THE UNIVERSITY OF RHODE ISLAND
GRADUATE SCHOOL OF OCEANOGRAPHY

2017 ANNUAL REPORT

R/V *Endeavor* moored at her home pier.

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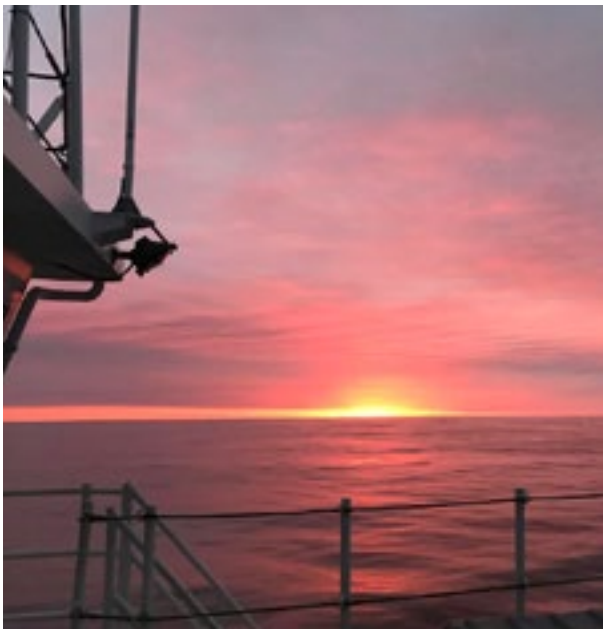


PHOTOS: (LEFT) COURTESY OF *ENDEAVOR* CREW, (ABOVE) J.P. WALSH, (RIGHT) ALEX DECICCIO.

FROM THE DEAN

One of the defining characteristics of the Graduate School of Oceanography (GSO) is the breadth of activities pursued within the school and the impact they have on the state of Rhode Island. The 2017 GSO Annual Report reflects this tradition with a broad range of important and timely topics pursued by our faculty, staff and graduate students to address research, education and outreach objectives.

GSO has had a strong partnership with the state of Rhode Island over the years and nothing exemplifies this better than research on Narragansett Bay. “Changes in Narragansett Bay: A Conversation Among Citizens and Scientists” was the theme for the Rhode Island Sea Grant Ronald C. Baird Sea Grant Science Symposium. Hosted at GSO, this event facilitated discussion among diverse stakeholders interested in the health of the bay’s ecosystems, and GSO contributed the latest scientific findings to inform the discussion.

In addition, last year we made significant inroads in developing public-private partnerships. Culturing bluefin tuna has been a holy grail of aquaculture due to its high economic value and the effects of fishing pressure on wild-caught populations. An article on the research efforts to culture bluefin on the Narragansett Bay Campus documents the progress being made by Greenfins, a private company, in collaboration with GSO and the College of the Environment and Life Sciences, in growing these highly sought fish to marketable size. This partnership will serve as a model for future partnerships with Rhode Island companies.

This report includes profiles of three faculty members’ exciting work. Professor Rainer Lohmann is the director of a new National Institutes of Health Superfund Research Center that will study the health risks of industrial chemicals with an $8 million grant. Professor Isaac Ginis’ research focuses on the role oceans play in hurricane intensity and is widely used by forecasters and government agencies. Ginis is currently leading a U.S. Department of Homeland Security project relating his work in hurricane prediction to coastal resilience. Assistant Professor Matt Wei joined the GSO faculty in 2016 and received a prestigious National Science Foundation Early Career Development Award to research ocean earthquakes and improve prediction of earthquakes on land.

We also highlight new faculty members—Assistant Professors Roxanne Beinart and Kelton McMahon, and Professor J.P. Walsh—who arrived at GSO in 2017. Over the last six years, GSO has hired some of the best young oceanographers in the country, and these new hires now comprise 20 percent of the faculty. GSO will continue to invest in new faculty to position the school and the University of Rhode Island to respond to emerging themes in oceanographic research for years to come.

The activities in this report build on a foundation of cutting-edge research, outreach and education that GSO has conducted for over 50 years—work that has had a significant impact on Rhode Island and beyond. As we look to the future of GSO and the Narragansett Bay Campus, we are committed to providing critical information needed to manage Rhode Island’s coasts, as well as coastal areas throughout the world’s oceans, and to contributing to a better understanding of oceanic environments.

“The activities in this report build on a foundation of cutting-edge research, outreach and education that GSO has conducted for over 50 years—work that has had a significant impact on Rhode Island and beyond.”

