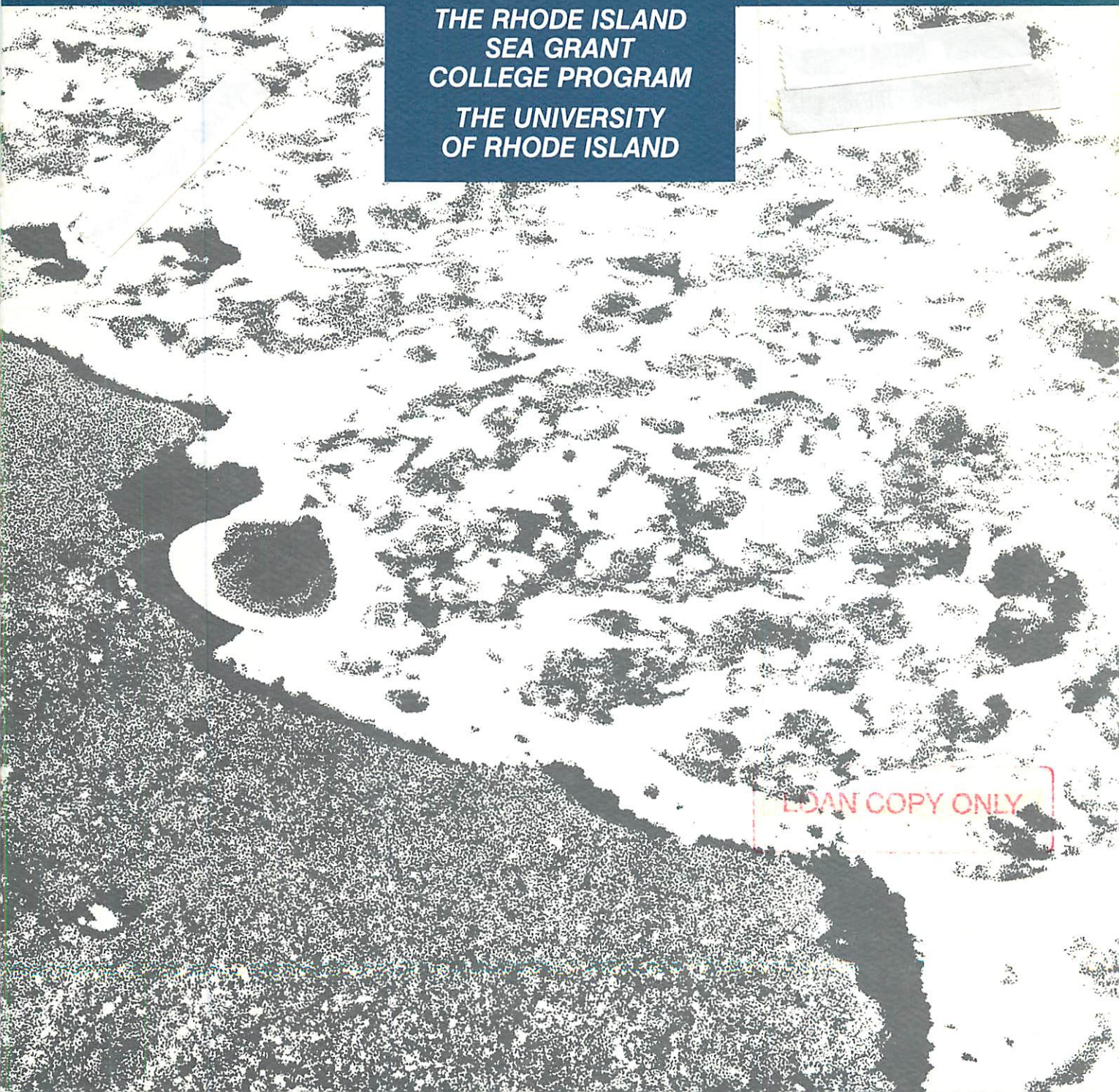
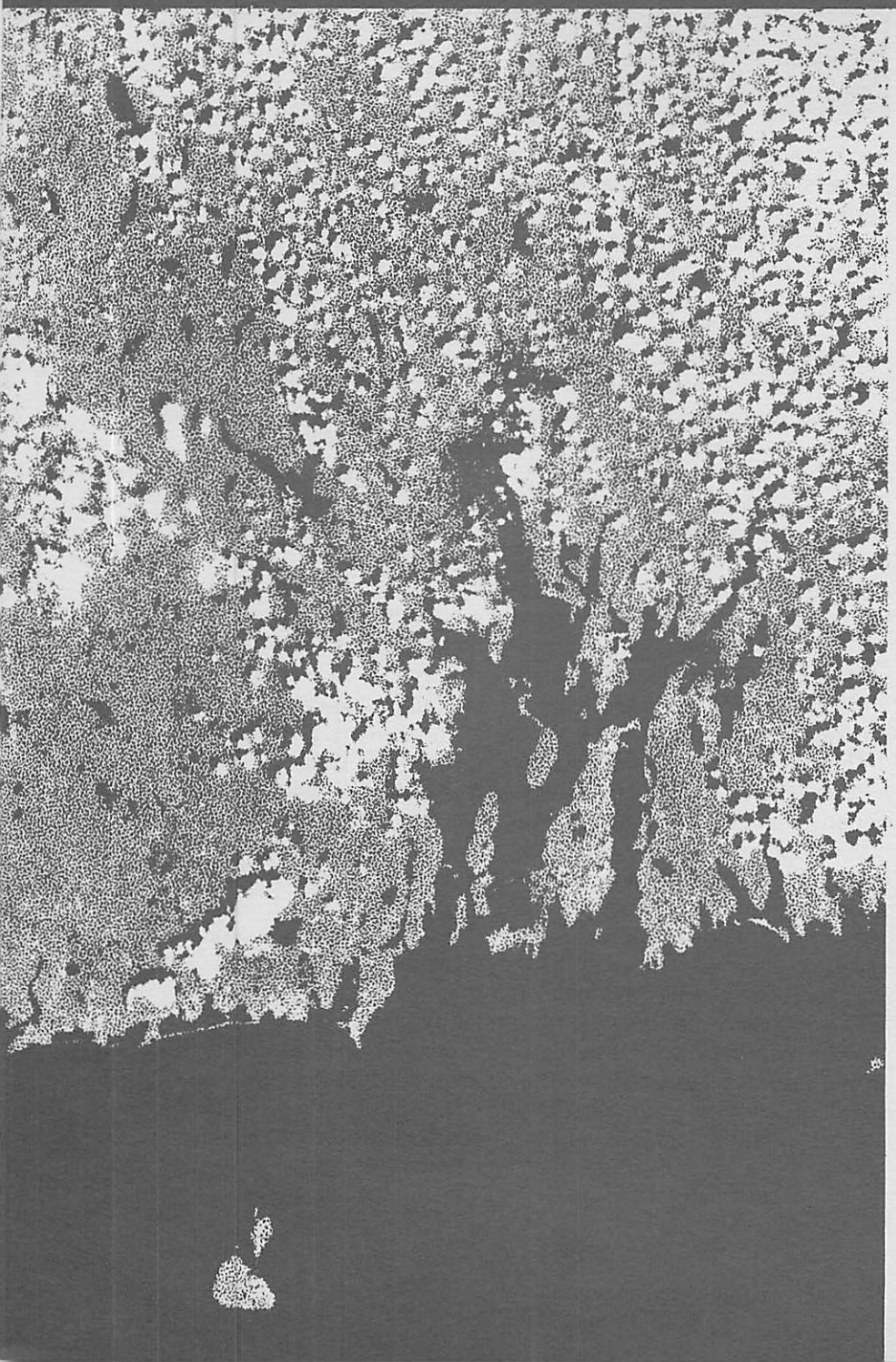
THE RHODE ISLAND SEA GRANT COLLEGE PROGRAM

