocean, and diminishing groundwater recharge, many coastal areas are faced with saltwater intrusion along with serious pollution of productive estuarine areas by massive fresh water discharges. Alternative disposal methods involving discharge into the groundwater systems may have adverse effects on drinking water. Finally, there exists the ever-present problem of erosion.

Solutions to the runoff problem require a modification of current land use and drainage practices. Detention in spreader lagoons can spread the discharge of fresh water over a broad coastal area and avoid the harm that often results from massive point source discharges of fresh water into a saline environment. The physical solutions to these problems present numerous legal problems, not the least of which is finding the means to provide funds for their accomplishment.

At this point in the project, a great deal of data have been collected, including ordinances, publications, and governmental policies and recommendations. Land use planners and environmental engineers of such agencies as the U.S. Environmental Protection Agency have been consulted and the Southwest Florida Regional Planning Council has undertaken partial funding of the project.

Preliminary reports on the common law and federal statutory law regarding surface water runoff and pollution control have been prepared. Furthermore, a paper dealing with the legal ramifications of the runoff problem in the proposed Estero Bay Development of Regional Impact has been completed. Work is proceeding for a report on relevant statutory law in Florida which could be used to regulate surface water runoff. Technical alternatives are being studied for implementation into model surface water runoff ordinances.

It is anticipated that by the end of 1978, a comprehensive report will be prepared on existing laws affecting surface water runoff. Moreover, model ordinances will be prepared providing for wetland protection, surface water runoff control, septic tank regulation, and erosion and sedimentation control. The final document should be valuable to state, regional and local governments in Florida to assist them in implementing area-wide quality and coastal zone management planning.

While much of the offshore energy activity will take place in areas of predominate federal jurisdiction, the associated onshore impacts such as pipelines, transmission lines, and storage facilities, will be subject to predominate state and local jurisdiction. Although the federal government may preempt state and local regulation in a field through the supremacy clause of the Constitution, Congress does not always choose to do so.

For example, the Federal Water Pollution Control Act places major responsibility for regulation on the states, as it does in many areas important to onshore impact of offshore energy facilities.

The purpose of this project is to analyze the conflict between federal and state governments over energy-related activity off the coast of the United States and to recommend to local officials appropriate steps to prepare for the onshore impact of that activity.

The four types of activity analyzed thus far are offshore oil and gas drilling, shipping, deepwater ports, and offshore power plants. Analysis has centered on the most important laws which control each activity. In each of these four areas, local government has a limited function, usually limited to participation in a broader state or federal framework. There are several local powers, as yet not utilized, which could be used if local governments desire to broaden their existing role.

An important function of the immediate response grant was to provide for the monitoring of developments in 1977 of several items important to the overall research. These include the lease sale of the Northeast Coast and court challenges under NEPA, the licensing of two deepwater ports in the Gulf of Mexico, and review of federal shipping regulations following the series of accidents last winter.

Research has also begun into the implementation of the Coastal Zone Management Act in Florida. The Florida Coastal Zone Management Program is moving through the draft stages with submission to the legislature planned for March 1978. As the program now stands, local governments will play a significant role in the implementation.

Phase I of the 1978 project is two-thirds complete, with the identification of federal and state laws which control decisions concerning offshore energy activity and the onshore response. These laws were drawn from work done during the immediate response and work done by the Center for the Bureau of Coastal Zone Planning in 1976. The laws have been summarized and the impact on local government identified.

Interaction with state agency officials will begin in March 1978. Individuals in state agencies such as the Department of Environmental Regulation, Division of State Planning, and Department of Administration will be contacted in order to gain an appreciation of the implementation of existing law. Contacts with local officials will follow.

Matching funds were provided by the Center for Governmental Responsibility.



## EDUCATION

*In essence, everything done under the auspices of the Florida Sea Grant College involves education, specifically marine education. Research projects aim at solving practical problems. If successfully terminated, they result in the education of both scientist and recipient in the field. By reporting these results, and by conducting conferences, workshops, seminars, and person to person interchange, advisory agents are educating the coastal user groups.*

*Under the broad category of education, which is the second prong of the 3-pronged Sea Grant program, are more formal education projects sponsored by the Sea Grant College. This year two programs of study were continued with "start-up" funds—one offering an AA degree in marine technology, the other an AA degree in underwater technology. After 1977, both projects will continue under funding from the respective institutions since both are now firmly established and self-sustaining.*

*In still another area of education, participation in marine 4-H activities has continued to grow. From a zero enrollment in 1974, Florida now has an enrollment of nearly 7,000 in the 4-H marine science category. Also, during the year, nearly 60 graduate and undergraduate students were supported as research assistants in many of the investigations covered in this report.*



*"And all I ask is a windy day with the white clouds flying,  
And the flung spray and the blown spume, and the seagulls crying."*



CONFERENCES  
SEMINARS  
WORKSHOPS...

The saying goes that a ring has no end. Neither has the chain effect of the research, education and advisory roles created by the Florida Sea Grant College. Contributing to this 'round robin' are the conferences, seminars and workshops sponsored by the program. Human interests—commercial, sociological and environmental—coupled with research and government regulatory agencies, often come together to foster awareness of the interrelationships and interdependence that exist between them.

In April, the Brevard County Coastal Seminar brought together representatives of the diverse special interests in the Coastal Zone and showed how all are linked by the natural processes associated with coastal systems. The rancher panelist who commented, "I didn't know I was in a Coastal Zone," saw the effect of his operation on a fisherman who said, "I would rather be setting in my boat fishing than standing here, but something has to be done about pollution in the estuary."

Marine advisory agents were present to offer information and guidance. In this way, the public was given an opportunity to learn about marine problems and to gain insight into how they might become involved in the coastal planning process. One by-product of the seminar is a planned publication in comic book format with a tentative title, "Man and the Coast—A Love Affair."

In May, a seminar for the Southwest Florida Water Management District considered ways to resolve some of the issues concerning groups such as fishermen, coastal planners and others who rely on Florida's important fisheries such as shrimp, oysters and sea trout depend

on a critical balance of salt and fresh water along the coast. At the same time, about three-fourths of Florida's new residents want to live in coastal areas.

