Program Guide 2010 – 2012

RHODE ISLAND SEA GRANT

research . outreach . rhode island sound . nutrients . marine spatial planning seafood safety . newport harbor . fellowships . narragansett bay . vibrant waterfronts . **fisheries** . innovative management . **coastal communities** marine law symposium . special area management plans . visual arts aquaculture . reducing bycatch . baird science symposium . gear technology ecosystem-based management . **legal program** . climate change . coastal community development . **education** . lobster shell disease . behavior change collaborative research . sea level rise . marine affairs institute . coastal smart growth . joint degree program . hydrodynamics . block island sound

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Rhode Island Sea Grant

Program Guide 2010–2012

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About Rhode Island Sea Grant

Rhode Island Sea Grant is an award-wining organization that has a 40-year history of working in the state, the region, and beyond to address issues affecting coastal resources and the people who use them. Rhode Island Sea Grant funds top-notch research and runs high-quality outreach and education programs to seek answers, apply solutions, and educate public and professional audiences alike.

The program, located on the University of Rhode Island Graduate School of Oceanography campus, has two major focus areas—Sustainable Coastal Communities & Ecosystems, and Sustainable Fisheries & Seafood. Rhode Island Sea Grant is also home to one of only four Sea Grant Legal Programs in the country—the only one in the Northeast—located at Roger Williams University School of Law.

All facets of the program integrate outreach and education with research findings to improve the ability of Rhode Islanders to live in harmony with their natural surroundings.

Because of its small geographic size, Rhode Island is an ideal location to apply science to management, and as such is often referred to as a "living laboratory." The knowledge gained in Rhode Island is exported to other states and other countries to improve understanding and foster stewardship of marine systems globally.

Rhode Island Sea Grant is one of over 30 programs that make up the National Sea Grant College Program, a part of the National Oceanic & Atmospheric Administration. Each program, by blending research with outreach and education to address pertinent local issues, creates an integrated network that provides critical support and services to resource managers and coastal residents throughout the United States.

To find out more about the work we do, visit us on-line at **seagrant.gso.uri.edu** or call (401) 874-6800.

Letter from the Director

Rhode Island's coastal and marine ecosystems—of which humans are very much a part—are facing unprecedented challenges. Population growth and redevelopment along the coast continue to occur even in the midst of the current economic recession. Climate change is accelerating sea level rise, increasing the potential severity and frequency of storms, and leading to risks that could spread marine diseases and significantly alter marine ecosystems. Sea Grant researchers published in *Nature* that such a fundamental change in the marine nitrogen cycle of Narragansett Bay may have already occurred. Reductions in nutrient inputs to Narragansett Bay thanks to millions of dollars of investments in treating combined sewer overflows are improving water quality but are also altering the Bay's food web and productivity. Rhode Island's proposed offshore wind farms have the potential to generate green energy but will undoubtedly affect the physical, biological, social, and economic resources of the ocean areas where they would be developed. And Rhode Island's commercial fisheries, which have long struggled with management regimes, are embarking on an innovative, if controversial, management experiment—sector allocation ("catch shares")—that has been approved for the summer flounder (fluke) fishery.

Rhode Island Sea Grant-funded researchers and staff are making significant contributions to our state of knowledge of all these processes as well as working to develop tools, assist in policy development, and provide education to stakeholders, resources managers, and the public to address the issues at hand.

If you have any input regarding the priority coastal and marine issues facing Rhode Island, the region, and beyond, I look forward to hearing from you.

Sincerely,

Barry A. Costa-Pierce, Ph.D.
Director, Rhode Island Sea Grant

Rhode Island Sea Grant Funded Research

Rhode Island Sound is one focus of Rhode Island Sea Grant–funded research for 2010–2012.

Rhode Island and Block Island Sounds include important habitat, fishing grounds, and marine transportation routes, and are an area where offshore wind farm development is being proposed. However, research is needed to understand the physical and biological processes that govern the sounds' circulation patterns and living ecosystems. Though more is known about Narragansett Bay, its response to climate change and other anthropogenic changes is just beginning to be understood, and it isn't known how well that might translate to Rhode Island or Block Island Sound.

To help fill this void and provide new information for both science and management, Rhode Island Sea Grant issued a request for research proposals that focused on Rhode Island and Block Island Sounds, and on Narragansett Bay and its response to climate change.

The response to this quest for knowledge was excellent, and for the 2010–2012 omnibus period Rhode Island Sea Grant has funded nine research projects that are described below.

Improving understanding of nutrient cycling in marine ecosystems

Just like adding fertilizer (nutrients) to your lawn makes the grass grow more vigorously, adding nutrients—particularly nitrogen—to marine waters fuels the growth of marine plants from microscopic phytoplankton to larger "seaweeds" (macroalgae). The nutrients are then recycled between organisms living in the water column and the sediments, fueling the functions of the marine ecosystem. The state of Rhode Island is pursuing an aggressive program of nitrogen reduction from sewage treatment plants, and it is important to understand how this reduction will change phytoplankton growth in the bay and adjacent coastal waters. Will reduced nutrients equate to less plant growth, which might then mean less food for fish and other marine life?

