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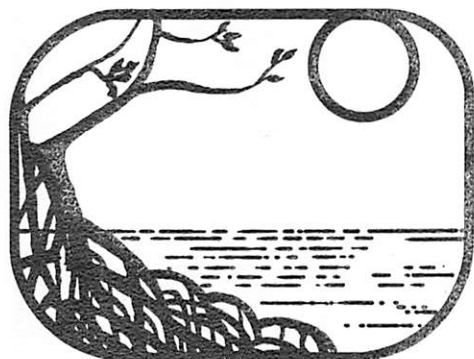
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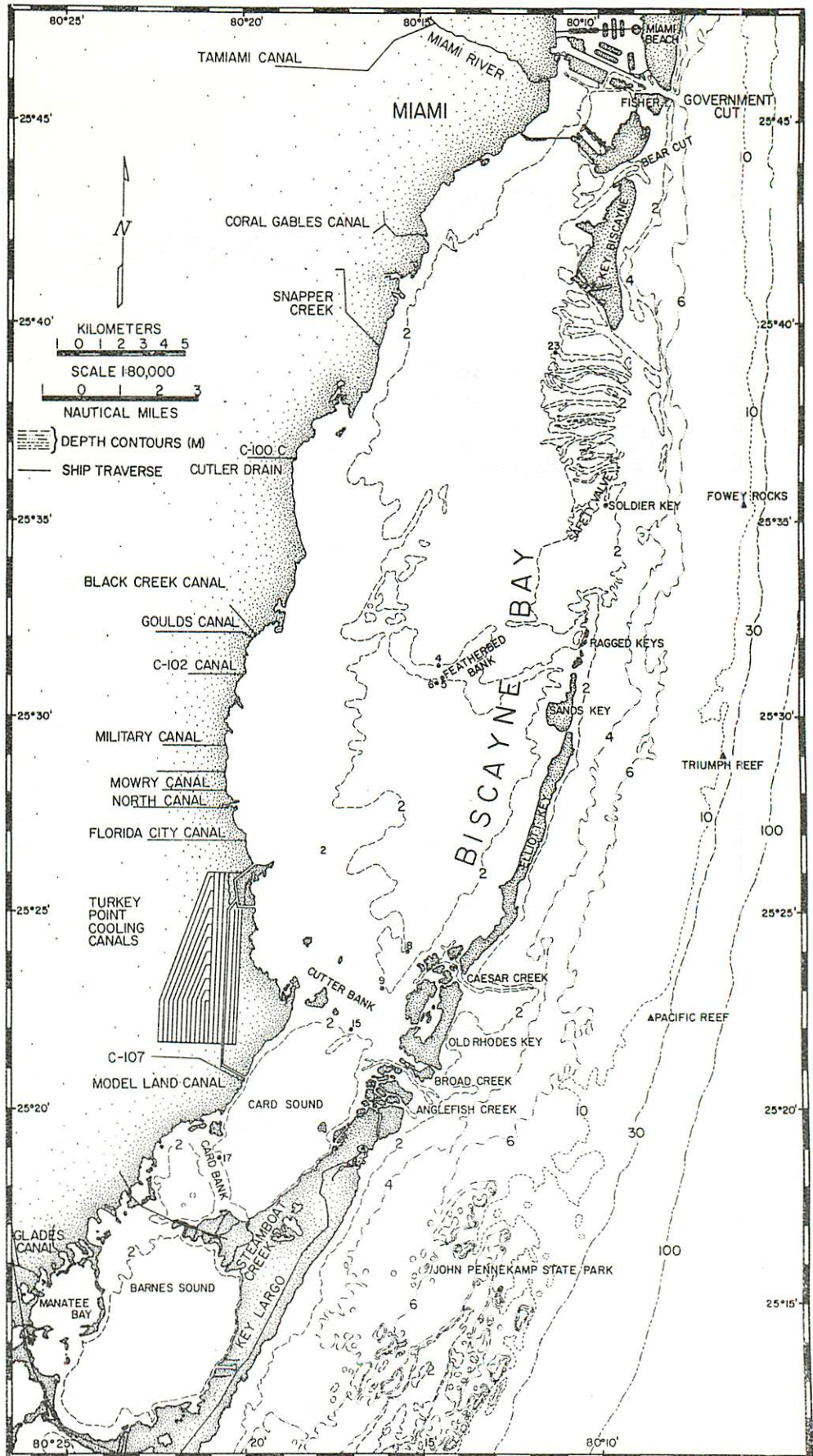
ANNUAL REPORT 1975—1976



UNIVERSITY OF
MIAMI
SEA GRANT

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Biscayne Bay and Connecting Lagoons

INTRODUCTION

During the past year, the Sea Grant Program has become increasingly involved in the complex relationship of an immensely endowed natural resource, an affluent seaside community, and an institution rich in research and education capabilities.

The demands upon Biscayne Bay, the 50-mile long southeast Florida lagoon on the shores of which has settled a population now surpassing 1,500,000, are manifold, often competitive. They produce some perplexing confrontations:

1. Should absolute water clarity – considered indispensable by the tourism industry – be maintained by halting all dredging and bulkheading, essential to development of the shoreline?
2. Should the death of North Bay, now a biological desert, be conceded and limited resources dedicated to keeping South Bay viable?
3. Should all commercial fishing be prohibited to preserve dwindling stocks for increasing numbers of sport fishermen?
4. Should powerboating and water skiing be curtailed because they endanger skin divers and swimmers?

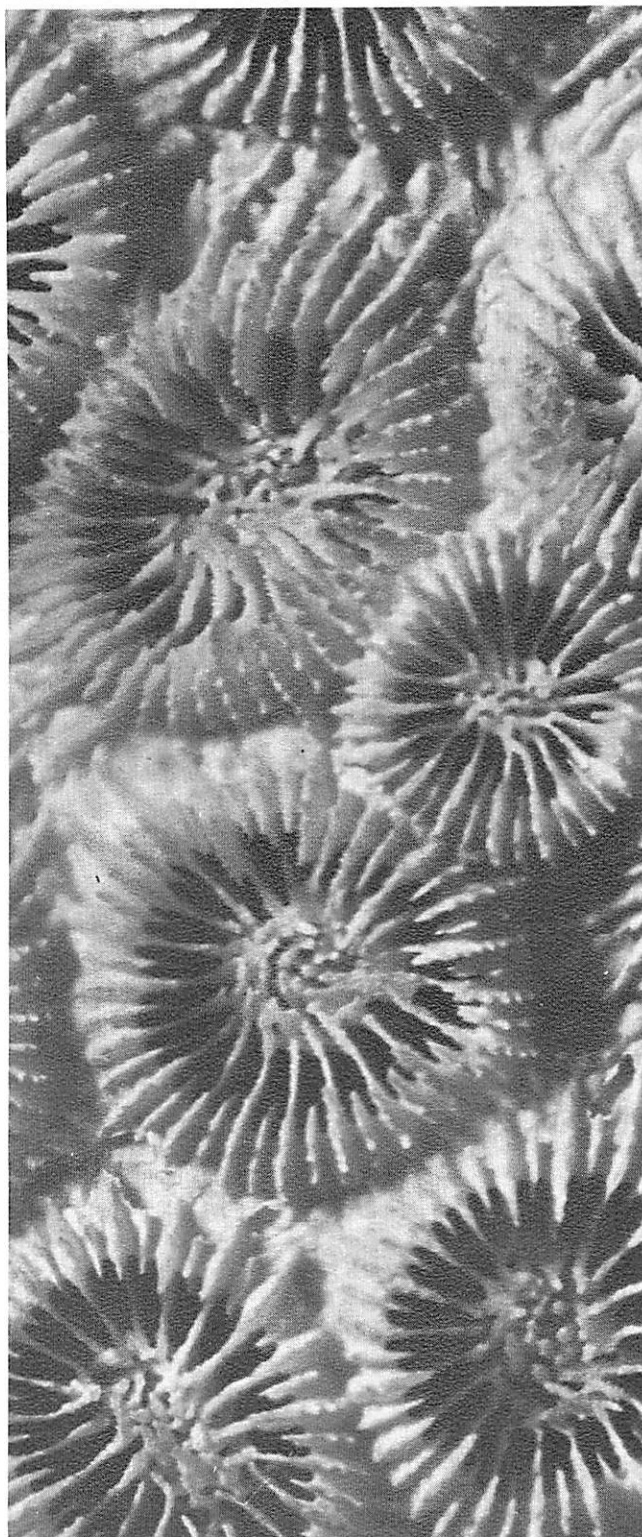
To these adversary interests may be added many legal questions concerning vegetation lines, mean high water lines, zoning, bulkheading, pollution, and oil spillage, as well as many management problems such as placement of marinas, licensing, safety, measurement and prediction of circulation patterns, assignment of authority and responsibility – many of them typical land/marine use issues. Their treatment here may be illuminating and illustrative.