Best wishes,

Bruce H. Corliss, Dean

FINANCE AND ADMINISTRATION

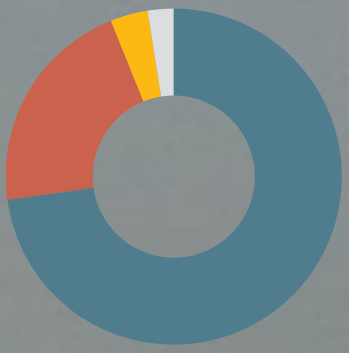
James W. Patti
Director of Administration

In FY17, the Graduate School of Oceanography expended over $40 million in funding provided by federal, state and private sponsors in support of our research, educational and outreach missions. The appropriation from the State of Rhode Island, just shy of $10 million, provides a base of support that enables our faculty and staff to successfully compete for sponsored funding from the National Science Foundation (NSF), the National Oceanic and Atmospheric Administration (NOAA), the U.S. Agency for International Development (USAID), the Department of Defense (DOD), and other federal agencies. This sponsored funding resulted in $31 million in new awards for FY17. Of that total, $15 million—approximately half—is attributable to the oceanography faculty and marine research scientists; about $11 million in sponsored projects at the Coastal Resources Center; and nearly $5 million in supported R/V *Endeavor* operations and other programming. These figures are near record levels for the school and reflect positively on the outstanding caliber of our people in an era of tight federal funding for science. Collectively, this support allows the school to generate new knowledge through discovery and exploration, educate the next generation of scientists and policymakers, and share an understanding and appreciation for ocean science with the public.

As an administration, we are focused on operational excellence in support of the school's mission and to advance the priorities of Dean Corliss. We operate with lean budgets to manage the school's complex finances, maintain over 300,000 square feet of campus facilities, and ensure students are well-supported in our educational programs. The school employs a talented group of professionals working in a variety of functions and affiliated entities. Many staff have devoted their entire careers to the school, and we are fortunate to enjoy a low turnover rate with employees who are passionate about their work.

Over the next year, we will be focusing on securing new financial support for our strategic initiatives, primarily the campus-renewal initiatives outlined in our Master Plan. To that end, we have developed a philanthropic case statement (see p. 42) and will soon be enhancing our digital marketing capabilities. We believe these measures will provide a strong foundation for enhanced support from the public and private sectors in the years ahead.

FY17 REVENUES BY SOURCE

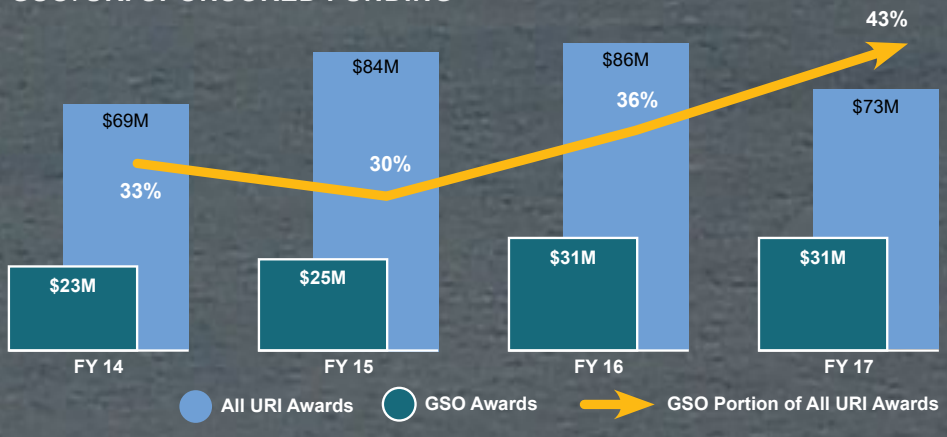


- Sponsored Funding. . . . 72.8%
- State Appropriation 21.1
- Overhead (GSO share) . . 3.7
- Gifts/Endowment. 2.4

FY17 SPONSORED FUNDING

- Faculty and Marine Research Scientists . $15M
- URI Coastal Resources Center 11M
- R/V *Endeavor* and Other Programs 5M

GSO/URI SPONSORED FUNDING



A view from the Narragansett Bay Campus: Claiborne Pell Bridge, Jamestown, and the West Passage of Narragansett Bay.

PHOTOS: (LEFT) DAVID SMITH, (ABOVE) J.P. WALSH.

FACILITIES AND OPERATIONS

David J. Palazzetti
Director, Narragansett Bay Campus Facilities and Operations

Renovation, Upgrades Revive Mesocosm

In 2017, the Facilities and Operations Department completed several renovation and improvement projects to meet the ever-evolving needs of GSO's research and teaching facilities.

