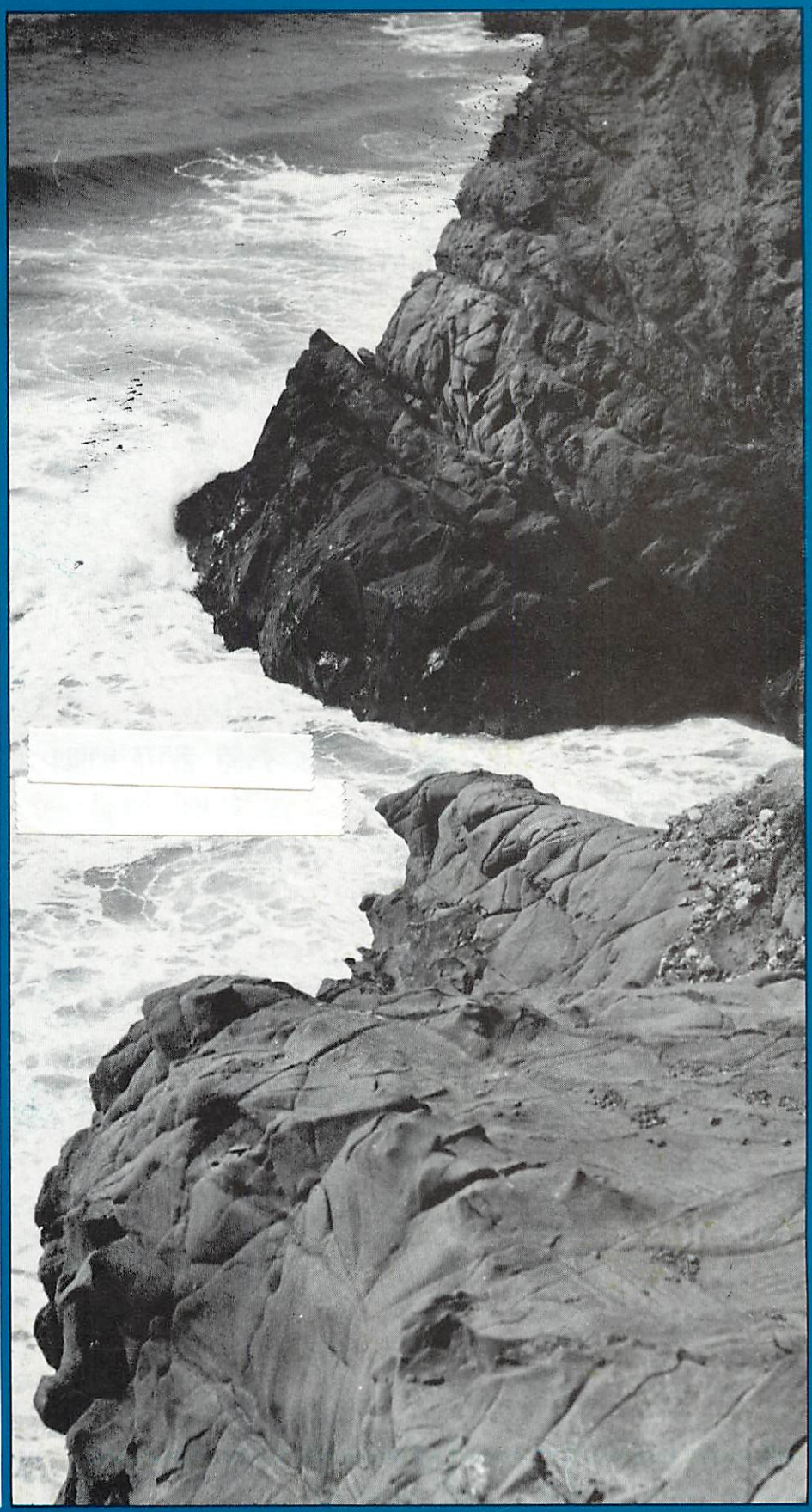
A Report on the University of Rhode Island Sea Grant Program

July 1981 to June 1983



Marine Memorandum 75

Foreword

This report covers the fourteenth and fifteenth years of The University of Rhode Island's activities contributing to the National Sea Grant College Program. Reading reports such as this one every other year is somewhat like looking at snapshots in a time sequence. The brief descriptions of individual projects cannot convey the way the projects grow and build on one another through the years.

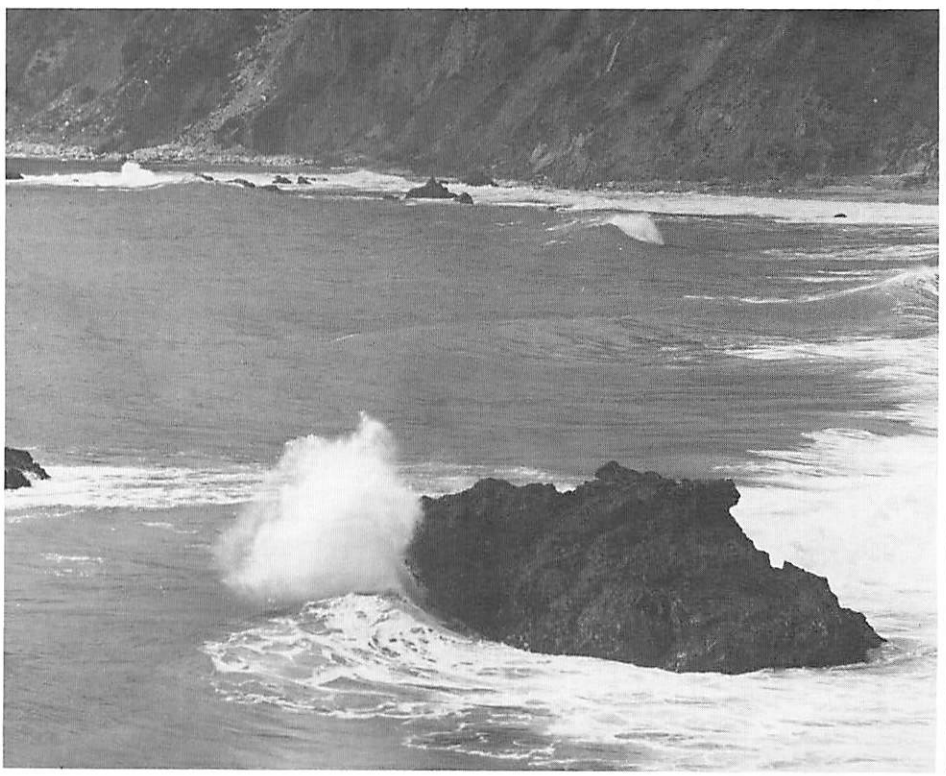
But the growth is constant. One example is the very effective fishing gear program of the URI Marine Advisory Service. That work had a halting start in 1966, but it did not really develop until much later, when Sea Grant support became available. It has now reached a level of excellence as a joint program with the Fisheries Engineering Center of the National Marine Fisheries Service which gives it nationwide impact.

Another example of research and advisory service efforts which have earned international recognition is the ecosystems work that began in a small way under the University's former Marine Resources Group in the 1960s and was formalized when Scott Nixon arrived here from the University of North Carolina in 1970. The five-year examination of six coastal ponds described in this report has produced needed scientific documentation of how the land, the sea, and people affect one another and has given communities here and elsewhere important perspectives on how to use their estuarine environments without destroying them.

Our snapshot-like reports cannot capture the excitement of the program. Watching its steady growth is a satisfaction of long association with Sea Grant—for this writer, nearly 19 years.

When this is printed, Scott Nixon will be coordinator of The University of Rhode Island Sea Grant College Program. He has already contributed much to its success, but many challenges lie ahead. There is no doubt that he and The University of Rhode Island faculty and staff will meet those challenges and continue to increase the value of Sea Grant to the state and the nation.