The challenge then can be summed up: *How can Biscayne Bay (and other estuarine systems in other urban areas) be managed so as to satisfy the many demands made by rapidly growing populaces – without ecological destruction?*

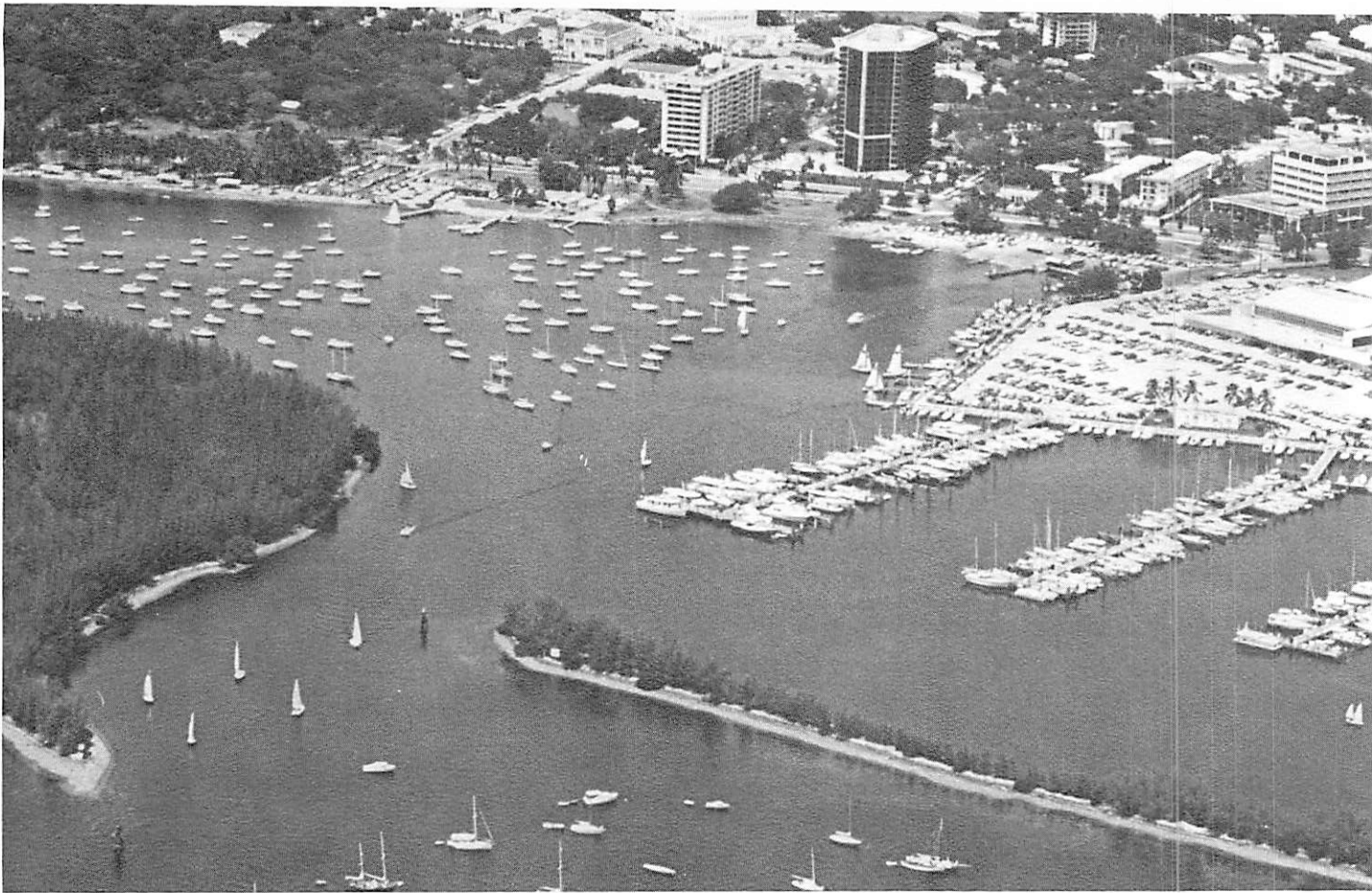
The Sea Grant Program at the University of Miami has been dealing with this challenge for several years. The program has been designed both to address long-term problems and to respond quickly when decision-makers seek help.

This Annual Report summarizes how various projects have been orchestrated into a coordinated attack on the problems South Florida and other coastal areas face.

Al Volker
Associate Director for Information



Coral Formations



DIRECTOR'S OVERVIEW

DR. EUGENE H. MAN

The official Sea Grant definition of a "good program" appears on page 25 of the National Sea Grant Program's *Program Description and Suggestions for Preparing Proposals*. Under a paragraph entitled "Approach" we find the following counsel:

A good program must reflect well-thought-out and clearly identified goals, and coordination of the disciplines to be involved in achieving these goals. *It must show that the program is well motivated in terms of area needs, and uniqueness of physical and biological features of the area.* (Italics added.)

The Miami Sea Grant Program described through the individual projects reported in this Annual Report for July, 1975, through June, 1976, does indeed demonstrate a program "well motivated" in terms of the needs of the Miami area, as well as emphasizing the uniqueness of its physical and biological features. In electing to concentrate a multi-disciplinary effort on utilization of the estuarine resources of Biscayne Bay, Miami Sea Grant has chosen the one physical feature upon which this area depends most heavily for its identity and well being. In south Florida, Miami Sea Grant is the undisputed center for activities concerning the

preservation and restoration of the Bay. Its "uniqueness of physical and biological features" was the subject matter of two weekend Sea Grant symposia and three major Sea Grant publications during the year as well as the subject matter of just about every project funded by Sea Grant in recent years.

We have chosen to be the "only show in town" on Biscayne Bay because the Bay poses not only the most critical set of physical, biological, social, economic, and legal problems we could find within the Sea Grant philosophical framework, but also because the Bay provides an unexcelled opportunity to develop good science, good economics, new legal concepts — and so on. A look at three milestone achievements during the report year illustrates the point:

*A new anaerobic bacterium, *Eubacterium tarantellus* sp. nov., was found to be implicated in many fish kills, and was characterized and named by University of Miami Sea Grant scientists. The new microbe acquired its name after the "dance of death," a wild, circular tail-chasing movement of fish afflicted with the newly discovered disease.

*Sea Grant economists have received statewide attention for their development of a new statistical meth-



Photo Courtesy of Thomas W. Bilhorn
Miami's Dinner Key Marina, a Public Facility

od for assessing the recreational uses of boats over a range of conditions. Requests for such analyses have come from Dade County (to assist in the design and placement of new marina facilities); from the Florida Department of Natural Resources for a specialized baseline study of the State's more than 350,000 boats; from NOAA's NMFS for an analysis of boats with spiny lobster commercial licenses; from the U.S. Park Service; and from numerous counties around the State.