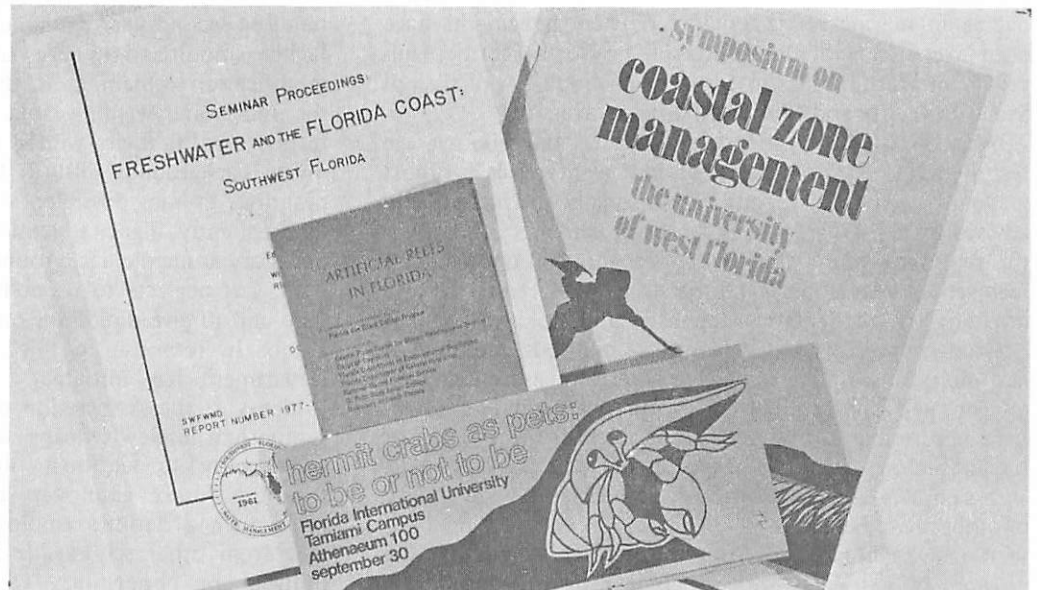
Questions addressed included the role of fresh water in the state's estuaries, how much water can be removed upstream and still provide sufficient flow to support important estuarine systems, what happens to water after it enters the sea and how the human element fits into the picture.

Speakers discussed the biological, economic and physical factors related to freshwater runoff into estuaries, and specialists made recommendations for selected drainage basins in the area and created general guidelines for freshwater runoff management. Proceedings of the seminar were published as Sea Grant Report Number 22, "Seminar Proceedings: Freshwater and the Florida Coast—Southwest Florida."

Early in June, the Florida Coastal Zone Symposium was held at the University of West Florida, Pensacola, and attracted over 100 participants. These people were professionals and private citizens who were interested in discussing and becoming better informed about coastal biology and coastal planning. Remote sensing and its use in the coastal zone, and the dynamics and significances of salt marches to the coastal zone were highlighted. "Coastal Zone Management," a report on the proceedings, was published following the symposium. Matching funds for the symposium were supplied by the Sperry and Hutchinson Foundation and the Department of Health, Education and Welfare, Public Service Education Institutional Grant Program.



...QUESTIONS  
ANSWERS  
INFORMATION  
EXCHANGE



Later in June, the artificial reef conference, Florida Sea Grant's first effort toward convening a statewide meeting of recreational marine interests, was held at the University of South Florida, Bayboro Campus, St. Petersburg. These man-made underwater structures, sited along inshore barren sea bottoms, are constructed of many diverse materials; but all of them have one characteristic in common—they attract heavy populations of fish, a boon for Florida's multi-million dollar sport fishing industry.

Types of materials used to construct the reefs were discussed and specialists indicated that it was better to use tires in shallower water and larger materials, such as liberty ships, in depths of 50 to 60 feet. It was also pointed out that a reef should be located on a sandy bottom or one which has pebble-size sediment and away from strong currents which might cause the reef to shift position. As an outgrowth of the conference a Sea Grant supported artificial reef resource team was established to provide assistance to communities in establishing and locating new reefs.

One problem mentioned by most builders of reefs was the extensive paperwork involved in getting state and federal permission for construction. Representatives from the Florida Department of Environmental Regulation and the Corps of Engineers were on hand to discuss this subject and suggest ways to streamline procedures. Since then, a joint permitting system has been implemented to reduce paper work and time required for processing. Conference proceedings will be published in early 1978.

Cooperating agencies included the Coastal Plains Marine Center, Wilmington, N.C.; the Corps of Engineers; the

Florida Departments of Environmental Regulation and Natural Resources; the National Marine Fisheries and St. Petersburg Junior College.

In September, approximately 60 people met on the Tamiami Campus of Florida International University, Miami, to discuss the dilemma of the commercialization of the hermit crab, *Coenobita clypeatus*. The conference consisted of a series of panel discussions to examine the scientific perspectives, commercial aspects, environmental issues and regulatory requirements of these tiny sea creatures.

Scientists brought to light the fact that scientific knowledge about the hermit crab is too meager to help in understanding the problems created by its commercial popularity. No data are available regarding existing stocks, recruitment, longevity, mortality, feeding habits, predator relationships or the ecological niche of the species.

Although no unified policy statement was formed, a tone of better understanding and cooperation between the groups was stimulated. Matching funds were supplied by the Great American Crab Company and the Department of Biological Sciences, Florida International University.

#### MARINE TECHNOLOGY PROGRAM [E/T-1]

Since January 1977, the Florida Junior College (FJC) Marine Technology Program has attracted strong community interest and support. Requests have come for talks, interviews, in-service training, specimen analysis, and advice on subject related committees. Gradually, marine

technology at FJC has become a self-perpetuating, somewhat self-supporting, viable working asset to the academic curriculum.

To allow interested graduates to transfer with maximum credit to the upper divisions of other Florida universities, articulation agreements were developed. These universities will offer a Bachelor of Arts and/or Bachelor of Science degree in marine related fields. Written agreements have been executed with the University of North Florida, University of West Florida Institute of Technology, Mississippi State University and Florida Atlantic University.

A study of the entire program shows that the average length of the FJC program required eight terms for most graduates, and each student was personally and individually advised by the program director. Many students entering for the first time found it necessary to enroll in one or more high school level courses in order to be prepared for college level physics, mathematics, chemistry and biology.

Students were prepared in various methods of biological and physical sampling and were able to measure dissolved oxygen, pH, salinity, tide stage, wind speed, wind direction, temperature and turbidity. They have learned techniques of taking biological sampling specimens with dredges, nets, core samplers and various traps, as well as a wide variety of other related tasks.