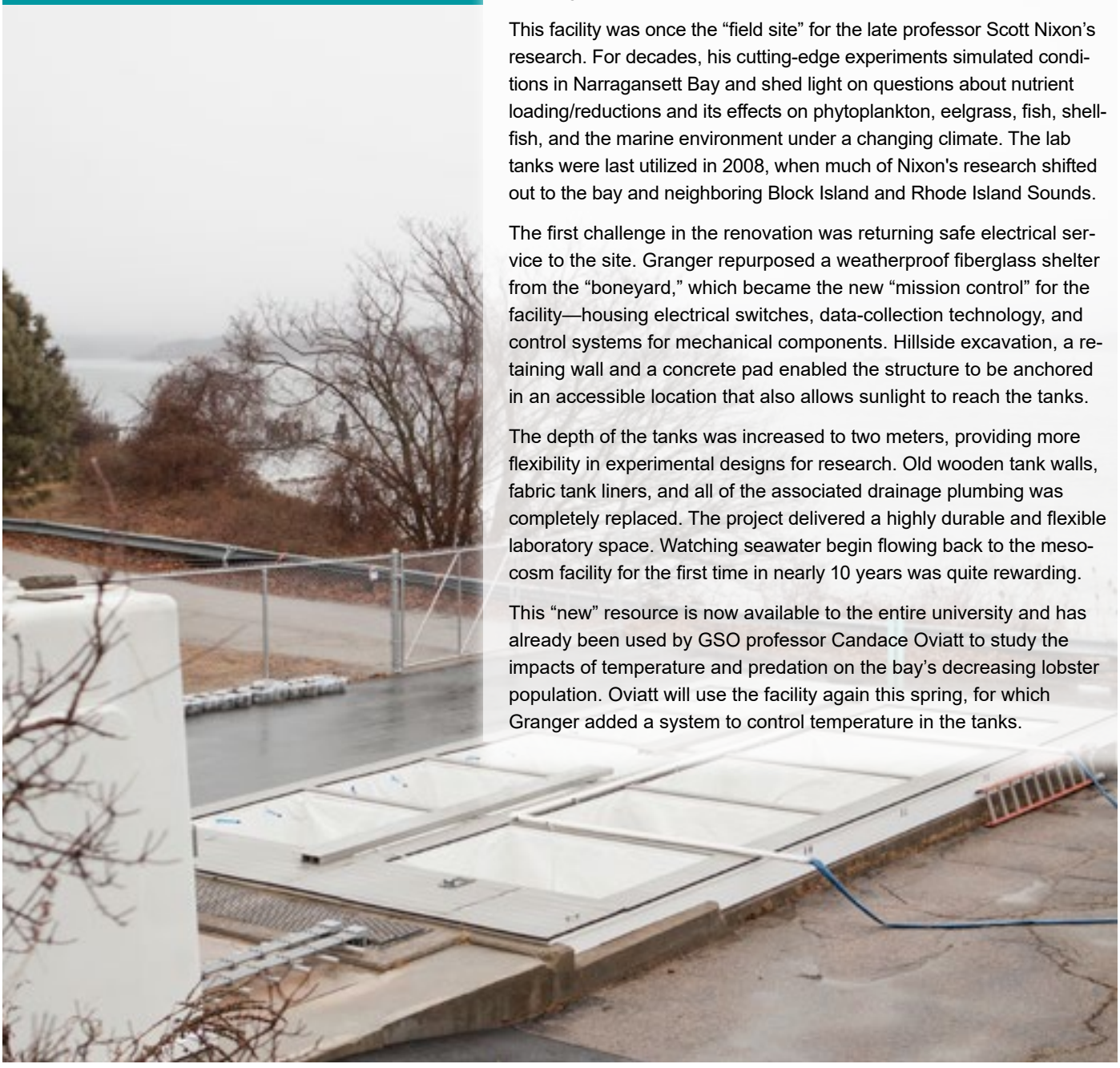
In the largest of these projects, Stephen Granger (MS 1994), GSO marine research associate, orchestrated a revival and modernization of the shallow-water mesocosm facility on Pier Road. The project—a jointly funded partnership between the Provost's Office, the College of the Environment and Life Sciences, and GSO—rebuilt infrastructure and upgraded and added features.

This facility was once the "field site" for the late professor Scott Nixon's research. For decades, his cutting-edge experiments simulated conditions in Narragansett Bay and shed light on questions about nutrient loading/reductions and its effects on phytoplankton, eelgrass, fish, shellfish, and the marine environment under a changing climate. The lab tanks were last utilized in 2008, when much of Nixon's research shifted out to the bay and neighboring Block Island and Rhode Island Sounds.

The first challenge in the renovation was returning safe electrical service to the site. Granger repurposed a weatherproof fiberglass shelter from the "boneyard," which became the new "mission control" for the facility—housing electrical switches, data-collection technology, and control systems for mechanical components. Hillside excavation, a retaining wall and a concrete pad enabled the structure to be anchored in an accessible location that also allows sunlight to reach the tanks.

The depth of the tanks was increased to two meters, providing more flexibility in experimental designs for research. Old wooden tank walls, fabric tank liners, and all of the associated drainage plumbing was completely replaced. The project delivered a highly durable and flexible laboratory space. Watching seawater begin flowing back to the mesocosm facility for the first time in nearly 10 years was quite rewarding.

This "new" resource is now available to the entire university and has already been used by GSO professor Candace Oviatt to study the impacts of temperature and predation on the bay's decreasing lobster population. Oviatt will use the facility again this spring, for which Granger added a system to control temperature in the tanks.