Niels Rorholm
Sea Grant Coordinator



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Marine Advisory and Technical Services

In general, the mission of the Marine Advisory Service is to introduce the best and most up-to-date information and technology to those who are using, managing, developing, or studying our marine resources. Its primary emphasis is on commercial fisheries development, marine recreation and coastal utilization, marine education, and information transfer. Specialists in those fields work closely with the public and with University scientists, whose research results they make available. They also import or develop technology as needed to solve particular problems.

The Marine Advisory Service is closely connected with Sea Grant administrators and investigators at URI. Its director is a member of the URI Sea Grant Executive Committee advising the Sea Grant coordinator, and thus is involved in the proposal review process.

Commercial Fisheries Development

The Rhode Island fishing industry has not only been growing—bigger vessels, higher landings—over the past few years, but has been developing new sophistication and new areas of interest.

By keeping a close eye on industry trends and maintaining close contacts with the local fleet, the MAS commercial fisheries specialist has been able to anticipate and respond to the industry's needs to develop new kinds of gear, improve fishing methods, upgrade product quality, and learn better business management.

Just one example is his introduction of pair ground trawling to the Rhode Island fleet. After ten vessels paired up to try it, the gross stock of each vessel doubled, with significant fuel savings and shortened trips. Thanks to this Sea Grant effort, the fleet was able to take full advantage of the seasonal codfish run in the early spring of 1983.

Rhode Island fishermen are recognizing that better quality products bring higher returns. Responding to their interest, the specialist evaluated a variety of onboard holding methods, worked with scientists and engineers to develop a promising enzymatic ice dip to preserve the catch, and focused the 1983 Fishermen's Forum on methods of achieving higher quality products.

Since the arrival of the National Marine Fisheries Service engineering group at URI, it has been possible to undertake a number of cooperative

Point Judith fishing vessel is tested for stability.

projects on board the NMFS 65-foot stern trawler, *Gloria Michelle*. Because fishermen are turning to costly electronic equipment, an early project involved determining the performance of color echo sounders and establishing a calibration area in Point Judith harbor.

The increasing use of new and applied technology by fishermen has created a demand for more education, primarily in the form of short courses, in the use of electronics and harvesting methods. To meet the demand, the specialist has offered short courses and workshops in single-vessel midwater trawling, pair ground trawling, and the use of echo-sounding equipment. An extremely useful video demonstration of gear in action was obtained from Scotland and has been seen by fishermen all over New England.

More general subjects in the educational effort included vessel safety and hypothermia.

During the period covered by this report, the commercial fisheries specialist was appointed an adjunct professor of electronics in the URI Department of Fisheries, Aquaculture, and Pathology, as well as chairman of a committee formed in that department on navigation equipment and technology requirements.

To help those involved with the fishing industry deal with its increasing complexity, the fisheries economist provided information to bankers, vessel owners, and insurance agents on current practices and trends. He also responded to requests for information on the economics of the quahog, shrimp, lobster, dogfish, squid, and shad and alewife industries, the Japanese market for herring roe, and fuel consumption.

Marine Recreation and Coastal Utilization

Marine recreation encompasses a wide range of activities, but in Rhode Island the primary focus is on boating. The recreational fleet numbers 35,000 resident craft, providing business for 130 marinas and boatyards. As an industry, boating had an economic impact on the state in 1982 of $226.4 million.

Since 1969, the Marine Advisory Service at URI has responded to boating and marine industry needs with relevant studies, workshops, conferences, and publications. The last two years have been no exception, despite the fact that the recreation specialist was on leave of absence from June 1982 to July 1983. Sea Grant activities at URI in the areas of marine business management, economics, marine biology, engineering, and safety have earned the program national recognition from the boating industry. According to the National Marine Manufacturers' Association Marine Trades Council, "Sea Grant has been the single most important source of training and information about recreational boating outside the industry itself, and URI has been the leader."

Public service has also been an important component of the division's work. As boat theft increases annually, the division has become increasingly active in the prevention of that crime, presenting information at seminars, distributing fact sheets to police stations, and providing information to a state agency police training program. It also initiated development of a widely used standardized theft report form.

Broadening its recreation-related base, the division initiated, and cosponsored with Rhode Island's governor, the Governor's Conference on Tourism held early in 1983, which resulted in the appointment of a Tourism Development Task Force to chart future directions for tourism in the state.

Marine Education

The need to preserve Rhode Island's priceless coastal environment, in the face of increasingly heavy use, lies behind the thrust of marine education programs sponsored by the Marine Advisory Service. These programs are aimed at increasing public understanding of the state's greatest natural resource.

For example, MAS sponsored a series of public lectures on the historical, social, scientific, and poli-

Students return from a field trip on Point Judith Pond with their teacher.

tical implications of Narragansett Bay as a total ecosystem. Besides stimulating creative thinking about the Bay, these lectures make Rhode Islanders aware of current marine research.

The education specialist also continued to work closely with elementary and secondary school systems to promote teaching of marine subjects. A teachers' conference, Marine Science—a Tool for National Science Literacy, produced a number of suggestions for Sea Grant educational projects.

The Seascope Marine Studies Center, begun by the education specialist four years ago with state and private support, is now completely self-supporting. Over 3,200 students and teachers made use of it in 1983.

The 3,600-entry Sawyer Marine Resources Collection was updated and computerized to allow faster and cheaper access. It is widely used by universities, schools, government agencies, and private corporations.

Information Transfer

Information transfer, as the term suggests, involves a continuing effort to transmit a variety of information to potential users via news releases, feature stories, newsletters, TV, and radio. It also means responding to requests for URI Sea Grant publications and informing targeted audiences of publications of special interest to them.

During 1982, the mailing list increased by 1,500 to 23,500, and over 55,000 copies of publications were distributed.

Because the general public is constantly inundated with more information than it can assimilate, the MAS communicator attempts to reach interested audiences through specialized media and to package information effectively for its users. Since many of URI's Sea Grant projects have regional and national applicability, the communicator frequently works with her counterparts at other institutions in the cooperative promotion of selected projects.

Other

Remote Sensing • The Sea Grant Program at URI has supported pioneering work in the uses of remotely sensed oceanographic data since 1979. Its first project, a publication on applications of satellite data, was described in the last report. In 1981, a comprehensive guide to environmental satellite data was published to describe for the first time what information was available and where. Both publications have been widely used and have educated a new audience to the value of satellite data available on the oceans.

Since 1981, a major effort has been directed at increasing the timeliness of (ocean) frontal analysis charts and improving the quality of information they provide. Once this is accomplished, they will be indispensable to commercial fishermen. Concurrently, the University established a Remote Sensing Unit within the Graduate School of Oceanography, which has greatly facilitated the project by providing a processing unit.

Vessel Safety • The all-too-frequent and tragic loss of life and property in the New England fishing industry prompted the establishment in 1981 of the Fishing Vessel Safety and Engineering Advisory Bureau at the University.

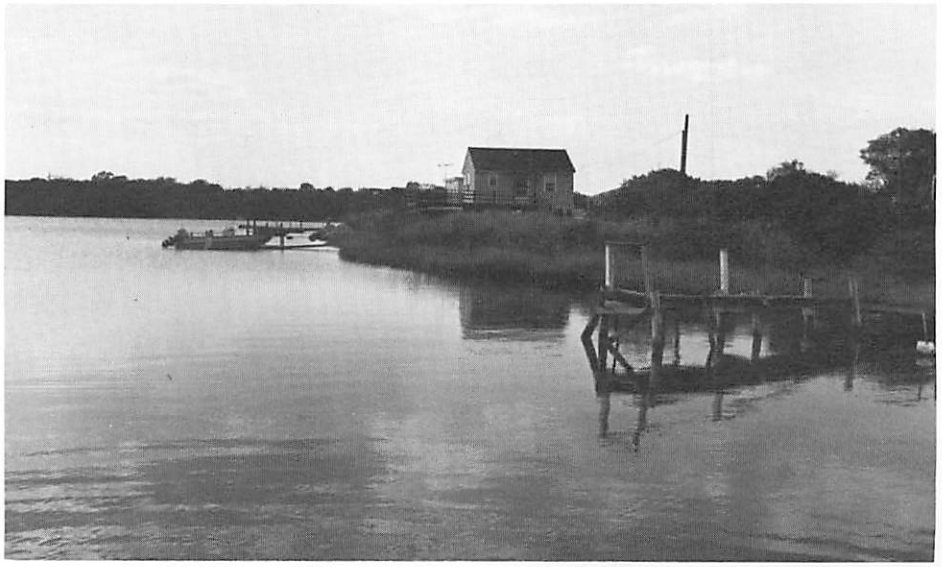
New England fishing boats have unique stability and safety problems because of their small size, the nature of the work of fishing, and, frequently, the design or modifications of the original design.