One of three closely linked research projects, **City to Sound: Benthic-Pelagic Coupling in the Providence River Estuary, Narragansett Bay, Rhode Island**

Sound, and Block Island Sound (Scott Nixon, Professor, URI Graduate School of Oceanography) focuses on better understanding nutrient cycling—for a suite of organic nutrients—between bottom sediments and the water column in Rhode Island's bay and coastal water ecosystems. The study has been designed to allow comparison, over a two-year period, of nutrient cycling along a gradient from the highly human influenced Providence River estuary to Rhode Island Sound, which is less impacted by humans. The findings of this research will help us better understand how Narragansett Bay and connected water bodies recycle available nutrients, and how and perhaps why they recycle nutrients differently from each other. It will also help us understand what impact, if any, management measures to reduce nutrients in wastewater are having on the ecology of Narragansett Bay and Rhode Island Sound.

Providence's combined sewer overflow tunnel has reduced nutrient inputs to Narragansett Bay. Photo courtesy Narragansett Bay Commission.

A second project of this multi-level research endeavor is **Evaluating Climate Change on Nitrogen Cycling Along a Gradient of Anthropogenic Impact—from Narragansett Bay to Rhode Island Sound and Block Island Sound** (Robinson Fulweiler, Assistant Professor, Earth Sciences, Boston University), which focuses directly on the mechanics of how nitrogen is being transported between bottom sediments and the water column. Recent research in Narragansett Bay conducted by Fulweiler and collaborators has highlighted, for the first time, how climate change can have unexpected effects on fundamental nutrient cycling in coastal ecosystems. Their findings suggest that a new model for nitrogen cycling in coastal systems may be emerging—instead of removing nitrogen and storing it in bottom sediments, nitrogen is being released into the water column. The bottom line is that some estuaries may no longer provide the nitrogen removal services they once did. Instead, they may be become a source of nitrogen to coastal waters. The currently funded research will look closely at this "twist" in nitrogen cycling in Narragansett Bay, and will sample Rhode Island Sound to see if similar change is taking shape, and will consider the potential ecological ramifications.

While Nixon and Fulweiler focus in on the more traditional pathways for nitrogen cycling, the third of these connected projects, **Impacts of Anaerobic Ammonium Oxidation (Anammox) on Benthic Nitrogen Cycling in Rhode Island Coastal Waters** (Jeremy Rich, Assistant Professor, Environmental Stud-

ies, Brown University), takes a look at a novel pathway for nitrogen movement through the ecosystem. Anaerobic ammonium oxidation—anammox—is a newly discovered mechanism by which nitrogen moves between bottom sediments and the water column, mediated by anaerobic bacteria, which don't need oxygen to sustain life. This process has recently been found to occur across broad geographical areas, and is being noted as a very significant component of nitrogen cycling in marine systems, accounting for up to 67 percent of nitrogen loss in some areas. This research will describe, for the first time, the role that anammox plays in nutrient cycling in Narragansett Bay and Rhode Island Sound, and how that alters our view of the ecological functioning of these marine ecosystems.

The three closely-linked research projects described above will go a long way in improving understanding of nitrogen dynamics in marine ecosystems across the board. More importantly for Rhode Islanders, the research findings will provide a much more complete picture of how Narragansett Bay and Rhode Island Sound respond to nutrients, particularly with regard to nutrient management schemes amidst changing climate, and will offer new perspectives on how these ecosystems function.

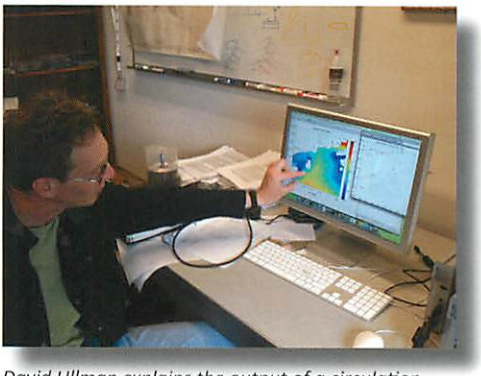
High-tech imaging offers a detailed view of the hidden seafloor

In 2004, John King, Professor of Oceanography at the URI Graduate School of Oceanography, submitted to Rhode Island Sea Grant a very ambitious proposal to map the entire seafloor and the benthic ecological habitats of Narragansett Bay and the south shore lagoon ecosystems (salt ponds). Now, six years later, King has nearly finished this heroic effort—**BayMap Habitat Mapping Project**—and Rhode Island Sea Grant is assisting in seeing the work through to completion. Along the way King has garnered substantial outside funding to expand coverage and improve image resolution. He has also parlayed the expertise built during this project into assisting federal agencies in developing national standards and baselines for seafloor mapping. His work has also located many archaeologically important sites, one of them being the possible finding of the Endeavour, the ship Captain James Cook used in his early explorations of the New World. The real treasures from this ongoing project, however, are the three-dimensional maps of Rhode Island coastal benthic habitats that have been created and posted online that others are now using in a variety of ways. Resource managers are using these maps to help

Rod Mather, URI history professor and member of the BayMap team, explores a wreck site in Rhode Island waters.

them better plan for and manage the state's natural resources, while shellfish growers are using them to identify the best habitats for raising shellfish. Guiding the creation of national benthic habitat mapping standards, discovering important archaeological sites, and providing significant economic assistance to aquaculture are all unanticipated benefits generated by funding what might have been envisioned as simply making maps.

Fitting a piece into the circulation puzzle



David Ullman explains the output of a circulation model for Rhode Island Sound.

