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Marine Research and Outreach Priorities

Revised Program Plan
2000 ■ 2005

Rhode Island Sea Grant
College Program





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**Rhode Island Sea Grant
Marine Research and Outreach Priorities**

Program Plan: 2000-2005

**Rhode Island Sea Grant College Program
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Introduction

The Rhode Island Sea Grant *Program Plan: 2000-2005—Marine Research and Outreach Priorities* is a revised and updated version of our first program plan, which was issued in March 1997. It will serve as an important basis for developing the next two omnibus proposals. Implementation strategies for this program plan will be delineated in separate implementation plans, the first of which will be issued in late 2000 and will cover the two years of the next omnibus proposal, 2001 to 2003.

Rhode Island Sea Grant recognizes the value of strategic planning for clarifying program goals and developing the research and outreach projects most likely to attain those goals. The program must continually make strategic decisions on how best to act on national coastal science and management imperatives established by Congress, the National Oceanic and Atmospheric Administration (NOAA), and the National Sea Grant Office (NSGO) within the unique contexts of Rhode Island and southern New England. This program plan, and the forthcoming implementation plans, will guide and inform Rhode Island Sea Grant's strategic short- and long-term decision-making. These plans must also support the evaluation of existing and proposed program activities and projects, and facilitate timely, appropriate responses to changing institutional contexts (a new Rhode Island governor, a new president, shifts in congressional priorities) and unforeseen events (a major oil spill, a hurricane).

The Rhode Island Sea Grant *Program Plan: 2000-2005—Marine Research and Outreach Priorities* has a modest educational purpose as well. It summarizes the major concerns that many scientists, managers, and resource users express regarding Rhode Island marine waters and their uses. And it briefly describes the organizational structure of Rhode Island Sea Grant and the administrative processes used to carry out the Sea Grant mission in Rhode Island and around the nation.

In conjunction with its two-year omnibus proposal cycle, Rhode Island Sea Grant must review its program plan biannually, with the next major revision planned for the late 2003. An implementation plan must accompany each omnibus proposal. This schedule of strategic and implementation planning complies with NSGO requirements for strategic and implementation planning.

We continually seek input and advice from the citizens of Rhode Island and the Northeast on how Rhode Island Sea Grant can better serve its diverse constituents. Please contact us about anything you find in this program plan that you have questions or comments on. We look forward to working with you in the new millennium.

Ames B. Colt, Ph.D.
Interim Director

Mission Statement

Rhode Island Sea Grant designs and implements research and outreach programs that:

- **Conserve and restore Rhode Island coastal waters, watersheds, and historic coastal communities.**
- **Foster sustainable community-based economic development in Rhode Island, the Northeast, and the United States, with particular concern for marine recreation and tourism, marine fisheries and aquaculture, marine trades, marine transportation, and marine technology development and commercialization.**

The Ocean State

Introduction

Rhode Island is the Ocean State. All Rhode Islanders live within a 30-minute drive to the Atlantic Ocean or Narragansett Bay. Two-thirds of Rhode Island's residents live in the state's 21 coastal municipalities. The Bay, the south shore salt ponds, and Rhode Island Sound not only define the state geographically, they have governed Rhode Island's history, and will always be essential to the well being of the state.

Narragansett Bay is a well-mixed, heavily indented estuary about 147 square miles in size, running north about 40 miles from the Atlantic Ocean to the capital city of Providence (Figure 1). A chain of shallow coastal lagoons lies along the state's south shore fronted by sandy barrier islands. Rhode Island's 400 miles of diverse coastline offer 75 miles of sandy beaches, 2,800 acres of salt marsh, 4,400 acres of tidal flats, pristine waterfowl and fishery habitats, unsullied rocky shorelines, historic urban waterfronts, 30 major harbors, and over 85 marinas.

Upper Narragansett Bay is dominated by historic, densely developed urban centers (Figure 2). The southern half of Rhode Island offers pristine rural coastlines and world-class fishing and boating opportunities. Approximately 25 percent of the Narragansett Bay coastline is lined with manmade features such as piers, marinas, bulkheads, and sea walls. About 1.8 million people occupy Narragansett Bay's densely developed watershed—about half in Rhode Island and half in Massachusetts—averaging about 1,100 people per square mile (Figure 3). In contrast, neighboring Buzzards Bay in southeastern Massachusetts averages only several hundred people per square mile of its watershed.

The Rhode Island Marine Science Community

Rhode Island estuaries, embayments, and salt ponds are some of the best studied marine ecosystems in the world, due largely to the dedication of scientists affiliated with the University of Rhode Island (URI) and other institutions of higher education in the state and in southern New England. The URI commitment to marine science and policy dates back to the establishment of the Narragansett Marine Laboratory in the mid-1930s. In 1961, the university formally established its Graduate School of Oceanography (GSO), where Rhode Island Sea Grant is currently housed. The GSO was designated a Center of Excellence in coastal marine studies in 1989 by the NOAA. The National Research Council ranks the GSO Ph.D. program as one of the best in the country and fifth among oceanographic institutions.

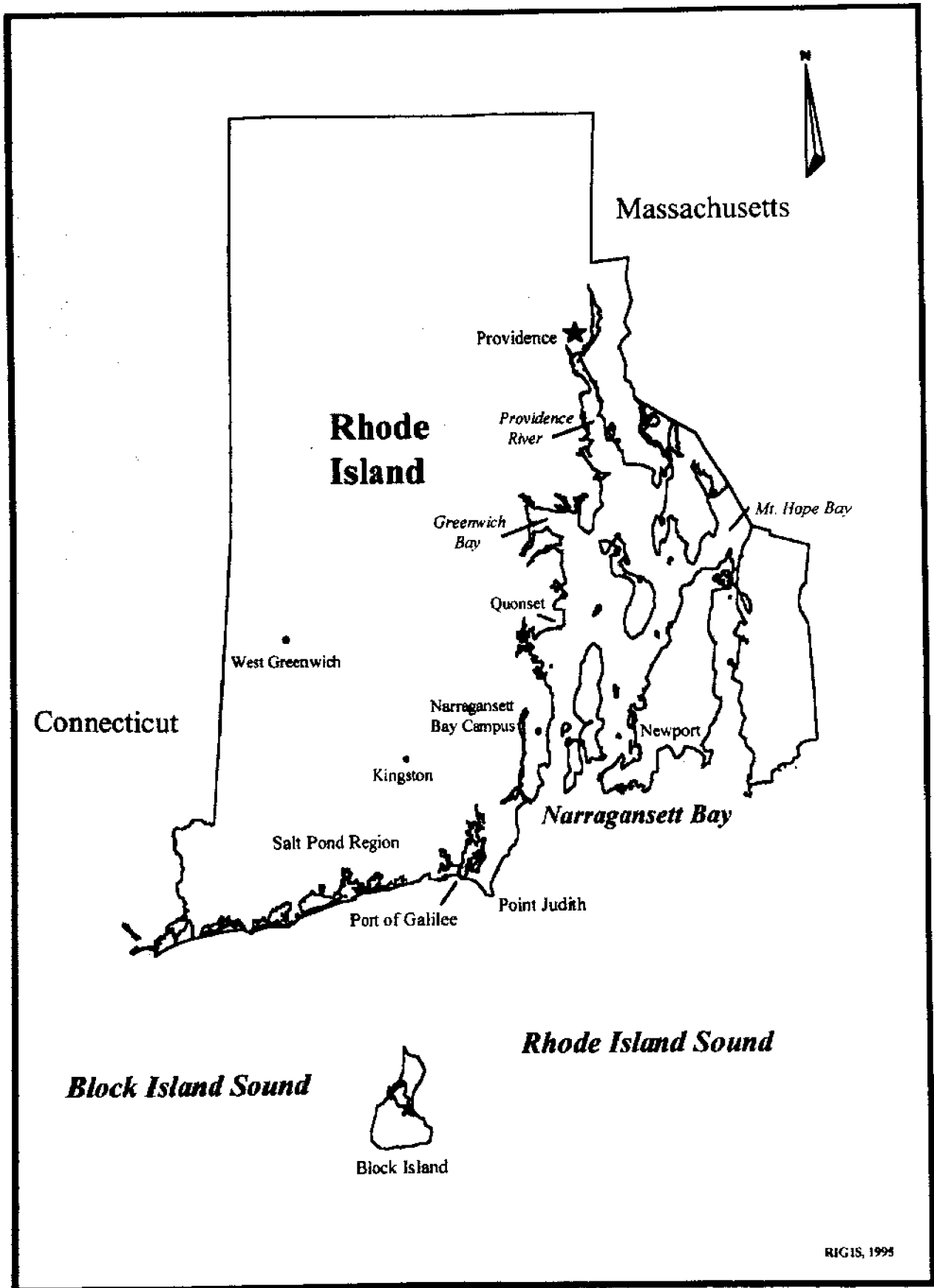


Figure 1. Location map of Rhode Island.

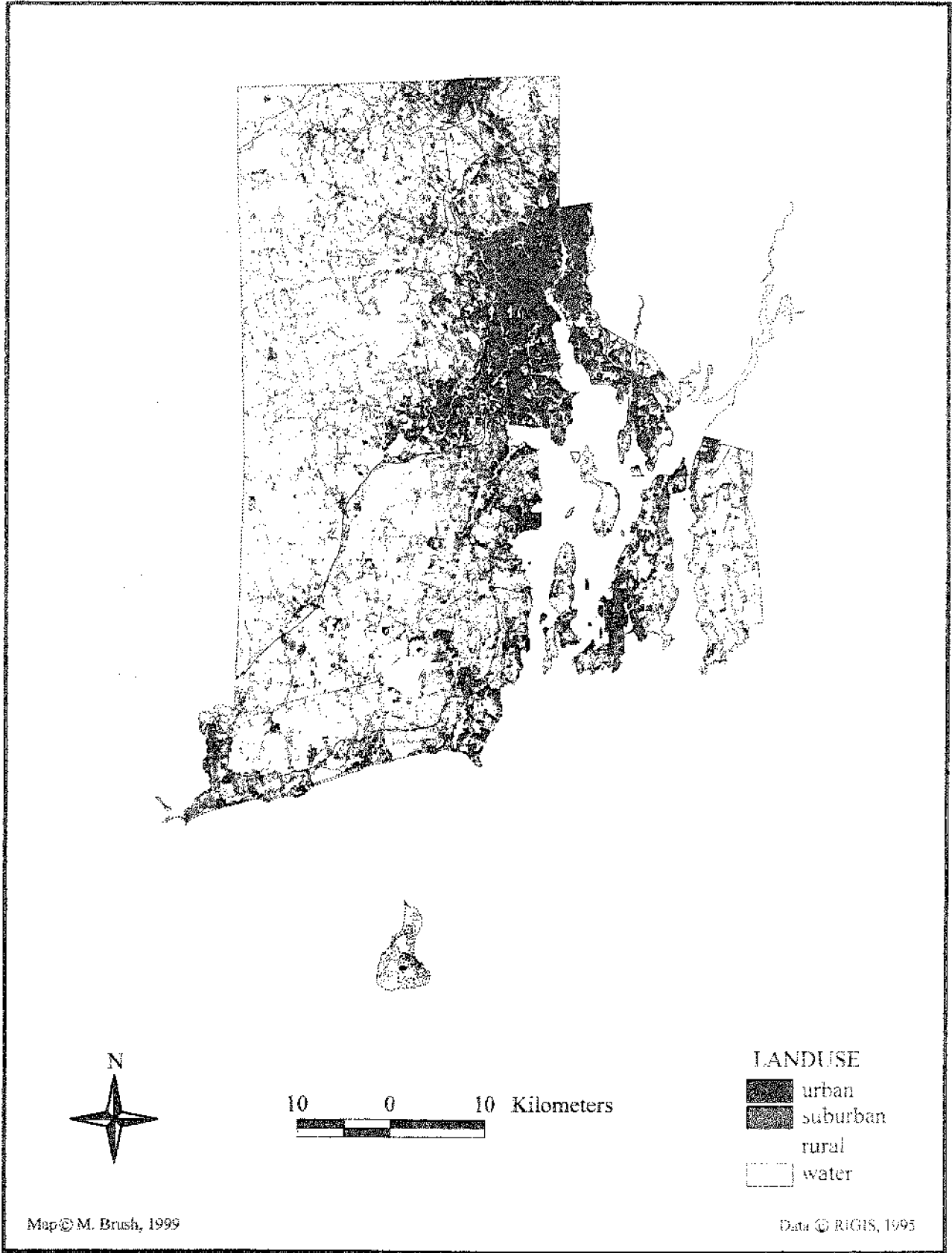


Figure 2. Major land use designations of Rhode Island.