Over the past two years, the Bureau, staffed by Department of Ocean Engineering and Marine Advisory Service personnel, has developed the special technology needed to help small-boat fishermen operate their vessels with greater safety and efficiency. Its evaluations of stability are increasingly requested by local fishermen, and the Coast Guard has made use of its expertise in estimating the compliance of sunken vessels with safety standards.

The Coastal Resources Center

The Coastal Resources Center, a unit of the University's Division of Marine Resources, continued its work of helping public officials and private citizens effectively use and maintain coastal ecosystems.

A major effort during the period covered by this report was the literature review, the interpretation, and the confirmation of scientific data that served as background for extensive revisions of the Rhode Island Coastal Resources Management Council's 1977 regulatory program. After wide public review, the Council

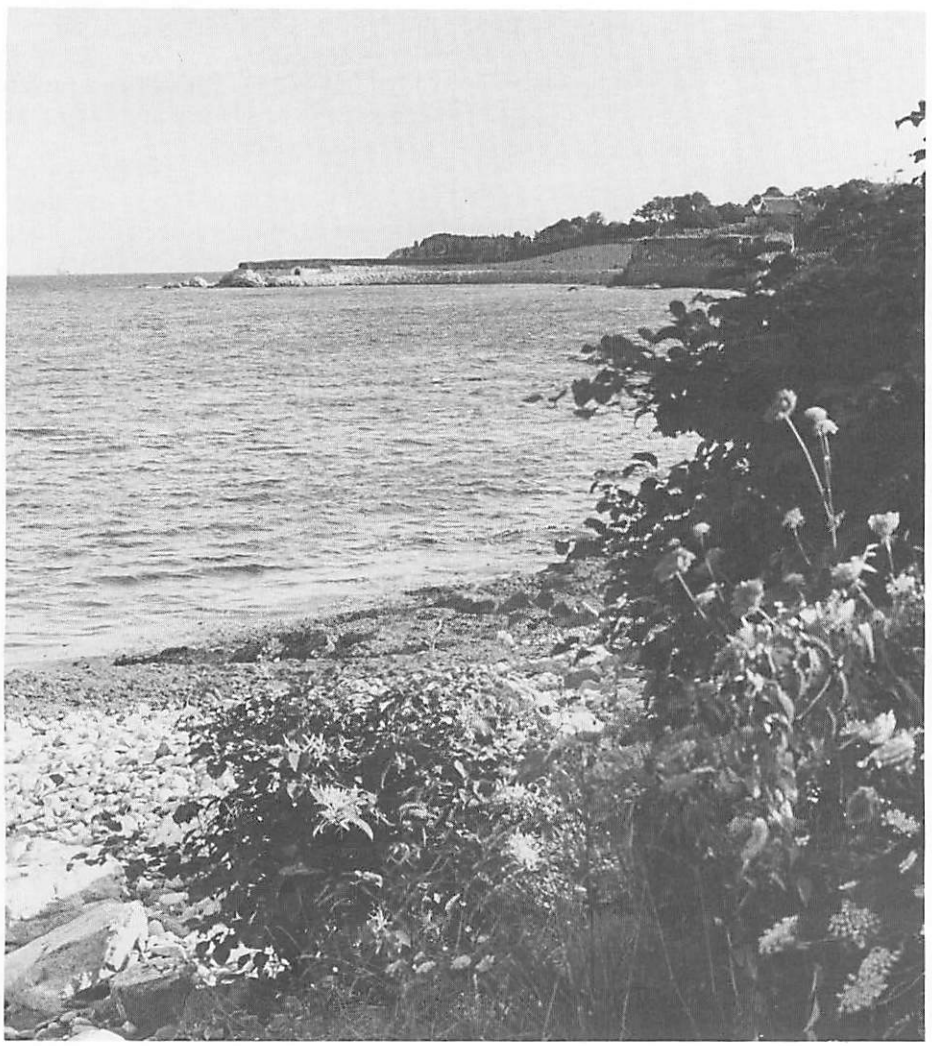


adopted the amendments in June of 1983. The new program, one-quarter the length of the original and far easier for the layman to understand, greatly simplifies the permitting process and sets forth detailed policies for balancing development and preservation along the Rhode Island shoreline.

Two important projects of the Center during 1983 involved bridging the gaps between science, private interests, and public management in totally different areas—the salt ponds along the state's South Shore and the badly polluted urbanized upper Narragansett Bay estuary. Three towns have already made use of the Salt Ponds Special Area Management (SAM) Plan in drafting new zoning regulations. Like the SAM Plan, the statewide regulatory program has been of considerable interest to planners and managers in other states. Coastal zone management agencies in Florida, Texas, Alabama, South Carolina, and New Jersey have asked for more information on various aspects of it.

Since 1981, the CRC and the University's advisory group it was asked to form have given considerable assistance to the Narragansett Bay Water Quality Management District Commission in its ongoing effort to upgrade the Providence sewer system.

Also, an increasing number of visitors from other countries have spent a day at the Coastal Resources Center to learn more about its activities and approach to managing coastal ecosystems. Many have mentioned that much of what they learned will be useful in managing their own coastal resources. Visitors included officials from Brazil, Colombia, Costa Rica, Malaysia, France, and Great Britain.



The Center for Ocean Management Studies

As of 1983, COMS was in its seventh year of promoting communication between marine interests within and outside the University through a variety of activities.

In cooperation with the International Center for Marine Resource Development, it began planning for a workshop or short-course series aimed at helping developing nations manage and make use of the 200-mile Exclusive Economic Zone.

The Center also continued work on a multi-institutional project related to management issues in the Bay of Fundy/Gulf of Maine/Georges Bank area, an area that will not be affected by the current Canadian-United States boundary dispute.

Its Research Fellows Program, created in 1978 to give top management people an opportunity to conduct research on important marine management issues, continues to be a success. Alan Ryan of the National Marine Fisheries Service, NOAA, was appointed research fellow for 1983 to explore innovative cooperative relationships between the academic community and NMFS that will further scientific research related to United States resource activities in Antarctica and to examine future policy directions.

During 1983, Lewis Alexander was named director of COMS. His association with the Center dates back to 1976 when he served as a member of the steering committee.

Lynne Carter Hanson was named executive director, a position she had held in an acting capacity for the past two years.