Rhode Island Sound is an important local resource, supporting valuable commercial and recreational fisheries, providing passage for vessels ranging from sail boats to cruise ships to oil tankers, and potentially being a site for offshore wind power generation. Although much is understood about the dynamics of water circulation in neighboring Long Island Sound, Block Island Sound, and the Massachusetts shelf, surprisingly little is known about circulation patterns in Rhode Island Sound. Modeling studies have hypothesized the existence of a current flowing counter-clockwise in Rhode Island Sound, but there are no data available to verify or disprove this idea. To address this gap in our understanding, a research and modeling study, **Observations of Rhode Island Sound Circulation and Hydrography: Interaction with Massachusetts Shelf Waters** (David Ullman, Associate Marine Research Scientist, URI Graduate School of Oceanography), is designed to collect information in areas where little or none currently exist. The research team will place continuous-recording instrument arrays along the border of Rhode Island Sound and the Massachusetts shelf, and in several locations within Rhode Island Sound. The data, collected in three-month periods, will then be fed into circulation models to create a more accurate picture of how currents behave in Rhode Island Sound. This information will aid scientists in better understanding how Rhode Island Sound interacts with adjacent water bodies, and how these interactions influence the ecology of the region as a whole. Results of this research will feed back directly into ongoing research, benefitting the regional research community at large.

Digging into the past for climate change clues

Sediment pours into Narragansett Bay daily from rivers, streams, and runoff coming directly over the landscape, while pollen, dust, and windblown particles end up in surface waters on the bay. Eventually all these particles end

up sinking to the bottom and becoming incorporated into the sediments. Fortunately, all of the particles carry chemical clues to their origins and to the conditions of the environment during the time when they entered the bay ecosystem. This allows scientists to extract cores from the bay bottom that they can use to reconstruct an environmental history for Narragansett Bay and its watershed that reaches back centuries. And that is precisely what **A Multi-Proxy Reconstruction of Anthropogenic-Induced Productivity and Spatial Coupling in Narragansett Bay** (Warren Prell, Professor of Geological Sciences, Brown University) is doing. Using Narragansett Bay sediment cores, Prell is reconstructing history—over a 500-year time span—in terms of biological response to recent global warming trends, the urbanization and industrialization of the bay watershed, and the onset of major land-use changes. Comparison of cores taken from the urbanized upper bay, mid bay, and more rural lower bay will help tell a story of human impact to Narragansett Bay. More importantly for ecologists, however, a story of ecosystem alteration as a result of changing climate may emerge that will help them better comprehend the interplay of human domination and climate change impacts on not only the Narragansett Bay ecosystem but also at regional, if not global, scales.

Urbanization and water quality in upper Narragansett Bay

Estuarine modeling is a tool commonly used to guide water quality management in urban areas. Because of the complexities involved in modeling estuarine waters—a blend of freshwater and saltwater—the models are often overly simplistic. Furthermore, urban estuaries are often highly engineered, with hardened shorelines, dredged channels, and other manmade features that influence current flows in very complicated ways. The problem is that while models are helpful in understanding what is going on, they often don't mimic reality very well. Models can of course be improved, but it takes sophisticated effort and determination to do so. **The Role of Environmental Forcing and Local Geometry on Flushing and Water Quality in Urban Marine Ecosystems** (Chris Kincaid, Professor, URI Graduate School of Oceanography) will undertake such an effort, working to improve modeling capabilities for management of water quality in upper Narragansett Bay, particularly the Providence River and Greenwich Bay. This is a timely project in that current management schemes are targeted at significantly reducing nutrient inputs to the bay to improve water quality—fewer algae blooms and less hypoxic (reduced oxygen content) water, for instance—with ecosystem health being enhanced as a result. The resulting model can be used by resource management professionals to better understand, and perhaps predict, cause-and-effect scenarios in the urban Narragansett Bay marine ecosystem, such as what impacts nutrient reduction programs will have.

Combating marine disease outbreaks

Changing climate is allowing a northward migration of southern diseases, and oysters could be a prime target.

Aquaculture is fast becoming a major source of protein for an ever-growing human population. One of the biggest challenges to increasing aquaculture production is bacterial disease outbreaks, which limit production and result in an annual loss of millions of dollars to growers. Pharmaceuticals are most often used to combat disease outbreaks in aquaculture operations, but they are expensive solutions and can have significant environmental consequences. **The Role of Interspecies Interactions in Mitigating Diseases of Marine Animals** (David Rowley, Associate Professor, URI Biomedical Sciences) will explore natural pathways for combating disease outbreaks in crustaceans and in bivalves. Researchers will study how various species of bacteria interact with one another, specifically looking for interactions that prevent infections and their subsequent spread, and then devise ways to exploit these interactions at scales that are practical for application in aquaculture operations, particularly with regard to oyster culture. Findings from this research study have clear implications in the growing field of probiotics—using live microorganisms to confer health benefits to host organisms. Research findings will also provide insight into the biology and ecology of the various microorganisms being studied, which will in turn be useful to others researching new ways to combat marine diseases. Research results will have use close to home as well—as climate changes, marine diseases once restricted to southern areas are expanding their range to the north, and oyster growers are concerned. Results from this research just might help them find ways to keep our marine waters disease free, and keep Rhode Island as a leading producer of top quality oysters.