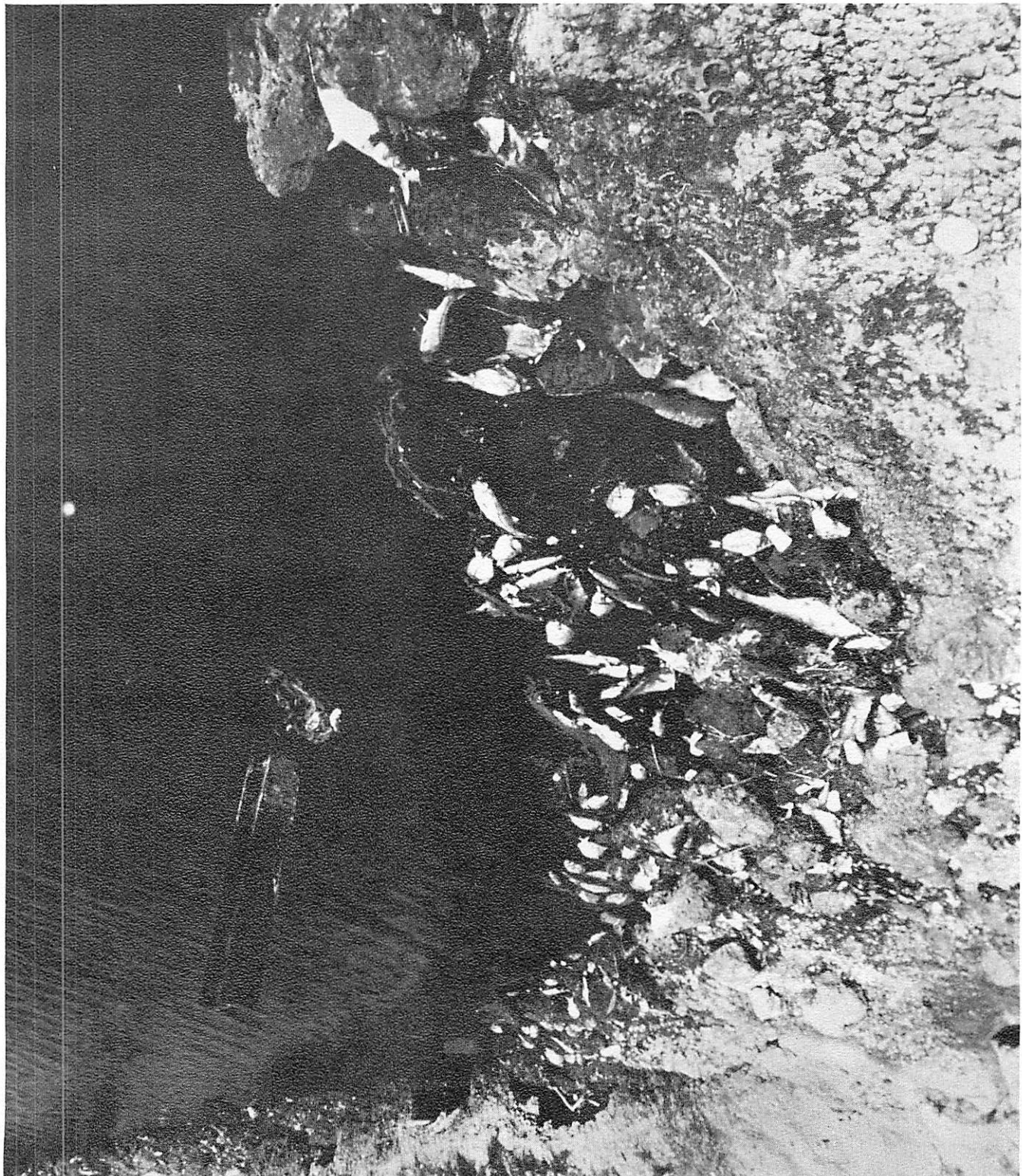
*Sea Grant Information Services organized and presented two symposia on Biscayne Bay, in response to numerous requests for a means to bring together all that is known and all that needs to be found out about Biscayne Bay. The initial process was a year of internal seminars under Sea Grant auspices, followed by a year of organization under the overall leadership of Dr. Anitra Thorhaug. The symposia were co-sponsored with Sea Grant by ERDA and the University's Rosenstiel School. The first weekend was devoted to presentation of information developed over many years of research, and presented in full in a Sea Grant publication (315 pages), *Biscayne Bay: Past/Present/Future*. The second weekend had the format

of a modified American Assembly at which scientists interacted with decision-makers and interested citizens to arrive at a "consensus" of recommendations, published by Sea Grant. The keynote address was presented by the Honorable Nathaniel P. Reed, Assistant U.S. Secretary of the Interior for Fish, Wildlife, and Parks. The result of these symposia was not only the accomplishment of a monumental scientific task and community service, but to clearly establish Miami Sea Grant as the undisputed focal point of regional activity concerned with the utilization of Biscayne Bay.

The University of Miami is a private institution, one of the few that receive Sea Grant support. It is also located in a state where the State University System has evolved an excellent Sea Grant Program which encompasses most of the coastal area of the State. We feel that it makes sense, then, for the University of Miami, with its strong marine tradition as represented by its internationally known Rosenstiel School of Marine and Atmospheric Science and its location in the State's most populous urban marine area, to select Biscayne Bay as the object of its concern. And we believe it is in the best Sea Grant tradition to apply our University talents to the solving of one of our region's most pressing needs.

A Major Fish-Kill in the Estuarine System

Photo Courtesy of Lanny R. Udey



PATHOLOGY OF MARINE ANIMALS

DR. BENNETT SALLMAN, DR. LANNY R. UDEY
Co-Principal Investigators

In the past year, 19 fish kills in Dade, Broward, and Monroe Counties were investigated. Seven of these kills occurred in salt water estuaries and canals while eight were in fresh water flood control canals and four in private development lakes and canals. Sites of frequent fish kills were visited either by car or boat on more than 30 occasions. These trips were scheduled to examine environmental conditions, collect moribund fish (not associated with a particular kill), as well as to collect water and sediment samples.

The probable cause of the majority of the kills was determined and reported to the appropriate governmental agencies, environmental concern groups, and where applicable to the news media. Among governmental groups which have been included are: 1) Dade County Public Health Department, 2) Dade County Environmental Resources Management, 3) The Central and South Florida Flood Control District, 4) Florida Department of Natural Resources, 5) Army Corps of Engineers, 6) U.S. Fish and Wildlife Service, and 7) U.S. Park Service. The pathology service has responded to more than 250 citizen and agency inquiries regarding: 1) fish kills, 2) human safety of fish and shellfish caught in Biscayne Bay, the canals and other fresh water enclosures. Many of the inquiries were stimulated by a public service announcement shown on a commercial television channel more than 100 times during the past year.

It is felt that the twirling-symptom disease is caused by an anaerobic bacterium. A single type of anaerobe was isolated from every moribund mullet and mojarra (26 specimens) sample.

This same anaerobic bacterium has also been isolated from: 1) hemorrhaging sea trout from Florida Bay in the Keys, 2) hemorrhaging bonefish, and 3) black drum, Atlantic croaker, porgy, mojarra, and silver jenny in North Biscayne Bay.

In order to identify this bacterium the biochemistry and physiology of the organism were extensively studied using the anaerobic methods outlined by the Center for Disease Control (CDC) and by the Virginia Polytechnic Institute Anaerobic Laboratory. The CDC confirmed results of tests using five strains supplied by UM scientists. The conclusion drawn from this testing was that this bacterium represents a new species in the genus *Eubacterium*, named *E. tarantellus*. A type culture has been sent to the American Type Culture Collection (ATCC) and a strain number will soon be assigned.



Photo Courtesy of The Miami News
Scavengers Have Feast

Mouse toxicity and guinea pig virulence tests were conducted to determine if this organism represented any human health hazard. The results of both of these tests were negative and it was concluded that the bacterium is non-pathogenic for mammals.

Four principal sampling stations (representing different habitats) were established in the middle and southern portions of North Biscayne Bay. Sampling of these stations has been conducted on a weekly basis for the past 45 weeks.

The fin-rot syndrome typified by eroded, split, and hemorrhaged fins is found in very high incidence in some species, namely: striped mojarra, black drum, yellow-tail mojarra, Atlantic Croaker, marine catfish, menhaden, bottom rays, and the porgy.

It has also been found that the scale patterns in the porgy have been disrupted in 28 percent of specimens. Several other species are showing similar changes in scale patterns (some affecting the lateral line). It seems likely that this condition is a manifestation of developmental or genetic alterations.

In addition to the "on board" observation of all fish, 210 fish, both normal and those displaying the disease symptoms described, have been brought to the laboratory for further analysis. Photographic documentation of these conditions were also made at this time. These samples are currently in various stages of processing.