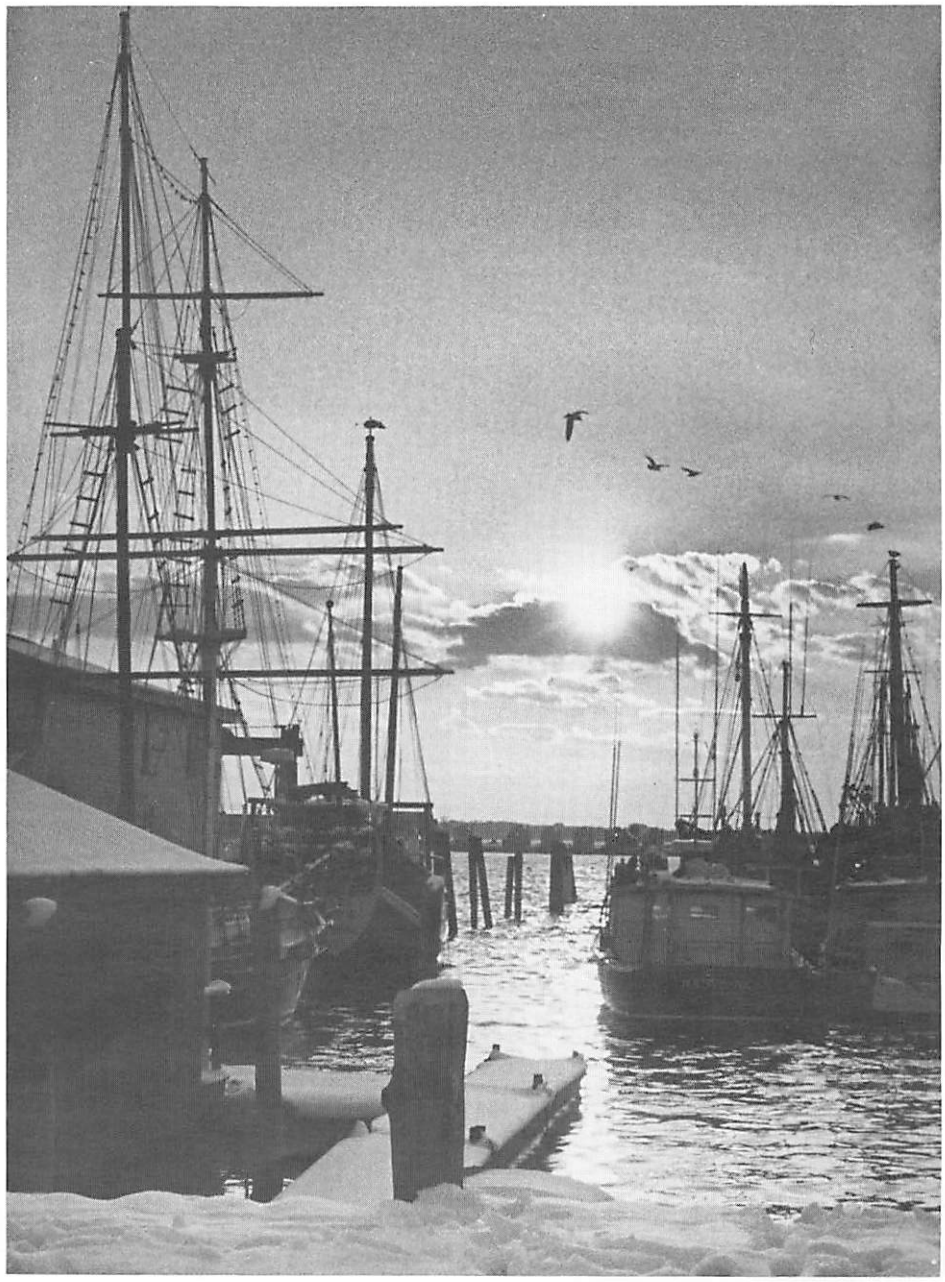
After five years of publication, the newsletter *Coastal Oceanography and Climatology News* was discontinued because of a reduction in funding.

Education

Marine Resource Economics

The innovative Ph.D. program in marine resource economics was developed by the University with Sea Grant support to fill a national need for trained economists with a grasp of marine issues. Although the program continues, with University support, its five-year period under Sea Grant funding ended in 1982.

Graduates were working in the U.S. Nuclear Regulatory Commission, the National Marine Fisheries Service, the World Bank, the National Sea Grant Office, the Catholic University of Chile, the Canadian Department of the Environment, the University of Rimouski in Quebec, the U.S. Navy Center for Naval Analysis (Captain USN), and the economics departments of Connecticut College (chairman of the department), University of Alaska, University of California at San Diego, University of Maryland (2), University of New Mexico, and Western Washington State College.



Research Projects Completed in 1982-83

Ecosystems Research

Multidisciplinary Study of Rhode Island Coastal Ponds • The final segments of a major interdisciplinary study begun by the University in 1978 were completed in 1983. This comprehensive assessment of a chain of key coastal ponds in southern Rhode Island was undertaken to provide management guidelines that may slow their further deterioration.

When scientists from seven disciplines had contributed their pieces of the puzzle, it was possible to understand for the first time what was happening to the ponds and why.

The separate studies showed that permanent breachways and periodic dredging unintentionally had done more to disrupt the ecology of the ponds than any single other human action. The resulting changes in water salinity and circulation have discouraged the spawning of many important species and encouraged the invasion of oyster predators.

Surveys of the bivalve resources, conducted jointly with the state's Department of Environmental Management, have already resulted in new fishery regulations to protect stocks in certain areas. New information on the winter flounder population was given to resource managers preparing new finfish regulations.

Because of public concern about bacterially contaminated groundwater going into the ponds and some residential wells, nutrient budgets were developed that provide up-to-date descriptions of water quality and help pinpoint sites of deterioration in quality. Both the bacterial contamination and eutrophication are believed to be the result of heavy residential development.

After studying all the research results, the Coastal Resources Center, which had been the scientists' liaison with government agencies and the public throughout the lengthy project, advised the Coastal Resources Management Council, the agency with a specific mandate to manage ecosystems in the state, on the formulation of a special area management plan.

Thanks to this research supported by Sea Grant, the Management Council and town governments now know that it is still possible to main-

tain the area's scenic quality, prevent further bacterial water pollution, keep drinking water potable, preserve the remaining fish and shellfish, and restore, at least partially, the beaches, dunes, and habitats.

Impacts of Mosquito Ditching on Salt Marsh Avifauna • As a result of mosquito control efforts years ago, 90 percent of the salt marshes on the Atlantic Coast from Maine to Virginia are crisscrossed with ditches to this day. A few decades ago, biologists began to worry that they were drastically altering the marshes, and several investigations of the effects on plant and animal life were undertaken. However, until this study there was virtually no information concerning the impacts of ditching on birds.

A variety of agencies involved with salt marsh management will welcome the data from this project, which represents the most intensive inventory of birds in New England salt marshes ever undertaken.

In the course of investigating the effects of mosquito ditching, the researchers identified the physical and biological features of salt marshes that determine size and variety of bird populations, as well as specific attributes that make the marshes suitable for breeding, wintering, or migration stops.

Because the project presents the first set of quantitative data on the impacts of mosquito ditching, it provides a sound framework for evaluating the probable effects on birds of various proposals for salt marsh alteration and for developing better approaches to mosquito control.

The information is being made available to a number of federal, state, and local agencies. Preliminary results have already been presented to mosquito managers at the annual meeting of the Northeastern Mosquito Control Association.

The principal investigator of the study, called upon several times as an expert witness in hearings on the potential impact of proposed housing on a salt marsh, has been able to draw on the extensive data accumulated during the project.

Fishing, Fisheries, and Seafood Science

Evaluation of Industry-Developed Trawls by Means of Tank Testing • Making a good fishing net even better has been the aim of URI experts in trawl design for a number of years. Working with the URI 340 series of trawls, long popular with fishermen here and abroad, they had developed a number of specific modifications calculated to increase both catch and fuel efficiency and constructed six scale models to use in tank testing.

Although the original set of models provided useful information, completely accurate measurements of trawl performance required models constructed with materials of the proper scale.

For this project, special scale twine was obtained from the White Fish Authority in England and new models were constructed. These were extensively tank tested in the University's tow tank before being taken to England for final testing in the White Fish Authority Flume Tank.

As a result of these tests, an entirely new trawl was designed that combines the best features of the long-used Yankee and URI 340 series trawls and eliminates the bad. To reduce drag, much larger meshes were used, and the front end was completely altered.