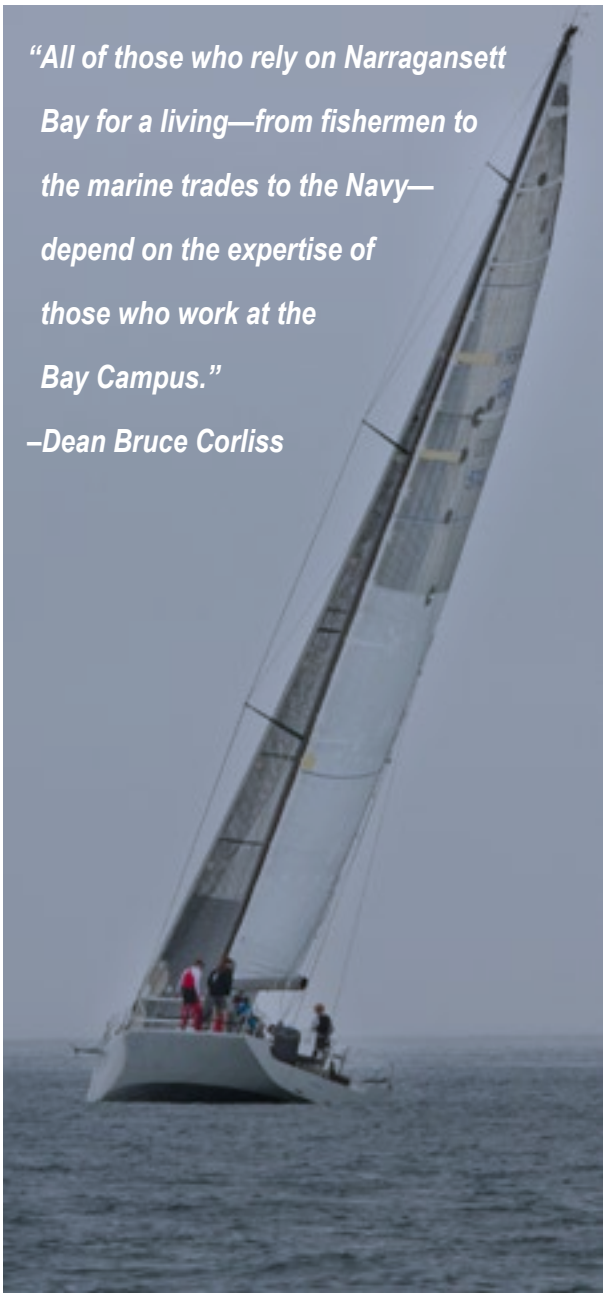
PHOTOS: (ABOVE) ALEX DECICCIO, (RIGHT) DAVID SMITH.

Anchoring the Blue Economy

URI's Graduate School of Oceanography educates the next generation of ocean scientists and provides critical expertise to policymakers and business.

A respected source of analysis and insights based on sound science, GSO convenes stakeholders from academia, government, and industry to support Rhode Island's Blue Economy—providing leadership, solving problems, and supporting sustainable growth.

RESEARCH AND DISCOVERY



"All of those who rely on Narragansett Bay for a living—from fishermen to the marine trades to the Navy—depend on the expertise of those who work at the Bay Campus."

–Dean Bruce Corliss

Building Sustainability in, on and around Narragansett Bay

GSO Initiatives Help Rhode Island's Marine-Based Industries Flourish

The annual Ronald C. Baird Science Symposium in December proved once again the crucial role that GSO plays in anchoring the economy of Narragansett Bay. The event, entitled "Changes in Narragansett Bay: A Conversation Between Citizens and Scientists," addressed concerns from many in the local fishing community that the dramatic reduction in nutrients discharged is making the water too clean and unable to support the abundance of fish it once did.

Sponsored by Rhode Island Sea Grant and the Coastal Resources Center, the event featured a crowd of fishermen sharing their first-hand observations and reacting to numerous scientific presentations about the current state of the bay and the implications of its cleaner condition.

PHOTOS: (LEFT) ALEX DECICCIO, (ABOVE) COURTESY OF R.I. SEA GRANT.

Monitoring fish stocks aboard the trawler *Captain Bert.*

Those in attendance were also challenged to identify pressing research topics that would shed additional light on the topic.

It's one of many examples during the year in which the school provided science-based evidence and guidance to workers in marine-based industries, so those industries can take the proper steps to remain vital contributors to the Rhode Island economy.

"Our talented faculty, marine scientists and staff truly are the centerpiece of the maritime enterprise in the state. They provide the crucial information and leadership to support the economic life of Narragansett Bay," said Dean Bruce Corliss. "All of those who rely on Narragansett Bay for a living—from fishermen to the marine trades to the Navy—depend on the expertise of those who work at the Bay Campus in order to continue to share in the wealth provided by this common resource."

Examples abound of how GSO-sponsored programs and events helped to boost the economic success of local marine industries.

For instance, Sea Grant and the Coastal Resources Center (CRC) launched the Rhode Island Shellfish Initiative in April to strengthen the partnership between the shellfish industry, researchers, government agencies and the community. The initiative, which included a yearlong series of public events, is bolstering the state's shellfish management practices and promoting growth and innovation in the local seafood industry.

The offshore wind energy industry in Rhode Island also received a lift from Sea Grant and CRC during a science forum in December. Industry representatives gathered with researchers and community members to examine issues raised by the Block Island Wind Farm as a way of improving the management and development of offshore wind energy in the region. In addition, a project to document the effects of the wind farm on Rhode Island recreation and tourism made great headway during the year.

Data was also compiled by CRC and Sea Grant to boost marketing efforts among those growing kelp and catching scup in Rhode Island waters. The project used interviews, surveys and information analysis to investigate how kelp is grown and sold in the region and how the supply chain for scup has evolved. The analysis is filling in gaps in the state's understanding of how these products could be incorporated in Rhode Island's comprehensive food strategy.

Sea Grant also sponsored the Coastal State Discussion Series, a forum that highlights current scientific research, seeks solutions, and builds partnerships around coastal communities and environments. The events bring together scientists, resource

managers, professionals and interested stakeholders to learn about marine and coastal-related research efforts and generate ways to use this knowledge in a way that best serves coastal communities and the environment now and in the future.