The bacteria which were isolated from fish with fin erosion have been identified to genus. The most commonly isolated organisms were of the genera *Vibrio*, *Pseudomonas*,

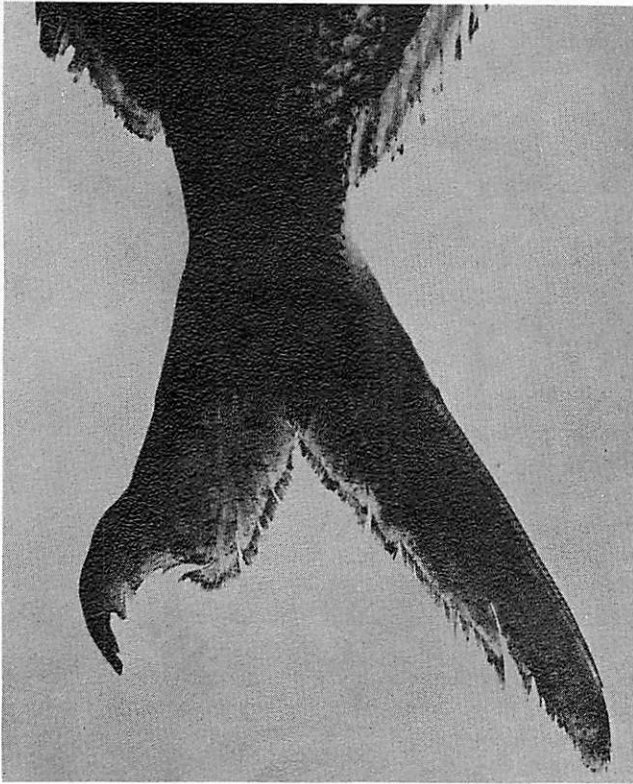


Photo Courtesy of Lanny R. Udey
Silver Jenny, Showing Tail-Rot

and *Aeromonas*. The vibrios were the most commonly encountered and these organisms as well as other vibrios from systematic isolations and from marine sediments have been extensively characterized. *Vibrio parahaemolyticus* and *V. alginolyticus* were found in high numbers in sediments by UM scientists and in Biscayne Bay waters by the National Marine Water Quality Laboratory (EPA). *Vibrio* isolates from fish in this area appear to be more akin to *V. anguillarum* but show very little or no serologic cross reaction with this species (as tested with antiserum from the UM lab and that supplied by Dr. J. L. Fryer, Oregon State University).

Much of the fin deformity seen in menhaden caudal fins can be attributed to infestation of the fin rays by a digenetic trematode metacercarian. It has been tentatively identified as a member of the metacercariidae (Skinner).

One paper resulting from this work has been published during the year: *Journal of Clinical Microbiology*, Vol. 4, No. 2, August 1976, p. 201-203.

A second paper has been submitted for publication to the *Journal of the Fisheries Research Board of Canada*.

VIROLOGY AND PROTECTIVE FACTORS

DR. M. MICHAEL SIGEL
Principal Investigator

Gaps in knowledge about viral pollution limit decision-making and enforcement of laws designed to safeguard the environment and protect human health. For example, methods currently used do not permit recovery of all viruses in waste water at any given time or determination of the exact amount of a particular virus at different times.

The ocean has long been used by seaboard communities as a dump for sewage. Growth of population has resulted in hundreds of millions of gallons of effluent being discharged daily into coastal waters and has evoked concern about dangers to human health and about the survival of marine animals, including commercially valuable fish and shellfish. The recent and continuing incidence of disease and death among fishes in Biscayne Bay may have been caused when noxious substances and/or infectious agents released into the ocean were later carried into bay waters by wind and tides.

It is not now possible to make precise recommendations on pollution control because of many unknowns and variables. There are no data about the magnitude of the problem in general and the intensity of viral pollution in particular.

Studies to date, partly under Sea Grant sponsorship at the University of Miami, have indicated that viruses infectious to humans can be detected in the vicinity of ocean outfalls. Some results indicate that viruses are not detected with nearly as much frequency in treated waste water.

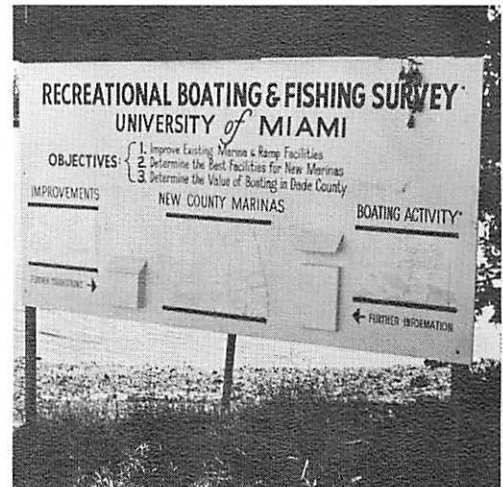
The main objective of this continuing study is to help develop mechanical devices and techniques for improvement of recovery and quantification of viruses from the sea, both those which have been put there by man and those which are indigenous. The difficulty is compounded by the detected presence in sea water of substances which neutralize or mask human viruses. Some viruses may even be "lost" as a result of adsorption to sediments.

In several laboratory experiments the Carborundum Virus Concentrator proved effective but efficiency declined in the field. The Millipore Pellicon Cassette has proved effective so far both in the laboratory and in the field.

Studies have been inhibited by the scarcity of conchs in home waters. Mucus obtained from these animals was found to inactivate polio virus and a virus previously isolated from a fish. These finds require further study when more conchs become available.



Boat Ramp at Matheson Hammock



*Photos Courtesy of Al Volker
Sea Grant Survey Sign*

ANALYSIS OF RECREATIONAL BOATING

DR. C. BRUCE AUSTIN
Principal Investigator

Recreational boating is a major interest in any marine resource; this is especially true in Dade and other Florida coastal counties where the increase in the number of boat owners continues to match or exceed the rate of population growth. There are more than 300,000 registered boats in Florida and more than 10 percent of these registrations are from Dade County. Local governments bear most of the responsibility for accommodating these huge fleets of pleasure craft.

Before decision-makers can act in the interests of their boating constituency, however, they must understand the dimensions of the task: 1) the size, composition, and economic impact of boating; 2) the sensitivity of boating to changing costs, water quality, anchorages; and 3) trends in the numbers, sizes, types, uses, and distribution of boats.

Dockage of powerboat owners who do not belong to clubs or have waterfront facilities of their own must be provided in public marinas, which typically also sell fuel, other consumables, bait, equipment. How should such public marinas be designed, where should they be located, and what services should they offer? Decision-makers in Dade County called upon Sea Grant to provide information on three such marinas.

Most of the boats not berthed in marinas are trailered to boat ramps where they are backed into the water. Where should such ramps be located, how many were needed? Sea Grant was asked to find out.

After extensive interviewing and circulation of thousands of questionnaires, a clear picture emerged of the Dade County boater and his equipment. It was learned where the boater lived, where he put his boat in the water, his destination, how often he put to sea, how much a day he spent on fuel and other consumables, the size of his boat, how long he spent on the water, the purposes of his trip, how well he succeeded in fulfilling his purpose.

The studies did indeed support with data the decisions on location of public marinas where they would be of best use to Dade boaters. They also established that recreational fishing was the primary recreational activity and that recreational fisheries were the primary resource concern of recreational boaters. The destination studies established patterns of fishing with respect to times, species, and areas fished.

In the data-gathering process used by University of Miami scientists, much information from state boating registration records and from 1970 U.S. Census statistics was utilized. Included were data on boats and boaters in other Florida seacoast counties.

The success of the methodology led to a follow-on research project supported by Sea Grant in the 1976-77 program: to develop ways to process these oceans of data easily and inexpensively into profiles useful to planners and decision-makers in other maritime counties.

BACTERIA AS PATHOGENS

DR. BENNETT SALLMAN, DR. SOL M. GERCHAKOV
Co-Principal Investigators

Periodic massive deaths of marine animals are observed along the coastlines of the world. Such occurrences are frequent in the so-called polluted waters adjacent to urbanized areas, particularly in tropical and subtropical zones, including Biscayne Bay, Florida. Associated with this phenomenon is the general public concern about the human health hazards which accompany the usage of coastal marine resources. Is it safe to consume fish caught in the affected areas? Can humans contract diseases through swimming in the "murky" waters?

The marine environment has been reported to be hostile to known human pathogens; yet infectious diseases have been contracted after exposure to seawater receiving terrigenous pollutants. Although information relative to the survival and proliferation of exogenous pathogens in the marine environment is extremely scant, it has been proposed that the virulence of these organisms is related to the chemical environment to which they are introduced. Furthermore, it has been suggested that indigenous potential pathogens may be rendered virulent by favorable chemical ecological conditions.