Tank tests with the model gave such satisfactory results that the trawl was built full scale in the final year of the project, and since then has been tested by a number of commercial fishermen who give it high marks for catch efficiency and fuel saving.

An Investigation of Digestive Rates of Fishes • This laboratory study, which consisted of feeding groups of fish a specific meal, then determining the amount of food that remained in the stomachs at subsequent intervals, marks an important step in estimating the food requirements of commercially important fish in New England waters.

Winter flounder, a key species in Rhode Island ecosystems, was the principal variety studied during the two-year project; yellowtail flounder and silver hake were researched less extensively.

The study was carried out cooperatively with the National Marine Fisheries Service Northeast Fisheries Center at Woods Hole, where the findings of URI investigators are being coordinated with ongoing programs and incorporated into multispecies assessment models.

The information provided by URI researchers is needed to calculate the daily food intake of fishes in nature. The daily food intake rates, in turn, provide information on rates of energy flow in the ecosystem and interactions between different fish species.

The study, which also determined the effects of temperature, food type, and meal size on evacuation rates of winter flounder, is the most complete ever carried out for any marine fish species. Since it includes a detailed comparison of several current methods for obtaining stomach evacuation data, it will be useful to other researchers in designing future experiments. It is also expected to resolve the current controversy in the literature concerning the nature of the evacuation rate curve and the kind of mathematical model that best describes the process.

Nutritional Value of Stored, Processed, and Cooked Fish • A project to increase the limited data available on cooked and processed fish, completed in 1982, has since brought URI a two-year contract from the Consumer Nutrition Center of the USDA to supply nutritional values for 14 species of fresh and processed fish.

The Department of Food Science and Technology, Nutrition and Dietetics demonstrated its expertise in nutritional evaluation by analyzing the effects of storing, cooking, and processing on codfish and measuring nutrient content of the meat after each of these processes. The effects of heat and industrial processing were also correlated with nutrient availability.

As a result of their findings, researchers involved in the project are

able to advise the public and the food service industry on how best to cook fresh fish for maximum tastiness and nutrient retention.

They are also able to provide information on the effects of long-term storage by comparing data collected on fresh Atlantic cod and on frozen cod blocks used by industrial processors. Their data will be used to develop and standardize recipes and improve the quality of a number of fish products.

Alternative for Expansion of Seafood-Processing Plant Capacity • Finding better ways to extend the shelf life of fresh fish has become a research priority with food scientists as the United States market for non-frozen products expands. One benefit would be to increase the output of seafood-processing plants without a major investment in increasing plant capacity. Another, of course, would be to extend marketing range.

Building on earlier Sea Grant-supported work with hypobaric and enzymatic methods of extending freshness, the researchers were able to arrange for long-term industry field testing in a demonstration hypobaric unit loaned by Grumman Allied Industries to the Point Judith, R.I., Fishermen's Cooperative.

Having already demonstrated in the laboratory that hypobaric storage alone increased the shelf life of flounder fillets by 50 percent—and, when coupled with a glucose oxidase dip treatment, by 90 percent—the URI team, which includes a food biochemist, a food microbiologist, and a food technologist/engineer, aimed to establish the best conditions for both storing and transporting fresh fish in a hypobaric unit on a commercial scale. They also wanted to learn the differences in effectiveness of the method with different types and cuts of fish.

Both lean and fatty fish were tested. They were headed, gutted, and stored in the unit in boxes, with and without ice.

The trials determined that the shelf life of flounder, a lean fish, can be extended 50 percent by hypobaric storage alone. When this is combined with ice, shelf life is increased by as much as 200 percent.

Fatty fish, on the other hand, do not respond as satisfactorily. The combination of hypobaric storage and ice prolonged freshness in fatty fish by only 15 percent. The researchers planned further work on this problem, which they felt was related to the fish muscle rather than to the fat content.

Recovery of By-Products from Rhode Island Seafood-Processing Industries • A project begun in 1980 with the aim of helping seafood processors meet the requirements of the Clean Water Act by identifying marketable, recoverable by-products from waste water ended with some notable findings.

Clam wastes can be a money-maker instead of a headache for the clam-processing industry, one facet of the study showed. Working with a Rhode Island seafood company, a graduate student in the Department of Food Science and Technology, Nutrition and Dietetics used wastes from the processing plant to produce a feed for cultured fish. Tested on rainbow trout for eight weeks, the clam diet was found to outperform the two comparison diets and to give maximum growth and food conversion.

A related portion of the study involved engineering and was aimed at determining the cheapest and most

Point Judith vessel unloads industrial fish onto waiting truck.

efficient system for recovering usable protein from processing wastes. Four different systems for clarifying waste water were tested. An ion exchange system removed most of the protein and was found to be more effective than acid precipitation, foam flotation, or ultrafiltration. The investigators were confident that a simple, low-cost technology can be developed, perhaps by combining flotation and ion exchange, which small processing plants can use to recover a salable product that will pay for their waste treatment costs. Currently, it is estimated, processors discard salable enzymes worth several thousands of dollars contained in plant wastes every day.

The Biochemical Composition and Biological Effectiveness of Selected Strains of Brine Shrimp • High demand for brine shrimp (*Artemia* ssp.) as food for cultured larval marine species has led to high prices and often unreliable quality in the commercially available product. Because of the striking quality differences documented in different populations of *Artemia*, there is a vital need to be able to identify batches of unknown or uncertain origin.

Just as human foods contain varying amounts of fatty acids, minerals, and sometimes pollutants, so do brine shrimp. In what way their chemical and biochemical composition affects growth and survival rates of the fish they are fed to has been the subject of long-term and extensive studies in the Department of Food Science and Technology, Nutrition and Dietetics.

For years, the only quality criterion in the multimillion-dollar brine shrimp industry was hatchability. In previous studies, URI researchers discovered that the quality of brine shrimp can vary dramatically, depending on the geographical location and quality of the water in which it is grown.

A major aim of the latest project was to develop a way to identify specific *Artemia* populations and detect geographical mixing in commercial batches. This was successfully done for the first time using the advanced electrophoretic protein separation technique of isoelectric focusing. As a result, aquatic scientists and aquaculturists will be able to know what they are feeding their fish.

Work on the biosynthesis of fatty acids by *Artemia* along with analysis of various geographic collections has also made it possible for the researchers to predict nutritional quality.

The URI studies are part of a large international comparative project prompted by lack of knowledge about the shrimps' nutritional qualities. Since 1978, research groups from the University and the U.S. Environmental Protection Agency, as well as from Belgium, Wales, and Spain, have been investigating various aspects of five brine shrimp strains.

Cost-Effectiveness of Alternative Methods of Collecting Economic Data on Fish Catching • Up-to-date cost and earnings records for vessels in different fisheries are needed more than ever for present-day fisheries management. Such records don't exist, however, because the conventional way of obtaining them, through personal interviews with skippers, is too costly and labor-intensive to be feasible.

To complement and extend research supported by the National Marine Fisheries Service, two resource economists investigated a method of obtaining the needed data, one that is used in other countries but has been untested here. Questionnaires mailed to skippers or vessel owners offered $100 for each fully completed, usable reply. The response was unexpectedly disappointing. Only six percent returned usable replies.

Because of confidentiality requirements of the NMFS, it was not possible to make follow-up telephone calls to those who did not reply to learn reasons for the low response. However, under a continuing program, especially one operated in-house by NMFS, these problems could be obviated. A sampling of fishermen willing to participate could be established in each port.

Distribution Mapping and Typing of Toxic Dinoflagellates • Since the early 1970s when paralytic shellfish poisoning (PSP) was recognized as a recurring health hazard, not to mention economic disaster for the shellfish industry of New England, pharmacognosists at URI have been working to unravel the many mysteries surrounding the periodic appearance of "red tides" (actually, population explosions of the toxic phytoplankton, *Gonyaulax tamarensis*, which tint the water by their sheer mass) in New England waters.