Perhaps the most comprehensive example of GSO's role in supporting the economy of Narragansett Bay in 2017 is a project by the Coastal Institute to determine the economic value of the benefits provided by the bay and its neighboring estuaries. By placing a dollar value on ecosystem services, like the clean water, flood protection and recreational opportunities provided by the state's most important natural resource, the project will help public officials and stakeholders understand the impacts and tradeoffs involved in various policies, regulations, development plans and other decisions. This economic valuation will result in more sound management decisions that will protect the state's natural resources—while also allowing for public use and economic growth—for the benefit of future generations.

The valuation of the bay's ecosystem services will be supplemented by an economic history of the watershed, written by URI's noted historian Maury Klein, that will track the inseparable relationship between the bay, its rivers, and the settlements that developed within it over the past three centuries. Both projects will be completed in the spring of 2018. —TODD MCLEISH

CONSORTIUM TO BOLSTER RI's LEADERSHIP IN CLIMATE-CHANGE STUDIES

A Bay Observatory to study how climate change is changing coastal ecosystems in Narragansett Bay will be created at GSO as part of a $19 million grant awarded by the National Science Foundation (NSF).

The grant, announced in the fall, also establishes a statewide research group that includes GSO to study changing environmental conditions in the Bay. The grant builds on $30 million of previous NSF funding through its Established Program to Stimulate Competitive Research, or EPSCoR.

In addition, the state of Rhode Island has committed $3.8 million more toward the initiative over the next five years.

The grant bolsters the Ocean State as a national leader in the study of climate change and coastal ecosystems through the new Rhode Island Consortium for Coastal Ecology, Assessment, Innovation and Modeling (RI C-AIM), which will create computer models to predict changes in coastal ecology, develop sensors to detect nutrient pollution that contributes to harmful algae blooms, study challenges facing the marine industries, and connect students to employment opportunities. The Bay Observatory will use high-tech instruments and wireless data transmission to gather information that will also be accessible to the public.

URI is leading the team, which also includes researchers from Brown University, Rhode Island School of Design, Rhode Island College, Bryant University, Providence College, Roger Williams University and Salve Regina University. GSO oceanography professor Lewis Rothstein is aprincipal investigator.

"The consortium has been carefully designed to steward our most precious natural resource, Narragansett Bay, in the face of natural climate variability and human-induced climate change," said Rothstein. "To accomplish this, we will demand that our predictive natural science and socioeconomic computer models are fully integrated with the Bay Observatory. All of the forecasts will be analyzed and visualized in ways to provide public and private decision-makers with the tools they need to optimize their decisions for the benefit of all Rhode Islanders."

A view along the Sakonnet Point Path.

PHOTO COURTESY OF R.I. SEA GRANT.

Rainer Lohmann addresses the Cape Cod community. Right: a student collects water samples.

Lohmann Assembles Interdisciplinary Team to Win Grant from National Institute

Investigators to Study Health and Environmental Risks of Industrial Chemicals

When URI announced the award of a five-year, $8-million Superfund Research Program Center funded by the National Institute of Environmental Health Sciences (NIEHS), GSO Dean Bruce Corliss offered his congratulations, saying, “Water quality in the United States continues to be one of the most pressing environmental problems we face.” The Center is focused on Sources, Transport, Exposure and Effects of PFAS (STEEP). STEEP’s primary research focus is on the effect of industrial chemicals, with particular focus on per- and polyfluoroalkyl substances known as PFAS. These chemical compounds have been found to contaminate drinking water and are a significant health risk, with new sites announced fairly regularly.

The impetus for seeking this prestigious award arose from the work of the Graduate School of Oceanography’s professor Rainer Lohmann and his focus on emerging contaminants. Lohmann is now the principal investigator for STEEP in collaboration with researchers from URI’s Colleges of Pharmacy, Engineering, the Environment and Life Sciences, and Coastal Institute; The Harvard T.H. Chan School of Public Health; and the Cape Cod-based nonprofit Silent Spring Institute. Provost and Vice President for Academic Affairs Donald DeHayes recognizes the value of STEEP as yet another model of interdisciplinary teams joining together to address “grand challenges,” a significant focus of URI’s research and teaching design to address increasingly complex topics.

The new STEEP Center will provide an integrated approach to the problem of emerging PFAS contaminants, maximizing URI’s expertise in a variety of fields. PFAS are an underregulated and emerging public health risk. They are dangerous to humans and reach people through contaminated groundwater, manufactured goods, and the food web. The STEEP team will be bringing the best available science to combat what has already become a problem in communities around the nation. One of the two focus areas of STEEP’s upcoming research and evaluation is on Cape Cod in and around Barnstable County, where PFAS enter drinking water from firefighting foams used at Joint Base Cape Cod and the county fire training academy. The other is in the Faroe Islands, where PFAS exposure is largely from consumer goods, with additional exposure tied to the consumption of pilot whales caught by the local fishing industry.