It can be concluded from the data collected that the program is reasonably self-sufficient, providing enrollment levels remain constant and the Jacksonville Shipyards, Inc. cooperative subsidy remains active. It has also been determined that articulation and student transfer problems can be solved effectively. Finally, employment trends through 1980 for the region and local community in the heavy marine industrial trades are very promising and openly encouraging. Careers in mid-management Marine Engineering technology are available as well as upper division scholarships for hard working students.

Matching funds were provided by Florida Junior College, the United States Navy and Jacksonville Shipyards, Inc.

## UNDERWATER TECHNOLOGY [E/T-2]

Heralding the event as "the end of the days of diving symbolized by all brawn and no brains!" Mr. Thomas Angel, Manager of Diving for Santa Fe Engineering, delivered the commencement address to the first graduates of the Associates of Science Degree in Underwater Technology at the Florida Institute of Technology, Jensen Beach Campus.

All of the October 1977 graduates seeking employment were quickly hired. In fact, demand for these graduates was so high that three students were released three weeks prior to graduation at the specific request of Santa Fe Engineering. They were then flown back to campus by Santa Fe to attend commencement exercises, and subsequently completed the remaining required practical work necessary for their degree in the field.

Last year's short range objectives of the project—finishing modifications and equipment testing on the LCM6 diving boat, obtaining the remainder of the necessary supplies for the program, and completing the facility modifications—were successfully completed. The LCM6 diving boat is now

operational and serves as the surface supplied diving platform. The twin diesel engine vessel has an on-board generator, dual hydraulic systems, recompression chamber, primary and backup air, oxygen and mixed gas systems, 3-point mooring system, and can support four air or mixed gas divers simultaneously. The boat is cable of carrying up to sixteen students, four staff, and a crew of two. All required second year equipment has been obtained and the facility modifications are largely completed. The only modification remaining is the permanent installation of the underwater welding tank. The Underwater Technology faculty, with their widely diversified and commercial diving backgrounds, insures that the student receives the best diver training possible.

Frequently, higher education provides a student with the necessary academic background to perform well in a desired field, but neglects to properly expose the student to the field and to give directions on the "how and when" to get a job. In response to this, the Underwater Technology Department has initiated a yearly trip for sophomore students to the Association of Diving Contractor's annual symposium in New Orleans, which provides them with the opportunity to see their future industry firsthand and to meet future employers on a one-to-one basis. This gives them a definite employment advantage over graduates from other schools. In the past, the students have utilized the opportunity very wisely. Selected industry leaders indicated that they were most impressed with the F.I.T. student's ambitious quest for knowledge, intelligent questioning, and obvious superb training. A more effective promotion or advertising campaign, or a better method of exchanging and acquiring new information could not be found.

Two new manual revisions, entitled F.I.T./JBC Diving Operations Manual [Revised 11/77] and F.I.T./JBC Recompression Chamber Operations [Revised 11/77], have been published and are used by all staff and students for diving and recompression chamber operations at Jensen Beach.

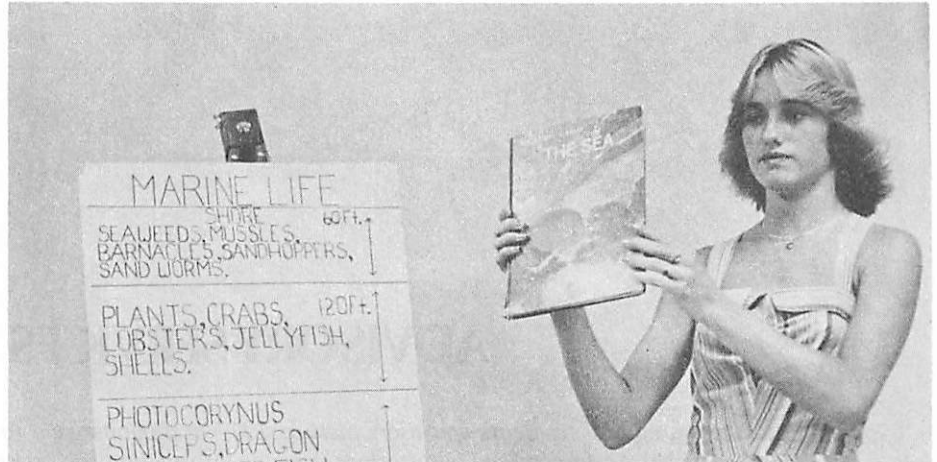
The program, as it now exists, is judged to be very successful, with present curriculum providing a stable base to which continuing modifications and updates can be readily accomplished. Although it is too early to obtain and evaluate inputs concerning work and training of graduates presently in the field, it is felt that the number of graduates is not large enough to meet employment demands. At the present time, the student enrollment is limited to an entering freshmen class of 99 students, once a year. From this group, approximately 45 to 50 students are expected to graduate, a number of which falls well below current and anticipated requirements. A study is currently in progress to explore possibilities of expanding this program to meet industry needs.

This cooperation among government, industry and a private university to create a new innovative technical degree, ranks as a major accomplishment in the educational field.

Outside matching funds were contributed by Manned Undersea Science and Technology, Santa Fe Engineering, J. Ray McDermott, Ocean Systems, Inc., Sub Sea International, Taylor Diving, Aqua Air Industries, and Divex.



## 4-H MARINE EDUCATION PROGRAM



The popular concept of 4-H is that of a highly effective and respected youth organization that has two basic functions—educational programs for youth, and demonstrating youth program methods and organizational patterns. Curriculum direction and development has always been of importance in 4-H, and today there is need for diversity of curriculum to attract and hold the interests of youth. The Florida 4-H Marine Education Program evolved from a demonstrated need for a comprehensive educational program of that nature for Florida 4-H youth.

The primary objective of the Program is to significantly increase the awareness of 4-H youth enrolled in 4-H marine education programs through the availability of quality opportunities which provide for the learning and sharing of marine related knowledge, values, and skills. The 4-H Department also serves to extend its capability for effectively serving selected interests of other state and federal agencies seeking information and direction regarding the development of youth marine curricula.

Based on 1977 USDA youth enrollment data, Florida ranks second in the southern region and second nationally in 4-H marine science enrollment. In cooperation with the Florida Marine Advisory Program, the State 4-H Department this past year involved several thousand youth in 4-H

marine camps, institutes, exhibits, demonstrations, tours and other learning experiences.

Florida youth, and other participants, have had an opportunity to integrate selected learning experiences derived from this program into a conceptual framework which is often applicable in principle and practice to other subject matter disciplines. The State 4-H Department has responded to inquiries from individuals and groups in 35 different states seeking selected information regarding the development and implementation of the Florida 4-H Marine Program. The high demand for 4-H marine publications for use in Florida counties has warranted a reprint of 10,000 copies each of 12 different special interest 4-H marine project modules. A third reprint of these materials is scheduled for 1978.