Earlier investigation conducted in the laboratory was concerned with the survival of indicator microorganisms (potential pathogens) in seawater augmented with organic rich marine sediments. The results indicated that the sediments had an effect of enhancing the survival of the organisms. In addition, field data indicated that some microorganisms commonly found in the human intestinal tract are more frequently detected in the areas enriched with certain chemical constituents.

The microbial and chemical data gathered periodically from the several Biscayne Bay locations prior to June, 1973, were examined. Although a general qualitative trend existed in the relationship between the nature of the substrate and the microbiota in the water column, the temporal variabilities were large and could not be meaningfully applied toward a predictive mathematical model, particularly when resources were insufficient for a more intensified spatial and temporal sampling.

As a result of the findings, commencing in June, 1973, the research approach was modified by directing attention to the study of the bay's sediments. That approach has permitted a sampling schedule which is more realistic in terms of manpower and is producing data suitable for statistical treatment and application to mathematical modeling procedures.

In the 1974-75 budget year a family of statistical models constructed for several areas in Biscayne Bay was described. These mathematical models relate the population of several types of bacteria, including chemical environment in the marine sediments.

During the current reporting period additional data were obtained on bacterial population and chemical constituents of the Bay sediments in the designated locations. As before, the chemical determinations were: water content, total organic carbon, total organic matter, total carbohydrates, soluble carbohydrates, total proteins, Kjeldahl nitrogen and ammonia content. Microbial counts were made for: total coliforms, fecal coliforms, *Streptococcus faecalis*, agarolytic organisms, chitinolytic organisms, and total heterotrophic organisms.

These additional data will endow the mathematical models with greater statistical validity.

It should be iterated that statistical models must be validated in order to be useful as deterministic or predictive models. For this reason attention was directed toward the experimental tank which represents one of the stations in Biscayne Bay. Chemical and microbiological data for the tank sediments were gathered regularly as a prelude for a validation phase of this investigation.

To date data show that the bacterial population in the tank sediments is lower than that observed in the Bay. In fact, the population of *Streptococcus faecalis* and of fecal coliform organisms were found on many occasions to be "below detectable level." If the old hypothesis that these organisms do not survive in marine environments impoverished with organic nutrients is correct, then the converse may be observed with the chemical and biological perturbation proposed for the year beginning July 1, 1976.

COST ANALYSIS OF TRANSPLANTING THALASSIA

DR. ANITRA THORHAUG,
Principal Investigator

The cost of transplanting seagrasses was analyzed, based on data accumulated from previous *Thalassia testudinum* transplant work at the University of Miami with Sea Grant support. The model included propagation, collection, nursing, and planting costs. The model was flexible and could be used for any seagrass and at a variety of sites with various environmental factors.

The five pieces of information clearly needed to estimate cost on any proposed transplantation or restoration study would be: 1) natural mortality rate of specimens to be planted; 2) natural growth rate of individual plants (in terms of lateral expansion rate); 3) the desired cover to be achieved [and number of blades per M²]; 4) time period to achieve the desired cover; 5) the area size to be planted. The first two variables are determined by environmental conditions. Variables 3 - 5 are policy decisions which must be handled cooperatively by other persons in cooperation with the scientists.

An important piece of information resulting from the economic analysis is that the highest cost of the restoration is the planting phase, which is done by hand. If mechanization of the planting phase could be worked out, the total cost of the restoration would significantly decrease.

Another important conclusion from this analysis is that costs are not linear as a function of the number of seeds to be planted. Costs are higher per seed for a lower number and as the total number of seeds planted increases, the cost decreases.

This information was used in a variety of ways:

*A paper was presented by University of Miami scientists at the American Institute of Biological Science meeting in New Orleans, La. The paper will be published in *Environmental Conservation* along with other papers and will be included in a book to be published by Elsevier Press, *Restoration of Major Plant Communities in the United States*.

*The paper was also presented at a workshop on Creation of Coastal Ecosystems, sponsored by the U.S. Department of Interior, at Sapelo Island, Ga. Workshop proceedings will be published by the Department of Interior.

*The feasibility of revegetating *Thalassia* and other seagrasses in areas disturbed by building of a series of bridges on the Overseas Highway (U.S. Rt. 1) was discussed at a hearing called by the Department of Transportation, the National Marine Fisheries Service, and the U.S. Army Corps of Engineers. A second hearing on the cost of transplanting *Thalassia* was called by the Florida Department of Environmental Regulation.

*A paper on *Ecology and Management of Biscayne Bay - A Subtropical Estuary on the Edge of the Caribbean* was presented at the First International Symposium on the Ecology and Management of Tropical Shallow Water Communities at Jakarta, Indonesia. The paper will be published in the Indonesian Academy of Sciences journal and will also be published by Sea Grant.

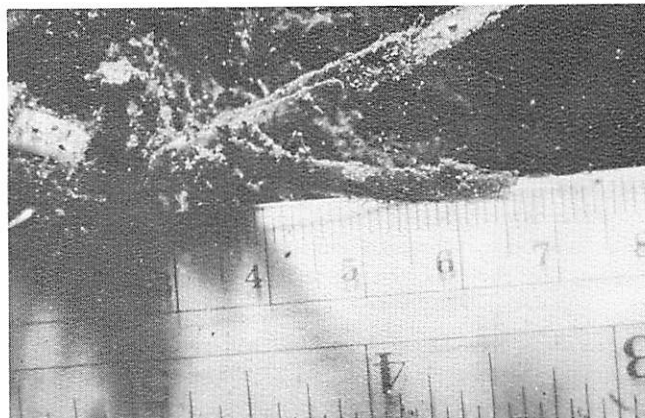


Photo Courtesy of Anitra Thorhaug
Transplanted Thalassia Shows Growth

OCEAN AND COASTAL LAW

PROFESSOR DENNIS M. O'CONNOR
Principal Investigator

The Ocean Law program at the University of Miami was the first in the country to offer professional law training in collaboration with a graduate school of marine science. The program has contained both education and research elements ever since. In the 1975-76 reporting year, the program's two projects were Juris Doctor Specialization and Community Legal Problem Services.

In the ongoing education project, students working toward their law degrees have been offered the opportunity to take a concentration in Ocean and Coastal Law. The project is designed to qualify lawyers to deal with many new domestic and international issues relating to extended jurisdiction and the land-water interrelationship. Graduates of the program are working in federal and state governments, academic institutions, industry, foundations, and private practice.

Students normally take courses in Ocean Law, International Law, Coastal Law, Marine Pollution Law, and Admiralty Law. They participate in seminars on advanced Ocean and Coastal Law topics. Some proceed toward a master's degree in Ocean Law offered by the University after Sea Grant had sponsored initiation of the program.

At the end of the 1975-76 academic year, 12 students received Juris Doctor degrees with specialization in Ocean and Coastal Law. During the current reporting year, the terminal year of Sea Grant support, 17 others are specializing. In all, 32 students had taken Juris Doctor degrees with Ocean and Coastal Law concentrations, as of June 30, 1976.

The research program, Community Legal Problem Services, was instituted to provide quick response to requests by government and community agencies for information on Ocean and Coastal Law problems. Law students are assigned to provide legal memoranda under faculty supervision. During quiet periods, graduate assistants update materials on Ocean and Coastal Law.

In the three years of CLPS operation, a number of reports have been completed and submitted to the requesting agencies. In the 1975-76 reporting year, six such studies were completed. They are:

1. *Extension of Federal Navigable Waters Permit Jurisdiction Above the Mean High Water Line.* Requested by Coastal State Agencies. 6 pp.
2. *Florida's Land and Water Management Act: A Contemporary Approach to Planned Growth.* 23 pp.
3. *May Metropolitan Dade County, Fl., Control Littering of Waters by County Ordinance?* Requested by Task Force for the Biscayne Coastal Region. 4 pp.
4. *Should the United States Adhere to a Law of the Sea Treaty Which Provides for Restrictions on the Dissemination of Marine Scientific Research?* Prepared as resource for the use of the U.S. Delegation to the Third Conference on the Law of the Sea. 34 pp.
5. *Control of Sunken and Offensive Vessels by Florida Counties.* Requested by the Task Force for the Biscayne Coastal Region. 27 pp.
6. *A Comparison of Regulations of Motor Vehicles and Water Craft Under Florida Law.* Requested by the Task Force for the Biscayne Coastal Region. 22 pp.