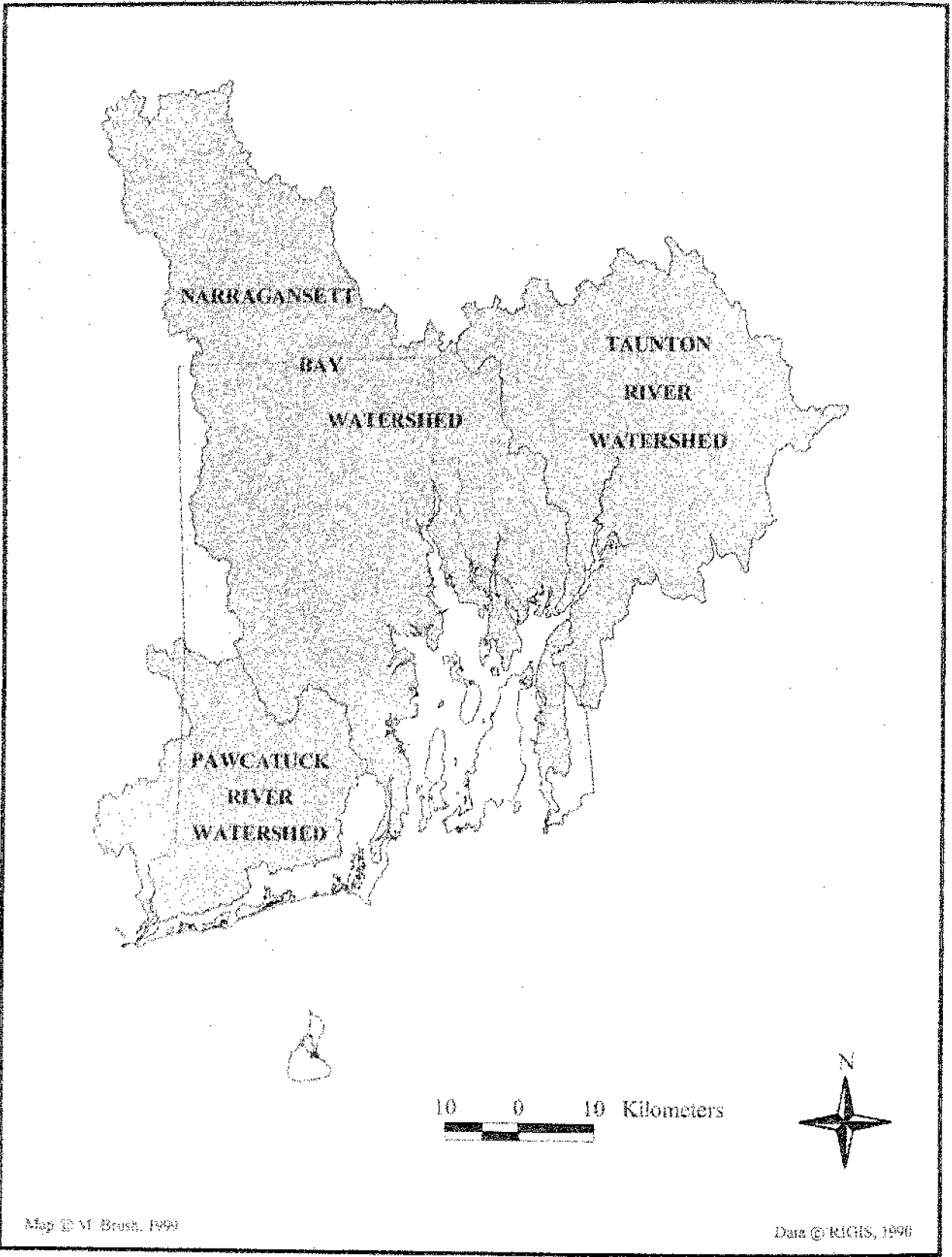


Figure 3. Major watersheds of Rhode Island.

The GSO shares its 165-acre waterfront campus with other institutions of marine science and management, including the URI Coastal Resources Center (CRC), department of ocean engineering (based in the College of Engineering), and Coastal Institute; the U.S. Environmental Protection Agency (EPA) Atlantic Ecology Division National Health and Environmental Effects Research Laboratory; the NOAA National Marine Fisheries Service (NMFS) Narragansett Laboratory; and the Pell Marine Science Library (home of the National Sea Grant Depository).

Rhode Island Sea Grant's future research mission is integrated closely with the priorities and capabilities of the GSO and other major research institutions in the state, such as Brown University, Roger Williams University, and the Narragansett Bay National Estuarine Research Reserve (NERR). Continued advances in scientific understanding of marine and coastal environments depend on the accomplishments of the past. A conference organized by Rhode Island Sea Grant in January 2000 to discuss previous and current research in Narragansett Bay revealed to many attendees that it is only now becoming possible to assemble a reasonably comprehensive and scientifically accurate picture of the Bay's major physical, chemical, and biological components and functions, its physical and ecological links to large scale oceanographic and climatological systems, and major long-term trends of critical importance such as sea level rise. Thus, the scientific data and knowledge painstakingly assembled over the past century for Narragansett Bay and other Rhode Island marine waters serve as an irreplaceable foundation for advancing the marine sciences for the good not only of Rhode Islanders, but also for all who depend on and value the health and vitality of Earth's coastal and marine resources.

University of Rhode Island's Marine Programs

"The University of Rhode Island has developed one of the strongest and most diverse marine programs in the country. The linkage of terrestrial and coastal elements with marine elements has allowed faculty and students to be at the forefront of integrated approaches to marine problems that recognize the importance of watersheds and airsheds to the health of the marine environment. Linking policy, management, economics, planning, and design with science will enable the University of Rhode Island to lead initiatives in integrated coastal and marine management worldwide."

—Margaret Leinen,
Assistant Director of the National Science
Foundation for Geosciences,
Former Vice Provost for URI Marine Programs

Rhode Island needs prudent, integrated research and management strategies to address the challenges of overexploitation, contamination, and restoration, and to achieve an equitable balance of the diverse uses of its coastal and marine resources. As an integral part of Rhode Island's extensive community of marine scientists and managers, Rhode Island Sea Grant will continue to work toward meeting these needs. To contextualize Rhode Island Sea Grant's strategic goals and objectives, the following sections review briefly the issues and trends in economic development—emphasizing the marine economic sectors and the principles of sustainable development—marine environmental management, and marine science specific to Rhode Island and southern New England.

Rhode Island's Economy

In 1996, the Rhode Island economy generated \$25.6 billion in gross state product and supported 441,000 jobs. In terms of employment, the three leading industrial sectors in Rhode Island were health services, tourism and travel, and manufacturing. In 1997, Rhode Island's per capita personal income ranked 16th in the nation at about \$25,600, well below personal income rates in the neighboring states of Connecticut and Massachusetts (about \$30,000). Overall, Rhode Island maintained pace with the strong growth of the U.S. economy in the 1990s. Unemployment rates fell by half through the 1990s, from a peak of 9 percent in 1992 to 4.5 percent in 1998.

In the next decade, Rhode Island faces significant challenges in maintaining and enhancing its economic well being. The Rhode Island economy has undergone a massive structural transformation from a manufacturing to a services economy as the state's manufacturers have steadily shed jobs annually since 1984. Leonard Lardaro, URI economics professor, reports that:

"In 1987, manufacturing employment for Rhode Island was surpassed by . . . service employment, marking its transition from a manufacturing-based economy to one based upon information and services. Ever since this major structural change, a series of negative structural factors have combined with the usual business cycle (i.e., cyclical) forces to alter economic activity in Rhode Island, at times making [the '90s recovery] appear . . . very slow."

In other words, negative forces generated by the long-term transformation of Rhode Island's economy dampened the state's economic growth in the 1990s. Service sector employment in the state now stands at about 160,000 and manufacturing employment at 80,000. Most politicians and economists agree that the major sources of employment in Rhode Island will continue to be in the services economy. As of 1998, health services provided about 50,000 jobs; finance, insurance, and real estate about 28,000; and wholesale and retail trade about 99,000. Eating and drinking establishments employ about 29,000—the second largest single service sector (after health services) in terms of employment, underscoring the importance of tourism to the economy. Tourism and travel now generate over \$2.5 billion in annual sales.

Another critical labor trend is the rapid rise in the number of Rhode Islanders employed out-of-state. In 1996, 16,100 more Rhode Islanders were working than in 1995, an encouraging increase. However, the total number of jobs based *within* Rhode Island increased by only 1,700 during 1996, indicating that about 90 percent of the job growth that year occurred in the neighboring states of Connecticut and Massachusetts. Out-of-state employment continued to grow through the latter half of the 1990s (Lardaro, 1999). Arguably, Rhode Island's small size and proximity to the robust Massachusetts economy, in particular, makes reliance on out-of-state employers inevitable. Integration of southern New England labor markets will continue as improved rail service connections among Providence, Fall River, and Boston are completed over the next 10 years.

While reliance on out-of-state employment obviously enriches individual jobholders and their families, it is not a healthy economic development trend for the state. At the least, it deprives the state of the benefits of growing, healthy companies located in-state, (i.e., corporate tax revenues) as well as other forms of economic development and vitality produced by in-state job growth. A fundamental challenge facing Rhode Islanders, then, is to nurture in-state economic development.

The R.I. Economic Policy Council (RIEPC) recommendations for meeting this challenge include the following:

- Develop new products, adopt new production technologies, increase exports, and enter growing, high value-added industries.
- Preserve and improve the quality of life currently enjoyed by Rhode Island residents, including maintaining a clean and attractive environment.
- Encourage public-private partnerships that will quicken and direct economic development.

The RIEPC attached great value to the quality of life factors offered by Rhode Island, including environmental and recreational amenities, competitive state and local tax burdens, affordable real estate, and a modernized transportation infrastructure. For decades, Rhode Islanders have been strongly committed to preserving the state's coastal and marine environments by ensuring that development projects are sustainable and ecologically sound and that irreplaceable resources are appropriately preserved and protected. Organizations and individuals considering relocation or business expansion in the state place tremendous value upon the quality of life benefits provided by Rhode Island's coastal environment and communities.

Rhode Island's Marine Economy

The transformation to a services and knowledge management economy and the imperative for greater in-state economic development underscore the importance of sustainable marine resource utilization and healthy coastal environments in Rhode Island. Marine recreation and tourism has been important to Rhode Island at least since the late 19th century—Newport proudly terms

itself "America's First Resort." Rhode Islanders appreciate the need to preserve and enhance that which attracts visitors to their state. The recent emergence of Providence as a tourist destination exemplifies the continued potential of Rhode Island's historic urban centers for redevelopment and revitalization. Continued growth in the tourism and travel industry is expected in Providence with the opening in 2002 of the Heritage Harbor Museum, a Smithsonian Institute affiliate, and the construction of new hotels in the city's core.

Perhaps less appreciated around the state is the potential for vigorous economic development within Rhode Island's other marine economic sectors to help replace the economic activity and diversification lost by the continued erosion of the state's traditional manufacturing sectors. Rhode Island's marine economy is already substantial as well as unique. Economists

Rhode Islanders' Commitment to the Bay: Public Responses to the 1996 North Cape Oil Spill

The following is excerpted from a column written by Thomas Morgan for the *Providence Journal-Bulletin* soon after the January 1996 North Cape spill.

Like pilgrims to a shrine they came, some slogging a mile through the soft sand of Browning Beach to a waist-high stretch of yellow tape, where they stood reverently and listened to the hiss of the surf and the call of the gulls and the throb of the diesels. For a week they tramped the sands, to keep watch over the salvage operations on neighboring Moonstone Beach, where the tug *Scandia* and the oil barge *North Cape* had run hard aground on Rhode Island's psyche. As workers planted booms and sopped up visible oil, scientists watched, and Rhode Island brooded for a week.

Were the tons of twitching, cast-up marine animals the final act, or would lethal tendrils of petroleum chemistry slide down the water column to commit further atrocity? The state early on closed off a wide swath of Block Island Sound to fishing. Lobster boats could not lift their pots through the contaminated water. Offshore lobstermen, whose catch remained untainted, could not bring it to port because seawater is pumped constantly through their tanks to keep the catch alive.

The focus now is on the future. Shallow draft tugs and tows have replaced ocean-going tankers in Narragansett Bay for a number of reasons, the primary ones being economics and the silting up of the shipping channel. Such realities contributed to a growing sense of public outrage as the week played out.

Pitching in to help clean Charlestown Pond, fisherman and boater Vincent Lanna summed up the feelings of many Rhode Islanders who love the South County shore and were wrenched by the spill: "There's so much that's enjoyable in that pond. All you have to do is sit down there and watch the sunsets and it's better than any Valium that you can prescribe. To think that oil may kill all of that, that's just disturbing."

Newport hotel executive Jon Coned said in a commentary on Thursday that government at all levels must stiffen regulations governing oil transport, including the use of double-hulled vessels, although he conceded that "the risk will always be there."

Over on Browning Beach, as salvors grappled with the *North Cape*, Kate Kavanaugh of Providence and Rehoboth spoke with her son, Ron Tremper, 11, a solemn fifth grader at the Beckwith School in Rehoboth.

To Kavanaugh, this virtually is home. Her mother owns a beach cottage just a mile or so from the grounding. "This was a great place to grow up," Kavanaugh said. "I spent every summer here since I was born. It's so sad."

"We brought the kids because it's something my son should see," Ron clutched a starfish, and when he spoke he did so quietly but firmly. "I think it's sad that all these animals are dying, suffering from the poison in the oil," he said. He said he would take the starfish to school.

working for the Narragansett Bay Project (now the Narragansett Bay Estuary Program) estimated that in 1989, activities associated with Narragansett Bay produced \$1.6 billion in annual revenues (1982 to 1984 dollars). Table 1 summarizes more recent estimates by Timothy Tyrrell, URI economist, and his colleagues.

Table 1. Estimated economic values (in thousands of 1994 dollars) and jobs derived from Narragansett Bay resources* (from Tyrrell et al., 1994).