PFAS are industrial compounds that have been manufactured since the 1950s for use in a myriad of products: stain and water-resistant fabrics, non-stick cookware, and grease-proof packaging—all of which are found in most homes. The environmental dissemination and the human health effects of PFAS

PHOTOS: (LEFT) ALAN BELANICH, COURTESY OF *BARNSTABLE PATRIOT*, (RIGHT) ELSIE SUNDERLAND.

Clockwise, from top left: Water sample testing in the lab; sources of PFAS contamination on Cape Cod; STEEP team with community partners.

are becoming increasingly apparent. “These compounds seem to be a particular problem during early development, and our complex immune system appears to be highly vulnerable,” said Philippe Grandjean, professor of Environmental Health at Harvard T.H. Chan School of Public Health and STEEP lead for human health studies. “In the STEEP project, we are now carrying out in-depth examinations of a cohort of close to 500 children that we have followed in the Faroe Islands since they were born. We are determining if health problems they are experiencing can be traced to cumulated exposures or to previous exposures, even prenatally. Our findings will hopefully provide new evidence on the need to limit current exposures and how to prevent chemicals with similar properties from entering the environment.”

When asked what was accomplished during 2017, Lohmann noted with intentional understatement, “Well, we actually got funded by NIEHS, and funds were eventually allocated. I think the biggest news for us was the successful launch of STEEP as a working center to inform URI, the Cape Cod community, and the general public.” STEEP was immediately welcomed into the national network of 23 Superfund Research Program Centers across the U.S. “While we celebrated our success,” Lohmann explained, “we are more aware than ever of the responsibility lying before us. STEEP is not only a combination of smart people with fascinating science, training and outreach ideas, but a center with a mission to help avert future exposure of humans and the environment to nasty chemicals.”

The STEEP team’s introduction to the Cape Cod community at a kick-off event was a vivid reminder that there is a very human face to the effects of PFAS on human health. Present were ordinary citizens whose deep concern about their health was exacerbated by a yearlong undisclosed exposure through their drinking water. STEEP can do little to rectify the past, but is committed to informing future efforts that limit exposure to PFAS. Ideally, the U.S. will eventually move away from persistent toxic chemicals altogether. As Lohmann states, “A replacement compound for PFAS/PFOA, GenX, has already been detected in very

PHOTOS: (TOP LEFT) COURTESY OF SILENT SPRING INSTITUTE, (ABOVE) BETTY ANNE BEVIS.

Above: Cape Cod community event kick off; Right: developmental testing of Faroese cohort.

high concentrations in the Cape Fear watershed, highlighting the whack-a-mole approach to chemical legislation still prevailing in the United States: Produce a chemical until it is banned, at which point you substitute with a similar chemical, until sufficient evidence is gathered to question the safety of the replacement chemicals. And so the increase in emerging contaminants continues." Ultimately, the problem of PFAS has been compounded by industrial negligence and lack of regulatory oversight. Last year the EPA finally took notice and issued lifetime health advisories for drinking water for two of the worst PFAS. Still, other countries have much stricter limits in-place.

As for plans for 2018, Lohmann said, "STEEP will really pick up steam and ramp up research efforts. This includes cross-discipline, inter-campus training of the STEEP trainees, both graduate students and postdocs, with a joint colloquium, trainee exchanges across institutions, and interactions with communities and other Superfund research programs." STEEP will also start analyzing private wells on Cape Cod for PFAS, continue the assessment of the different sources of PFAS affecting residents, and conduct field trials of PFAS samplers. On the biomedical side, the continuation of testing cohorts of children on the Faroe Islands will provide further insight as will the testing of various old and new fluorinated compounds using cell-based biological assessment.

As the director of STEEP, Lohmann oversees and guides the center, together with co-director Philippe Grandjean of the Harvard T.H. Chan School of Public Health. STEEP has four distinct research projects. Elsie Sunderland (Harvard T.H. Chan School of Public Health) will trace the unique chemical signature of PFAS as they enter the environment and travel through the food web, including fish and whales. Philippe Grandjean then observes developmental markers in the cohort of Faroese children, following them from prenatal into early teenage years to determine how

PFAS are industrial compounds that have been manufactured since the 1950s…"These compounds seem to be a particular problem during early development, and our complex immune system appears to be highly vulnerable."

they are impacted by PFAS. Then, to further elucidate the range of impacts of PFAS, Angela Slitt (Pharmacy) will investigate dosage levels of PFAS on rodents and cell models, while Geoff Bothun (Engineering) will examine how PFAS interact at the cellular level. Finally, Lohmann will develop passive environmental samplers for PFAS to determine levels in the environment, and Laurel Schaider (Silent Spring Institute) will work with Cape Cod communities to test these samplers.

These scientific results will be made available to a range of audiences by the Research Translation Core, led by Judith Swift (Coastal Institute and Communication Studies), and co-led by Nicole Rohr and Amber Neville (Coastal Institute). The Community Engagement Core, co-led by Alyson McCann (URI Extension) and Schaider, will ensure the Cape Cod communities are kept in the information loop of STEEP's progress. Graduate students and post-docs working on the STEEP team will participate in Training Core activities led by Bongsup Cho (Pharmacy).