The 4-H Department also continues to maintain a lending library of marine reference books which have received much attention from those responsible for developing and participating in 4-H marine projects and activities throughout the State. Supplemental to the library, which contains approximately 200 books and documents, is a locator file containing selected information on approximately 500 marine related resource individuals and groups.

## ADVISORY SERVICES

*Expanding services to coastal residents and users marked 1977 as a banner year for the Florida Marine Advisory Program with conferences, workshops, seminars, and publications bringing information and assistance to users and residents in Florida's coastal areas. Six agents, strategically located in County Extension Offices along the coast, served all but six counties in the Big Bend area along the west coast, with a seventh agent scheduled for assignment to that area effective early in 1978. More populous areas such as Dade County need an advisory agent for that one area alone and plans were formulated to provide a full-time agent for Dade County in 1978.*

*With support from the research and educational resources of the State University System of Florida, the Florida Cooperative Extension Service, and public and private interests, the Marine Advisory effort completed its most active and successful year to date.*



*"I must down to the seas again to the vagrant gypsy life."*



## MARINE ADVISORY PROGRAM [A/MAP-1]

One area which previously had not been served actively by the Marine Advisory Program was that of marine recreation. This was due to several reasons including limited resources, complexity of the industry and the immensity of the Florida coastline. Because of this, the program focus had been limited and, until this year, restricted to fishing and seafood marketing, coastal zone problems, and marine education. However, in 1977, in addition to continuing its activities in these areas, MAP reached out to include marine recreation for the first time.

### Marine Recreation

In June, as a follow-up of a regional artificial reef conference held in Sarasota in 1976, MAP agents and specialists participated in the state-wide artificial reef conference at the University of South Florida Bayboro Campus in St. Petersburg. As a direct result of that conference, Florida Sea Grant made funds available for an artificial reef resource team to provide assistance in establishing new reefs. At the request of reef committees or other organizations in the area involved, members of the team visit the community off which the reef is to be located, explain what is involved, benefits to be expected from the reef and other pertinent matters. Marine advisory agents are often involved in arranging for the reef team's visit and in assisting the local planning group.

As another big step into the marine recreation area, plans were initiated for a Marina and Boatyard Operators Conference to be held sometime in early 1978. With over 1000 marinas and 447,034 registered boats reported by the Florida Marine Patrol, the conference was planned to

give marina and boatyard operators an opportunity to discuss among themselves and with governmental agencies, problems faced by their industry.

### Publications

The MAP newsletter continued to be circulated to approximately 7,000 subscribers monthly. In addition, regular issues of Coastal News Reprints were sent out to key subscribers. These compilations of news articles from the Florida press proved to be very popular as a single source of news important to and impacting on Florida's coastal communities and residents. In addition, each MAP agent routinely issues newsletters and fact sheets to constituents in his geographical area.

Also published were advisory bulletins and fact sheets on such diverse subjects as commercial fisheries, floating tire breakwaters, selection and preparation of seafood, cold water survival, medical care for commercial fishermen, beach and dune stabilization through use of vegetation, and historical accounts of erosion and accretion on barrier islands off Florida's southwest coast.

Sea Grant Reports and Technical Papers were published on such subjects as commercial fisheries, beachfront construction, inlet glossaries, water management, artificial reefs, coastal ordinances, beach nourishment, and the national flood control program. Reprints of articles written by Sea Grant researchers and appearing in technical journals were also reproduced and distributed to a list of key subscribers.

The mass media was utilized as a channel for transmission of information with 18 news releases distributed, two feature articles published, and regular TV appearances by some of the marine agents.



Cleaning the blue crab. One of several illustrations in the Marine Advisory Fact Sheet—Fish Facts for Florida Consumers—concerning the procurement and preparation of that seafood delicacy. Three other fact sheets were also published on shrimp, finfish, and squid.

## Marine Education

Conference, workshops, and seminars played an important role in stimulating public awareness of the Marine Advisory program and serving coastal users on a person to person basis. This was especially true in the 4-H Marine area with two marine camps attended by a total of over 150 4-H members and a marine field day in Escambia county with 30 members participating. Marine agents organized and participated in these activities supported by extension 4-H personnel and adult leaders.

At the University of Florida, MAP co-sponsored the Fifth Annual Seminar on Coastal Engineering, and a business management workshop. Other workshops were held throughout the state and marine agents organized local workshops and seminars on use of fishing gear, coastal



Above, Dr. James Cato, marine economics advisory specialist, left, and Dr. Fred Prochaska, conduct a 3-day marine economics workshop at the University of Florida. In photo at right, Jeff Fisher, marine advisory agent, demonstrates the art of net making at the 4-H Marine Institute held at Marineland.



zone management, seafood preparation, tax and business management, bait worms, and others to more effectively utilize available marine resources.

## Commercial Fishing

Advisory services to the commercial fishing industry continued this year as in the past with several economic reports published and workshops held throughout the state. A first of its kind short course on nets and trawls was held in Panama City. The course, limited to 30 commercial seafood producers, covered a variety of subjects concerning nets and trawls such as history, basic net knot, net mending and repair, net design and construction, and wire splicing.

Vietnamese immigrants, some with commercial fishing experience, settled along the Northwest Gulf coast and fished commercially. Communication with this group was very difficult due to the language barrier. To overcome this, the marine agent in that area wrote a regular article for the regional library's Project Outreach newsletter for Vietnamese immigrants. This was translated into Vietnamese by the Outreach staff and represented the only reliable means of communicating with this new minority group on the waterfront.

Legal and sanitary disposal of seafood waste is a problem in every community that handles seafood products. In Panacea, where there is a concentration of blue crab plants, the waste generated has recently ranged from a low of 1,300 tons per year to approximately 4,000 tons a year. This substantial quantity of solid waste creates special problems due to its odor, pest attraction, chemical nature and the limitations of the county in terms of disposal alternatives.