Bay-Related Industry		
	Jobs	8,036
	Wages	\$167,431
Bay-Related Tourism		
	Jobs	15,526
	Wages	\$83,651
	Revenues	\$390,748
Commercial Fish Landings		\$23,878
Total Property Values in Bay Communities		\$39,890,849
Bay Recreation: State & Local Facilities		
	Visitors	1,379,481
	Revenues	\$2,190
	Wages	\$1,309
Recreational Fishing		\$120,000
Academic Research and State Regulation (Total Budgets)		\$38,161

*Note: With regard to interpreting these data, the authors state: "These estimates cannot be totaled to represent the overall net value of Narragansett Bay. Adding together the different measures of value would entail double-counting of certain values."

Two of the sectors that strongly influence the marine economy are boat building and marinas and marine recreation and tourism. Rhode Island's boat builders enjoy a worldwide reputation as providers of high-value, technologically advanced boats. According to the RIEPC, they are particularly strong in the market for 26-foot to 90-foot sailboats and high-end custom cruisers and powerboats. The sailing environment offered in Rhode Island coastal waters and climate nurtures the boat building industry, marinas, and other support facilities; and numerous national and international yachting events are hosted by Rhode Island every year. As a consequence, Rhode Island waters support some of the highest concentrations of recreational boaters in the world. (Boat registrations in Rhode Island reached 35,000 in 1998.) Approximately 35 boat building companies are based in Rhode Island—most are concentrated in the towns of Bristol, Warren, Portsmouth, and Middletown—with total industry employment ranging between 1,500 and 2,000. In the five years following the repeal of the federal luxury tax on boats in 1992, Rhode Island boat builders enjoyed a 52 percent sales increase with annual sales topping \$121 million in 1997.

The Rhode Island boat builders' competition in high-end yacht production is based in the Northeast, particularly Maine. Rhode Island boat builders have done well in this market as the

industry has switched over to flexible production techniques. The RIEPC reports that the boat-building industry has shifted over the last two decades with product design changes becoming quite frequent. As one builder has commented, "We are absolutely a fashion industry." People want more features, and, consequently, boats are becoming more costly. Another participant observed that more design changes have occurred in the last 20 years than in the entire history of boat building. In fact, it is this rapid change in design that has been responsible for avoiding competition from low-wage countries, which are unable to constantly develop new, faster designs. As a result, Rhode Island appears to gain its competitive edge both from high-quality construction and high-quality design and/or frequent design changes.

Tourism and recreation in Rhode Island is booming. Sales have increased steadily since 1996, and by 1998, tourism supported 33,000 jobs and more than \$500 million in full-time wages, according to the R.I. Tourism Division. Comparison of Tyrrell's estimates (Table 1) with overall state numbers indicates that at least half of the tourism and travel activity is tied directly to coastal or marine resources. Coastal tourism is a complex economic sector that includes the activities of restaurants, charter boat operations, hotels, travel facilities, marinas, seasonal rental properties, and more. Many of Rhode Island Sea Grant's outreach activities have indirectly produced substantial benefits for the Rhode Island tourism and travel industry.

A number of issues and initiatives have emerged in the late 1990s that bode well for the Rhode Island marine economy and are directly related to the Rhode Island Sea Grant mission:

- Revitalization of Providence's urban waterfront via Waterplace Park.
- Port and waterfront development initiatives at Quonset Point and Providence.
- Increased recreational and other water-dependent uses in upper Narragansett Bay.
- Strong growth in tourism and travel revenues through the 1990s.
- Revival of Rhode Island's boat building industry in the last seven years.
- Commercial fisheries and seafood processors with strong seafood export sales. (Rhode Island seafood processors generate 45 percent of New England seafood export sales.)
- State-led initiatives to redevelop the commercial fishing port of Galilee at Point Judith.
- The launching in 1999 of two major aquaculture operations, a land-based finfish grow-out facility and a shellfish seed culture operation.
- Increased efforts at aquatic habitat restoration via Rhode Island Sea Grant's Greenwich Bay Initiative and other embayment management and restoration initiatives.
- Approval and initial implementation in 1999 of the Narragansett Bay Commission's comprehensive, multi-decade combined sewer overflow abatement project for the Providence metropolitan region (construction to begin in mid-2001).
- Planned or potential upgrades to the Narragansett Bay Commission's Bucklin Point Wastewater Treatment Plant (WWTP) and other state WWTPs to control nutrient discharges.
- Increased public access to the Rhode Island coastal shoreline as overseen by the R.I. Coastal Resources Management Council (CRMC).
- Growing marine education resources with new educational centers planned or under construction by Save The Bay, the Audubon Society of Rhode Island, and the New England Aquarium.

- Integrated coastal management and land preservation initiatives on Aquidneck Island and Washington County.
- Increased collaboration between scientists actively studying Narragansett Bay and other Rhode Island waters.
- Emerging capabilities and initiatives to restore coastal habitats and living marine resources.
- New greenway corridors opened or being planned.
- The continued development of the Blackstone River Valley National Heritage Corridor.
- Expanded natural hazard mitigation planning and implementation by municipalities.
- Major state-wide land preservation initiatives spearheaded by the Nature Conservancy.

Rhode Island Sea Grant support for a sustainable marine economy in Rhode Island and beyond will continue to emerge from its commitment to science and outreach projects that collaborate across disciplines and link the science and management of Rhode Island watersheds and waters. Rhode Island Sea Grant considers its critical mission areas to be:

- Interdisciplinary Ocean and Coastal Science Research and Education
- Community-based Sustainable Development and Coastal Watershed Management
- Marine Fisheries, Seafood Processing, Marine Recreational Fishing, and Aquaculture

Interdisciplinary Ocean and Coastal Science Research and Education

The scientific study of ocean and coastal ecosystems is inherently interdisciplinary because of the inter-relatedness of their biological, physical, and chemical components. To truly understand, appreciate, and protect marine ecosystems, diverse sets of scientific knowledge and data are required. Coastal and ocean management require scientific and technical information to identify and define environmental problems, maintain policy agendas, define alternative solutions, and optimize governmental and economic decision making (Powell, 1999). Rhode Island Sea Grant encourages and supports interdisciplinary research as a central means for advancing the coastal and ocean sciences and for providing the scientific information critical for effective coastal and ocean management.

With regard to supporting effective management, the Rhode Island Sea Grant mobilization in response to the 1996 *North Cape* oil spill is illustrative. Before the first drop of oil seeped from the grounded barge, Malcolm Spaulding, Sea Grant researcher and URI ocean engineering professor, began to assemble localized wind and current data in order to generate computer-based model projections of oil spill trajectories in support of spill response activities by the U.S. Coast Guard, U.S. EPA, and URI fisheries experts. Spaulding's trajectory projections included those for the subsurface oil plume—that portion of the oil spill most lethal to planktonic and benthic organisms. Using these projections, Joseph DeAlteris and Kathy Castro, Rhode Island Sea Grant Extension leaders, and other fisheries scientists launched a series of sampling trawls to assess damage to finfish and groundfish stocks. Stanley Cobb, Sea Grant researcher and URI biology professor, initiated a preliminary assessment of impacts on lobster stocks. Lori Pivarnik, Sea Grant Extension specialist and URI food science and nutrition researcher, worked with the R.I. Department of Health to establish guidelines for contaminated seafood and closed fishing areas. Along with fisheries specialists, Virginia Lee, Sea Grant Extension leader in coastal management,

worked directly with spill response team leaders to provide technical information and to identify sampling sites for vulnerable coastal resources such as coastal lagoons. Rhode Island Sea Grant first appeared on the Web on January 24, 1996, in reaction to the oil spill. The oil spill Web page featured news reports on the spill, contacts for the media, information on Sea Grant and URI research, and links to other oil spill-related Web sites. The Sea Grant oil spill site received over 3,000 hits during the month of January, as people from all over the country checked for updates on the spill. The appearance of the Web site also spurred the *Providence Journal* to make its articles and photographs on the spill available on the Web. Before that, the *Journal*'s on-line service was available only to users of the Prodigy on-line service. When the newspaper discovered that Sea Grant had a Web site on the spill, they made their site available to Web users within several days. The oil spill Web site was also a first for Sea Grant programs nationwide—it was the first Sea Grant site specifically focussed on a special topic. The Rhode Island Sea Grant Communications Office continues to maintain the oil spill site, as well as the Rhode Island Sea Grant home site and its component Web pages/sites.

A collaborative project funded by Rhode Island Sea Grant in the 1998–2001 omnibus illustrates the importance of interdisciplinary collaboration in advancing scientific understanding of coastal ecosystems: “Physical, Biological, and Chemical Exchange Processes between Narragansett Bay and Rhode Island Sound” stemmed from the view that:

“Exchange processes along the interface between the Bay and Sound represent a dominant influence on the overall system [in terms of] a) residence time of Bay waters and related processes governing the fate of pollutants; b) nutrient cycling and processes governing primary production within the Bay; and c) advection and migration of commercially important shellfish. [Furthermore,] any model of Narragansett Bay, whether it be a straight hydrodynamic model, a water quality model, a biochemical mass balance model for a [plankton] bloom or a complex model of marine organism population dynamics, requires information on exchange processes taking place along this crucial interface. [Until this project, the mouth of the Bay exchange boundary] was unconstrained, thereby [limiting development of] any model of the system [for use] as the basis for management or policy decisions for the Bay and its watershed” (Buckley et al., 1997).

Rhode Island Sea Grant anticipates interdisciplinary collaboration among marine scientists to increase in the coming years. In January 2000, Rhode Island Sea Grant organized and sponsored a two-day conference for researchers currently working in Narragansett Bay, the south shore coastal lagoons, and Rhode Island Sound. The conference sought to encourage the sharing of current project designs and acquired data. Such collaborations can leverage scarce funding and resources and bring about integrated perspectives on the state of the science.

Community-based Sustainable Development and Coastal Watershed Management

Rhode Island Sea Grant is one of the few Sea Grant programs with a major portion of its outreach resources dedicated to enhancing coastal and ocean management and planning capacities at the state and local level. Sustainable community development, integrated coastal management, watershed management paradigms for governance and management have thoroughly emerged in the environmental planning and management literatures. Rhode Island Sea Grant Coastal Management Extension staff seek to apply these paradigms to actual economic development,

management, and preservation initiatives. The geographic, institutional, and temporal scales of the problems faced often greatly exceed the resources brought to bear on them. Lacking regulatory authority, these management facilitation initiatives rely on local and state officials to implement strategies developed by planners and stakeholders. Unrelated political and economic forces may overwhelm the good intentions of management reformers and facilitators.

The issue of growth management reveals these difficulties. The Rhode Island population has actually decreased slightly since 1990 from a peak of 1,004,000 to 988,000 in 1998. However, in the past 10 years, over 26,000 acres of open space (more than twice the areal extent of Providence) have been transformed into residential and commercial development, underscoring the need for ambitious urban redevelopment and smart growth policies and programs.

Accelerating sprawl in Rhode Island reflects national migration trends in coastal development, and the state's growing tourism economy. Through the 1990s, the state population shifted southward. Metropolitan areas in the north (Providence, Woonsocket, Pawtucket, and Central Falls) declined 6 to 10 percent. The urban-to-suburban cities of North Providence, East Providence, Cranston, and Warwick declined 1 to 5 percent. The suburban-to-rural towns south of Providence (East Greenwich, Bristol, Warren, and Jamestown) increased 1 to 5 percent.

The strongest population growth in the last decade occurred in the southern half of the state. Since 1990, the inland towns of West Greenwich, Exeter, Hopkinton, and Richmond grew 11 to 21 percent, and the shorefront towns of North Kingstown, Narragansett, South Kingstown, and Charlestown grew 5 to 10 percent. Interestingly, the shorefront city of Newport actually declined 16 percent in population, possibly due to cutbacks in the local defense industry. At the least, the Newport population trend underscores the de-urbanization of the state's population.

Population growth in the South County region has been directly correlated with rapid residential development. Some of the Rhode Island shorefront communities have attempted to slow the pace

Sustainable Development and Civic Capacity

"[Sustainable communities continually] engage in the task of building better systems of democratic governance and better places to live. . . . These two goals are inextricably linked. Environmental quality has everything to do with civic capacity; sustainable development hates political disaffection. Sustainable development must be understood as an ethical precept, a mandate to integrate into all development decisions a public concern for the protection of ecosystems and future generations. . . . Sustainable development requires that we account for the environmental and social costs of development and avoid displacing those costs to another place or time.

— William Shukin
President, New Ecology, Inc.

of housing development through "phasing and pacing" ordinances, designed to limit the number of residential building permits issued in a given time period. Table 2 details growth and building rates for selected shoreline towns in southern Rhode Island.

Table 2. Changes in population and housing units for selected Rhode Island municipalities.