NUMERICAL MODELS FOR CIRCULATION AND DISPERSION

DR. JOHN D. WANG
Principal Investigator

The objective of this report is to investigate the feasibility of establishing numerical models for the prediction of hydrodynamic circulation and mass dispersion on south Biscayne Bay. Such models are essential for evaluating long- and short-time natural variations and the impact of man's activities in the Bay.

Due to the shallowness and well mixed conditions pre-eminent in this area, models of the vertically integrated type should serve well. Since January of 1976 one such model (see ref. 2) has been adapted to the special features of Biscayne Bay from Rickenbacker Causeway in the north to Card Bank in the south. At first a coarse grid was very carefully constructed for numerical computation of tidal circulation using long-time average boundary forcing obtained from the Tide Tables. Plots of computed velocities were shown. Near both eastern and western boundaries rather large currents were generated which as far as we know do not exist in reality.

Tide data for Ragged Keys and Adams Key were obtained for the period July, 1974, which showed that actual phase lags were much smaller between the two stations, than the assumed average values of 1.0 hr for HW and 25 min for LW. This may completely or at least partly explain the strong boundary currents which incidentally also were found in a separate study (see ref. 1).

To obtain any kind of accuracy it is essential to "drive" the model with the right boundary conditions. Consequently, we have initiated a field program that will give tidal ranges and phase lags at various locations along the ocean boundaries for the same period (synoptic sampling). For this program we are employing four self-recording, float-type gauges which are, or will be, placed at Cape Florida, Soldier Key, Ragged Key III, Adams Key, Broad or Angelfish Creek, and Bear Cut. In addition, we are obtaining the measured tide at Miami Harbor (NOAA gauge) for the entire period.

At the same time we are refining the model grid for improving computational efficiency to allow for a more detailed flow simulation. Besides the tidal information we have already obtained from NOAA, we will also request current information in the bay for model verification and to plan our own current measurements. Finally, work is proceeding rapidly on implementing computer graphic software for display of current velocities and particle paths.

Shortly, the capability of predicting wind-driven circulation and dispersion will be implemented as scheduled.

References:

1. Department of Coastal and Oceanographic Engineering, University of Florida, Gainesville, Fla., *Numerical Modeling of Hydromechanics of Biscayne Bay/Card Sound System - Part I: Non-Dispersive Characteristics*, Report, August 1971.
2. Wang, J. D., Connor, J. J., *Mathematical Modeling of Near Coastal Circulation*, R. M. Parsons Laboratory for Water Resources and Hydrodynamics, M.I.T., April, 1975.

BIOLOGY AND FISHERIES OF BAITFISHES IN SOUTH FLORIDA

DR. E. D. HOUDE
Principal Investigator

A large marine sport fishery has developed in South Florida that provides recreational activity for millions of residents and tourists. Most marine fishing in Florida waters depends on the use of bait, usually in the form of baitfishes or bait shrimp. Stocks of fishes that comprise the baitfish resource have been little studied. Research on them benefits recreational fishermen who use them, the commercial fishermen who exploit the resource, and bait dealers and wholesalers in the South Florida area. A knowledge of the biology of the stocks and the characteristics of the fishery will be valuable to management agencies, should the need arise to regulate the fisheries for bait species in the future.

Two species of ballyhoo (Exocoetidae) *Hemiramphus brasiliensis* and *H. balao*, and the silver mullet, *Mugil curema*, were investigated in this project. Ballyhoo are the most important baitfishes used in the offshore sport fishery for billfishes, dolphin, and other large gamefishes. Beginning in 1974 the Sport Fishery Research Foundation awarded a small grant to begin research on ballyhoo. Sea Grant support for continuation of this research began in January 1975 and the project also was expanded to include an investigation of the fishery for and biology of the silver mullet. Support through Sea Grant continued until September 1976.

Commercial catch statistics are neither complete nor accurate for baitfish species. Reported Florida catches in 1974 totaled more than 4 million pounds and had a retail value of about \$2.5 million. A record ballyhoo catch of 440,608 pounds was reported for 1973 but a decline to 391,721 pounds occurred in 1974. These fish retailed for \$1.75 to \$2.75 per dozen in Miami during 1973 and 1974. Silver mullet landings were 1.2 million pounds in 1974 but they have a lower retail value, usually selling at prices ranging from \$.50 to \$.60 per pound in the Miami area. Both catches and values of baitfish species are likely to increase significantly in the future, due to increased demands by sport fishermen and increased costs in the commercial fishery.

The fishery was studied by direct contact with fishermen and wholesale bait dealers. Local fishermen and wholesale bait dealers cooperated in providing catch and effort statistics. Data collected from the wholesalers were used to determine seasonal and annual abundance of ballyhoo and silver mullet along the southeast Florida coast.

Seasonal abundance of ballyhoo and silver mullet was monitored by sampling commercial catches of these species. Initially, shore seining in Biscayne Bay was attempted as a means to supplement data on silver mullet but this approach was abandoned when catches were found to be small using this technique. The two species of ballyhoo were both available for biological studies from catches of commercial fishermen.

Age and growth of ballyhoo and silver mullet were investigated from examination of length/frequency distributions and observance of annuli on scales. Empirical growth data were used to derive theoretical growth relationships for the species. Other growth-related factors such as length-weight relationships and condition factors were determined.

Size and age at maturity, as well as fecundity, were determined for ballyhoo by gonad examination on a seasonal basis. The gonad index (ratio of gonad weight to body weight) for both males and females and the oocyte diameter frequency distribution in females were used as indicators of spawning condition and maturity. A gravimetric technique, based on ovary aliquot sampling, provided estimates of fecundity.

Characteristics of the ballyhoo fishery have been determined. The fishery is mostly confined to the reef areas of Dade and Monroe Counties. The fishery operates year-round but the biggest catches are made during fall and winter when newly recruited fish predominate.

The silver mullet fishery is seasonal in Dade County, although some catches may be made year-round. Most fish are caught during March through May when silver mullet aggregate prior to an offshore spawning migration.

Publications:

1. Berkeley, S., E. D. Houde and F. Williams. Fishery and biology of ballyhoo on the southeast Florida coast. *University of Miami Sea Grant Special Report No. 4*. 15 pp. 1975.
2. Houde, E. D., S. A. Berkeley, J. J. Klinovsky and R. C. Schekter. Culture of larvae of the white mullet, *Mugil curema* Valenciennes. *Aquaculture* 8:365-370. 1976.

Presented Papers:

1. S. Berkeley. Amer. Soc. of Ichthyologists and Herpetologists. Fishery and biology of ballyhoo on the southeast Florida coast. June 1975.

ADVISORY SERVICES

MR. AL VOLKER
Principal Investigator

The Advisory Services function in the University of Miami Sea Grant Program was combined for fiscal purposes in 1975-76 with the Management and Development Program. It has been active and effective in the University and in the Community.

One of the few private universities in the Sea Grant Program, the University of Miami does not have available a network of extension workers to allow easy transfer of data from Sea Grant scientists to those who can use the data. However, the UM research and education programs are primarily shaped to meet the needs of a populace gathered densely and stressfully upon the shores of Biscayne Bay and this concentration allows Sea Grant to be specific in its Advisory Services and to deliver them at minimum effort and expense.

A double-barreled approach has been devised: 1) personal contact with decision-makers and 2) contact through publications and the media with the citizens who elect the decision-makers. It is worthy of emphasis that all program managers and principal investigators consider themselves to be engaged in Advisory Services, so close is the interaction between Sea Grant and its constituency.

The Advisory Services/Information Services function of Management and Development Program may be summarized as follows:

*In the budget year just concluded, a busy publishing schedule was carried out. Issued or in press since the 1974-75 Annual Report are two Field Guides, five Special Reports, four Technical Bulletins and a Publications Catalog (see page 17 for titles). Special mention is given to the Field Guide series, designed to assist in quick field and laboratory identification of marine animals and plants by non-specialists equipped with nothing more sophisticated than a hand lens. In addition to the two Field Guides produced in the report year, three more were planned for 1976-77. *Biscayne Bay, Past/Present/Future*, mentioned later in this section, was a major publication. In addition to the mandatory free distribution of all publications, more than 1,000 copies were sold throughout the world.