THE UNIVERSITY OF RHODE ISLAND



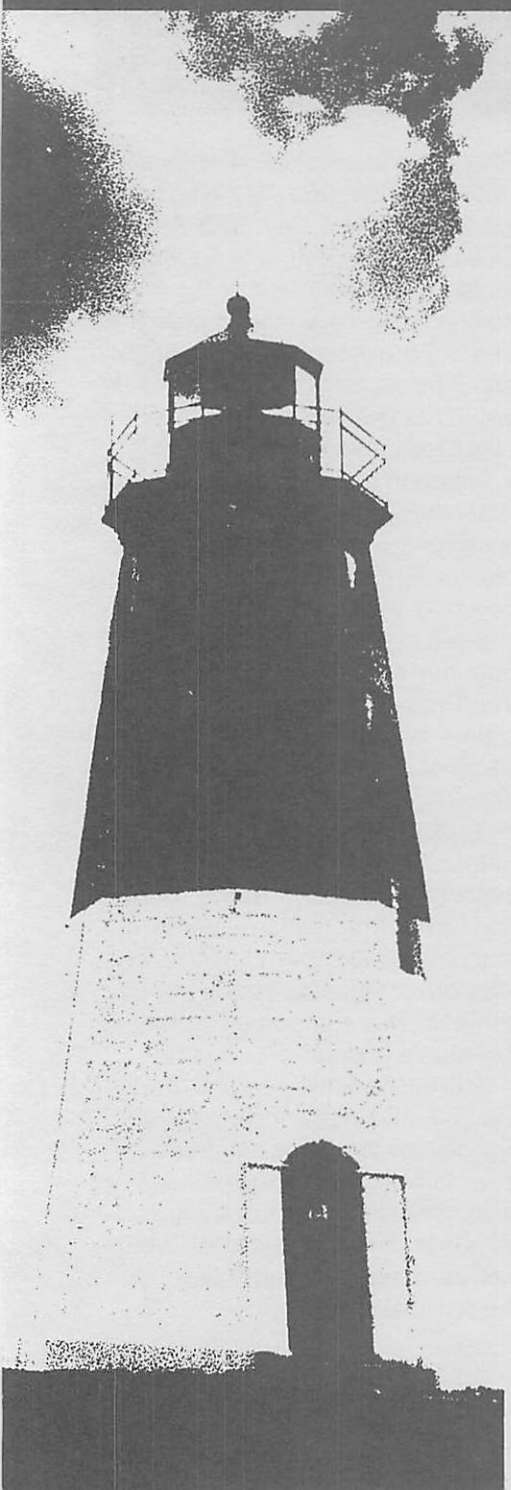


INTRODUCTION

Rhode Island is a small, densely populated New England state, dominated by Narragansett Bay. The Atlantic Ocean and the Bay, with fingers extending into the heart of the state, contribute over 400 miles of coastline, nearly 75 miles of sandy beaches, and 3,600 acres of salt marsh. Rhode Island has been appropriately named "the Ocean State."

Although the population of Rhode Island has remained essentially constant for the past decade, a shift of residents toward coastal areas has occurred, with resultant population increases of up to 88 percent in some communities. This demographic trend has a profound effect on the state's coastal resources. The impacts of coastal development have altered perceptively the quality and character of the nearshore environment. Marine-related industry—especially, rapidly growing tourism and marine recreation—places demands upon the environment as well. Offshore commercial fishing and Bay shellfishing are important factors in the state's economy.

With all the activity on and around the Bay, and with constantly changing demands on coastal areas, the Sea Grant Program provides a unique resource for providing solutions to problems on the local level as well as management implications on the national level.



WHAT IS SEA GRANT?

The National Sea Grant Program is a partnership between government, universities, and industry that was created in 1966 to increase scientific understanding of the oceans and coastal waters, improve management of marine resources, and promote development of marine products.

It consists of research, education, and advisory services carried on primarily in 29 colleges and educational institutions across the country. It is administered by the National Oceanic and Atmospheric Administration (NOAA) in the Department of Commerce, which provides two-thirds of its annual budget, close to $40 million. The remainder is provided by matching funds from state and local governments and private industry.

The Sea Grant concept was born at a time when government leaders began to realize that in the race to be first in space our country had badly neglected ocean science. Meanwhile, the number of problems and questions concerning the ocean and its exploitation was growing daily. Pollution, coastal conflicts, a tottering fishing industry were only the most obvious. Who could solve these problems and answer the questions? They seemed too large and complex for any one group to tackle alone.

In 1963, an educator named Athelstan Spilhaus suggested publicly that government, universities, and industry work on the problems together. In his keynote address at the annual meeting of the American Fisheries Society, he asked, "Why do we not do what wise men had done for the better cultivation of the land a century ago? Why not have Sea Grant colleges?"

It was a persuasive idea. Land Grant colleges, established by the Morrill Act of 1862, had revolutionized higher education in the United States by creating a unique university-based system that combined education, research, and extension activities, and made us the world's leading agricultural nation.

Three years later, Spilhaus' suggestion was shaped into a program that the U.S. Congress passed as the National Sea Grant College and Program Act. President Lyndon B. Johnson signed it into law on October 15, 1966.

In the years since, university research supported by Sea Grant has greatly increased understanding of the basic ecology of the marine environment and has made possible wiser management and use of a vast resource. Aquaculture, fishing, and seafood processing are just three commercial fields that have advanced spectacularly.

SEA GRANT AT URI

The University of Rhode Island was named one of the first four Sea Grant colleges in 1971—a distinction based on "sustained excellence along a broad front of marine work."