Helping coastal communities cope with climate change

Global warming due to changing climate presents many challenges to coastal communities. Rising sea level and an increased number and intensity of storms are major ones, with significant repercussions. Businesses, private dwellings, and public infrastructure located along the coastline are all facing increased risk of flooding and threat of destruction or serious damage in the future. And the future will be here sooner than

Hurricanes are a harbinger of global climate change.

expected as scientists continue to find that climate change impacts are happening much faster than anticipated or projected. Since Rhode Island is the Ocean State, this is a serious situation that communities must begin to grapple with now. In a collaborative approach to addressing the problem, **Linking Natural, Behavioral, and Communication Sciences to Enhance Coastal Community Wellbeing in the Face of Climate Change** (Pamela Rubinoff, URI Coastal Resources Center/Rhode Island Sea Grant), is bringing experts from different fields together to assist Rhode Island communities in finding a way forward. The collaborative team will gather the latest and best science available on changing climate and its impacts, and will work with communities to help them understand the science, the projected impacts, and the uncertainty involved in both. Faced with uncertainty, individuals, and the communities they make up, are often unwilling to commit to a path of action because of the risk involved. The collaborative team will address this issue by implementing a process of shaping and changing behaviors, at both individual and community levels, that will address the issue of risk and help people enter an action-taking phase. Such an undertaking is a risk in itself, but the benefits—Rhode Island communities that are implementing actions to address impacts of changing climate—is well worth it.

For updates on findings from Rhode Island Sea Grant funded research, visit our website at **seagrant.gso.uri.edu.**

"Black Point Pentrametos (Detail 1)" by 2000 Rhode Island Sea Grant Visual Arts Award winner Lilla Samson. Image courtesy the artist.

Ronald C. Baird Sea Grant Science Symposium

Scientific research findings are often shared primarily in specialized, highly technical journals that are read only by other researchers. While that is the foremost mechanism for getting new information to other specialists in the field—a critically important function within the scientific community—it does not provide readily usable information to resource managers and decision-makers who need it on a practical, day-to-day basis.

The Ronald C. Baird Sea Grant Science Symposium is an example of outreach at its best—science being interpreted and made available for applied use to address current problems.

To address this issue, Rhode Island Sea Grant sponsors the annual Ronald C. Baird Sea Grant Science Symposium. The symposium has been developed as a forum for researchers, resource managers, decision-makers, and other stakeholders to discuss the state of the science in areas important to Rhode Island's coastal communities. Topics have included the ecology of marine wind farms, developing and maintaining vibrant waterfronts, and the science of Rhode Island and Block Island Sounds. The focus is always on opening a dialog—sometimes heated and sometimes controversial—between the scientific research community and potential beneficiaries and users of research findings.

Topics have included vibrant waterfronts and the ecology of marine wind farms.

In 2010, the focus of the symposium is on emerging marine diseases, with a spotlight on lobster shell disease, an issue of great importance to the local and regional lobster fishery. The 2011 symposium is tentatively set to focus on the issue of sustainable seafood—what it means and how to attain it.

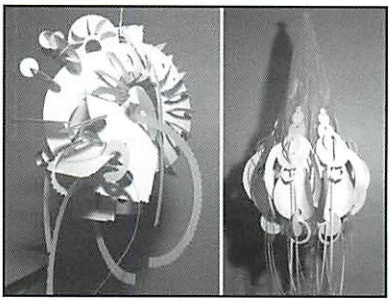
Visit **seagrant.gso.uri.edu/baird/** for details on past and future symposia.

Lobster shell disease is a feature of the 2010 symposium.

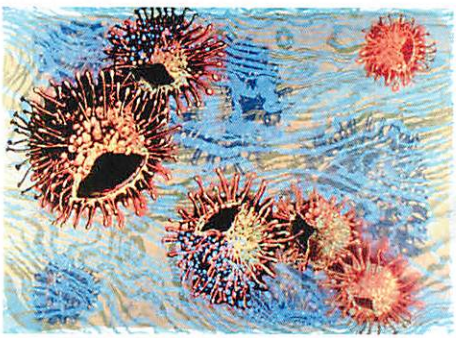
Rhode Island Sea Grant Visual Arts Awards

Rhode Island Sea Grant realizes that technical treatment of scientific knowledge, while useful for many purposes, is not the only mechanism by which to broaden our understanding of the marine realm.

Color, form, and function shape life beneath the waves, and for over 20 years Rhode Island Sea Grant has supported artists who portray these characteristics in works that challenge observers to consider the marine landscape and its inhabitants in new, interesting, and perhaps provocative ways.



Images courtesy 2008 Visual Arts Award winner Kim Salerno, who is creating an installation, "White Sea," of cut paper organisms from the marine environment.



"Fire Adrift in a Drop of Sea" and "Black Point Fragment #2" by 2000 Visual Arts Award winner Lilla Samson. Images courtesy the artist.

The Visual Arts Sea Grant program, run by the URI Department of Art and Art History, was established in 1988 to encourage New England artists to address the issue of the environment of the ocean and its coastal communities. Grants are intended to financially assist individuals and/or collaborating artists whose works are related to themes of the marine environment.

During the 2010–2012 omnibus period, Rhode Island Sea Grant is expanding its support of the Visual Arts program to engage a larger number of artists and to better share the works of the funded artists with the public.

For more information, visit **www.uri.edu/artsci/art/grant.php**.

Education

Rhode Island is fortunate to have several groups, most notably the URI Office of Marine Programs, that provide high quality marine educational programs for K–12 students. Rhode Island Sea Grant, because of its location and integration within a research university, focuses its educational efforts on providing graduate and undergraduate students, who are the marine decision-makers of tomorrow, with opportunities to learn and build professional skill sets.

Student opportunities

Rhode Island Sea Grant believes that providing students with experiential learning will improve science, management, and the future of marine ecosystems. Therefore the program is initiating more educational opportunities that offer students a chance to test out career paths and build their resumes while working hands-on in collaboration with marine science professionals.