The project completed in 1983 involved mapping the locations and typing the strains of *Gonyaulax* found in waters from the Bay of Fundy to Long Island Sound in order to establish the regional distribution of toxic strains. Until now there had been little or no investigation of variations in toxicity among populations.

The laboratory analysis of samples from a number of locations produced the astonishing finding that there is tremendous variation in toxin content not only from area to area but within a single sample.

In certain clones, only one or two toxins were detected, whereas others contained all the known toxins. Clones with a more or less complete toxin profile often came from a northern location, whereas those from a southern area not only had lower toxicity per cell but harbored fewer of the toxins. This suggests that populations of *Gonyaulax* could potentially be identified on the basis of their toxin profile.

Corresponding with experience, laboratory analysis showed a decrease in toxin content per cell for populations from north to south. Red tide outbreaks have historically been more serious in Maine waters than anywhere else.

With this data, coastal health monitoring agencies will be better able to tell where preventive measures should be taken on a regular basis and which areas are potentially safer for shellfish culture ventures.

Impacts of Groundfish Imports on the Domestic Groundfish Industry • For years, United States fishermen

have claimed that imports of groundfish hurt the domestic industry by depressing prices. They have called repeatedly for governmental relief in the form of tariffs or countervailing duties.

A study was undertaken to determine the extent to which imported groundfish influence domestic ex-vessel prices; the long- and short-term benefits to domestic fishermen of alternative trade policies; and whether associated costs would be imposed on consumers, processors, and other users of groundfish and groundfish-based products.

An economic model of the New England groundfish fishery was developed, using available monthly data from 1965 to 1982. It predicts that higher tariffs would not significantly reduce the amount of foreign product entering the country, that a price increase of 10 percent on imported fish would only raise ex-vessel prices to domestic fishermen by 1.5 to 2 percent, and that the burden of any tariff, countervailing or other, would be largely borne by suppliers and consumers. In short, in the opinion of these researchers, the gains for fishermen would not justify the losses in other sections of the economy. Since the issue is a highly controversial one, these predictions have drawn a debate on what the true conclusions should be.

Results of the study have been broadcast on Maine, Massachusetts, and Rhode Island radio stations by the URI Marine Advisory Service.

Other

United States Interests and the UNCTAD Code of Conduct for Liner Conferences • In the context of shipping, "liner conferences" are organized bodies formed by shipowners serving a particular trade to control membership in their ranks and divide cargoes and revenues between them. They have existed since the 1870s with the avowed purpose of avoiding rate wars and providing more stable and reliable service. But because they discourage competition, they have long been controversial.

They became even more so in the 1960s as developing nations, newcomers to the shipping scene, began to clamor for representation in the transport of goods to and from their countries.

The combined pressure these countries brought to bear resulted in adoption of the 1974 United Nations Conference on Trade and Development (UNCTAD) Code of Conduct for Liner Conferences, which was to enter force in October 1983.

Anticipating that the United States would need to decide before that date whether it would be a party to the treaty, a professor in the Department of Geography and Marine Affairs undertook to study the Code and evaluate United States options as an aid to those in legislative and executive branches who are involved in shaping and implementing maritime policy.

His conclusions appeared in a 234-page book, *The UNCTAD Liner Code: United States Maritime Policy at the Crossroads*, published by Westview Press in 1983.

The project also resulted in a major international conference hosted by the University's Center for Ocean Management Studies. Close to 40 top officials of United States and foreign governments, representatives of the European Economic Community, and executives of cargo carriers and shipping lines met to discuss the failure of the United States to become party to the Code and the alternatives open to it as a result. Participants agreed that the conference had been extremely useful in making various shipping interests aware of other points of view and laying the groundwork for future international dialogue on an important topic.

Information, Decision Making, and Strategic Behavior in the Regional Fisheries Management Councils • When the four regional fisheries management councils were created by the 1976 Fishery Conservation and Management Act, they represented a novel experiment in localized management of a natural resource.

To determine how well this new form of regulatory organization is working, a political scientist, a lawyer, an anthropologist, and an economist pooled their expertise in a detailed analysis of the decision-making processes of the regional councils.

They focused on the organizational setting for decisions, the implementation process, the role of information, the design of fishing regulations and their enforcement, and, finally, on attitudes toward management of people associated with the regional councils.

In addition to in-depth interviews and scrutiny of council decisions over a three-year period, a mail survey of 1,200 people was used to determine attitudes toward management. Of the four regional bodies, the New England Fisheries Management Council was the one studied most intensively.

Findings from the study suggest that management of the resource could function more effectively than it presently does.

Specifically, the authors determined that the information on which decisions are based is inadequate, particularly the economic and social data. The biological data, while adequate in some respects, is not usually presented to the councils in a way that is relevant to the decisions they need to make.

The authors also conclude that fishery regulations are often complex and that enforcement costs can outweigh the benefits.

The 500 respondents to the questionnaire—a sample of past and present council members, plus advisory, scientific, and statistical committee members—were generally positive toward the goals of the Fishery Conservation and Management Act, though significant regional, educational, and experiential differences were reflected in their attitudes.

The material from this study will be included in a book on fisheries management in the United States on which the four investigators are collaborating.

Ongoing Research Projects

Aquaculture

In aquaculture research, emphasis is on helping industry solve production problems.

A study of the so-called "Maillard browning reaction," which results in significant nutrient losses in stored fish feed, will provide information to the fish feed and aquaculture industries on how to minimize this loss through new formulation and processing methods and improved storage conditions.

Prevention of gonadal development in cultured salmonids would open a market for larger fish. A URI project is directed at developing a method of inducing mass autoimmune castration and measuring its effects on feed conversion, flesh quality, behavior, and susceptibility to disease.

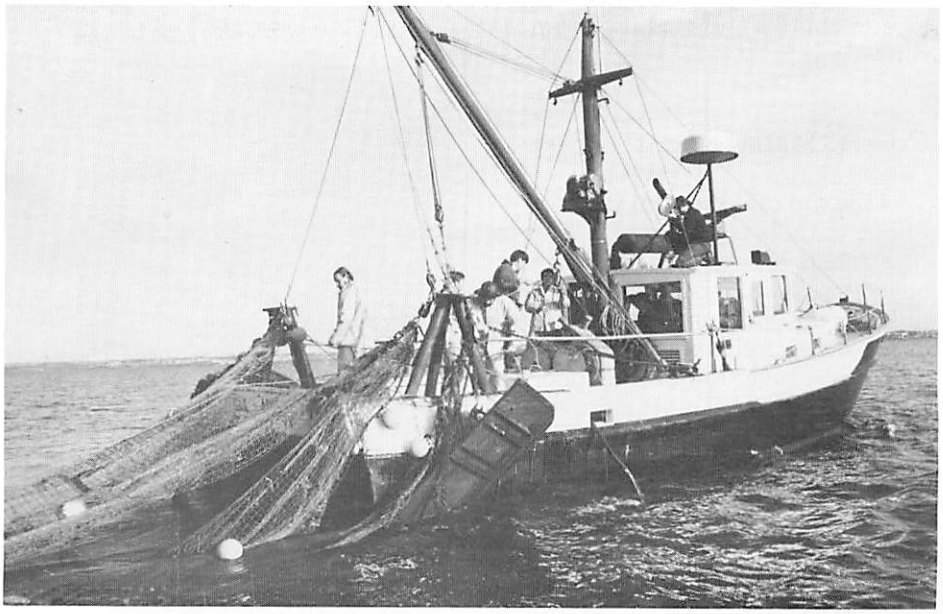
Artemia, or brine shrimp, a diet staple in aquaculture, is in growing demand and increasingly short supply. Product quality is also extremely variable from population to population. A group that has been in the forefront of *Artemia* research for close to a decade is presently trying to determine the causes of this variation, as well as the unique characteristics that make high-quality batches of *Artemia* a superior feed so that these qualities can be incorporated into less satisfactory foods.