Town	Population Increase (Since 1990)	Growth in Housing (1980-1990)	Projected Growth In Housing (1995-2000)	Growth Management Ordinances
Narragansett	6%	25%	3%	Building moratorium since mid-1980s
S. Kingstown	8%	20%	8%	Limits residential building permits
Charlestown	10%	39%	5.2%	Emergency ordinance limiting building permits from 5/99-10/99; draft ordinance would restrict residential building permits to 108 annually.
Westerly	Declined 2%	28%	4%	
N. Kingstown	9%	6%	5%	
Block Island	13%	25%	6%	
Newport	Declined 16%	10%	1%	

In other coastal communities where year-round population growth has not been as rapid, seasonal housing construction has substantially impacted open space and important coastal resources. All types of sprawl can engender use conflicts over coastal and marine resources. The degradation of drinking water supplies, nearshore coastal waters, and coastal wetlands has been attributed to changes in land use due to rapid residential and commercial development. The R.I. Department of Environmental Management (RIDEM) concludes:

"The suburbanization of land bordering lower [Narragansett] Bay increases the possibility of water quality degradation and habitat loss in coves and embayments since septic systems, lawn fertilizers, stormwater discharges and other nutrient sources increase with development Such population trends increase the likelihood that some parts of the Bay will be impacted by non-point sources of pollution."

Growing Rhode Island shoreline populations have intensified the demand for, and the socioeconomic value of, shoreline access, coastal and marine recreation, coastal waters of the highest quality, and pristine environmental aesthetics. Major urban centers in the upper Bay are struggling to retain population, rebuild their public infrastructures—upon which the state economy depends—and spur long-term shifts in their economies away from traditional manufacturing operations.

Rhode Island's diverse communities, land-uses, and coastal and marine environments serve as a microcosm for developing and testing techniques for community-based, sustainable economic development. Rhode Island Sea Grant projects function within a sociopolitical and geographic

environment suited for experimentation and innovation in integrated coastal management. In addition, Rhode Island Sea Grant seeks to build on the view held by many Rhode Islanders that the well being of their communities depends on successful management strategies and programs in growth management, sustainable economic development, and marine resource conservation and restoration. One current Rhode Island Sea Grant outreach initiative in integrated coastal management, The Aquidneck Island Partnership (AIP), seeks to take advantage of the positive political, socioeconomic, and environmental factors present in Rhode Island for achieving excellence in integrated coastal management.

Recognizing that no single planning entity existed to address land use planning and management for Aquidneck Island, in 1997 Rhode Island Sea Grant launched the AIP. Partnership members include the island's public and private organizations, including the three municipalities (Newport, Middletown, and Portsmouth), the Newport County Chamber of Commerce, the Newport County Board of Realtors, the Newport Naval Station, and the Aquidneck Island Land Trust. The first goal of the AIP was to create a vision for preserving and managing Aquidneck Island's natural and social ecologies, and to develop coherent action plans to achieve that vision. To develop a shared vision for Aquidneck Island, the AIP organized numerous local meetings with civic, school, real estate, and business organizations. The results have been incorporated into *Aquidneck Island: Our Shared Vision*, produced by Sea Grant and released for distribution in late 1999. *Our Shared Vision* is presented in four chapters: "A Livable Landscape," "A Strong Economy," "Social Well-Being," and "Multiple Modes of Transportation."

Aquidneck Island: Our Shared Vision is serving as the basis for a series of workshops intended to produce action plans for land preservation, sustainable development of the West Side of the island, and, correspondingly, revision of municipal comprehensive land-use plans. The workshops produced consensus on management strategies in the following areas: active farmland, linked open spaces for recreation, alternative modes of transportation, drinking water supply, and protected habitat. As they develop, strategies for these issues will be integrated to enhance the management of Aquidneck Island. The AIP has also spearheaded the production of proposals for funding from the R.I. Economic Development Administration to allow municipal planners to develop their own geographic information system (GIS) capabilities. The AIP will participate in a master planning process for the west side of Aquidneck Island in anticipation of an excessing by the U.S. Navy of about 600 acres of land. The AIP also helped organize a caucus of local, state, and federal legislative staff to garner state financial support totaling \$50,000 to match the \$100,000 to be provided by the U.S. Economic Development Administration for comprehensive planning for excessed Navy land.

Marine Fisheries, Seafood Processing, and Aquaculture

Rhode Island commercial finfish, lobster, and shellfish resources are integral to its economy and its culture. The combined value of fish, shellfish, and lobster landings has ranged from \$60 million to \$80 million annually since the mid-1980s (Table 3). Approximately 5,000 full- and part-time harvesters work in the commercial fishing industry. The substantial economic multipliers associated with commercial fishing and seafood processing increase their total contribution to the state economy to \$300 to \$500 million annually. A 1993–1995 survey of major U.S. fishing ports placed Point Judith 14th in commercial landings (out of 60 ports). In 1996, Point Judith moved from 10th to seventh in terms of the value of product landed.

However, the value of healthy commercial fisheries to Rhode Island extends beyond traditional measures of commerce. In its 1997 annual review, the RIEPC acknowledged that:

“Perhaps no other industry in Rhode Island has such a sentimental and historic legacy than the seafood industry – it is almost the essence of what makes Rhode Island the Ocean State. Even for people outside the seafood industry there is a sense that this is an important industry not only for the state’s economy but also for our quality of life. . . . [M]any Rhode Islanders treasure the opportunity to go fishing and quahogging. And those individuals making a living from the industry are often staunch reminders of the legacy of the “independent man.”

The landings and economic value of particular species fluctuated by as much as 30 percent through the 1990s. Quahog landings in Narragansett Bay declined 68 percent between 1991 and 1998 probably for several reasons, including increased shellfish bed closures due to pathogenic contamination. Declines in one major fishery have often been compensated by increased landings and pricing in others (Atlantic herring landings, for instance, have increased 650 percent since 1990). There have been major declines in fisheries that rely on Narragansett Bay waters (quahog, butterfish, and summer flounder), with increased landings from offshore stocks (squid and goosefish) as commercial fishermen redirected their efforts and fishing methods in response to declining inshore stocks. Narragansett Bay nevertheless continues to support inshore, small-boat fisheries that target winter flounder, lobster, and soft-shelled clams.

The devastation of New England commercial fisheries of cod, haddock, and flounder stocks in the northwest Atlantic has not been felt as strongly in Rhode Island as in Massachusetts. Beginning in the 1970s, Rhode Island fishermen and seafood processors turned to alternative stocks and seafood marketing strategies. The Rhode Island fishing industry implemented enhanced fishing techniques and diversified into formerly underutilized species with export market potential, such as squid, scup, butterfish, and mackerel.

Table 3. 1998 commercial landings and their values.

		Trends in Landings & Landed Values	
Species	Landed Values (\$)	Landings (lbs)	Value (\$)
American Lobster	19,137,500	Steady, 1988–1998	Averaged \$18 million
Squid, Longfin	15,605,671	Up 800% since 1980	Up 1600% since 1980
Squid, Northern Shortfin	4,453,581	Steady, 1994–1998	Averaged \$4.7 million 1994–1998
Goosefish (Monkfish)	4,110,272	Up 400% since 1989	Up 400% since 1989
Clam, Quahog	4,098,670	Down 68% since 1991	Down 68% since 1991
Flounder, Summer	3,924,671	Down 75% since 1985	Down 59% since 1985
Hake, Silver	3,486,898	Steady, 1988–1998	Averaged \$3.3 million
Herring, Atlantic	2,065,088	Up 800% since 1990	Up 650% since 1990
Mackerel, Atlantic	1,626,324	Substantial fluctuations, 1989–1998	Averaged \$2.3 million
Flounder, Winter	1,536,438	Down 80% since 1985	Down 64% since 1985
Butterfish	1,457,574	Down 66% since 1993	Down 75% since 1993
Total Landed Value	61,502,687		

The R.I. Seafood Council recently reported that the total value (dockside landing values, value adding processing, and multiplier effects) of the seafood export industry in Rhode Island is about \$270,500,000 annually. Rhode Island is responsible for about 45 percent of New England seafood exports and 16 percent of East Coast seafood exports. Given the critical importance of “traded” industries (industries that sell goods and services primarily outside of the state) to the state’s economic future, Rhode Island seafood exporters merit careful attention and support.

The willingness and ability to adapt to change has been a notable strength of the Rhode Island commercial fishing industry. It has produced an important state-based export industry despite the highly adverse conditions the New England marine seafood industry has faced in recent decades. The Rhode Island Sea Grant fisheries and seafood outreach program has worked

diligently for many years to support innovations in commercial fishing. The diversity of targeted species, the marketing of new seafood products in new domestic and international markets, and improved harvesting methods are all aspects of the commercial fisheries that Rhode Island Sea Grant will continue to advance through its outreach and research efforts.

Rhode Island seafood processors also have weathered difficult challenges due to reduced landings and tightening requirements for treating process wastes. The state is reviewing plans for redevelopment of the Port of Galilee, where many seafood processor facilities are located, to increase tourism resources. Rhode Island Sea Grant will work to ensure that the interests of the Galilee fleet and processors are recognized and accounted for adequately in any redevelopment initiative.

Recreational Fishing in Rhode Island

Recreational or sport fishing in Rhode Island ranges from offshore tuna fishing aboard sport tournament vessels to digging quahogs in the intertidal zone. Although there are insufficient data available, it is estimated that recreational fishing contributes about \$125 million annually to the economy, primarily in terms of the costs of boats that support fishing activity. Rhode Island Sea Grant Fisheries Extension staff will expand activities directly beneficial to recreational fishing with the following general goals:

- Improve public appreciation for the habitat qualities of Rhode Island waters that support healthy commercial and recreational fisheries.
- Support businesses tied to recreational fishing.
- Help to resolve differences between commercial and recreational fishermen.

The Emerging Rhode Island Aquaculture Industry

The Rhode Island aquaculture industry consists largely of private leaseholders cultivating oysters and other shellfish in the Bay. Also present in the state are public freshwater fish hatcheries, a shellfish seed culture operation, and a land-based finfish growout facility. State aquaculture sales in 1998 totaled \$296,000. Growth in Rhode Island aquaculture will probably come from increased bottom lease holdings for cage-based shellfish culturing, particularly oysters.

Growth in Rhode Island aquaculture has been slowed by political, legal, and environmental factors. With significant educational support provided by David Beutel, Sea Grant Fisheries Extension agent, there are indications that policy and permitting issues have been substantially resolved at the state and local level. The presence of a reliable source—the recently launched Hope Shellfish Co.—of in-state seed stock may encourage Rhode Island shellfish aquaculture. The relevant state agencies, RIDEM and CRMC, must continue to assemble a coherent policy and regulatory framework to manage conflicts between traditional fisheries and aquaculture operations and address policy concerns regarding aquaculture wastewater discharges and the exclusive use of public trust submerged lands.

Nevertheless, Rhode Island Sea Grant strongly supports the sustainable development of aquaculture in Rhode Island as interest in land-based and at-sea aquaculture grows. Rhode Island Sea Grant and URI-based researchers actively engage in the following areas of research and outreach, as cited in the URI "Fish, Fisheries, and Aquaculture Initiative: A Developing Document for Discussion," released in fall 1999:

- Culture Technology—development of transient gear shellfish grow-out methods, recirculation system hydraulics and biofiltration; development of shellfish upweller technology
- Aquaculture Biology—development of new species; biological indicators of smoltification, metamorphosis, feeding, and nutrition
- Pathology and Health Management—development of vaccines; identification of marine pathogens.
- Aquaculture and the Environment—management of effluent; ecological impacts of bivalve biofiltration.
- Aquaculture Economics, Policy, and Management—production, marketing, regulation.

Recently, commercial diggers and shellfish aquaculturalists began working together in greater recognition that they share in the use of Rhode Island coastal waters and have a common interest in protecting them. There is growing recognition within the shellfishing industry that aquaculture techniques may provide powerful means for increasing shellfish resource availability.

The Rhode Island Sea Grant College Program

Institutional Setting

For over 30 years, the National Sea Grant College Program has sought to increase scientific understanding of the marine environment and promote the sustainable use and development of marine resources for the public benefit. The impetus for the Sea Grant College Program concept actually began at a meeting held in Rhode Island in the early 1960s. Sen. Claiborne Pell, former URI president Francis Horn, and former GSO dean John Knauss were instrumental in founding the National Sea Grant Program in 1966. It made sense, therefore, that in 1968, the first sea grant funds were awarded to the URI GSO. In 1971, URI was honored as one of the first four universities in the nation to be designated a Sea Grant College. Rhode Island Sea Grant was formally reviewed by the NSGO in 1985 and 1998. In 2001, URI will celebrate its 30th anniversary as a Sea Grant College.

In 1998, Rhode Island Sea Grant was among the first eight Sea Grant programs to be evaluated under the NSGO Program Assessment Team (PAT) review process and one of only two programs to be rated "excellent" that year. As a result of that evaluation, Rhode Island Sea Grant will enjoy a Category I designation, the highest possible, through 2003, at which time it will be reevaluated by NSGO. Category I programs receive additional merit funding annually from the NSGO.

The National Sea Grant Depository (NSGD) resides at the GSO Claiborne Pell Marine Science Library. The NSGD was established in 1970 to archive all Sea Grant-funded documents. It houses the only complete collection of Sea Grant funded publications currently totaling 72,000 documents, including peer-reviewed publications, technical reports, educational pieces, videos, and other multi-media products. Although Rhode Island Sea Grant and the NSGD function independently, the presence of the NSGD on campus provides an important research tool for Rhode Island Sea Grant staff and researchers throughout southern New England.