The County Commission, faced with the need for hard long-lasting decisions solicited the aid of the marine advisory program through the County Extension Office. A team was formed and in one week met, outlined, wrote, and distributed a document which serves as the single factual basis

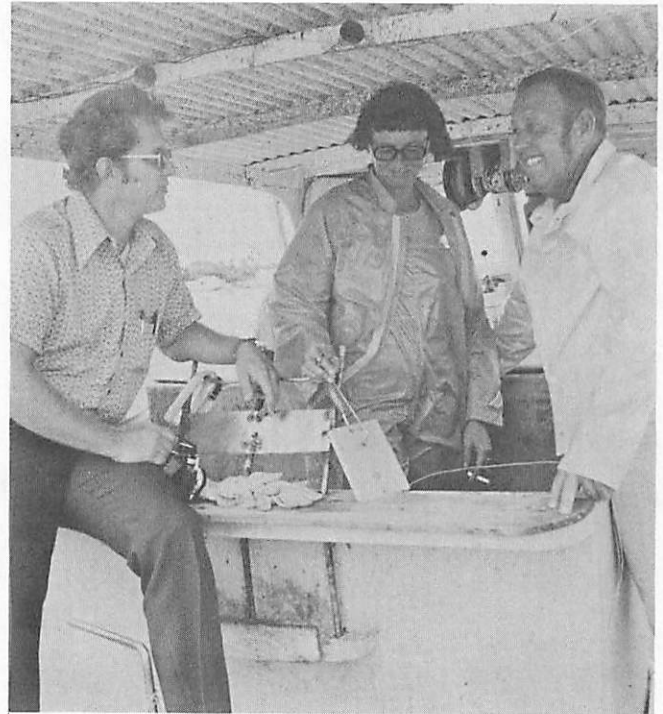


for local decision makers. The report was described by the County Administrator as an important and essential document in solving this critical problem.

"The Florida Marine Advisory Program's efforts to help that state's fishermen solve such a basic problem as uncomfortable foul weather gear demonstrates the potential effectiveness of the nation's Sea Grant advisory branches."  
 — National Fisherman, October 1977.

The customary foul weather gear used by fishermen to ward off the elements is a heavy, rubberized fabric which is great for colder climates but for Florida fishermen who need protection from wind and rain but not cold weather, the gear is often unbearably hot, especially during the summer months. As a result of a suggestion arising from a marine advisory committee meeting in Brevard county, the Extension clothing specialist and marine agent for the area cooperated in the construction of an experimental lightweight type of garment. Three different kinds of fabric were tested along with various fasteners, and garments were constructed in different ways to test durability of seams and fasteners. Although first tests of the garment by a commercial fisherman and his wife were not successful, work is continuing using other types of fabrics and fasteners.

During the year, extensive efforts and programs were undertaken by the marine advisory program to assist interagency cooperation and implementation of the Fishery Conservation and Management Act of 1976.



Joe Halusky, left, marine advisory agent for Northeast Florida chats with Sue and Elmer Stokes on their fishing boat. The Stokes are wearing the lightweight test garments designed by extension home economists.

### ADVISORY SERVICES RESEARCH Sea Grant Information Diffusion in Northwest Florida

This investigation was initiated to provide a report to the Florida Sea Grant Program concerning the job-related communication behavior patterns of commercially-licensed boat owners in the Northwest Florida Marine Area. Its purpose was to provide information to use in developing a model for more effective information diffusion by the program personnel.

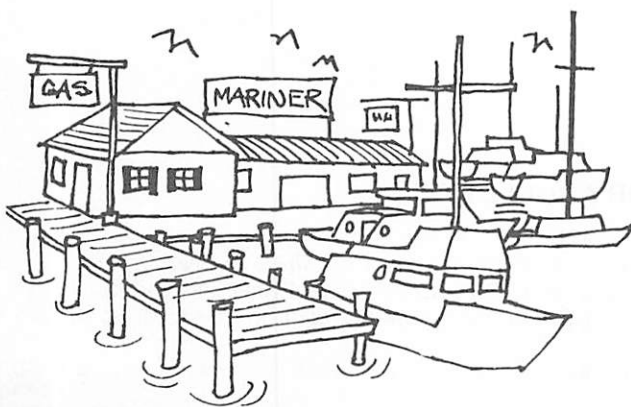
Activities used to reach these objectives included interviews with Florida Sea Grant personnel; the Northwest Florida marine advisory agent; group interviews with commercial boat owners in Panama City, Pensacola,

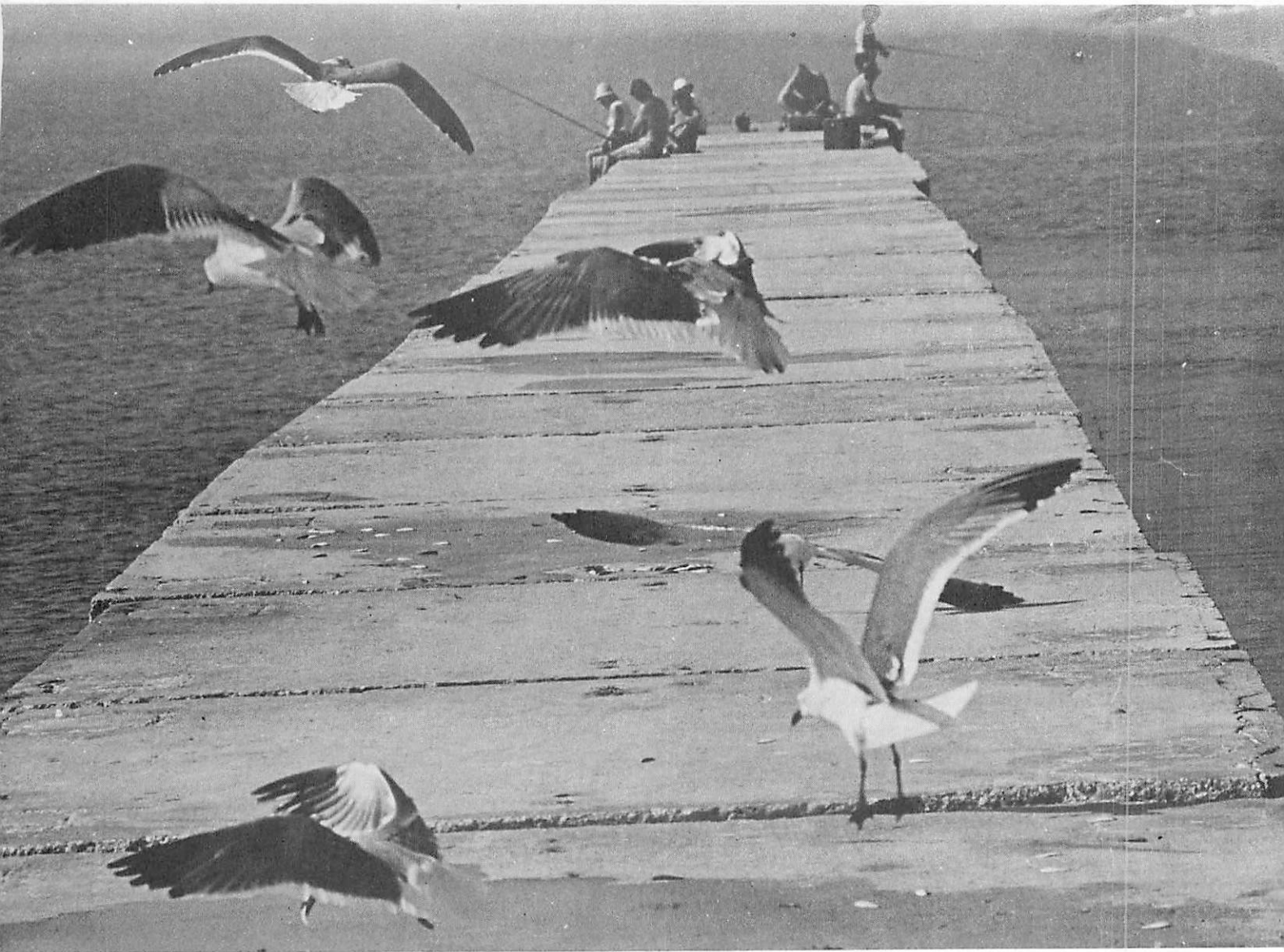
Ft. Walton Beach and Destin; and telephone interviews with a sample of 309 commercial boat licensees in the area.