Rhode Island Sea Grant supports the URI Coastal Fellows Program, the Rhode Island Sea Grant Law Fellows Program, which is being expanded in 2010, and the URI Sustainable Seafood Fellows. Rhode Island Sea Grant also nominates local graduate students to the National Sea Grant Knauss Marine Policy Fellowship Program, the National Sea Grant Industry Fellowship Program, the National Marine Fisheries Service (NMFS)/National Sea Grant Fisheries Science Graduate Fellowship Program, and the Coastal Services Center Coastal Management Fellowship.

In addition to these research-oriented opportunities, Rhode Island Sea Grant is planning more internship positions for graduate and undergraduate students looking to work in communications and marine extension program activities.

Public programs

Rhode Island Sea Grant believes that learning is a lifelong endeavor, and therefore offers a suite of lectures and on-board and in-the-field learning experiences to community audiences to help them better understand and appreciate coastal ecosystems. Rhode Island Sea Grant seeks to reach new audiences through enhancing annual programs such as the consumer lecture series and Coastweeks. To find out more about our upcoming public programs, please regularly visit our website, **seagrant.gso.uri.edu**.

You never know what you'll catch on a Coastweeks trawl trip.

Sustainable Coastal Communities Extension Program

The Sustainable Coastal Communities Extension (SCCE) Program, located at the University of Rhode Island's Coastal Resources Center, partners with state and local governments and coastal community members to create policies—based on research findings—that help them manage their resources more effectively and efficiently. Response to global climate change is a theme that runs throughout SCCE initiatives.

The program is helping bring Rhode Island to the national forefront in ecosystem-based management of coastal resources. For example, the program is developing an innovative marine spatial plan for Rhode Island's offshore waters that considers the emergence of renewable energy resources development, such as wind farms. It is also honoring its longtime commitment to Rhode Island coastal industries with several firsts, including developing an inventory of the state's ports and harbor facilities for economic planning purposes, and conducting a Newport Harbor economic study so the city can base its planning strategies on pertinent data.

R.I. Ocean SAMP research is examining offshore ecology, habitats, physical properties, and human uses, among other topics.

Secure ecosystem-based management for Rhode Island's offshore waters by engaging in marine spatial planning

The R.I. Ocean Special Area Management Plan (SAMP) builds on Rhode Island Sea Grant's 30 years of experience in marine spatial planning. This effort is helping the state develop tailored, place-specific plans to manage and protect its coastal resources, and applying science and innovation to solving marine-based issues. With national attention upon it, the Ocean SAMP is a marine spatial plan that looks comprehensively at the offshore area's characteristics, resources, uses, and constraints. It combines research by experts in a variety of fields with the input of stakeholders representing numerous user groups.

The plan is intended to guide the development and protection of ocean resources, and to aid in determining appropriate and compatible roles for offshore renewable energy develop-

SCCE staff seek to help the public understand marine spatial planning in Rhode Island.

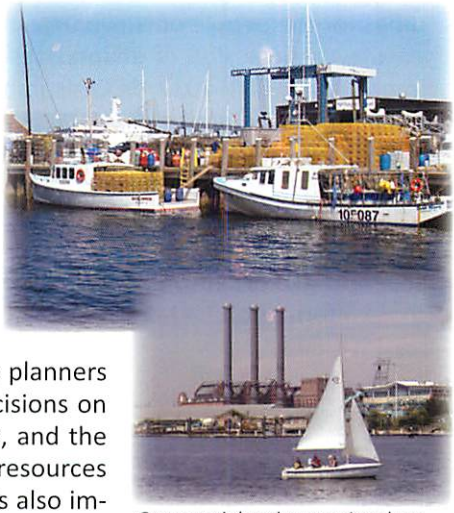
ment. It is the intent of the SAMP to assist the state in adapting to global climate change, as well as facilitate coordination between state and federal agencies and the people of Rhode Island.

Because of growing interest in managing the uses of offshore resources, the developing SAMP is already being considered a regional and national model of marine spatial planning, providing for an iterative process to organize marine space, balance uses, and achieve social and economic objectives. In fact, the effort was lauded by the Ocean Renewable Energy Coalition in a report to the Ocean Policy Task Force as being "at the vanguard of marine spatial planning" in the nation.

The Ocean SAMP started in 2008, with research and public education taking place in 2009, with a policy document to be produced in 2010. Visit **seagrant.gso.uri.edu/oceansamp** for more information.

Creating diverse and vibrant waterfronts for Rhode Island

Ports and harbors project



Commercial and recreational use of the waterfront is critical to the Rhode Island economy.

In 2008–2009, SCCE established a Rhode Island Ports and Commercial Harbors Inventory and Planning Study for incorporation into the State Guide Plan. The study provided the first single, comprehensive source of data that identified and quantified the assets, facilities, and infrastructure of Rhode Island's multiple ports and harbors. This information will help planners assess the impact of development decisions on communities, other ports and harbors, and the economic, environmental, and social resources of Narragansett Bay. This information is also important because harbors may provide solutions to many of Rhode Island's future problems with freight transportation, traffic congestion, and economic development. The initial study phase focused on commercial and industrial harbors, and in 2010–2012 the second phase enhances the study with recreational harbor information (e.g., marinas) and provides technical assistance to the state and municipalities so they can use these data to plan waterfront redevelopment more effectively and cohesively.

Newport Harbor

The goal of this project is to foster a Newport Harbor waterfront that contributes to the economic and social well-being of Newport and the state. SCCE's work with Aquidneck Island communities started in 1995 when they sought assistance with identifying a futuristic vision for the island. Since then, with public and private support, SCCE has collaboratively provided the island with scientific and coastal management expertise, building the capacity of local decision makers and the community to protect and enhance their coastal resources. Projects include development and implementation of a $1 million-plus West Side Master Plan, a pioneering set of Coastal Smart Growth Principles, and the initiation of the island SAMP process, which is still underway.