*The *Sea Grant Log*, issued for internal use each month, has grown from one 8½ x 14-inch sheet to four sheets of that size. It circulated among Program Managers, Principal Investigators, Sea Grant Deans,

the Community Advisory Board, and other members of the Sea Grant family. Sea Grant publications received by Information Services were listed in the *Log* before being sent to the library of the Rosenstiel School of Marine and Atmospheric Science for cataloging. Information Services also served the Sea Grant family as a clearinghouse for information exchange, reprints, announcements, and the like.

*Advisory services continued to contribute to the cost of printing the bimonthly *MAP Newsletter* by the State University System of Florida and prepared an article for each issue.

*Media contacts were well maintained. Announcements in the print and electronic media were frequent and special coverage was enjoyed at Sea Grant events. Sea Grant scientists and managers appeared in a dozen radio-television news and talk shows and frequently served as a marine information resource for the media. The Associate Director for Information Services was a contributing editor to *Sea Grant '70s*.

*Advisory Services worked closely with the Community Advisory Board (see page 18) through correspondence and made arrangements for all meetings. Advisory Services similarly served as a link between Sea Grant and the Biscayne Bay Implementation Task Force, to be mentioned later in this report.

*Advisory Services also prepared the *Annual Report* and was responsible for design and coordination of the proposal volumes.

*Advisory Services contributed to the expenses of a UM scientist presenting a paper at an international symposium in Jakarta, Indonesia.

*Finally, Advisory Services, supported by the University of Miami, the Office of Sea Grant, and the U.S. Energy Research and Development Administration, coordinated the two Biscayne Bay Symposia of April 2-3 and 9-10, 1976, on Virginia Key. It partly subsidized four scientist/participants.

Symposium I was an effort to gather at one time and one place all that is scientifically known — and that needs to be learned — about Biscayne Bay. More than 20 speakers made oral presentations. Advisory Services assisted in editing and then published Special Report No. 5, *Biscayne Bay: Past/Present/Future*, the 315-page document containing 25 reports on various aspects of Bay research.

The following weekend Symposium II was held. It consisted of discussions of carefully drawn Biscayne Bay policy questions (listed on next page), by four groups of 20 persons each, representing local, state, and federal governments, conservationists, developers, teachers, scientists, and the media. Special Report No. 6, *Consensus: Biscayne Bay*



Photo Courtesy of Roy Champagne

Roy Champagne, Florida Sea Grant College Marine Advisory Service, Dr. Man and Mr. Volker at Biscayne Bay Symposium II.

media. Special Report No. 6, *Consensus: Biscayne Bay Symposium II*, a summary of policy views brought forward by the discussants, was published and distributed free throughout the community and state.

Out of these symposia and these publications, lavishly praised by media editorialists, came formation of the Biscayne Bay Implementation Task Force, chaired by the Sea Grant Director. This body of 25 state and local planners, scientists, and administrators now meets regularly, with Advisory Services as host, and is shaping a number of Biscayne Bay policy recommendations which will be submitted to the Dade County Commission.

The UM Sea Grant Program feels this is an advisory service in the highest sense of quick-response community service.

BISCAYNE BAY SYMPOSIUM II WORKSHOP QUESTIONS

Environmental Quality

A. *Water* – South Floridians place a high premium not only on water purity but water clarity, believing that the million-plus tourists who come to Dade County annually

expect to see the bottom of the Bay. Can water purity and clarity in South Bay be preserved? At what cost in effort and money? Is there any hope for improvement of water quality in North Bay? At what investment of time and tax revenues?

1. Is sewage pollution still a major problem in South Bay? In North Bay? Are regulations adequate to halt dumping of raw wastes from boats? Are these regulations enforceable?
2. What progress has been made in halting the dumping of industrial wastes in canals emptying into South Bay? North Bay?
3. Runoff of fertilizers and pesticides into South Bay is considered by some to be the worst pollution problem. Can anyone suggest any practical way to reduce or control this runoff?
4. Is thermal pollution still considered a problem? Was the cooling system now in force at Turkey Point the best answer? Have standards been set up for future construction of electric generating or other plants that must use great quantities of water for cooling purposes?

B. Biota

1. Is the fish and wildlife presence in the Bay important enough to justify great expenditures of time and money to preserve it – in view of the fact that the Gulf Stream and the Florida Keys are easily accessible?
2. Commercial and sport fishermen have traditionally staked exclusive claims on the fish and shellfish in the Bay. Is the value of the commercial catch significant enough to be considered? Should the Bay be reserved for sport fishing? Is it possible to limit commercial fishing to baitfish without damaging the Bay bottom or other fish? Is it possible to draft regulations fair both to commercial and sport fishermen?

C. Shore and Bay Bottom

1. It has been said that bayside development has reached its limit in North Bay. Should a moratorium on such development be imposed in South Bay? Is it possible to define rights of access and assign priorities? Should steps be taken to preserve shoreline mangroves as a valuable estuarine resource? A Sea Grant scientist has demonstrated that *Thalassia* (turtle grass) can be transplanted to barren bottom and reestablished much more quickly than by natural means. Is this a practical way to restore plant – and eventually animal – life to North Bay?

Utilization

A. *Recreational* – Biscayne Bay is the playground of power and sail boaters, sport fishermen, skin-divers, bathers and those who enjoy picnicking at waterfront parks.

1. Are there enough facilities for those recreation-seekers or should more be developed? Will new ones be compatible with existing uses?
2. Public access by boaters, bathers, fishermen, divers, and skiers is limited in North Bay. What can be done in South Bay to provide access for recreational purposes? Is enough being done?

B. Commercial Development

1. Considering the problems of low-lying land, the estuarine ecosystem and emergency evacuation realities, should development now be restricted along South Bay or should it be allowed to proceed much as it has in North Bay?
2. Should bayside population be allowed to increase? If so, what should be the priorities concerning private residence and multi-family units? Is it possible to define “bayside” areas and, if it is, is it desirable or undesirable to limit greatly their densities through special zoning categories?

3. Should provisions for public access be a requirement for development of private lands as in the San Francisco Bay area?

C. Public Development

1. The County is planning to construct or enlarge three marinas in response to heavy public demand. Will these be the last public marinas to be built, because the County holds no more sizeable plots of bayside land, or will future great outlays to buy privately held land be justified?
2. Is an attempt being made to provide other facilities for boaters and boat-related recreations, such as lifts and ramps and trailer parking facilities? Are these needs pressing at this time?
3. Is the use of public funds to maintain a park facility on Elliott Key, reachable only by boat owners, justified? Will ferry access meet this complaint? Are any additional limited-access facilities defensible or indefensible?
4. Ownership – or rental – of deepsea fishing boats is denied the poor, who fish for grunts instead of sailfish. Would it be feasible to construct an artificial reef in shallow Biscayne Bay to improve the fishing for poor people? Are small bayside parks for picnickers and seawall fishermen planned in South Bay?

Bay Management

A. Jurisdictions

1. Who understand the layers of municipal, county, state, and federal jurisdictions in the Bay? Can anyone cite examples of clashing authority? Should there be an attempt to clarify these overlapping jurisdictions? Can these political entities be reasonably effective in managing the Bay and its shorelines, or is there a better way?

B. Enforcement

1. Are the powers of municipal, county, state, and federal agencies strong enough to enforce regulations in the Bay or should they be invested in some sort of cooperative Biscayne Bay Authority?
2. Is there, in fact, communication between the levels of government regarding enforcement? Is there any organization for reconciling differences? How can such communications be improved?

C. Boundaries

1. Should regulations concerning the Bay be extended to deal, for example, with pollution that enters canals upstream from the Bay? Or is the present situation likely to continue?



*Dr. Henry King Stanford addressed
Biscayne Bay Symposium II*

2. Are the Bay and its environs sufficiently integrated into the ongoing, day-to-day community gestalt, or is there a need to develop further this concept of the Bay?
3. Can the shoreline be treated as an ordinary piece of real estate, or should it be treated as a unique place? For example, do areas that offer fragile scenic or aesthetic qualities require special environmental safeguards? Can these safeguards be made palatable to all?

PUBLICATIONS

Field Guide Series

- FG No. 5 *A Guide to the Larger Marine Gastropods of Florida, the Gulf of Mexico, and the Caribbean Region.* 54 pp. July 1976.
- FG No. 6 *A Guide to the Commoner Shallow-Water Gorgonians (the Whips, Sea Feathers, and Sea Fans) of Florida, the Gulf of Mexico, and the Caribbean Region.* 25 pp. (In press.)