URI's involvement with Sea Grant began much earlier. At the time the concept was beginning to take shape, the University was entering a new phase of its development. A growing number of the faculty and students had become interested in marine-related studies, and President Francis H. Horn strongly supported the growth of marine programs. In 1961, the Graduate School of Oceanography was established, building on the foundation of the earlier Marine Laboratory and Marine Resources Program. Its dean, John A. Knauss, recognized the potential of Sea Grant and found a strong legislative ally in Rhode Island Senator Claiborne Pell.

In 1965, seeing nationwide interest growing in the Sea Grant college idea, URI sponsored the first national Sea Grant conference. The following year, when the Pell-Rogers Sea Grant College and Program Act was introduced in Congress, the first day of Senate hearings was held at URI.

Having provided much of the impetus for the creation of Sea Grant, URI set out to broaden its curriculum to meet the mandate set forth by Congress: to accelerate the development of marine resources, their conservation, management and maximum social and economic use. The Department of Ocean Engineering was established at the University, as well as the Master of Marine Affairs program and a fisheries technology school. In addition, a growing number of marine research projects developed in formerly "landlocked" disciplines like geography, engineering, and resource economics.

As URI's marine expertise sharpened, the public in increasing numbers began to ask for answers to questions and solutions to problems. There was an obvious need for a formal extension division that could furnish information, technology, and research findings to the community. The Division of Marine Resources (recently changed to the Office of Marine Programs) was established to meet this need in 1975. Each of its two units—the Marine Advisory Service and the Coastal Resources Center—acts as a link between the academic community and the public and private sectors.

Marine Advisory personnel specialize in the pragmatic: commercial fishing, coastal use and recreation, marine education, and marine resource economics. They work directly with the public and, because of these contacts, are able to keep university scientists informed of current needs in applied marine research.

The Coastal Resources Center was established to provide technical assistance to the state's Coastal Resources Management Council. Its initial task was to help that body prepare a coastal management program for Rhode Island. With Sea Grant support, the Center has since become engaged in major university research projects such as a multidisciplinary study of coastal ponds and another of upper Narragansett Bay.

Sea Grant has also contributed to the URI Center for Ocean Management Studies, a forum for the exchange of ideas related to ocean policy on a regional, national, and international level.

The University has strong ties with the laboratories of two federal agencies based at the Narragansett Bay Campus—the Northeast Fisheries Center Laboratory of the National Marine Fisheries Service and the EPA's Environmental Research Laboratory—and has cooperated with them in several projects sponsored by Sea Grant.

The following pages present some of the recent research and advisory activities at URI Sea Grant. Most of the studies are related to the common goal of understanding, protecting, and enjoying the resources of Narragansett Bay and other coastal areas of the Ocean State.

The URI Salt Ponds Project

A chain of shallow salt ponds stretches for miles along Rhode Island's southern coast, narrowly separated from the sea by inlet-pierced barrier beaches. This salt pond or coastal lagoon region is one of the most beautiful in the state, and is historically one of the most productive. Due to their small size and limited exchange with offshore waters, coastal lagoons are particularly vulnerable to human-generated stress. They are dependent upon and sensitive to conditions on the shore and in the sea beyond. This narrow ribbon of land has been heavily developed over the past 30 years, and the environment has deteriorated. Fewer species of fish inhabit the area, shellfishing has diminished, oyster stocks are disappearing, and sand flats obstruct access to breachways. Polluted wells, rank summer algal blooms in the ponds, and closures of fishing areas herald the declining quality of the pond water and the groundwater that supplies thousands of wells in the region.

In 1977, concerned local officials and residents approached the state's Coastal Resources Management Council for help in identifying the problems and initiating possible remedial action. The Council, through its research arm, the Coastal Resources Center at The University of Rhode Island, has access to a broad range of expertise.

The effects of stress on the area are interdependent. It was therefore necessary to understand the history, marine biology, botany, geology, and hydrodynamics of the area to discover a remedy that would not worsen the situation. Sea Grant and the state's Coastal Zone Management Program agreed to fund an ambitious interdisciplinary project. In 1978, scientists in seven fields, their graduate students, and a dedicated group of citizen monitors set to work.