URI is the state's largest institution of higher education with three major campuses. The university was established in 1892 as a Land Grant institution and maintains a connection to its origins through the Agricultural Experiment Station and the Cooperative Extension (CE). In the 1960s, with the founding of the GSO, URI marine and environmental programs grew significantly. In addition to the GSO, strong marine and environmental programs are located in the College of Environmental and Life Sciences (Marine Affairs; Fisheries, Animal, and Veterinary Sciences; Community Planning and Area Development; Food Science and Nutrition; Geology; Natural Resources Science; Plant Science; Resource and Environmental Economics; Biochemistry, Microbiology and Molecular Genetics), the College of Engineering (Ocean Engineering, Civil and Environmental Engineering), and the College of Arts and Sciences (Biological Sciences).

As a world-renowned center for oceanographic science and education, the GSO hosts a variety of institutions, including the Center for Atmospheric Chemistry Studies, the CRC, the URI-NOAA Cooperative Marine Education and Research Program, the Marine Ecosystems Research Lab (MERL), and the Ocean Technology Center (OTC), a state-federal initiative to develop industrial partners in marine technology. Recently, URI founded the Coastal Institute, whose mission is to promote the integration of marine science, policy, and management.

Approximately 70 percent of the university's total funded research budget (about \$40 million per year) is generated by marine-related work. The Carnegie Foundation classifies URI as a Category II Research Institution. The GSO was awarded \$21.7 million worth of research grants in 1998–99, representing about 50 percent of the total research dollars awarded to URI.

Several federal research facilities are located at the URI Narragansett Bay Campus, including the NMFS Northeast Fisheries Science Center Narragansett Laboratory, the U.S. EPA Atlantic Ecology Division Environmental Research Laboratory, and the Cooperative National Park Service Studies Unit for Coastal Science, part of the Biological Resources Division of the U.S. Geological Survey.

While the major marine academic programs in Rhode Island are located at URI, other institutions feature high quality centers of education and research in marine science and policy. Several of the most prominent are the Brown University Center for Environmental Studies and Graduate Program in Ecology and Evolutionary Biology and the Roger Williams University Marine Affairs Institute located within the Ralph R. Papitto School of Law. Finally, The Narragansett Bay NERR on Prudence, Patience, and Hope islands provides a diversity of field research opportunities for scientists.

In addition to its substantial cadre of marine researchers and educators, the Rhode Island marine community includes state and federal agencies and programs, environmental advocacy organizations, and marine trade organizations.

Program Organization

The URI Vice-Provost for Marine and Environmental Programs holds oversight responsibility for the activities of Rhode Island Sea Grant (Appendix I). The position of Vice-Provost for Marine and Environmental Programs reflects URI's commitment to its marine and environmental programs. Rhode Island Sea Grant will work with university administrators and other officials in the coming years to increase its direct support from URI and the state of Rhode Island.

The Sea Grant director oversees all research, outreach, and program management functions of Rhode Island Sea Grant. The director works closely with the assistant director for programs and the assistant director for finance. All three receive support from an administrative assistant and a program associate. Rhode Island Sea Grant program staff in turn work with the Sea Grant Communications Office, also located in the Coastal Institute Building, and with Rhode Island Sea Grant Extension Program staff located at the GSO and the URI East Farm Fisheries Center. (Appendix I provides job descriptions of program staff positions.)

Rhode Island Sea Grant Outreach Program

Rhode Island Sea Grant Outreach Program staff work within a number of URI academic departments and research centers. Outreach staff seek to develop and maintain strong links to the organizations and individuals that Rhode Island Sea Grant research and outreach is intended to benefit, including commercial and recreational fishermen, seafood processors, state and municipal officials, local and state planners, the media, and the public. Outreach staff also must forge and maintain links with these constituencies and the marine research community in order to enhance the provision of relevant scientific and technical information to user groups and government decisionmakers, as well as enabling them to inform researchers of current needs and priorities. Rhode Island Sea Grant has traditionally not sponsored education programs that target K-12 students, primarily because such programs are the purview of the GSO Office of Marine Programs (OMP). OMP and Rhode Island Sea Grant do collaborate on projects of mutual interest, particularly with regard to adult education efforts.

Continuous effort is required to ensure that outreach and education programs are tightly linked to current research, and that information and technology transfer accurately target user groups and public policy processes. Accordingly, in the early 1990s the outreach program was restructured to render its efforts more responsive and focused. The outreach program is now divided into three distinct teams: 1) Fisheries, Aquaculture, and Seafood; 2) Coastal Management; and 3) Communications. A leader (or coleaders) guides each team in pursuit of projects relevant to its focus area.

The Fisheries, Aquaculture, and Seafood Program supports the Rhode Island and southeastern New England commercial fishing and seafood industry from vessel to market through successful regional and national programs in vessel safety; seafood quality, processing, and marketing; habitat restoration; bycatch reduction; and alternative fishing gear and methods.

The Coastal Management Program is based at the URI CRC. CRC identifies emerging coastal management issues, formulates management strategies to address these issues, and fosters public and private sector stewardship of Rhode Island coastal resources. One of its major U.S. programs is the previously described Aquidneck Island Partnership.

The Communications Program disseminates the results of Sea Grant-sponsored research and outreach activities through the production of publications, Web sites, videos, and other products tailored to specific audiences or user groups. Communications staff work directly with Sea Grant program staff and researchers to produce and distribute germane publications. A recent publication is the *Guide to Marine Mammals and Turtles of the U.S. Atlantic and Gulf of Mexico*, published in June 1999.

Outreach program staff coordinate activities across the three teams, with assistance from the assistant director for programs. The assistant director and other outreach staff participate in the URI Outreach Council, which encourages a unified approach to the university's diverse outreach programs and focus areas. Rhode Island Sea Grant collaborates with CE to develop joint Land Grant-Sea Grant outreach projects. In planning is a joint URI Land Grant-Sea Grant publication (titled *Spartina*) that will replace the Northeast Sea Grant publication *Nor'easter*, the last issue of which was published in the summer of 1999.

State and Regional Planning and Management

Rhode Island Sea Grant participates actively in marine resources planning and management for Rhode Island and the northwest Atlantic region. Critical program themes include environmental monitoring and impact assessment and management capacity-building. Rhode Island Sea Grant has a responsibility to produce and disseminate unbiased scientific and technical expertise and information. To meet that responsibility, Rhode Island Sea Grant seeks to identify the types of information most germane to particular management and policy processes and decisions. Nationally, Sea Grant is a network of college and institutional programs, each working to identify and fulfill critical research needs, translate research information for resource users, regulators, and the public, and develop state and local policies and regulations. Sea Grant programs have been cited nationally for serving as unique repositories and providers of critical scientific and management information (President's Council on Sustainable Development, 1996).

Rhode Island Sea Grant was involved in the Narragansett Bay Project (NBP), a major research and planning initiative led by the U.S. EPA and RIDEM from 1988-92. The central purpose of the NBP was to assess water quality issues and trends in the Bay, and produce a comprehensive management plan for the Bay and its estuarine watershed. Rhode Island Sea Grant continues to work with the Narragansett Bay Estuary Program (NBEP) (previously the NBP), on coastal habitat restoration projects. Rhode Island Sea Grant is working with the NBEP and other state organizations to organize Narragansett Bay Summit 2000, the first in a series of conferences dedicated to presenting multiple perspectives on the state of Bay resources and management. Following the inaugural conference, scheduled for April 2000, Rhode Island Sea Grant intends to participate in a forthcoming stakeholders group that will be tasked with developing a comprehensive multiple use plan for Narragansett Bay and other Rhode Island waters.

Rhode Island Sea Grant staff and researchers have frequently participated in large regional and national initiatives. For example, in the early 1990s, Scott Nixon, then Rhode Island Sea Grant director, chaired the Greater New York Bight Regional Marine Research Program, a joint NOAA/EPA initiative to identify the most important research and management issues for the Bight region. Coastal marine eutrophication and management of contaminated sediments were identified as priority management issues. Rhode Island Sea Grant will continue to participate in local, university, and regional fora. Important affiliations include the URI Marine Programs Advisory Council, the Coastal Ocean Committee of the National Research Council, the Estuarine Research Federation, and the Sea Grant College Network.

Looking to the Future: Database Development and Electronic Proposal Submission

Rhode Island Sea Grant is one of a number of Sea Grant programs fully engaged in finding better, more systematic ways to apply program performance and accountability measures. Rhode Island Sea Grant staff began in 1999 to develop a relational database titled *Rhode Island Sea Grant: Making a Difference*. The database, based on pioneering designs from Oregon Sea Grant, will offer a comprehensive overview of Rhode Island Sea Grant current and past outreach and research projects. It will also track graduate and undergraduate students supported by Rhode Island Sea Grant projects. Eventually the database will be publicly accessible via the Web and could serve as the basis for marine educational CD-ROMs. Finally, *Making a Difference* will be an important tool for future state and federal reviews of Rhode Island Sea Grant. Development of this database is Rhode Island Sea Grant's first incorporation of emerging knowledge management software technologies into its program functions.

An important future activity will be development of an electronic omnibus proposal development and submission database system, designed and implemented as a national network of Sea Grant programs. Rhode Island Sea Grant actively participates in an *ad hoc* working group of the Sea Grant network dedicated to database development and implementation for electronic proposal submissions and program accountability measures.

Strategic Planning and Public Participation

Rhode Island Sea Grant continually seeks input and advice from the Rhode Island marine community about Sea Grant current priorities and projects. For Rhode Island Sea Grant's *Program Plan 1998-2004*, issued in March 1997, focus group meetings were conducted to gather advice and recommendations on program priorities. Input was solicited from a regional community of coastal scientists, managers, regulators, and business and environmental groups. In addition, meetings were convened with members of the Rhode Island Sea Grant Outreach Program, Sea Grant-funded project staff (past, present, and potential), and likely partners in a Land Grant-Sea Grant collaborative working group. The responses received formed the basis of the priority areas identified in the first program plan.

The planning meetings convened for the first edition of the Rhode Island Sea Grant program plan yielded significant input. Both the scientific and regulatory communities requested new approaches to coordination and cooperation in order to increase research payoffs, to increase the decision-making skills of state and local officials, and to improve information accessibility. These demands comprise the goals of the Rhode Island Sea Grant Outreach Program as it enters the next century. The goals and objectives of the revised program plan do not differ significantly from the first edition largely thanks to the broad, detailed public participation achieved during the production of the first program plan.

In evaluating projects in the context of this program plan and other Rhode Island Sea Grant plans, serious consideration is also given to scientific merit, degree of community concern, opportunities for interagency collaboration, and extent and kind of benefits generated for the environment, user groups, and the public. To expand and update its first program plan, Rhode Island Sea Grant solicited input and review from its outreach and senior advisory committees, URI outreach, scientific, and policy professionals, other academics, government officials, and public interest organizations.

Additional management planning is required to ensure successful implementation of any strategic plan. The Sea Grant network and the NSGO have agreed to require that the management proposal section of forthcoming omnibus proposals will include specified implementation plans. In late 2001, Rhode Island Sea Grant will review this program plan and as necessary issue an addendum prior to developing the Request for Proposals (RFP) for the 2003–05 omnibus proposal (Appendix II).

Rhode Island Sea Grant Research and Outreach Goals

This section identifies the main priorities and objectives for Rhode Island Sea Grant research and outreach for 2000 to 2005. These priorities should be assessed in relation to other NOAA strategic plans that also guide decision-making. Three are most important to Rhode Island Sea Grant: The *NOAA Strategic Plan: A Vision for 2005* (May 1996), *Sea Grant's Network Plan: 1995-2005* (November 1995), and the 1999 draft *Strategic Plan for NOAA Research* issued by the NOAA Office of Oceanic and Atmospheric Research. A Sea Grant program strategic plan should nest within these major strategic plans, building on and supplementing broad national goals and program topics. Rhode Island Sea Grant priority goals for research and outreach are:

1. Preserve, restore, and manage coastal and marine habitats and ecosystems.
2. Achieve sustainable seafood production.
3. Advance environmental technologies in support of Rhode Island's marine economy.
4. Foster sustainable coastal communities through integrated coastal management.

Program priorities correspond with the following priorities identified in *Sea Grant's Network Plan: 1995-2005*:

- Protect and enhance coastal and marine environmental quality.
- Foster sustainable development by strengthening marine-related industries while enhancing the social and economic well being of coastal communities.
- Improve economic competitiveness and better integration of the sciences with the development of resource management policies.

Program priorities also correspond to priorities and principals established by The President's Council on Sustainable Development, The National Research Council, and the Coastal Futures 2025 vision established by the NOAA National Ocean Service.

The major objectives that Rhode Island Sea Grant has derived for each of its major outreach and research goals are detailed below. Specific topics and issues are delineated and categorized to encourage interdisciplinary collaboration. Additional specifics will be provided in forthcoming implementation plans for each of the next two omnibus proposals. Meeting these priorities will enable Rhode Island Sea Grant, its partners, and Rhode Island to pioneer better means for enhancing and integrating the management of the nation's coastal and marine environments.

Preserve, Restore, and Manage Coastal and Marine Habitats and Ecosystems

Since the 1970s, treatment of industrial and municipal wastewater point source discharges has steadily advanced via implementation of the federal Clean Water Act and state water pollution control laws and regulations. Rhode Island's modernized water pollution control facilities have substantially reduced major pollutants, such as heavy metals, and biochemical oxygen demand in riverine, estuarine, and nearshore waterbodies. For example, the Narragansett Bay Commission pretreatment office reported that total metal discharges into upper Narragansett Bay from the Fields Point plant—the largest of five major wastewater treatment facilities in the Providence metropolitan region—totaled about 25,000 pounds in 1998, a 90 percent decrease in total metal discharges from Fields Point since 1981.