The study was designed to discover where and how boat owners receive job-related information by comparing patterns of source usage by respondents, channels utilized, frequencies of source contact and the perceived usefulness of the contact.

Results from the study indicated a strong preference and usage of personal contact as a primary channel for receiving information, and fellow fishermen as a primary source of job-related information. Respondents were not heavy users of the other seven sources indicated. These seven were marine representatives, government agencies, newsmen, broadcast, writers, speakers, and commercial outlets. The majority indicated contact with only two or three sources during the year. While frequency of usage of the sources was not high, most respondents indicated a high satisfaction rating for most sources.

To summarize, respondents in the Northwest Florida Marine area appear to be highly oriented toward oral communication—personal contact. One way of increasing the efficiency of interpersonal networks is to create information sources among the more knowledgeable and interested members. One marine agent through personal contact with twenty "middle men," can multiply these twenty into 400 other fishermen.





*"To the gull's way and the whale's way. . ."*

## PROGRAM SUMMARY

### PUBLICATIONS

#### MARINE ADVISORY BULLETINS

- SUSF-SG-77-001 *Florida Sea Grant Program Directory—1977.*
- SUSF-SG-77-002 *Floating Tire Breakwaters—A Case Study of a Potential Low Cost Shore Protection Structure for Florida's Protected Marine Waters.* Charles A. Gifford, Jeffrey A. Fisher and Todd L. Walton, Jr.
- SUSF-SG-77-003 *Landings, Values and Prices in Commercial Fisheries for the Florida East Coast.* James C. Cato and Fred J. Prochaska.
- SUSF-SG-77-004 *Landings, Values and Prices in Commercial Fisheries for the Florida Northwest Coast.* James C. Cato and Fred J. Prochaska.
- MAP-1 *An Economic Analysis of King Mackerel Production by Hook-and-Line on the Florida Atlantic Coast.* R. Alan Morris, Fred J. Prochaska and James C. Cato.

Sea Grant and Marine Advisory Program publications contribute directly to public awareness and education—both essential components of an effective advisory program.

—Hugh Popenoe

### SEA GRANT REPORTS

- Report No. 19 *An Economic Profile of Florida Commercial Fishing Firms: Fishermen, Commercial Activities and Financial Considerations.* Fred J. Prochaska and James C. Cato.
- Report No. 20 *Guidelines for Beachfront Construction with Special Reference to the Coastal Construction Set-back Line.* Courtland A. Collier, Kamran Eshaghi, George Cooper and Richard S. Wolfe.
- Report No. 21 *Matanzas Inlet—Glossary of Inlets Report No. 5.* A. J. Mehta and C. P. Jones.
- Report No. 22 *Seminar Proceedings: Freshwater and the Florida Coast: Southwest Florida.* William Seaman, Jr. and Richard McLean, Editors.
- Report No. 23 *Ponce de Leon Inlet—Glossary of Inlets Report No. 6.* C. P. Jones and A. J. Mehta.

### TECHNICAL PAPERS

- Benefit-Cost Study of Pinellas County Artificial Reefs.* Eila Hanni. No. 1
- Development of County and Local Ordinances Designed to Protect the Public Interest in Florida's Coastal Beaches.* Frank E. Maloney and Dan Fernandez, et al.
- Beach Nourishments in Florida and on the Lower Atlantic and Gulf Coasts.* Todd L. Walton, Jr. No. 2
- The National Flood Insurance Program Revisited—An Updated Model Ordinance for Implementation of Its Land Management Criteria.* Frank E. Maloney and Dennis C. Dambly. No. 3.

### BROCHURES AND FACT SHEETS

- This Flag is Important.* Douglas Coughenower. Provides safety information for recreational boaters and commercial fishermen.
- Building Construction on Shoreline Property.* C. A. Collier. Construction guidelines and considerations for owners, designers and builders of shore area buildings.
- Fish Facts for Florida Consumers.* Don E. Sweat and James C. Cato. Series of four individual brochures. *Blue Crab* (MAPB-1). *Finfish* (MAPB-2). *Shrimp* (MAPB-3). *Squid* (MAPB-4). Demonstrates how to select, buy, and prepare seafood.
- Coastal History Notes.* Todd L. Walton, Jr. History of high water shorelines and erosion patterns over a period of 100 years for each of the following coastal areas: Anna Maria Key, Captiva Island, Estero Island, Gasparilla Island, Lido Key, Longboat Key, Sanibel Island, Siesta Key.
- Stabilizing Beaches and Dunes with Vegetation in Florida.* (MAFS-1). Extracted from Sea Grant Report Number 7, *Stabilization of Beaches and Dunes by Vegetation in Florida*, Written by John H. Davis, Jr.

### MISCELLANEOUS

- 1977 Symposium: Coastal Zone Management - University of West Florida.* Sneed B. Collard and Luther W. Skelton, Editors.