SCCE is also in the midst of helping Newport develop and implement an innovative plan for harbor development. The program is working with government, citizens, and private industry to identify key economic, social, and environmental needs for the harbor, and is helping to develop a unifying vision for the waterfront. SCCE has also worked with a citizens group—Friends of the Waterfront— to enhance and connect existing public access and identify new public access opportunities.

The harbor plan focuses on building and leveraging new economic opportunities for the people of Newport, but is also mindful of the pressing need to ensure the inclusion of adaptations for climate change and natural hazard impacts. In 2008–2012, SCCE is implementing an economic study to fill in substantial data gaps standing in the way of the community's ability to make sound decisions in support of their harbor vision. Visit **seagrant.gso.uri.edu/ai** for more information.

A mix of waterfront uses is a principle of coastal smart growth.

Fisheries Extension Program

The Fisheries Extension Program conducts applied research and extension activities to support the long-term sustainable use of fishery resources. The Fisheries Extension program implements projects that create knowledge, educate stakeholders, and help develop the social networking structures that promote collaboration to address problems.

Fisheries Extension brings stakeholders together to find solutions to a variety of fisheries issues.

Today's fisheries focus on catching fewer fish with greater value using less effort and with less habitat alteration. This paradigm shift is occurring in a world confronted with global climate change that is shifting abundance and distribution of marine organisms, imports and exports of seafood that raise questions of safety and quality, and technology that accelerates the pace of globalization. Fishermen, environmental groups, and fisheries managers are helping design solutions that balance social, biological, economic, legal, conservation, and resource exploitation goals.

The major focus areas of the Fisheries Extension program include the science, engineering, and testing of gear design; improving knowledge and building capacity for developing innovative management; and increasing the value of the health benefits from the resource.

Rhode Island's commercial fishing fleet faces environmental, economic, and regulatory change.

Gear technology transfer program

The reduction of unwanted bycatch continues to be a driving force in fisheries management, and fishermen and gear specialists are continually modifying equipment to reduce bycatch, increase profit, and reduce carbon emissions.

This control net was used in the testing of an innovative gear design, developed by fishermen, to reduce bycatch.

Fishermen are generally the best sources for gear design ideas, but they often have difficulties with developing a proof-of-concept project to obtain financial support for testing their ideas. Fisheries Extension in 2010–2012 continues assisting fishermen in developing novel gear concepts, presenting findings, and seeking research funding. The program is also taking advantage of partnerships with Memorial University in Canada and the Centre for Environment, Fisheries and Aquaculture Science in the U.K. to utilize their cutting edge technologies and equipment to test and observe gear underwater prior to commercial-scale testing. For example, one study will further investigate the use of the Eliminator trawl to capture flounder while releasing cod. Camera systems will be used to evaluate the differences in behavior between the species and modified net designs. These findings can then be used to inform flounder management.

Innovative management

In an attempt to improve fisheries management, new innovative methods are currently being evaluated, including sector management and ecosystem based approaches. In Rhode Island, the first sector allocation project for summer flounder, or fluke, was approved in 2009. Fisheries Extension has assisted the industry and regulators in monitoring the effects of this program. In 2010–2012, Fisheries Extension is sponsoring a workshop on the pilot fluke sector that will be cosponsored by the environmental community, management agencies, and fishing organizations, incorporating results from a Sea Grant-funded research project that evaluated sectors as management tools. Results from these research projects, as well as other regional initiatives, will be discussed, and lessons learned will be highlighted for application to management.

Fisheries Extension is also working to engage Rhode Island fishermen in a discussion of ecosystems and their management to develop an ecosystem approach. The first step is a survey to determine their understanding of ecosystems and what the roles are of fishermen and other resource users in the ecosystem. The second step is a workshop to educate fishermen about ap-

proaches to ecosystem-based fisheries management. The final step will be an opportunity for the fishermen, with their new knowledge, to explore issues and to try to define their role in ecosystem-based fisheries management.

One of the most significant aspects of ecosystem-based approaches is the fate of bycatch and discards. Mortality of fish, whether by design or accidental capture, must be accounted for in stock assessment and management, especially in setting quotas. Assumptions that discarded bycatch have high mortality rates have contributed to more restrictive quotas. Research has indicated that testing a variety of reflexes on fish that are being discarded provides information regarding their likely survival. Fisheries Extension has developed a reflex action mortality predictor (RAMP) index that appears to predict mortality of trawl-caught summer flounder with a relatively high degree of accuracy. In 2010–2012, Fisheries Extension is conducting collaborative research with the recreational fishing and/or commercial fish trap community, applying the RAMP method to document behaviors upon release using diving and underwater camera. Results will be used to influence management policies by providing hard data to challenge existing assumptions.

Summer flounder are the subject of a study to determine their survival upon release.

Health benefits, quality, and safety of seafood

While research has shown the extraordinary health benefits of seafood, those benefits mean nothing if seafood is improperly handled, since it can also produce serious food-borne illnesses. In 1997, the Food and Drug Administration Hazard Analysis and Critical Control Point (HACCP) program went into effect and requires seafood processors to follow a prescribed food safety system. The HACCP program is dynamic, as the seafood hazards and the ways of controlling or eliminating them are always evolving. Fisheries Extension, jointly with URI Cooperative Extension, has long been integrally involved with Sea Grant programs nationally in educating all target audiences, including general consumers, health care providers, and industry. In 2010–2012, Fisheries Extension is working to help update the HACCP curriculum, provide training, and conduct preliminary research on the inhibition of the bacteria *Listeria*—which is the cause of listeriosis, an uncommon but potentially lethal food-borne illness—by the use of spices in seafood preparation.