Mussel culture is a rapidly growing industry, but it is one that has been seeing substantial production losses as the result of byssus thread disease, which causes affected mussels to become detached from the ropes on which they grow. A group at URI is working with one of the largest Northeast mussel growers to find the cause of the disease and devise management strategies to combat it.

Fishing, Fisheries, and Seafood Science

Current economic research sponsored by Sea Grant involves improving an existing URI-NMFS financial simulator for fishing vessels so that it can forecast up to a year ahead of available data. Variables for which forecasts are being sought are catch per unit effort and ex-vessel prices for the New England deep-sea scallop and otter trawl fleets.

An attempt to find the cause of gray muscle disease in scallops, to determine whether it results in mass mortalities, and to map its occurrence in the Northeast has already accomplished its first aim. Cause of the disease—which resulted in mass mortality in Narragansett Bay in 1979-80—has been identified for the first time as a rickettsia-like organism that lives



Fisheries students gain firsthand experience on board URI vessel.

in the gills and epithelial cells of this economically important species. Methods of culturing the parasite are currently being developed.

Preserving fresh fish without freezing it has been a longtime goal of the seafood industry, since it would permit geographical expansion of the fresh fish market to the benefit of both fishermen and consumers. URI researchers, who have done considerable work with hypobaric storage and enzyme treatments, are currently refining their approach by using the enzymes to control the surface environment of the fish within a modified atmosphere. If lipid oxidation proves not to be a problem, this newest storage method could result in considerable industry savings and be effective with a wider variety of fish than is hypobaric storage alone.

Surimi gel, a protein derived from fish flesh, has long been used in Japan as a base for many manufactured foods that look and taste like nature's products. Interest in producing surimi is rising in this country, but little has been done to improve the technology. A URI food scientist, who has worked on the technology of protein gels for some eight years, is currently engaged in developing the most efficient, economical, and effective manufacturing process. He has interested three companies in Rhode Island and Massachusetts in producing surimi and two in Rhode Island in developing products such as lobster chunks and shellfish from surimi gel.

Coastal Management

Like the multifaceted study of Rhode Island's coastal ponds, current research in coastal management is concerned with another of the state's most urgent problems and involves a group of interrelated studies. The problem is pollution of the upper Narragansett Bay and the Providence River. One of the questions to be answered is: What constitutes pollution for the different uses of these waters—for the fisheries, for instance, in contrast to swimming? Another is: How can we treat urban waste economically while still maintaining a healthy and productive estuary?

Data from one study—of the hydrodynamics of these waters—will be used to construct a pollutant transport model for the river and upper Bay.

A second study is concerned in part with the Bay's most important fishery—the hardshell clam, or quahog. Water pollution in some of the most abundant clam beds—located primarily in the upper Bay—has had a profound effect on the entire industry over the past ten years. Consequently, a marine biologist is compiling all available information on quahog biology and the fishery, and determining how compatible Rhode Island water quality goals are with those of the industry and management authorities. Another component of the work involves comparing the development of winter flounder larvae from a spawning habitat in heavily polluted upper Bay waters with those from an unpolluted coastal lagoon. Until now, the impact of pollution—if there is one—on this important resource has not been documented.

A third project concerns establishing nutrient and oxygen flux in the upper Bay, partially to enable a realistic prediction of how much effluent this urban estuary can assimilate. Information gathered so far has helped pinpoint major effluent contributors to the problem of anoxic areas and will be used to develop an oxygen budget.

As it did in the earlier salt ponds study, the Coastal Resources Center has the job of integrating all information and seeing that management agencies are aware of the findings as soon as they become available. Developing new strategies for better water quality and acting as liaison with various segments of the public are other ongoing responsibilities.

The tourism industry, a major income generator for many states including Rhode Island, can carry the seeds of its own destruction if it is allowed to grow so fast and haphazardly that it degrades the environment. A final project in coastal management is a response to this state's need for guidelines in tourism management. In January 1983, a resource economist began construction of an economic forecasting simulation model of publicly and privately owned marine recreation areas.

Other

Satellite-derived data is a relatively new tool in oceanographic research. The first satellite devoted to oceanography was launched in 1978. Shortly thereafter, a URI oceanographer and ocean engineer began the first of a series of projects designed to make satellite data more accessible and more widely used.

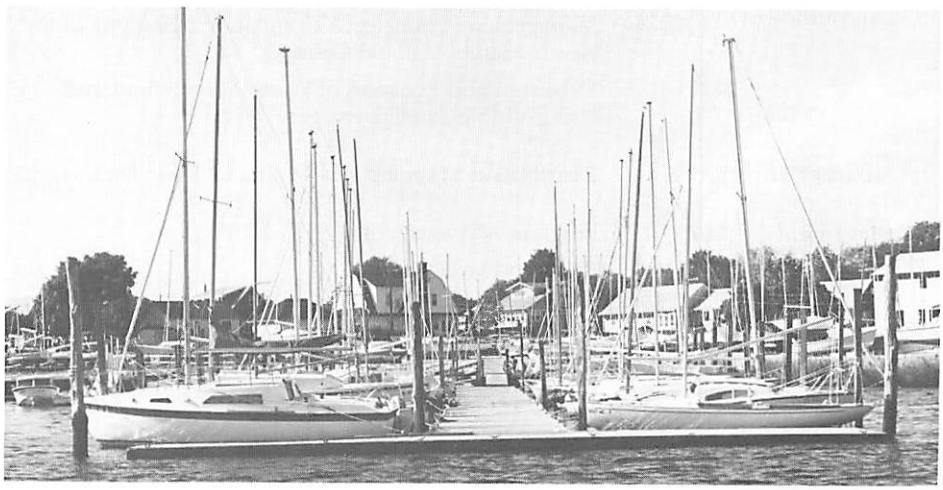
In 1982, after three years of Sea Grant support, he published a user's guide to environmental satellite data, the first such guide available.

Since 1981 he has been involved in an ongoing project to establish a retrospective data base of satellite digital data for the Cape Hatteras to Nova Scotia region as an essential part of a remote-sensing laboratory at the University. Several aspects of this work promise practical applications for commercial fishermen.

Program Development

"Program development" might also be described as "quick response." PD funds are used to produce results that are needed quickly, to support short-term projects of immediate usefulness, and to launch promising research that may continue with other funding. Over a dozen such projects received Program Development support during 1981-83. Among them:

- A Rhode Island fresh fish retailer, tired of the waste of lobster meat he saw in his operation, offered a grant to a URI food scientist to develop a method of extracting the meat in lobster legs and combining it with finfish meat to produce a salable "lobster stick." The Sea Grant Program responded with matching funds.
- Similarly, a commercial fish-processing firm offered its cooperation and matching support to the same researcher to develop edible products from fish frames and crab shells left after normal processing.
- Another project with commercial applications was overseen by a biochemist. His group discovered that enzymes important in basic research and genetic disorders, which presently are available only from Japan, can be extracted from the stomachs of clams, which are routinely discarded in processing operations. Eleven of the enzymes, traditionally used by pharmaceutical companies in basic research, have been identified in the clam wastes.
- Three echo-sounder calibration areas were established and a brochure published to help commercial fishermen correct operational adjustments and interpret their wheelhouse displays.
- The tow tank's usefulness was increased by the addition of accurate instruments to measure speeds and loads.
- Fuel consumption on New England trawlers was measured with warp tension meters fitted on the NMFS R/V *Gloria Michelle* and used in single-vessel and pair trawling operations.
- As part of the large coastal ponds study, data on the value of the surrounding land were collected and analyzed. As a result of his work, the principal investigator was asked by town planners to assist in managing these lands.
- A multivariate stock identification method was developed, using chemical microanalyses of sequentially deposited rings in fish otoliths.
- To help the state plan future directions for management of marine tourism, a survey of Rhode Island residents was completed, giving managers new insights into the attitudes of residents toward tourists.
- At the request of the marine trades associations of three New England states, a study of the economic impact of boat service facilities was carried out by the Sea Grant coordinator and a graduate assistant. As a result, other states in the region became interested in having the same data.