Consequently, the habitat qualities of Rhode Island's coastal waters have improved significantly for a variety of flora and fauna. Many observers have been encouraged by the return of substantial oyster populations in Narragansett Bay as a consequence of improving water quality. Commercial culturing and harvesting oysters in the Bay prospered through the 19th century and then collapsed due to economic and environmental reasons in the early 1900s. The RIDEM Council for Marine Fisheries states:

“In the early 1900s, the oyster fishery in Narragansett Bay produced over 14 million pounds per year at its peak, . . . [and] was the foundation for a multi-million dollar industry [employing] thousands of Rhode Islanders. Today, the resource is so small that it has very little commercial value. Only sound management of today's marine resources can ensure that [Narragansett Bay's] oysters will support a healthy commercial fishery now and into the future.”

However, significant problems with habitat viability remain. For example, URI researchers have identified the presence of *Dermo* in Rhode Island oysters, a parasitic disease that has devastated oyster populations along the East Coast. Research reported by Marta Gomez-Chiarri, URI fisheries, animal, and veterinary sciences assistant professor, indicates that:

“*Dermo* disease shows a strong seasonal pattern that seems to be determined by changes in temperature and salinity. The high temperatures experienced by the oysters in the late summer favor the proliferation of the parasite and the development of heavy infections, leading to oyster mortalities. However, temperature and salinity alone do not entirely explain the patterns in geographical distribution and the variability in infection intensity and oyster mortalities. These contrasting patterns of infection indicate that complex interactions between environmental and biological variables influence infection intensity and distribution.”

The work of Gomez-Chiarri and others reveals that yet-to-be-determined causal agents in Bay oyster habitats are significantly affecting oyster mortality rates.

Another example of loss of habitat value is the fact that Bay eelgrass beds currently occupy a small fraction of their historical range. Up to 70 percent of historic Bay eelgrass beds have disappeared over the past half-century. Some researchers argue that the primary cause of eelgrass bed loss is the greatly increased flow of nitrogen-based nutrients into the Bay from both point and nonpoint source discharges. Whatever the causes may be, Rhode Island Sea Grant has and will continue to develop and support programs in eelgrass research and restoration.

Finally, pathogen discharges from combined sewer overflows in the Providence area and from stormwater runoff throughout the Bay watershed lead to permanent and temporary shellfish bed closures, as well as numerous beach closures. Seasonal depletions of dissolved oxygen occur in embayments around the Bay, such as the Pawtuxet, Providence, Seekonk, Kickemuit, and Palmer rivers, as well as Greenwich Cove, Apponaug Cove, and Warwick Cove. RIDEM attributes these seasonal depletions primarily to eutrophication (RIDEM, 1998).

Overall, despite significant investments in water pollution control over the past two decades, much remains to be accomplished. Great concern remains regarding our collective ability to protect and maintain the ecological integrity and socioeconomic values of the Rhode Island watersheds and coastal waters, particularly in light of current land development trends.

In recent decades, computationally intense numerical models have been developed to understand physical, chemical, and biological components of coastal waterbodies. Computer models are now capable of emulating complex physical, chemical, and biological interactions within the water column and at benthic and sea surface boundaries, providing useful projections to managers of the impacts on water quality of different regulatory approaches, and identifying the kinds and quantity of data critical to the integrated management of coastal resources.

As computer simulation techniques and programs have advanced, appreciation of their potential utility for government decision-making has grown. There is a growing demand for computer-based tools that can integrate massive, multi-faceted data sets and provide relevant predictive information to the policy process. Significant work remains to be done to increase the comprehensiveness and accuracy of computer models and better meet the needs of policy-makers and user groups.

GSO researchers have been at the forefront of research in computer modeling utilizing Narragansett Bay. It is now possible to accurately model physical transport processes (currents, tides, waves, internal mixing) and the impact of these processes on the distribution of some pollutants. For example, researchers at the GSO, URI, and EPA developed a model to predict dissolved oxygen levels in the upper Bay. The study sought to define more precisely maximum acceptable loads of oxygen-demanding discharges from water pollution control facilities. The model's output results indicated that algal respiration played a greater role in oxygen depletion than loads from treatment plants, underscoring the influence of eutrophication processes on dissolved oxygen trends in the Bay water column and sediments.

Support of computer-based modeling research will remain a priority for Rhode Island Sea Grant. Narragansett Bay is one of the most thoroughly studied estuarine systems in the world. The availability of long-term data sets and models for Narragansett Bay, and the ongoing efforts of oceanographers who have devoted their scientific careers to Bay study, create unprecedented opportunities to advance state-of-the-art estuarine monitoring and modeling science.

Strategic Objectives

Rhode Island Sea Grant sponsors research to delineate the linkages between land use practices, pollutant discharges, water quality, ecosystem functions, and coastal and nearshore habitat qualities. Rhode Island Sea Grant supports the development of better means to communicate information on such linkages to government officials, user groups, and the concerned public. Specific objectives in this priority area include:

- Improve scientific understanding of the physical, chemical, and biological processes that contribute to eutrophication and hypoxia in Rhode Island's and other marine waters.
- Improve scientific understanding of the environmental and ecological factors that govern the occurrence and virulence of hazardous algal blooms (HABs) in Rhode Island's and other marine waters.
- Improve scientific understanding of the direct and cumulative effects of physical, chemical, and biological contaminants on marine ecosystem functions and marine ecological interactions.
- Develop innovative monitoring techniques and indicators to characterize more precisely the sources, pathways, and effects of nutrients, toxics, and biocontaminants, emphasizing development of environmental quality indicators based on emerging marine biotechnological tools and capabilities.
- Develop models for linking changes in marine water quality to nutrient and toxic pollutant discharges specific to particular land use practices.
- Develop land use models to predict cumulative effects of watershed alterations and threats to downstream habitats and to assess the ecological risks of land use alterations.
- Link water quality and land use models to help identify optimal pollution control strategies.
- Work with Rhode Island wastewater treatment and management authorities to devise advanced nutrient discharge controls.
- Work with partners to develop and implement stormwater management techniques and management programs.
- Develop and empirically verify scientifically rigorous marine biological diversity indices for Rhode Island's and other marine waters. Link the application of such indices to habitat loss or degradation indices.
- Identify and quantify the socioeconomic effects of lessening marine biological diversity.
- Improve scientific understanding of the presence and impacts of marine bioinvasive species on Rhode Island's and other marine waters.
- Identify and quantify the socioeconomic effects of marine bioinvasives on Rhode Island and southern New England.
- Assess the long-term ecological and socioeconomic consequences of coastal habitat restoration projects in Rhode Island.
- Develop adaptive water quality and habitat management strategies that evolve as new scientific and technical information and monitoring techniques are developed.

Partners and Capabilities

Rhode Island Sea Grant's current and future projects in these areas offer extensive potential for collaboration due to the scope of issues involved and the importance of stakeholder involvement in management policy. With funding support from Rhode Island Sea Grant over the past 15 years, CRMC and CRC staff have developed and adopted special area management (SAM) plans to address the special management needs of vulnerable coastal waterbodies possessing critical habitat values. Continued refinement and implementation of these plans will help guide Rhode Island Sea Grant support for the relevant projects outlined above.

The RIDEM Water Resources Division has recently been reorganized to integrate policy and permitting processes along watershed boundaries. The opportunity now exists to capitalize on the growing willingness to implement and institute the watershed management paradigm. The Sea Grant integrated coastal management initiatives on Aquidneck Island and in Washington County explicitly build upon the principles of watershed management. It is hoped that these initiatives will be seen as models by RIDEM and other government entities in expanding the watershed approach throughout the state.

Linking land use planning with coastal water quality management offers opportunities for Land Grant-Sea Grant partnering. Potential URI partners include researchers and outreach personnel in watershed science and management, aquatic ecosystems, and fisheries science. Other potential partners include other Northeast Sea Grant programs, RIDEM Fish, Wildlife, and Estuarine Resources Division, NMFS Habitat and Protected Resources Division, U.S. EPA Region I Office of Ecosystem Protection, U.S. Department of Agriculture Natural Resources Conservation Service, municipal planning boards, local land trusts, and nonprofit organizations.

Achieve Sustainable Seafood Production

Many marine fisheries scientists, commercial fishermen, and environmental activists agree that the state of marine fisheries in the northwest Atlantic and elsewhere is in a state of crisis. Over the next decade, a number of difficult but critical management goals must be met to ensure sustainable and economically viable marine fisheries for all New Englanders. Harvesting effort will have to be scaled down to promote the recovery of severely depleted commercial stocks. Management strategies—yet to be identified consensually—to address the overcapitalization of fishing fleets will need to be implemented. And government and industry decision-makers will have to develop equitable means for allocating the substantial economic hardships such management reforms will inevitably engender. Rhode Island Sea Grant will continue to provide unbiased scientific information to support regional fisheries planning and management for lobster, finfish, and shellfish. As an important example of the synergy between Rhode Island Sea Grant strategic goals in computer modeling and sustainable seafood production, the use of multi-species and ecosystem-based models of Northeast fisheries stocks will continue to be a priority research and outreach area.

As Rhode Island commercial fishermen diversified into previously underutilized species such as squid, scup, butterfish, and mackerel, they developed new value-added products and markets. These responses to groundfish stock enabled the Rhode Island fleet to maintain acceptable landing rates and profitability. However, recent federal restrictions on groundfish harvesting (Amendment Seven to the New England Groundfish Management Plan, Magnuson Fishery Conservation and Management Act) indirectly impact Rhode Island fishermen. Due to the stringent restrictions placed on harvesting groundfish stocks, vessels from neighboring states are targeting nontraditional species, and thus present new challenges to the Rhode Island seafood industry that Sea Grant is poised to address.

The seafood processing and marketing sector faces many associated challenges to compete nationally and internationally. The development of new value-added products continues to be an important area of research. The safety and quality of seafood remains a critical issue of concern to the entire industry. The Hazard Analysis at Critical Control Points (HACCP) Program will continue to contribute to better seafood quality and safety, and continue to develop sanitation standard operating procedures for all seafood products.

Fishing gear impacts on the physical characteristics of the ocean bottom and the associated flora and fauna is another area of concern to fisheries managers. The Sustainable Fisheries Act imposes new guidelines for reducing bycatch of depleted groundfish species, but disregard for bycatch quota systems will continue to negatively impact stock sizes. The capture of protected or endangered species is further restricted under the Marine Mammal Protection Act and the Endangered Species Act. The design of selective fishing gear may provide a manageable solution to this problem. Improving gear selectivity or developing alternative management techniques will be needed to deal with these urgent issues. As an example, the lobster fishery has been reclassified as a fishery with significant interaction with marine mammals (Category 1). Information on encounter rate, gear modifications, and animal ecology and behavior are critically

important to solve this problem, which threatens to place significant restrictions on one of Rhode Island's most important marine fisheries.

Other commercial fisheries in the state are also undergoing transitions similar to groundfish fisheries. Hard clam (quahog) stocks, once the most productive small-scale Bay fishery, have declined, along with winter and summer flounders. This has fueled state and regional interest in aquaculture. URI researchers are actively working on aquaculture techniques such as transient gear for shellfish culturing and land-based and ocean-based systems for finfish. For these fledgling industries to establish themselves, a number of issues will have to be addressed, including disposal of waste from recirculating systems, a coherent, equitable political and regulatory framework, variable market-based product valuations, diseases and parasites, and scaling up innovative culturing techniques.

Although biological enhancement of marine fisheries is still an emerging science, habitat and stock enhancement/rehabilitation using aquaculture techniques is attracting significant attention in Rhode Island. The *World Prodigy* oil spill in 1989 and the *North Cape* oil spill in 1996 were assumed to have significant impacts on commercial and recreational stocks in Rhode Island Sound and Narragansett Bay. These potential impacts, which are still being assessed by fisheries scientists, highlighted the potential for wild stock enhancement techniques for remediation and mitigation programs in response to oil spills and other major polluting events.

Recreational fishing and diving activities are expected to grow because of expanding tourism. Increased pressure on recreational fisheries has led to bag limits for individual fishermen and minimum size restrictions for most species. Although use of catch-and-release techniques has increased, unless these fish survive, there is no benefit to the resource. Previous studies by the Rhode Island and New York Sea Grant programs have demonstrated survival rates of greater than 90 percent for released fish if not gut- or gill-hooked and released properly. In light of this, Rhode Island Sea Grant intends to compile existing information concerning hooking mortality for valuable recreational fisheries, to integrate mortality projections into stock assessment models, and to reduce hook mortality rates through education. Efforts are also underway to improve the assessment of game fish stocks using tag/recapture models.

The Rhode Island offshore sport fishery takes a variety of highly migratory pelagic species, including billfishes, tunas, and sharks. There is growing concern that these stocks are overexploited. The first step in improving the management of these stocks will be collecting better data on species identification and catch mortality rates. To this end, Rhode Island Sea Grant communications and Fisheries Extension staff are currently working cooperatively with the NMFS to produce a guide to pelagic fish identification, similar in design to the marine mammal and turtle guide published by Rhode Island Sea Grant in 1999. Also ongoing is an applied research project investigating the sensitivity of recreational fishery tag-recapture models to the input assumptions concerning the way that fish respond to the tags.