For more information about Fisheries Extension, visit **seagrant.gso.uri.edu**.

The Rhode Island Sea Grant Legal Program

The Rhode Island Sea Grant Legal Program, located at the Marine Affairs Institute at Roger Williams University (RWU) School of Law, is one of only four Sea Grant Legal Programs in the country and the only one in the Northeast. As management issues become increasingly (and rapidly) more complex, the Legal Program plays an important role in educating the next generation of marine policy professionals. It also provides legal research to constituents, and acts as a clearinghouse for information sharing among regional and national marine law and policy practitioners.

Education

Sea Grant Law Fellows

Sea Grant Law Fellows are law students who are competitively selected to conduct legal research and analysis for constituents on marine law questions in major thematic areas such as marine ecosystems, sustainable communities, sustainable fisheries, and admiralty law issues. Examples of previous projects include research on invasive species impacts, impacts of fisheries management decisions, alternative energy legal issues, and ownership of submerged bottom lands.

Sea Grant Law Fellows provide affordable, quality legal research.

Students receive a tremendous benefit from applying in-class knowledge to real-world situations, interacting with constituent groups, producing a quality work sample, and developing professional skills and personal contacts to assist them in future employment. Clients get high-quality research, performed under the supervision of Legal Program attorneys, that assists them in problem solving and decision-making.

Curriculum

Legal Program staff play an essential role in the instruction and oversight of the marine law curriculum at the RWU School of Law, one of the country's leading comprehensive marine law programs. Staff teach marine law and policy topics, and advise the law school on curriculum offerings to help ensure students develop the skills they need as marine law professionals.

Joint-Degree Program

View from RWU campus, which hosts the Rhode Island Sea Grant Legal Program at the Marine Affairs Institute.

The Legal Program supports the joint-degree program offered by the RWU School of Law, in conjunction with the URI Department of Marine Affairs. This program is one of only two in the country that provide students intensive, interdisciplinary study of marine law and policy through RWU's excellent marine law curriculum and URI's renowned marine affairs program. Joint degree students complete both the Juris Doctor and Master of Marine Affairs degrees by combining course work at the two institutions to reduce the overall time necessary to obtain the two degrees. Graduates of this program are now working in government, nonprofit, private, and academic settings.

Outreach

The Legal Program provides a neutral forum for gathering state, regional, national, and international marine law and policy experts, and exports its expertise through diverse outside venues.

Symposia and other events

The biennial Marine Law Symposium, held at the RWU School of Law, will continue to be a centerpiece of the Legal Program's outreach activities. Symposia address issues that are topical, relevant, interdisciplinary, and rigorous in legal content. Previous symposia have addressed topics such as the management and legal implications of ecosystem-based management as it pertains to New England, and marine renewable energy development in Rhode Island. In 2010, the symposium will examine the Magnuson-Stevens Fishery Conservation and Management Act.

Law Fellow Colloquium

The Legal Program is launching an annual spring Law Fellow Colloquium at the URI Bay Campus, where Law Fellows present their research to an audience of faculty, staff, and constituent groups. This event will enhance the student experience by providing them a formal presentation opportunity, highlight the legal research conducted through the Legal Program, enhance understanding among the partner organizations of Law Fellow research and constituent needs, and provide for professional networking opportunities for Fellows and partner organization staff.

Research

The Legal Program continues to produce quality, relevant research during 2010–2012 to serve diverse constituents. Staff focus on topics such as renewable energy law and policy, marine spatial planning legal and policy issues, and ocean management reform. Law Fellow research, supervised by Legal Program staff, will continue to address client needs in a variety of areas.

New England Ocean Law Collaborative

During 2010–2012, the Legal Program is establishing the New England Ocean Law Collaborative. This initiative will utilize the activities surrounding siting of offshore wind energy facilities off Rhode Island, Massachusetts, and Maine to coordinate the limited legal resources supporting each state's activities. It will also allow states to better share information, leverage limited capacity, and avoid duplication, will provide a forum for lessons learned so that mistakes are not propagated.

For more information on the Legal Program, visit **law.rwu.edu/sites/marineaffairs/.**

The New England Ocean Law Collaborative is addressing offshore wind energy issues.

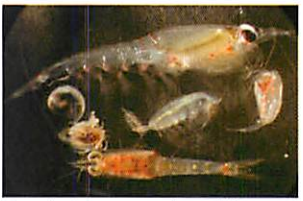
Program Development

Rhode Island Sea Grant funds promising marine/coastal projects that need to first gain proof-of-concept status. Such projects are often the brainchild of an academic entrepreneur who needs start-up funds to test an idea before seeking more robust funding. Rhode Island Sea Grant looks for promising science investments that may fuel significant benefits from a small infusion of funds. In 2010–2012, program development funds are being used to investigate the acidification of Narragansett Bay, to continue building the Sustainable Seafood Initiative started in 2008, and to promote the development of integrated seaweed–oyster aquaculture in a Rhode Island coastal lagoon ecosystem. Also supported is a regional Sea Grant research initiative ongoing in the Gulf of Maine.