By 1983, it was possible to say what had been happening to the ponds and why. The studies showed that the building of permanent breachways and the accompanying periodic dredging had seriously harmed the area—although the initial rationale for the breachways had been to preserve the ecological quality of the ponds. Permanent access to the sea, though convenient to boaters, has had a deleterious effect on the fish and shellfish stocks it was intended to enhance. Changes in water circulation and salinity have discouraged spawning of many important species and encouraged invasion by oyster predators. The decline in fish and shellfish populations was attributable to a combination of altered habitat and overfishing. The breachways also allowed sand to be eroded from the ocean beaches and deposited in the ponds, forming sandbars that became obstacles for boaters.

The bacterially contaminated fresh water going into the ponds and into some residential wells, principally through surface runoff, is believed to come from homes with failing septic systems, from discharges of improperly treated sewage, and from the excrement of domestic animals.

Nutrient enrichment of the ponds, choking some of them with algae in summer, was also traced to residential development. Nitrogen-laden domestic wastes and the fertilizers used to beautify lawns leach into the groundwater, and thence into drinking water and the ponds.

The Coastal Resources Center completed a Special Area Management Plan to maintain the area's scenic quality, prevent further bacterial water pollution, keep drinking water potable, preserve and enhance the remaining fish and shellfish populations, restore, to whatever extent possible, the beaches, dunes, and wildlife habitats, and provide guidelines for hurricane preparedness.

The Coastal Resources Center has established a long-term citizens' monitoring scheme for Rhode Island's salt ponds conducted by volunteer local residents. The goals of the program are to promote active stewardship of the resource, to provide a long-term data base for parameters known to be useful indicators of the condition of the ponds, and to provide an early warning system

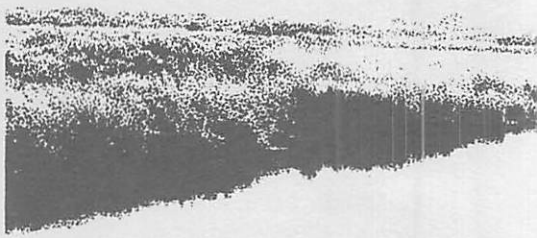
for new problems. The responsibility for the monitoring activities is now being transferred from the Center to the Pond Watchers themselves.

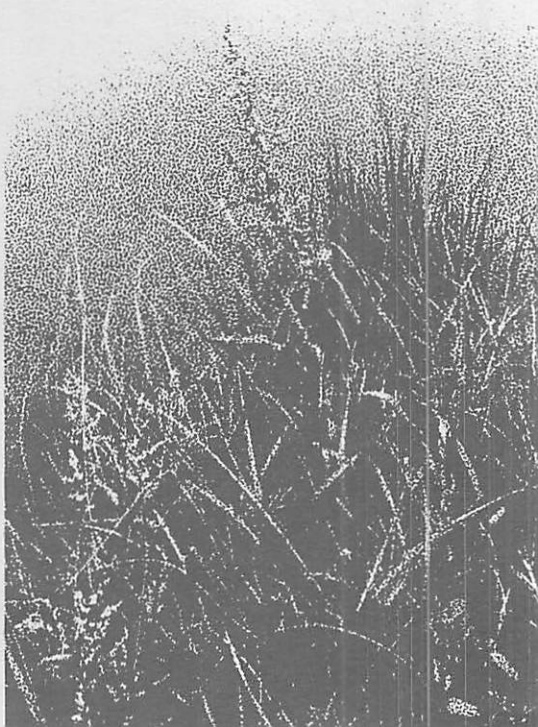
A coastal lagoon mesocosms project was designed to create replicate lagoons on a small scale for use in experimental ecosystem studies of nutrient inputs and eutrophication in shallow, high-salinity, temperate estuaries which are dominated by eelgrass and macroalgae. The danger of eutrophication in lagoons from nitrate-enriched groundwater discharge, clearly related to housing development, was indicated by the early pond studies. Construction of the mesocosms has been completed, and research is in progress on the effects of various levels of inorganic nitrogen input on the lagoons.

Individual sewage disposal systems are a major source of contamination to surface and groundwater in unsewered coastal regions. Nitrogen inputs can promote accelerated eutrophication in coastal ponds and estuaries and degrade drinking water sources. URI Sea Grant researchers are using replicated, small-scale disposal systems of different types to monitor the transformations and pathways of nitrogen in alternative and conventional septic systems, to isolate the specific environmental factors which affect nitrogen removal in each system, and to evaluate each system's potential for nitrogen control.