Strategic Objectives

Rhode Island Sea Grant works with fisheries scientists, managers, and industry to achieve the sustainable production of affordable and safe seafood products for consumers in Rhode Island and around the world. Specific objectives appropriate to the Rhode Island commercial and recreational fisheries include:

- Develop better biological, physical, and socioeconomic tools to manage multiple-use conflicts, scale back capitalization of the commercial fishing industry, and reduce fishing gear impacts on habitat.
- Develop innovative fishing methods and gear based on improved understanding of the behavior of marine species in order to reduce bycatch.
- Develop better stock assessment tools for existing fisheries and developing pelagic fisheries.
- Advance scientific and technical understanding of reproduction, hatchery growth, nutrition, disease diagnosis and control, and vaccine development and delivery in marine fish and shellfish species.
- Evaluate and disseminate information on the effectiveness, economics, and acceptability of emerging land-based and transient-gear aquaculture.
- Investigate and alleviate the obstacles to new aquaculture ventures such as waste treatment and disposal, state regulations and permitting processes, and consumer acceptance of innovative seafood products produced by marine aquaculture operations.
- Assess the ecological and economic feasibility of wild stock enhancement techniques.
- Develop new value-added products and markets for commercial fisheries and emerging aquaculture enterprises.
- Develop probes and techniques for real-time measurements of seafood contamination.
- Develop programs to support the Rhode Island recreational fishing industry and educate recreational fishermen.

Partners and Capabilities

URI offers substantial resources and expertise in fisheries, aquaculture, and seafood sciences. In GSO and the College of Environmental and Life Sciences, researchers possess expertise in gear technology; fish husbandry, behavior, and selectivity; and land-based aquaculture systems. Researchers in environmental and resource economics work extensively in both marine fisheries management and the commercialization of aquaculture. The natural resources science department supports research and training for on-site wastewater treatment systems. Researchers in food science and nutrition are developing pizo-electric and fiber optic sensors for monitoring and enhancing seafood quality.

In the College of Arts and Sciences, the marine affairs department possesses broad expertise in marine law, policy, and regulation. Researchers from the biological sciences department conduct research on the biology and ecology of marine organisms. Sociology and anthropology faculty have been studying the social impacts of fishery regulations. Researchers in political science have evaluated international fisheries management policies.

Other research and education centers in Rhode Island make important contributions to marine fisheries management and aquaculture. The Roger Williams University Papitto School of Law specializes in Admiralty issues and works closely with the URI community planning department. Brown University has strengths in the ecological sciences and in civil and chemical engineering.

Informal partnerships are currently in place with state and federal management agencies, such as the NMFS, Atlantic States Marine Fisheries Commission, RIDEM, and the U.S. Food and Drug Administration. Industry partners include the Northeast Regional Aquaculture Consortium, the Rhode Island Aquaculture Association, the Rhode Island Seafood Council, fishermen's organizations, and private companies. Aquaculture, stock enhancement, and other fisheries development strategies are supported by the R.I. Office of Strategic Planning in its *Rhode Island Commercial Fisheries Economic Adjustment Strategy* (1995). The *Sea Grant Network Plan: 1995-2005* places seafood production in the category of "Economic Leadership" and recognizes the need for minimizing bycatch, enhancing wild stocks, developing sustainable aquaculture, and enhancing competitiveness of the seafood industry through product quality and safety and improved processing techniques. On a broader scale, in the most recent reauthorizations of the Magnuson-Stevens Fishery Conservation and Management Act, the Marine Mammal Protection Act, and the Endangered Species Act, Congress has reaffirmed the importance of these fisheries issues as well as requiring the definition and protection of essential fish habitat for commercial fishing stocks.

Finally, Kathleen Castro, Fisheries, Aquaculture, and Seafood Program coleader, has spearheaded the new URI Fish, Fisheries, and Aquaculture (FFA) Initiative, a university-wide effort to enhance URI's already considerable abilities to conduct multidisciplinary research and education in fisheries science and aquaculture. Rhode Island Sea Grant will support this effort as a potentially powerful contributor to its own research and outreach efforts.

Advance Marine Technologies

In the 1970s, the National Science Foundation initiated the Industry-University Cooperative Research Centers Program, which currently includes more than 50 centers of study at universities nationwide. In 1993, Rhode Island initiated its third center, the OTC, with support from the U.S. Economic Development Administration. In 1997, the OTC was designated a Slater Center by the state. Funding from the Slater Technology Fund is used by the OTC to support the Ocean Industry Grant Program and its expanded mission of marine technology commercialization. The OTC facility opened in 1998 on the URI Narragansett Bay Campus.

The OTC encourages entrepreneurial enterprises, facilitates technology transfer, and nurtures young firms through a three-pronged, comprehensive program of research and development grants, marine enterprise loans, and business development initiatives. Its \$1.6 million Marine Enterprise Development Program provides low-interest loans to startup companies. To date, the OTC has helped to launch three new Rhode Island companies, provided grant funding to seven companies, and provided loans to six others. As a result, the OTC has supported technology development projects in the fields of object-avoidance sonar, nutrient monitoring, marine electronics, ultra-lightweight yachting fixtures, and aquaculture. The OTC is starting a new program, the Ocean Technology Transfer Initiative, to foster collaborative research and development among the Naval Undersea Warfare Center (NUWC), URI, and industry in navigation and sensor systems for autonomous underwater vehicles and remotely operated vehicles.

Collaborating with OTC enables Rhode Island Sea Grant to expand beyond its traditional industry relationships in the seafood industry and develop projects in emerging marine environmental technologies. Environmental technologies nationally are considered an important area of economic development over the next 20 years. In addition to contributing to the overall economic well being of Rhode Island, collaboration with OTC will enhance Rhode Island Sea Grant contributions to sustainable development of coastal communities, where the marine trades are frequently located. Finally, Rhode Island Sea Grant will seek to develop with OTC National Sea Grant industrial fellowships with local companies involved in marine technology and aquaculture.

Strategic Objectives

Rhode Island Sea Grant supports development and commercialization of marine environmental technologies. Sea Grant will work to strengthen the knowledge, skills, and business opportunities in Rhode Island maritime and tourism industries, while promoting sustainable use of its coastal and marine resources. Specific objectives include efforts to:

- Develop and maintain partnerships with companies working in the marine trades, fisheries, and aquaculture.

- Support development of technologies for environmental monitoring systems based on real-time, multi-parameter measurements.
- Support development of monitoring instrumentation for remote sensing and *in situ* sampling.
- Support development of pollution control technologies such as alternative on-site treatment systems and biofilters for recirculating aquaculture.
- Support development of remediation technologies for contaminated marine waters and sediments and for habitat restoration.

Partners and Capabilities

OTC represents a leading partner for Rhode Island Sea Grant in this strategic area. In collaboration with the OTC, Rhode Island Sea Grant will recruit applicants and sponsoring companies for the National Sea Grant Industrial Fellows Program. Substantial marine technology expertise and resources are present in Rhode Island via the NUWC in Newport, Raytheon Corporation facilities in Portsmouth, other naval defense contractors, and technology and consulting firms associated with the URI ocean engineering department. Additional partnerships are possible with researchers affiliated with the URI On-Site Treatment Training Program, an initiative to develop and certify alternative septic system technologies and to train municipal officials and contractors in their proper utilization and operation.

Foster Sustainable Coastal Communities Through Integrated Coastal Management

Defining “sustainable coastal community” in a precise, useful, and generally accepted manner remains a challenge. Part of the difficulty stems from the fact that sustainability is an emergent beneficial property dependent on specific natural and human resources and systems inherent to a community or a region. It is possible to identify how social investments allow for better protection and management of discrete marine resources. Arguably, currently it is not possible to articulate to political leaders and the general public how their governments and businesses could invest directly in “resource sustainability.”

Nevertheless, Rhode Island Sea Grant believes that there are several key management areas that will govern economic and environmental sustainability in Rhode Island coastal communities: land and water (both marine and fresh) use planning and management, marine recreation and tourism, marine transportation, and natural hazard mitigation.

Marine recreation and tourism has emerged over the past decade as the major component of the state’s marine economy, surpassing commercial shipping and fishing. Marine trades associated with tourism and recreation are of critical economic importance in Rhode Island. Marinas, recreational fishing, and boat building, sales, and repairs experienced healthy recoveries in the 1990s. Tourism and travel in Rhode Island, which includes these industries, contributed over \$2.5 billion to the Rhode Island economy in 1998.

Marine transportation and port and harbor management are critical issues in Rhode Island. Quonset Point continues to be targeted as a possible site for a major container port facility. Newport has been working to expand its role as a destination for cruise ships. The Providence River Dredging Project currently in planning will help maintain and expand activities in the Port of Providence. NOAA and the state are about to initiate installation of a significant maritime navigation buoy system, known as PORTS—physical oceanographic real-time system.

Many Rhode Islanders have expressed concern that development of a large container port or other port facilities at Quonset Point will diminish critical natural and socioeconomic resources upon which Rhode Island recreational and tourism industries depend. Many also question the economic viability of a large container port facility and the consequent need for taxpayer subsidies to keep such facility operations solvent once built. In 1999, Gov. Lincoln Almond and the Economic Development Corporation rejected a large container port facility proposal put forth by private developers. However, the governor reiterated his support in principle for development of a port facility at Quonset Point. Such a development may proceed in conjunction with efforts to develop a tourism and recreational facility at Quonset Point centered on the decommissioned naval aircraft carrier *USS Saratoga*.

Of all current economic development trends in Rhode Island, development of a major new commercial port in Narragansett Bay presents the greatest potential to substantially alter the

Bay's ecological quality and patterns of human uses. What has been missing to date from public and private debates regarding the future of Quonset Point is the information and planning necessary to situate these continuing debates within the appropriate contexts of Narragansett Bay's current environmental status and uses.

As an impartial provider of scientific and technical information, Rhode Island Sea Grant can help to contextualize development decisions for the Bay and help Rhode Islanders achieve a balance of uses that preserves coastal resources and ecologies and contributes to the economic vitality of the state. Rhode Island Sea Grant recognizes that using integrated coastal management techniques to achieve sustainable coastal communities is an important strategic goal—as important as identifying and fulfilling critical gaps in our scientific understanding of coastal ecology.

Sustainable coastal communities are not only about economic vitality and ecological abundance. They are also resilient in the face of natural hazards, large and small. The United States has endured natural disasters in the last 10 years amounting to billions of dollars of damage. Rhode Island has endured several major hurricanes since 1985. The most severe were Hurricane Gloria in 1985 and Hurricane Bob in 1991. Hurricane Bob alone caused over \$61 million in economic losses in Rhode Island. Because shorefront communities in Rhode Island experienced marked growth in recent decades, at-risk populations have grown substantially. The Rhode Island salt pond region is particularly vulnerable to flooding, erosion, and related damages caused by coastal storms. Since the last major hurricane to directly strike the region, Hurricane Carol of 1954, the number of houses has tripled on the barrier spits and islands and low lying coastal plains adjacent to the salt ponds.

In the late 1990s, the Federal Emergency Management Agency (FEMA) began to couple comprehensive response programs with preventative actions to natural hazards in order to increase community resilience and speed recovery. The Rhode Island Sea Grant Coastal Management Extension team has been at the forefront of the new national model for natural hazard mitigation. They have conducted highly successful programs in natural hazard mitigation planning that placed Rhode Island in a leadership role among the states. Extension staff and the R.I. Emergency Management Agency (RIEMA) worked with FEMA and local officials to establish local and state natural hazard mitigation plans. Prior to these programs, there was no mechanism in Rhode Island for local and state agencies to work together in a proactive way to reduce damages and costs from natural disasters.

The next steps require increasing awareness of, and involvement in, natural hazard mitigation by architects and builders, transportation planners, municipalities, and coastal scientists (physical oceanographers, engineers, geologists, economists, and maritime law analysts). As hazard mitigation plans are issued, federal, state, and municipal officials need to move into implementation through funding of infrastructure improvements and other programs.

Strategic Objectives

Recognizing that economic growth and environmental protection are inextricably linked, Rhode Island Sea Grant will undertake the following:

- Evaluate the impacts of specific kinds of economic development to help government and the public assess and select options for coastal resource and community development.
- Develop and disseminate unbiased economic and environmental knowledge and information relevant to comprehensive planning and integrated coastal management for Rhode Island marine waters.
- Articulate the relevance of public trust management for emerging programs in integrated coastal management.
- Provide a forum for multilateral evaluation of opportunities for expanded marine recreation and tourism, including the cruise ship industry, scuba diving, resort development, and historic sites.
- Help develop, implement, and evaluate coastal economic development projects and policies that adequately account for environmental protection, multiple uses, local, regional, and national economic development, and emerging integrated coastal management ideas and plans for Rhode Island coastal waters and watersheds.
- Promote interagency and private sector coordination and cooperation for hazard mitigation plan development and implementation.
- Advance basic knowledge of coastal storm and flooding hazards in order to enhance prediction capabilities and our understanding of human and environmental impacts.
- Influence national policies and programs for community-based sustainable development and hazard mitigation, particularly through Sea Grant Network initiatives such as the "Theme Teams."