Project Status Fiscal Year 1982

	Project Number and Title		*Planned Termination Date*	*Date Initiated*
Advisory Services	A/AS-3	Marine Advisory Service	None	1975
	A/COM-1	Center for Ocean Management Studies	1983	1977
	A/CR-5	Coastal Resources Center	None	1971
	A/OE-4	Fishing Vessel Safety Center	1983	1981
Education	E/ME-2	Marine Resource Economics, Ph.D. Program	1982C	1981
Fishing, Fisheries, and Seafood Science	R/F-28	Evaluation of Industry Development Trawls	1982C	1980
	R/F-29	Cost-Effectiveness of Alternative Methods for Collecting Economic Data on Fish Catching	1982C	1980
	R/F-30	Investigation of Digestion Rates of Winter Flounder, Silver Hake, and Yellowtail Flounder: A First Step in Estimating Food Requirements of Commercially Important Fishes in New England Waters	1983	1981
	R/MP-1	Virus-caused Mortality of Sea Scallop on the Northeast Coast of U.S.	1984	1981
	R/T-13	Recovery of By-Products from R.I. Seafood-processing Industries	1982C	1980
	R/T-14	Nutritional Evaluation of Stored, Cooked, and Processed Fish	1982C	1980
	R/T-16	Alternatives for Expansion of Seafood-processing Plant Capacity	1983	1981
Aquaculture	R/A-15	Biochemical Composition and Biological Effectiveness of Selected Strains of Brine Shrimp. Effect of Temporal Variation, Some Chlorinated Hydrocarbons, and Fatty Acid Composition on the Use of Brine Shrimp in Aquaculture	1982C	1980
	R/A-18	Nutritional and Economic Consequences of Maillard Browning Reaction in Fish Feed	1984	1981
Coastal Resources	R/CL-5	Fish and Fisheries of R.I. Lagoons and Ponds	1982C	1978
	R/CL-6	Options and Techniques for the Management of Salt Ponds	1983	1978
	R/CL-7	Carbon, Nitrogen, and Phosphorus Budgets for Coastal Lagoons and Salt Ponds	1982C	1979
	R/E-13	Impact of Mosquito Ditching on Salt Marsh Avifauna	1983	1980
	R/ES-16	Providence River Pollutant Transport Dynamics	1984	1981
Socioeconomic and Legal Studies	R/OL-1	U.S. Interests and UNCTAD Code of Conduct for Liner Conferences	1982C	1980
	R/SP-1	Information, Decision Making, and Strategic Behavior in the Regional Fisheries Management Councils: A Comparative Analysis of the Northeast Gulf and North Pacific Regional Councils	1982C	1981
	R/RS-1	Detection and Location of Water Mass Boundaries Using Visible Satellite Imagery	1984	1981
Food and Drugs	R/D-6	Distribution Mapping and Typing of Toxic Dinoflagellates	1983	1979
Management and Development	M/PM-1	Program Management	Continuing	1971
	M/PD-1	Program Development	Continuing	1973

C indicates project was completed in that year.

Project Status Fiscal Year 1983

	Project Number and Title		*Planned Termination Date*	*Date Initiated*
Advisory Services	A/AS-3	Marine Advisory Service	None	1975
	A/COM-1	Center for Ocean Management Studies	1983C	1977
	A/CR-5	Coastal Resources Center	None	1971
	A/OE-4	Fishing Vessel Safety Center	1983C	1981
Fishing, Fisheries, and Seafood Science	R/F-30	Investigation of Digestion Rates of Winter Flounder, Silver Hake, and Yellowtail Flounder: A First Step in Estimating Food Requirements of Commercially Important Fishes in New England Waters	1983C	1981
	R/F-31	Impacts of Groundfish Imports on the Domestic Groundfish Industry: An Implied Welfare Analysis	1984	1981
	R/F-32	Economic Models for Fisheries Decision Makers	1985	1981
	R/MP-1	Virus-caused Mortality of Sea Scallop on the Northeast Coast of U.S.	1984	1981
	R/T-16	Alternatives for Expansion of Seafood-processing Plant Capacity	1983C	1981
Aquaculture	R/A-18	Nutritional and Economic Consequences of Maillard Browning Reaction in Fish Feed	1984	1981
Coastal Resources	R/CL-6	Options and Techniques for the Management of Salt Ponds	1983C	1978
	R/ES-16	Providence River Pollutant Transport Dynamics	1984	1981
	R/ES-17	Integration of Management Objectives for Upper Narragansett Bay with Known Characteristics of the Ecosystem	1984	1982
	R/ES-18	The Integration of Wastewater Management Objectives, Upper Narragansett Bay, with Management Objectives for R.I. Quahog Fishery	1984	1982
	R/ES-19	Dissolved Oxygen Dynamics and the Assimilative Capacity of an Urban Estuary	1985	1982
	R/E-13	Impact of Mosquito Ditching on Salt Marsh Avifauna	1983C	1980
	R/RS-1	Detection and Location of Water Mass Boundaries Using Visible Satellite Imagery	1984	1981
Food and Drugs	R/D-6	Distribution Mapping and Typing of Toxic Dinoflagellates	1983C	1979
Management and Development	M/PM-1	Program Management	Continuing	1971
	M/PD-1	Program Development	Continuing	1973

C indicates project was completed in that year.

Activity Budget Fiscal Year 1982

	NOAA Grant Funds	*University Matching Funds*
Marine Resources Development		
Aquaculture	$160,832	$158,321
Living Resources Other Than Aquaculture	79,094	44,302
Marine Extracts—Toxins	46,966	38,501
Socioeconomic and Legal Studies		
Marine Economics	31,797	1,614
Ocean Law—International	18,410	5,346
Sociopolitical Studies	42,501	25,385
Marine Technology Research and Development		
Resources Recovery and Utilization	170,474	87,530
Marine Environmental Research		
Research and Studies in Direct Support of Coastal Management Decisions	98,156	68,536
Ecosystems Research	240,800	64,904
Pollution Studies	73,722	50,032
Marine Education and Training		
College Level	42,394	36,902
Advisory Services		
Marine Advisory Service	483,017	274,045
Other Advisory Services	84,213	63,891
Program Management and Development		
Program Management	115,268	9,794
Program Development	99,356	—
TOTAL	$1,787,000	$929,103
ROUNDED TO	$1,787,000	$929,000*

*While matching is shown at $929,000, The University of Rhode Island does not wish to claim matching for audit purposes for more than one-third of the total cost of The University of Rhode Island Sea Grant College Program.

Activity Budget Fiscal Year 1983

	NOAA Grant Funds	*University Matching Funds*
Marine Resources Development		
Aquaculture	$130,000	$126,695
Living Resources Other Than Aquaculture	159,155	36,576
Marine Extracts—Toxins	21,881	14,257
Socioeconomic and Legal Studies		
Marine Economics	161,000	—
Marine Technology Research and Development		
Resources Recovery and Utilization	41,199	31,611
Marine Environmental Research		
Research and Studies in Direct Support of Coastal Management Decisions	142,789	39,153
Ecosystems Research	239,867	23,704
Pollution Studies	77,598	32,246
Marine Education and Training		
Vocational Marine Technician Training	40,000	—
Advisory Services		
Marine Advisory Service	531,945	285,408
Other Advisory Services	74,677	62,766
Program Management and Development		
Program Management	124,323	10,577
Program Development	106,339	40,000
TOTAL	$1,850,000	$925,000*

*It is too early to specify matching funds on a project-by-project basis. What is listed are the amounts known at the time of submission of this proposal. It is certified that the grand total of $925,000 will be achieved before July 1, 1983.

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Note: The P number at the end of citation is the order number used by the Publications Unit of the URI Marine Advisory Service.

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