Investigating the acidification of Narragansett Bay

This project assesses the current acidification status of Narragansett Bay and predicts the effects on the bay of continued acid build up and changing pH over both short- and long-term time scales. The implications of this are significant enough that Rhode Island Sea Grant is providing funds to complete initial analytic work to establish a baseline for acidification and assessment of risk to the bay ecosystem.

The burning of fossil fuels is one of the primary sources of atmospheric carbon, which is readily taken up or absorbed by the ocean, making the ocean more acidic. Oceans are measurably more acidic than they were 100 years ago, and if this shift continues, it will have dramatic adverse impacts on marine life. For instance, in some coastal ecosystems along the Pacific coast of the United States, researchers are finding clams, oysters, and mussels whose thin shells are making them less able to resist predation by crabs. Increased acidification of ocean waters means there is less calcium carbonate available for crustaceans—lobsters, for instance—to incorporate into their shells, and so the shells become thinner.



Zooplankton are vulnerable to increasing ocean acidity. Image courtesy NOAA.

While the effects of ocean acidification have been studied in the open ocean, little is known about the status and impacts of acidification in a coastal estuary like Narragansett Bay, where pH levels fluctuate more widely than they do in open ocean ecosystems. But the impacts may be as dramatic, if not more so: the pelagic food webs of Narragansett Bay have been traditionally structured around zooplankton—small crustaceans that build shells and are susceptible to changing pH—and shifts in zooplankton abundance could have significant impact on the overall ecology of Narragansett Bay.

Sustainable seafood efforts move information from academy to marketplace

Rhode Island Sea Grant invested in the development of the URI Sustainable Seafood Initiative in 2008–2010 to provide independent, unbiased information on the issue of sustainable seafood, the various approaches being used to promote demand for sustainable seafood, and the effectiveness of those approaches.

Is the seafood you had for dinner grown or harvested in a sustainable fashion? The URI Sustainable Seafood Initiative can help provide answers.

One of the fruits of this initiative has been the development of a website that hosts a searchable database of reports addressing fisheries and aquaculture certification, consumer preferences for ecolabeled seafood, international trade implications, and other related issues to provide visitors with access to as wide a perspective of reputable research as possible. The lead researcher for this initiative, Cathy Roheim, with a number of co-authors, recently published an article in *Science* focused on the economics of sustainable seafoods.

Sea Grant continues support for this bold initiative and is providing support to develop an innovative partnership among Sea Grant, the University of Rhode Island, and Johnson & Wales University, a leading culinary school, to better share science-based outreach information with the marketplace and the restaurant trade.

For more information, visit the URI Sustainable Seafood Initiative website at **seagrant.gso.uri.edu/sustainable_seafood/**.

Growing seaweed and shellfish together for increased food production and improved water quality

Rhode Island Sea Grant is investing in an integrated aquaculture experiment to assess the effectiveness of adding seaweed cultivation to an innovative shellfish farm in one of Rhode Island's south shore lagoon ecosystems, i.e., the salt ponds.

Through this project, a local aquaculturist, Perry Raso, is working with a Rhode Island Sea Grant–sponsored Coastal Fellow to cultivate seaweed at

commercial scales, to develop a training program for extension specialists and aquaculturists to integrate seaweed production into shellfish farm operations, and to explore the local market for "sea vegetables" in both the supermarket and restaurant trades.

Sea Grant–supported URI Coastal Fellow Ariel Tobin explores cultivating edible seaweed along with oysters in Potter Pond. Photo courtesy URI.

This project has several potential benefits, including assessing the economic benefits of cultivating two species in one location, as well as improving the water quality of the shellfish operation—seaweed consumes nutrients, thus cleansing the water column. Success means a win-win situation economically and ecologically.

Working collaboratively at regional scales

Rhode Island Sea Grant, as part of the Northeast Sea Grant Consortium, supports regional efforts to improve stewardship of coastal resources, in recognition that ecosystems are not constrained by political boundaries and that human activities have far-ranging impacts. The program's investments in regional initiatives are intended to support new research, improve scientific information sharing, and foster regional planning and coordination activities.

For this omnibus period the Northeast Sea Grant Consortium is supporting the National Sea Grant Gulf of Maine Regional Planning Initiative, which produced its science plan for the Gulf of Maine in 2009. The consortium is providing funding for two peer-reviewed science projects, one focused on invasive species and another on marine spatial planning, as identified in the Gulf of Maine Regional Ocean Science Plan.

As part of another regional initiative to the south, Rhode Island Sea Grant is engaged in the National Sea Grant New York Bight Regional Planning Initiative. In 2010–2012, Rhode Island Sea Grant is assisting New York Sea Grant to develop a workshop entitled "Is Science Properly Informing Decision-Making for Public Investments for Nutrient Control in the New York Bight Region?" This workshop is intended, in part, to define needed research in the New York Bight ecosystem and to develop a summary management plan to guide Sea Grant's future regional investments.

For more information on Program Development–funded projects, visit **seagrant.gso.uri.edu**.

41°N

41°N is a magazine that is produced twice a year in partnership between Rhode Island Sea Grant and the URI Coastal Institute. This publication serves not only to keep readers informed of the programs' activities and research findings but to bring them science-based perspectives on critical issues such as climate change. The name *41°N* is taken from the degree of latitude at which Rhode Island is located, but it also represents the concept that many of these issues are of concern around the world.

To read *41°N* online, visit **seagrant.gso.uri.edu/41N**. To receive *41°N* by mail, contact Rhode Island Sea Grant at (401) 874-6800 or 41n@gso.uri.edu.

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