Partners and Capabilities

The Coastal Management Extension team is predominantly composed of management experts at CRC. CRC's U.S. programs emphasize partnering and management capacity-building as exemplified by the Aquidneck Island Partnership. Numerous federal and state programs are working toward reconciling coastal economic development with protecting coastal environments. The National Sea Grant College Program calls for research and outreach that promote alternative forms of economic development, improve coastal business management, reduce conflicts among users, and improve port and harbor planning and operation. These goals are also central to the *Narragansett Bay Comprehensive Conservation and Management Plan*. Natural disaster preparedness intended to minimize the risks of property loss and threats to personal safety is a priority for federal agencies such as FEMA, the NOAA Office of Coastal Resource Management, Coastal Services Center, and Office of Oceanic and Atmospheric Research.

Program Plan Implementation

During development of the biannual omnibus proposal, this program plan will serve as an important, but not exclusive, basis for funding decisions and program design. Implementation of Rhode Island Sea Grant strategic priorities occurs simultaneously in a variety of policy and science settings, and across short- and long-term time frames. Achieving the goals and objectives stipulated in this document also depends on the efforts and decisions of other academic and governmental institutions as well as the efforts of Rhode Island Sea Grant. Thus, it is exceedingly difficult to project how progress toward these goals and objectives will occur over the next five years.

To provide greater flexibility to Rhode Island Sea Grant program managers, investigators, and outreach staff, implementation plans are to be developed for each biannual omnibus proposal. These plans will articulate implementation pathways and milestones for tracking achievement of outreach and research priorities. Assessments of milestone achievements and necessary corrections to implementation strategy should occur at least annually in conjunction with annual progress reports submitted for each funded project and the development of annual project budgets and workplans.

The following sections briefly summarize the omnibus development process used by Rhode Island Sea Grant. This process is a central means by which funding and program design decisions are made at Rhode Island Sea Grant.

Omnibus Proposal Development

Development of the biannual omnibus proposal begins with issuance by Rhode Island Sea Grant of a Request for Research Proposals (RFP). The RFP identifies research and outreach priorities for the forthcoming omnibus proposal and is distributed widely throughout the marine community in Rhode Island, as well as to the other Northeast Sea Grant programs. Preproposals must be submitted in advance of full proposals. Preproposals submitted in response to the RFP will be evaluated based on their compatibility with the priorities identified in the RFP, the program plan, and relevant local, state, and federal coastal and marine priorities. If opportunities for collaboration among proposers become apparent from review of the preproposals, Rhode Island Sea Grant will strongly encourage communication between proposers in order to develop collaborative projects.

Upon careful review by Rhode Island Sea Grant program staff, external advisors, and at least one independent technical review panel, a subset of the preproposals is invited to submit full proposals to Rhode Island Sea Grant. Those investigators whose preproposals are not invited for full submission may still submit a full proposal if they so choose. Full proposals are evaluated along a number of dimensions, including:

- Scientific merit and scientific feasibility
- Priorities and objectives identified in this program plan
- Relevance to NOAA regional and national strategic goals
- Degree of, or potential for, interdisciplinary collaboration
- Quality and relevance of the proposed outreach component

Each full proposal is evaluated by at least three independent peer reviewers who are based outside of Rhode Island. A technical review panel will examine and evaluate the proposals, their peer reviews, and any responses by the proposers to the peer reviews to judge overall quality and advise the Rhode Island Sea Grant director on which proposals should be incorporated into the omnibus proposal to be submitted to the NSGO.

Based on technical review panel recommendations, the Rhode Island Sea Grant director, in consultation with the Sea Grant Senior Advisory Committee and other external advisors, will make the final decisions on which research proposals are to be included in the omnibus proposal. The director then must expeditiously notify the NSGO of his or her research funding decisions, document the rationale for these decisions, and subsequently notify all proposers of the decisions after final approval by the NSGO.

Outreach program proposals developed by the outreach team leaders are also subjected to independent peer review. The individual outreach team proposals are combined and sent for review and comment to at least three Extension leaders associated with other Sea Grant programs, to each team's advisory committee, and to other qualified peer reviewers as deemed necessary by the Rhode Island Sea Grant director and assistant director.

Ongoing Program Management

In addition, other program management decisions governed by the program plan include:

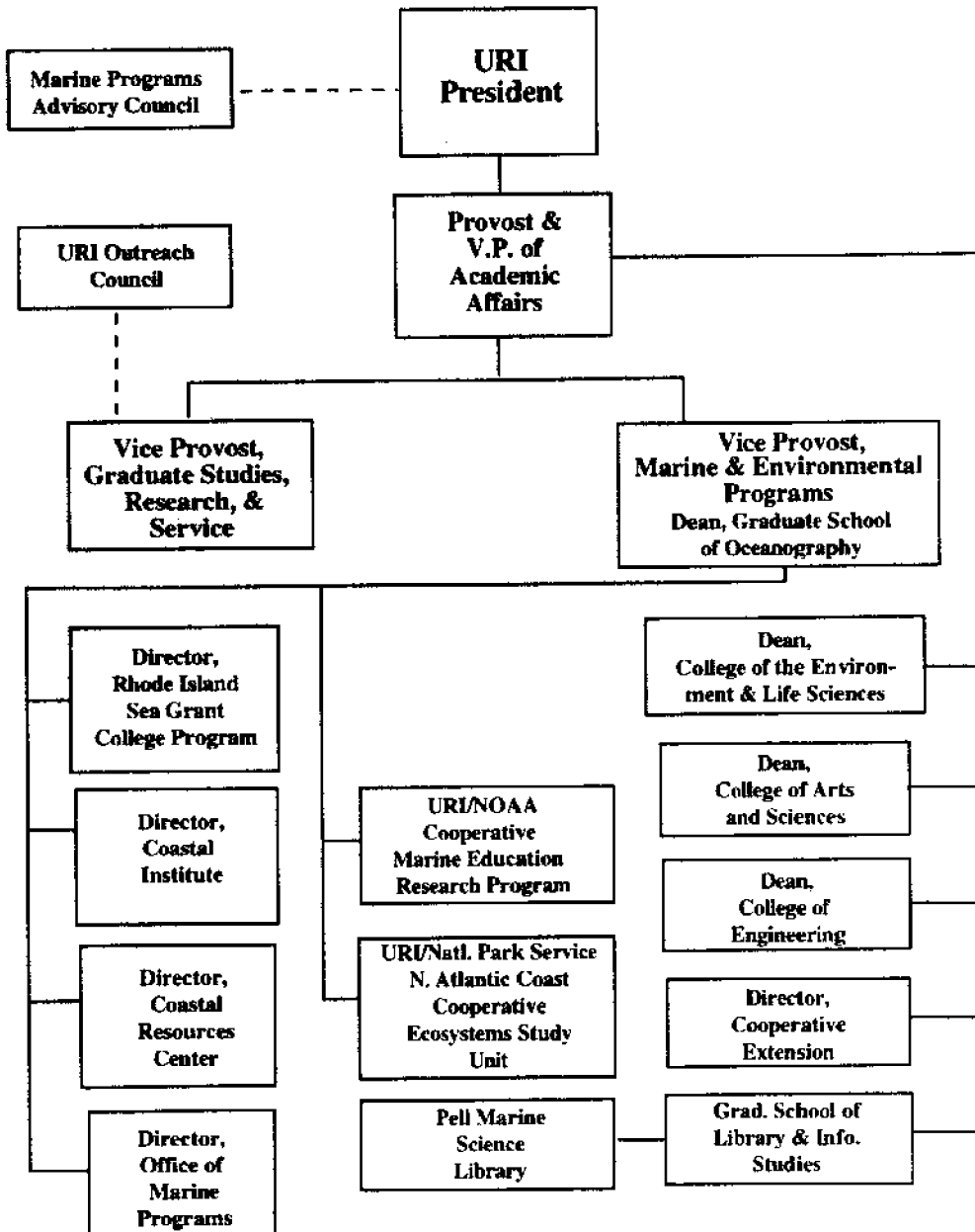
- Review and selection of development proposals presented for funding to the Rhode Island Sea Grant Program Development Fund.
- Periodic refinement of outreach projects on a semi-annual to annual basis.
- Development of collaborative proposals with other Northeast Sea Grant programs, particularly in relation to the Sea Grant Network Theme Teams.
- Assessing, evaluating, and documenting the progress of funded research and outreach programs by the director, assistant directors, and outreach team leaders.
- Review and evaluation of Rhode Island Sea Grant program functions and projects by Rhode Island Sea Grant Senior Advisory Committee and Outreach Advisory committees.

Program staff is responsible for monitoring and evaluating current projects. Annual progress reports from each project are submitted by May 1 for the previous year of work ending February 28. Personal interviews are conducted annually and the assistant director for programs is responsible for ensuring close, productive ties among Rhode Island Sea Grant-funded research and outreach projects and investigators.

Detailed information on the purpose, methods, and accomplishments of each project will be assembled and entered into the *Rhode Island Sea Grant Making a Difference* relational database currently under development. Rhode Island Sea Grant staff will utilize this database to track and evaluate projects and provide program data and insight for external accountability reviews.

**Appendix One
Organizational Structure of URI Marine
Programs**

(As of January 2000)



Staff Position Descriptions

PROGRAM DIRECTOR: Provide leadership for the development, evaluation, and administration of Rhode Island Sea Grant. Serve as an advocate and catalyst for interdisciplinary cooperative research and outreach to address marine environmental issues. Serve as primary liaison among Rhode Island Sea Grant, the GSO, the Coastal Institute, other URI marine programs, and the university. Serve as the Rhode Island program delegate to the Sea Grant Association. Maintain a positive working relationship with the Rhode Island congressional delegation and provide them with marine environmental information as appropriate. Maintain positive working relationships with state and federal marine environmental regulatory agencies. Maintain an overall familiarity with the intellectual and infrastructure resources available within Rhode Island that may be brought to bear on marine environmental problems. Responsible for all final decisions on project funding for outreach and research. Directly oversees all program administration staff, communications staff, and Extension leaders.

ASSISTANT DIRECTOR FOR PROGRAMS AND SEA GRANT EXTENSION

COORDINATOR: In consultation with the director, other program staff, and program advisors, develop and implement strategic plans for Rhode Island Sea Grant. Prepare and submit omnibus proposals and National Sea Grant "special competition" proposals in conjunction with program staff, outreach leaders, and principal investigators. Prepare and submit research and outreach proposals to public and private funding sources for work and projects consistent with the goals of Sea Grant. Oversee university participation in Sea Grant and other NOAA fellowship programs. Coordinate Rhode Island Sea Grant outreach programs in Coastal Management, Fisheries, Communications, and other outreach initiatives. Monitor and document progress and impact of Rhode Island Sea Grant-sponsored research, outreach, and education projects.

ASSISTANT DIRECTOR FOR FINANCE: Monitors daily program functions with regard to fiscal and related program matters. Works with university administrative personnel and Sea Grant investigators on budgetary matters and grant administration. Acts as liaison between Sea Grant investigators and the university grants, contracts, and research offices, the NSGO, and the NOAA Division of Grants Management. Works with other program staff on development of omnibus proposals, progress and completion reports, and annual reports.

PROGRAM ASSOCIATE: Provides administrative and research support to program director and assistant directors.

ADMINISTRATIVE ASSISTANT: Provides administrative and clerical support for program management.

Appendix II

Program Management and Omnibus Proposal Schedule

2000

- January:** Issue revised program plan.
- February 1:** Issue RFP for funding in 2001–2003 omnibus proposal.
- February 29:** Completion of year two of 1998–2001 omnibus proposal projects.
- March 1:** Beginning of year three of 1998–2001 omnibus proposal projects.
- April–May:** Evaluate preproposals for 2001–2003 omnibus and select those for full proposal development.
- May:** Year two progress reports from 1998–2001 omnibus proposal projects due.
- July:** Release of Rhode Island Sea Grant Annual Report summarizing accomplishments from March 1, 1999 to February 29, 2000.
- July 21:** Invited full proposals for 2001–2003 omnibus submitted to Rhode Island Sea Grant.
- September:** Evaluate full proposals (peer and technical review). Convene peer review panels to review full proposals. Select proposals for 2001–2003 omnibus proposal.
- November 15:** Rhode Island Sea Grant Omnibus Proposal: 2001–2003 submitted to the NSGO. Release implementation plan to accompany 2001–2003 omnibus proposal.

2001

- February 28:** Completion of year three of 1998–2001 omnibus proposal projects.
- March 1:** Beginning of year one of 2001–2003 omnibus proposal projects.
- December:** Review *Rhode Island Sea Grant Program Plan: 2000–2005* in preparation for 2003–2005 omnibus proposal development.

2002

- February:** Issue RFP for 2003–2005 omnibus proposal.
- May:** Evaluate preproposals and select those for full proposal development.
- July:** Full proposals submitted for 2003–2005 omnibus proposal.
- August–**
- September:** Evaluate and select proposals for 2003–2005 omnibus proposal.
- November:** 2003–2005 omnibus proposal submitted to NSGO. Release implementation plan to accompany 2003–2005 omnibus proposal.

2003

- February 28:** Completion of 2001–2003 omnibus projects.
- March 1:** Beginning of 2003–2005 omnibus projects.
- Summer:** Undertake fundamental review and revision of Rhode Island Sea Grant program plan in preparation for 2005–2007 omnibus proposal development.
- Fall:** Rhode Island Sea Grant's second PAT visit (tentative).

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