During the past 20 years, a large data base on shoreline changes to the southern barrier and bluff coastline of the state has been collected. Sea Grant investigators have synthesized these data into a format that is usable by coastal zone managers, planners, and other researchers. Current studies are focused on developing a regional sediment budget for the south shore that includes beaches, barriers, headlands, tidal delta and surge platform lagoons, and shoreface. It is important not only to understand shoreline dynamics but to learn where sediments and sand originate and where they are deposited.

While the URI Sea Grant studies have provided valuable tools for assessing and protecting our coastal resources, they have also left a clear message: if the residents of one of the state's loveliest areas want to keep what they have, they will need to show a rare degree of responsibility as dwellers on the land and a rare amount of support for the efforts of town governments to ease the pressures on it. By the same token, town government and state agencies must agree on management objectives and cooperate with one another in their role as guardians of the ecosystem.





Numerical Modeling of Tidal Circulation

Since 1969 URI ocean engineers funded by Sea Grant have used computer modeling to simulate and predict patterns of water circulation and pollutant transport in ponds, bays, and open ocean areas. The models can be used to compute tidal heights, currents, temperature, salinity, and water quality. With their predictive ability, these simulations can solve important marine problems, such as the selection of oil-drilling sites that will not interfere with whale migration.

URI's efforts in modeling have been guided over the years by Dr. Frank White, an ocean engineer whose first love is the physics of water motion. One of his early students, Dr. Malcolm Spaulding, is, as White says, "our real expert." Professors White and Spaulding have provided Rhode Island and New England with computer models to answer pressing questions on the marine environment.

White first began modeling in 1969, when he modeled circulation patterns in Point Judith Harbor. The model, verified through a series of experiments, plainly demonstrated the flow of tides into one breachway opening and out the other during slack conditions.

In 1972, a model of Narragansett Bay was designed. It provided information on tidal flows and flushing times. It too was verified through an experimental program, Bay Watch. The model computed hurricane surges and flooding in the Bay, flushing times, and paths of drifting particles. In 1973 the ocean engineers developed a model that depicted the movement of an oil spill—a precursor of the state's contingency plan for spill cleanups. It was designed so that new information, as it became available, could be incorporated into the simulation.

From this hydrodynamic model, Drs. Jim Kremer and Scott Nixon of the URI Graduate School of Oceanography developed an ecological system of the Bay which synthesized much of the available data on phytoplankton, zooplankton, and nutrients and could depict major variations in these components. Among other applications, the model has been used to predict the effects of changes in sewage outflow.

Dr. Spaulding has recently developed a complex three-dimensional technique to tackle a variety of complicated marine problems. To determine the impacts of oil spills on commercial fisheries, for instance, three independent models were integrated into a single system—oil spill fates, hydrodynamic patterns, and impacts on the fisheries.

Dynamics of Secondary Production

In studies aimed at defining the ecological basis for the high biological productivity of estuaries, researchers have investigated the effects of the environment on estuarine zooplankton and the growth, survival, and food habits of winter flounder. Predation and other biological factors controlling the distribution and abundance of species within an ecosystem may be difficult to define until the boundaries set by physical and chemical factors are known. Determination of the physical bounds of the dominant zooplankton in Narragansett Bay has important management implications, as well as relevance to the studies of winter flounder—which, as the most abundant demersal fish in the Bay, supports a major commercial fishery. Relatively little information exists on the factors governing the recruitment of the flounder. Survivorship in larval stages is believed to have a major impact upon year class strength and eventual yield to the commercial fishery. These studies have been integrated with other work related to the environmental quality of Narragansett Bay.

Comparative Studies of Estuarine Management

Three innovative companion projects are directed at assessing governance methods and policies in four major estuaries. The ultimate goal of the projects is to prepare a primer for estuarine management.

The estuaries being assessed for trends in waste disposal, water quality, fisheries, recreational and residential uses, economic activity and port development are Narragansett Bay, Delaware Bay, San Francisco Bay, and Galveston Bay. The governance systems and their impact on the estuaries are systematically evaluated. This evaluation is timely because more than a decade has elapsed since major environmental programs were launched in the early 1970s, providing a suitable period for an implementation assessment. Interest is reviving in holistic approaches to the management of estuaries. Under consideration also are the perceptions of constituent user groups as to the overall quality of the estuaries, and the congruency of these perceptions with those of resource managers. The results of these projects will provide valuable insights into how well the governance systems currently function and how they might be improved.