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## PROJECTS AND INVESTIGATORS

Project	Complete Title Estuarine Management	Duration		Investigator and Institution
		Begin	End	
R/EM-6	The St. Johns River Estuary: A Chemical, Physical and Biological Study	1975	1978	Carole L. DeMort, R. D. Bowman, UNF
R/EM-7	Effects of Sewage Pollution Abatement on Hillsborough Bay	1975	1978	Joseph L. Simon, Wen H. Huang, USF
R/EM-10	Culture and Transplant Studies of the Seagrass <i>Ruppia maritima</i>	1977	1979	Peggy A. Winter, UWF
R/EM-11	Stormwater Runoff in the Apalachicola Estuary	1977	1977	Robert J. Livingston, David E. White, FSU, B. A. Christensen, UF
<b>Ocean Engineering</b>				
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
R/OE-7	Environmental Assessment of Near-Shore Borrow Areas	1977	1977	W. R. Courtenay, Jr. and G. A. Marsh, FAU
<b>Fisheries Resources</b>				
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-9	Management: Biology of the Northwest Florida Snapper-Grouper Fishery	1977	1979	Stephen A. Bortone, UWF
R/FR-10	Spiny Lobster Larval Recruitment in the Florida Keys	1977	1979	R. A. Menzies, Nova U
<b>Coastal Policy</b>				
R/CP-2	Developments of Legal Alternatives for Effective Management of Storm Water Runoff	1977	1978	Frank E. Maloney, Dan Fernandez, UF
R/CP-3	Onshore Impact of Offshore Energy Facilities: A Legal Analysis	1977	1978	Jon L. Mills, R. D. Woodson, UF
<b>Education</b>				
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
<b>Advisory Services</b>				
A/MAP-1	Marine Advisory Program		Continuous	John T. Woeste, Marion L. Clarke, UF
<b>Short Term, Pilot &amp; Demonstration Projects</b>				
M/PM-2	Florida Sea Grant Immediate Response Projects:			
	Assessment of Damage from Hurricane Eloise and Its Effects on the Beach	9/75	9/77	T. Y. Chiu, UF
	Cathodic Protection against Sea Water Corrosion Fatigue Elver ( <i>Anguilla rostrata</i> Lesueur) Assessment in Northeast Florida	1/76 3/76	4/78 2/78	William H. Hart, FAU Jerome Shireman, Michael Oesterling, UF
	Data Management for Estuarine Projects	6/76	6/78	James T. McClave, UF
	Tongue Net Demonstration Project—Field Test of a Twin Trawl Modification	9/76	2/78	Joseph G. Halusky, UF
	Environmental System Analysis of a Lock and Dam on Turkey Creek, Palm Bay, Florida	10/76	4/78	Diane D. Barile, FIT
	4-H Marine Education Program	1/77	1/78	Thomas Greenawalt, UF
	Diffusion of Sea Grant Information in the West Florida Marine Area	1/77	3/78	J. F. Lloyd, C. G. Mills, UWF
	Economic Study of Artificial Reefs	1/77	12/77	Eila Hanni, USF
	Brevard Coastal Seminar	4/77	4/77	Diane Barile, FIT
	Salt Tolerant Plants for Florida	6/77	12/77	W. E. Barrick, UF
	Coastal Zone Symposium at UWF	6/77	6/77	Sneed Collard, Luther Skelton, UWF
	Animal Communities in Seagrass	8/77	8/78	P. A. McLaughlin, FIU
	Floating Tire Breakwater	8/77	12/77	Jeffrey A. Fisher, UF
	Hermit Crabs as Pets—A conference	9/77	10/77	P. A. McLaughlin, FIU
<b>Administration</b>				
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 1977\*

Florida Program Area & Federal Classification	NOAA Sea Grant	University System Guarantees & Sponsors**
<b>ESTUARINE MANAGEMENT RESEARCH</b>		
Support of Coastal Decisions	\$ 43,100	\$ 27,200
Ecosystem Research	99,100	43,200
Pollution Studies	49,200	30,500
<b>OCEAN ENGINEERING RESEARCH</b>		
Coastal Engineering	153,200	134,100
Product Development	56,500	21,700
<b>FISHERIES RESOURCES</b>		
Living Resources	86,800	52,400
Marine Economics	29,400	36,700
<b>COASTAL POLICY</b>		
Law	20,800	16,000
<b>EDUCATION</b>		
Vocational	99,500	633,600
<b>ADVISORY SERVICES</b>		
Extension Programs	337,100	376,400
<b>SHORT TERM &amp; PILOT STUDIES</b>	100,000	35,200
<b>ADMINISTRATION</b>	48,900	25,600
<b>Totals</b>	<b>\$1,123,600</b>	<b>\$1,432,600</b>