The team is growing in its broader understanding of the implications of the impact of PFAS and, by association, other contaminants. Along with the intense interest generated by the work, there is gratitude for the opportunity to address the social injustice experienced by the communities facing these challenges. The STEEP Center is proud to add to GSO's long history of cutting edge research. —RESEARCH TRANSLATION CORE / URI COASTAL INSTITUTE

The URI STEEP Superfund Research Program is in partnership with scientists form Harvard T.H. Chan School of Public Health and the Silent Spring Institute, with funding and support provided by the Superfund Research Program, National Institute of Environmental Health Sciences. Dr. Lohmann initiated a global effort to monitor organic contaminants in the waters of the world, termed AQUA-GAPS, which started field trials in 2016. With funding from NSF, NIH, SERDP and private foundations, Lohmanns's GSO lab conducts research into the sources, transport, and bioaccumulation of anthropogenic pollutants. He has over 100 peer-reviewed publications and serves as editor for Environmental Toxicology and Chemistry and on the boards of several other journals. Earlier this year, Lohmann was appointed to the U.S. EPA Board of Scientific Counselor's committee on Sustainable and healthy communities. Lohmann obtained a BSc in Chemical Engineering from EHICS (Strasbourg, France) in 1996 and a PhD in Environmental Science from Lancaster University (UK) in 1999. Lohmann was a postdoctoral fellow at MIT's Parson's laboratory, and held fellowship appointments with both the University of Bremen and the Max-Planck Institute of Meteorology (Hamburg). Lohmann received the Roy F. Weston Environmental Chemistry Award from the Society of Environmental Toxicology & Chemistry in 2006. In 2010/11, he was named a fellow of the Alexander-von-Humboldt Foundation and a visiting fellow of India's National Institute of Oceanography and Indian Institute of Technology Madras.

PHOTOS: (LEFT) BETTY ANNE BEVIS, (RIGHT) PHILIPPE GRANDJEAN.

Pushing the Boundaries of Aquaculture

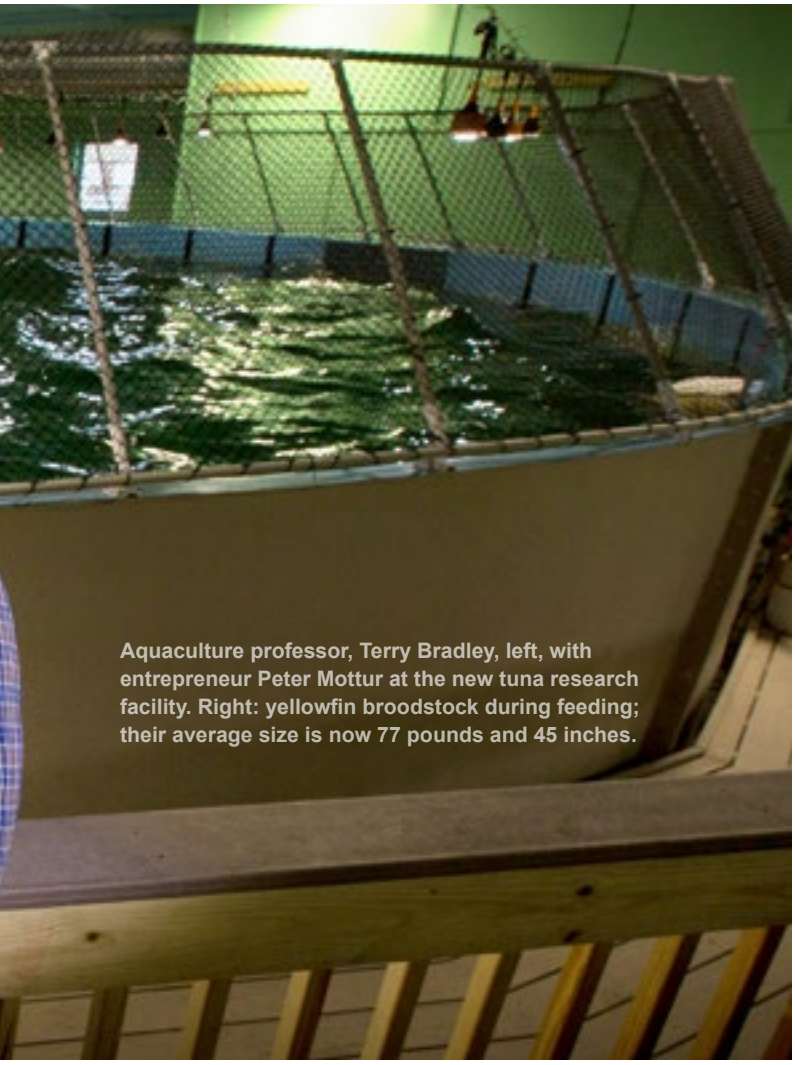
"These early stages of the project are all about research—learning about the early life cycle of these fish and developing the techniques to breed them. But we also think there is a lot of commercial potential."

—Terence Bradley

CELS Professor and Entrepreneur Team Up to Breed Tuna at New Bay Campus Facility

Tuna is a favorite food for many, and the growing demand has led to so many bluefin tuna "ranching" operations that the species has become threatened. Terence Bradley, professor of aquaculture, animal and veterinary science at URI'S College of the Environment and Life Sciences, and his students are working on a solution: They're trying to breed and produce tuna in captivity and take the pressure off the wild stock.