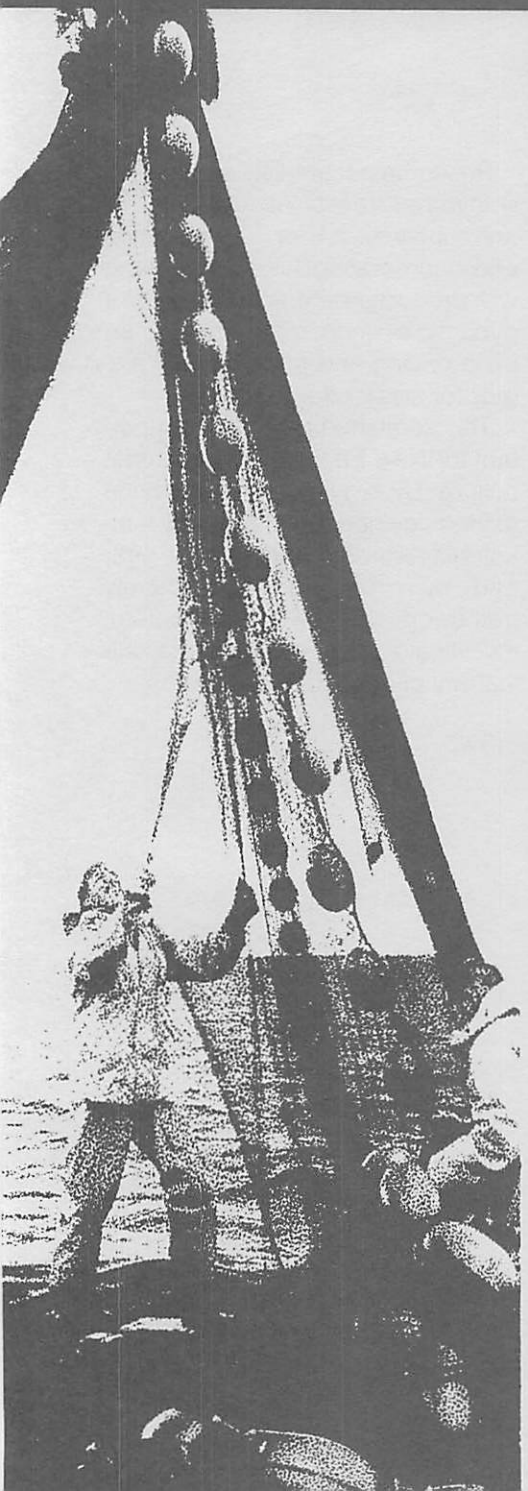
Atlantic Salmon

The demand for Atlantic salmon (*Salmo salar*) has been increasing at a greater rate than has the supply. This trend has resulted in the development of aquaculture programs, and the Atlantic salmon has been responding favorably. Norway has an especially successful system of pen-rearing salmon. The United States and Canada are attempting to develop similar aquaculture programs and capture some of the regional and national market before it is lost to foreign competitors. Research at URI funded by Sea Grant addressed this issue from both a biological and an economics vantage point.

Biologists are concerned with several aspects of salmon development. A sensitive test is being developed to assess smoltification in order to reduce mortality caused by premature introduction to seawater. The effects of photoperiod manipulation (that is, changing the amount of time an organism is exposed to light) as a means of altering the time of smoltification to allow multiple introductions of juvenile salmon to seawater is under examination. Advances in endocrine technology are being pursued to accelerate the growth rate of salmon, and a comparison of smoltification-related endocrine changes of salmon in hatcheries to those in their natural habitat is in progress.

Resource economists are currently involved in estimating a demand and supply system for Atlantic salmon and incorporating this system, along with production characteristics, into a dynamic economic model to determine pricing and production strategies for aquacultural firms.

This combined research is important for New England salmon aquaculture. By providing the endocrine technology needed to produce marketable salmon throughout the year and by providing an economic framework within which to operate, investigators hope to assure the viability of aquaculture ventures.



MARINE ADVISORY SERVICE

Activities of the Rhode Island Marine Advisory Service are vital to the wise future use of the nearshore marine environment of Rhode Island.

In the area of commercial fisheries, aquaculture, and seafood marketing, Advisory Service staff worked with local fishermen on projects to introduce innovative gear technology, to improve on-board fish quality with modern cooling systems, and to increase fishing vessel safety. Seafood marketing programs were geared toward developing efficient methods of fresh fish distribution to access new inland markets, developing underutilized species, and employing new technologies for new products through processing, packaging, and marketing. The Marine Advisory Service was instrumental in producing the *Seafood Trucking Guide* and, later, the *Seafood Shipping Guide*, directories of trucking and airline companies involved in the transport of seafood. Resource economists worked with the Advisory Service to study the benefits of extending the shelf life of fresh cod, flounder, and scallops and to prepare the publication *The State of Atlantic Salmon Aquaculture.*

Rhode Island recreation and conservation strategies identify three issues critical to meeting future marine recreation needs: expanding public access to the shore; maintaining the quality of the recreational experience at Rhode Island beaches; and preserving sufficient shoreside facilities to satisfy boating needs.