Special Reports

- SR No. 5 *Biscayne Bay: Past/Present/Future.* 315 pp. April 1976.
- SR No. 6 *Biscayne Bay Symposium II.* 23 pp. April 1976.
- SR No. 7 *Biscayne Bay and Its Environs.* 32 pp. April 1976.
- SR No. 8 *Fishing for Spiny Lobster.* 51 pp. August 1976.
- SR No. 9 *Recreational Boating in Dade County.* 150 pp. (In press.)

Technical Bulletins

- TB No. 33 *International Cooperation for the Prevention of Marine Oil Pollution.* 145 pp. September 1975.
- TB No. 34 *Transplantation Techniques for the Seagrass *Thalassia Testudinum*.* 6 pp. June 1976.
- TB No. 35 *Intensive Culture of the Stone Crab *Menippe Mercenaria*.* 18 pp. (In press.)
- TB No. 36 *Culture of Pink Shrimp, *Penaeus Duorarum*, at Turkey Point Experimental Mariculture Laboratory.* 45 pp. (In press.)

Catalog

Sea Grant publications through September, 1976.

APPENDIX I: RESOURCES AND FUNDS

Grouping Sea Grant Research	Sea Grant Classifica- tion	Project Number	Title	NOAA 75-76 Sea Grant Award	75-76 Matching Funds	Total 75-76 Program
I. MARINE RESOURCES DEVELOPMENT						
B. Living Resources, other than aquaculture						
	06	R/LR-7	Biology and Fisheries of Baitfishes in South Florida	20,900	—	20,900
	08	R/MP-1	Pathology of Marine Animals	100,700	16,500	117,200
		R/MP-2	Bacteria as Pathogens in Marine Environment	31,200	26,400	57,600
		R/MP-3	Virology and Protective Factors	29,700	13,000	42,700
			SUBTOTAL	182,500	55,900	238,400
II. SOCIO-ECONOMIC AND LEGAL STUDIES						
B. Ocean Law						
	15	R/L-10	Coastal Legal Problems Study	28,500	21,700	50,200
		R/L-5	Community Legal Problem Services (State and Local)	26,500	15,700	42,200
C. Marine Recreation						
	19	R/E-1	Analysis of Recreational Boating for Planning Future Waterfront Boating Facilities in Dade County	9,800	18,200	28,000
			SUBTOTAL	64,800	55,600	120,400
IV. MARINE ENVIRONMENTAL RESEARCH						
B. Ecosystem Research						
	40	R/ES-5	Analysis of Transplantation of Submerged Seagrass	9,400	—	9,400
D. Environmental Models						
	46	R/ES-1	Mathematical Model for Prediction of Hydrodynamic Dispersion and Circulation	14,998	—	14,998
		R/ES-7	Summary Analysis of Physical Pro- cesses in the Biscayne Bay System	7,800	—	7,800
			SUBTOTAL	32,198	—	32,198
V. MARINE EDUCATION AND TRAINING						
D. Other Education						
	70	E/L-2	Juris Doctor Specialization in Ocean and Coastal Law	—	48,400	48,400
			SUBTOTAL	—	48,400	48,400
VI. ADVISORY SERVICES						
B. Other Advisory Services						
	74	AS/C	Gulf and Caribbean Fisheries Institute	10,700	21,318	32,018
	76	AS/PO-2	Manuals on Marine Organisms	11,700	7,000	18,700
			SUBTOTAL	22,400	28,318	50,718
VII. PROGRAM MANAGEMENT AND DEVELOPMENT						
A. Program Administration						
	79	A/MD	Program Management and Development	33,802	43,600	77,402
			SUBTOTAL	33,802	43,600	77,402
			GRAND TOTAL	335,700	231,818	567,518

APPENDIX II: PROGRAM SUMMARY

Grouping Sea Grant Research	Sea Grant Classifica- tion	Project Number	Title	Year 1975-76			Year 1976-77		
				N	C	T	N	C	R
I. MARINE RESOURCES DEVELOPMENT									
A. Living Resources, Other Than Aquaculture									
	06	R/LR-7	Biology and Fisheries of Baitfishes in South Florida			C	T		
	08	R/MP-1	Pathology in Marine Animals			C		R/MP-1	C
		R/MP-2	Bacteria as Pathogens in the Marine Environment			C		R/MP-2	C
		R/MP-3	Viruses in the Sea and Marine Invertebrates			C		R/MP-3	C
II. SOCIO-ECONOMIC AND LEGAL STUDIES									
B. Ocean Law									
	15	R/L-10	Coastal Legal Problems Study			C	T		
	17	R/L-5	Community Legal Problems Study (State and Local)		N			R/L-5	C
C. Marine Recreation									
	19	R/E-1	Analysis of Recreational Boating for Planning Future Waterfront Boating Facilities in Dade County		N			R/MR-1	C
IV. MARINE ENVIRONMENT RESEARCH									
B. Ecosystems Research									
	40	R/ES-5	Analysis of Transplantation of Submerged Seagrass			C	T		
D. Environmental Models									
	46	R/ES-1	Mathematical Model for Prediction of Hydrodynamic Dispersion and Circulation		N			R/ES-1	C
		R/ES-7	Summary Analysis of Physical Processes in the Biscayne Bay System		N		T		
V. MARINE EDUCATION AND TRAINING									
D. Other Education									
	70	E/L-2	Juris Doctor Specialization in Ocean and Coastal Law			C		E/L-2	C
VI. ADVISORY SERVICES									
B. Other Advisory Services									
	74	AS/C	Gulf and Caribbean Fisheries Institute			C			C
	76	AS/PO-2	Manuals on Marine Organisms			C	T		
VII. PROGRAM MANAGEMENT AND DEVELOPMENT									
A. Program Administration									
	79	AM/D	Program Management and Development			C		M/PD-1 M/PA-1	C R N

N = New C = Continuing T = Terminated or Completed R = Restructured

APPENDIX III: COMMUNITY ADVISORY BOARD

(As of December 29, 1975)

Hon. James Redford
Dade County Commissioner

Hon. Harvey Ruvin
Dade County Commissioner

Mr. Richard Brusuelas
Director, Environmental Health Planning

Dr. Harris B. Stewart, Jr.
Director, NOAA-AOML

Ms. Maureen Harwitz
Izaak Walton League

Mr. Thomas J. Buchanan
U.S. Geological Survey

Hon. Ray Goode
Dade County Manager

Mr. Harmon Shields
Director, Florida Department of Natural Resources

Mr. Peter Baljet
Ludovici & Orange, Consulting Engineers

Mr. John W. Greenleaf
Marine Council of Greater Miami

Ms. Rose Gordon
Vice Mayor of Miami

R. Adm. A. C. Wagner, U.S.C.G.
Commander, Seventh Coast Guard District

Ms. Juanita Greene
Editorial Board, The Miami Herald

Mr. Garrett Sloan
Director, Miami Dade Water & Sewer Authority

Mr. Ronald Schaming
Greater Miami Chamber of Commerce

Ms. Jeanne Bellamy
Vice President, Midtown Bank

EX OFFICIO

Ms. Susan Wilson
Miami Dade Community College

Ms. Priscilla Perry
Director, Institute for the Study of Aging

Mr. Thomas W. Bilhorn
General Development Corporation

Dr. Eugene H. Man
Director, UM Sea Grant Program

APPENDIX IV

DEANS ADVISORY COUNCIL

- Dr. Jerome Catz
Acting Dean, School of Engineering and Environmental Design
- Dr. John A. Harrison
Dean, Honors and Privileged Studies and Senior Academic Dean
- Dr. Carl E. B. McKenry
Assistant to the President for External Affairs
- Dr. Soia Mentschikoff
Dean, School of Law
- Dr. Clarence Stuckwisch
Dean, Graduate School
- Dr. William J. Whelan
Associate Dean for University Affairs, School of Medicine
- Dr. Warren Wooster
Dean, Rosenstiel School of Marine and Atmospheric Science

SEA GRANT PROGRAM MANAGERS COUNCIL

- Dr. C. Bruce Austin
Marine Recreation
- Dr. Dennis M. O'Connor
Ocean Law
- Dr. Bennett Sallman
Living Resources Quality
- Dr. Francis Williams
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