\*Approximate figures subject to final audit

\*\*No federal funds included

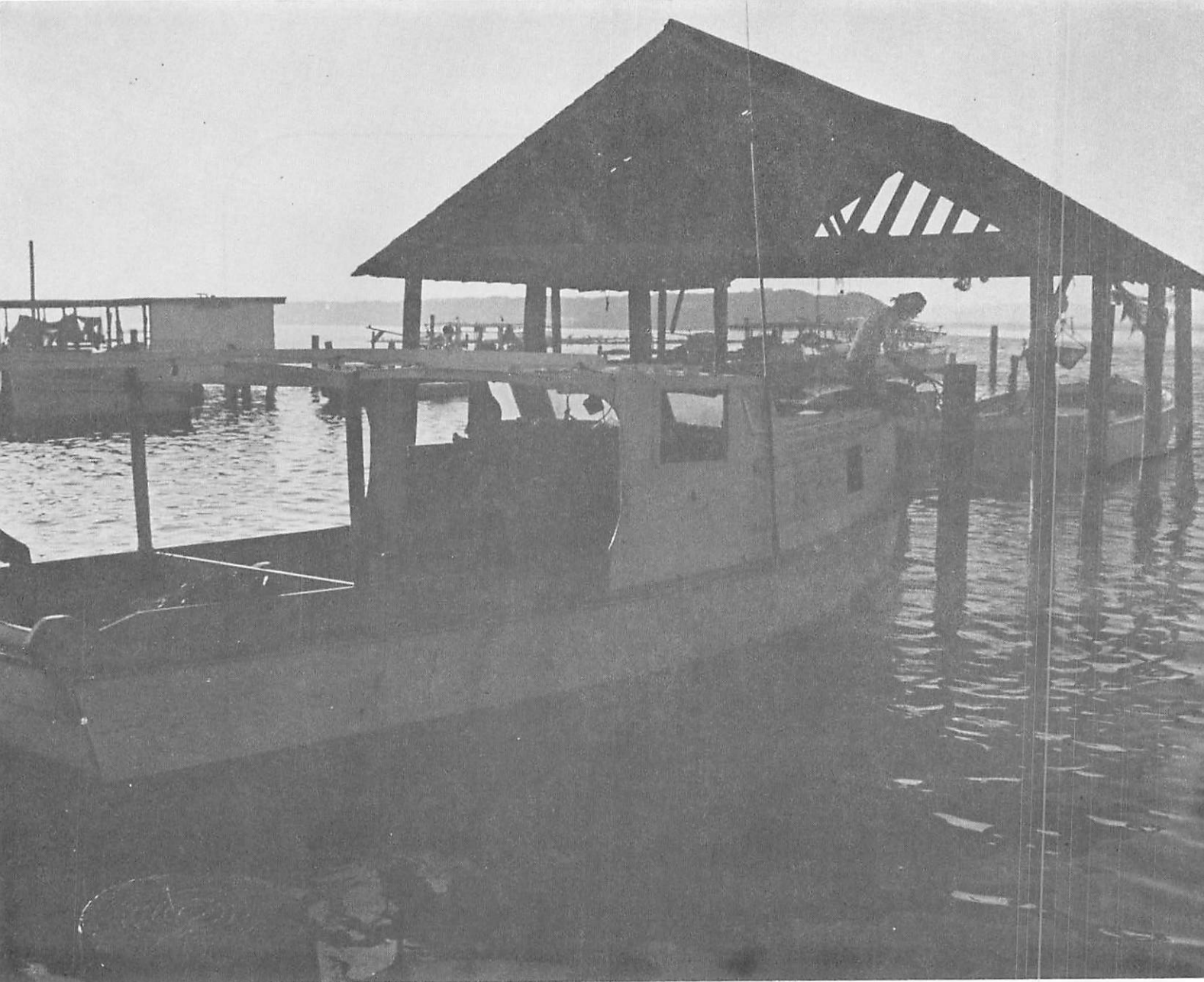


## SPONSORS

Academy of Marine Science, Miami  
Applied Marine Ecological Service  
Aqua Air Industries  
Board of County Commissioners of Various Coastal Counties (advisory services)  
Brevard County  
Buckeye Cellulose Corporation  
Center for Governmental Responsibility  
Clearwater (city of)  
Coastal Plains Center for Marine Development Services, Wilmington, N.C.  
Divex  
Escambia County  
Florida Board of Regents  
Florida Department of Environmental Regulation  
Florida Department of Natural Resources  
Florida Department of Transportation  
Franklin County Board of County Commissioners  
Georgia Marine Advisory Program  
Gifford, Charles A., Pensacola  
Great American Crab Company  
Gulf-Tampa Drydock Company  
Gulf of Mexico Fishery Management Council  
Hillsborough County Environmental Protection Commission  
Jacksonville (city of)  
Jacksonville Shipyards, Inc.  
Jones, Bruce (commercial fisherman)  
J. Ray McDermott Co.  
Klima, W. M.  
Manned Undersea Science and Technology  
Ocean Systems, Inc.  
Palm Beach County  
Paschke, Capt. Rusty  
Pensacola (city of)  
Pensacola Party Boats, Inc.  
Port Malabar Civic Association  
Port Malabar Country Home Owners Association  
Santa Fe Engineering  
Southwest Florida Regional Planning Council  
Southwest Florida Water Management District  
St. John's River Water Management District  
Sub Sea International  
Tampa (city of)  
Taylor Diving  
U.S. Environmental Protection Agency  
U.S. National Aeronautic and Space Administration  
U.S. Navy

## GRANTEES

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

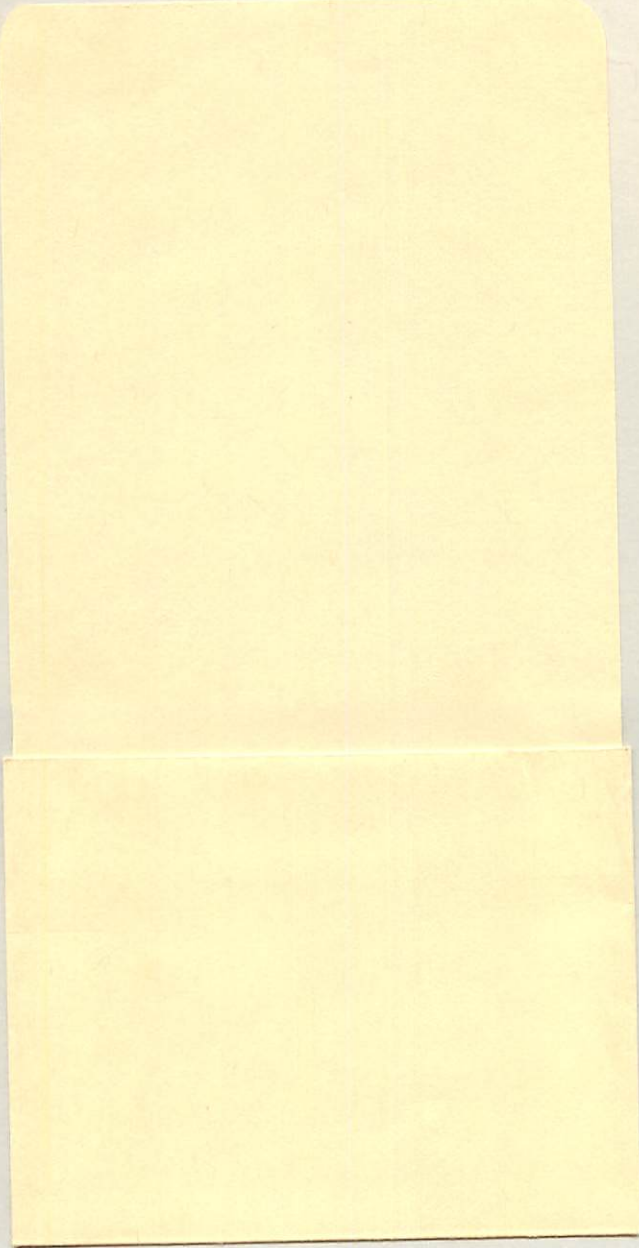


*"And quiet sleep and a sweet dream when the long trick's over."*

Quotations from John Masefield's poem, "Sea Fever."

Written and edited by:  
Tom Leahy and Billie Lowry

Graphics by:  
Ralph Knudsen



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