Other programs over the past few years have focused on recreational boating and sportfishing. The Advisory Service coordinated a workshop for Sea Grant and boating industry representatives, hosted a welding-skills workshop for local boatyard workers, and conducted a nationwide inventory of recreational boating facilities. Staff members organized and presented a five-day marina and boatyard management seminar series, which provided information on marina law and risk management, coastal permit processes, boating markets, computer software for marina businesses, and strategies for renting, leasing, and selling slips.

The cooperation of Advisory Service staff with the local marine community is essential and often rewarding. In 1985 a local sailboat manufacturer approached the Advisory Service with a gel-coat "blistering" problem. Researchers in the Department of Chemical Engineering are progressing with their efforts to identify materials and procedures that will improve blister resistance.

The Rhode Island Marine Advisory Service welcomes the opportunity to interact in a constructive fashion with the user community, and recognizes a common need to solve marine-related problems and enhance Rhode Island's beautiful and productive coastal environment.

PROGRAM DEVELOPMENT

One of the unique features of Sea Grant is that it provides resources for stimulating new research directions at the University by making available "seed money" for innovative projects that may later grow into full-scale Sea Grant research. The seed money funds also give Sea Grant the capability for rapid response to problems as they arise.

For example, development funds were used for a cooperative study with the New York Sea Grant Institute and the Woods Hole Oceanographic Institution Sea Grant Program to study the brown tide phenomenon which has plagued southern New England coastal waters for the past two summers.

Program Development has encompassed a wide range of activities over the past few years. Funds were provided to initiate promising new research efforts, to augment research budgets, to defray publication costs, and to provide much-needed equipment to the Rhode Island Sea Grant community.

Among the research projects supported in full or in part by development funds were: "An Oral History of Fishing in Newport, Rhode Island," "Canadian-U.S. Groundfish and Scallop Import Flow," "Population Dynamics of Kelp (*Laminaria* spp.) in Narragansett Bay," and "Physical Factors Affecting the Textural Hardening of Minced Washed Fish Meat During Frozen Storage." Three projects that were initiated with development funds are being continued; these deal with fish oils and public health, predation by *Crangon septemspinosa* in Narragansett Bay, and Narragansett Bay sediments.

A decline in the landings of traditional species has altered the economics of southern New England fisheries. Several species have the potential to improve the value of Rhode Island landings. Developing a market for these species to stimulate Rhode Island's fishing and processing industries and make high-quality, moderately priced fish available to the consumer led to a project investigating the utilization and consumer acceptance of red hake in the area.

The increased demand for fresh fish among U.S. consumers creates a need for development of long-term, economically feasible fresh fish preservation techniques, beginning at the point of harvest. The project "Efficacy of Glucose Oxidase for Preservation of Seafood" addressed this issue, and is one of several biotechnological projects related to seafood.

Contributions from discretionary funds resulted in the publication of a diversity of materials. Sea Grant sponsored, in part, the tenth and final volume of the *Marine Affairs Journal*, as well as the inaugural issue of the journal *Marine Resource Economics*. "Freshwater and Marine Plants of Rhode Island," a series of papers prepared for *Rhodora*, was also supported in part by development funds.

The Center for Ocean Management Studies (COMS), with partial Sea Grant support, recently conducted a conference on the issue of fisheries management and the exclusive economic zone. The COMS conference stimulated discussion on a number of alternatives to present management systems. The Center has also continued to enlarge its depository of information on the EEZ, which is available to student and faculty scholars, members of private industry, environmental groups, and the interested public.

Program development funds were used to co-sponsor, with the Rhode Island Department of Environmental Management and the U.S. Environmental Protection Agency, the Narragansett Bay Symposium. The symposium featured a multidisciplinary approach to examining the state of knowledge of Narragansett Bay.

A Seminar Fund was recently created to provide travel expenses and an honorarium for speakers of interest to the marine community.

A Sea Grant Teacher Education Program was designed for middle, junior high, and high school teachers to familiarize them with Rhode Island's coastal ecology and to provide them with activities for the classroom and for field trips.

For information regarding the Rhode Island Sea Grant Program or any of our projects, please contact:

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