Unlike what's happening in other places around the world, where large schools of juvenile tuna are captured from the wild, put into pens and raised to harvest size, Bradley wants to breed tuna from eggs, beginning with a small number of wild-caught tuna and a huge tank in a new tuna research facility on the Narragansett Bay Campus.



Aquaculture professor, Terry Bradley, left, with entrepreneur Peter Mottur at the new tuna research facility. Right: yellowfin broodstock during feeding; their average size is now 77 pounds and 45 inches.

To accomplish this, Bradley teamed up with URI alumnus and entrepreneur Peter Mottur, who started Greenfins Global LLC, a company focused on tuna aquaculture. Greenfins and URI have developed a public-private partnership to create a privately funded research facility, known as the Greenfins Aquaculture Tuna Center of Excellence, a 4,200-square-foot facility dedicated to tuna research with a 40-foot diameter tank holding more than 125,000 gallons of seawater.

In the tank are reproductively mature yellowfin tuna, called broodstock, which will be used to study the early stages of tuna reproduction. The center's goal is to determine the technology, techniques and protocols to successfully breed and raise tuna in captivity while minimizing impacts on the marine ecosystem.

Mottur and Bradley are beginning their work with the smaller and less demanding (as far as breeding goes) yellowfin tuna. But it won't be easy. Tuna are long-distance migrants that swim at great speeds and need a lot of space, and acclimating them to a tank could prove challenging. The sex of yellowfin tuna can't be readily determined, so the researchers have to catch enough wild fish to make spawning probable. But too many fish in even a large tank jeopardizes water quality and makes spawning less likely. And finally, once the fish do spawn and the eggs hatch, the microscopic larvae first must be fed live food raised on site and then weaned to a dry, formulated feed.

"These early stages of the project are all about research—learning about the early life cycle of these fish and developing the techniques to breed them. But we also think there is a lot of commercial potential," said Bradley. "We are building on work done by other facilities holding tuna and by collaborators." He and Mottur envision local entrepreneurs using the techniques

they develop to produce juvenile tuna that could then be sold to others who want to grow them further.

"It's a sustainable project that we hope will create green technology jobs here in Rhode Island," said Mottur. "We've already developed a partnership between URI and my company, and we hope to take it from the research phase to the commercialization phase once we demonstrate tuna breeding and larval rearing success."

Bradley said that right now, Japan can't produce all the tuna it needs for the country's own purposes, and the United States is a big importer of tuna. "There's a tremendous potential for us to produce fish that could easily be sold in the United States, especially if it's a sustainable product produced in an environmentally responsible manner." —ELIZABETH RAU

PHOTOS: (ABOVE) AYLA FOX, (RIGHT) ERIC SAVETSKY.

Sustainable Fishing Off West African Shores

Projects in Ghana and Senegal Advance Food Security for Millions

Many countries in West Africa are struggling with issues of population growth, poverty and food insecurity, which has led to a massive exodus of people moving from inland areas to the coast, where they believe they can have easy access to fish to feed their families. The result has been declining stocks of fish, rampant illegal fishing, and other issues that threaten to make the situation worse for the millions of residents who depend on fish for 60 percent of their animal protein.

With funding from the U.S. Agency for International Development, the URI Coastal Resources Center (CRC) is helping the governments of the West African nations of Senegal and Ghana improve their capacity to manage the local fisheries and rebuild fish stocks. According to Brian Crawford, who directs the project in Ghana, the problem of overfishing is due largely to the fact that the fisheries have open access.

“Anyone who wants to get into the business of fishing can do so, especially in the small-scale fisheries,” he said. “So the number of fishing boats keeps going up and up and up. The more boats out there fishing, the smaller the piece of pie for each one. And the total biomass of fish in the system is declining.”

Illegal fishing is also a serious concern, especially in Senegal, where foreign fishing fleets from Europe and the Far East scoop up large quantities of fish in coastal waters without fear of repercussions because the country doesn’t have the wherewithal to enforce fishery regulations.

“As overfishing continues, it’s leading to concern about increasing poverty in fishing communities,” Crawford said. “And that may lead to other social issues, like smuggling people and drugs, because the residents are so desperate to make a living."

The result, he said, is that “tens of thousands of metric tons of fish are being lost due to bad management. If they manage the fishery better, they could increase the food supply.”

In 2014, the CRC and its project partners began helping the Ghanaian government to better understand the status of various fish stocks, how badly they are overfished, and what steps can

> “The number of fishing boats keeps going up and up and up. The more boats out there fishing, the smaller the piece of pie for each one.” *—Brian Crawford*

be taken to improve the situation. They are also developing management plans and policies to guide future efforts. Among the most important strategies being employed is the creation of management committees that include the fishermen so the governance is much more participatory, which leads to more successful management.

In Senegal, where CRC’s Najih Lazar works closely with government officials and the fishing communities, a similar project launched two years earlier has already achieved measurable success.

“We use a bottom-up approach,” explained Lazar. “We mobilize the communities, educate them, try to get them to use the best fishing methods and the best management methods, and then

PHOTOS BY NAJIH LAZAR.

From left: most fishermen ply their trade in large wooden boats, or "canoes;" the community brings in the day's catch; the relative biomass (number and size of fish) of small-pelagics has dwindled to a small fraction of levels observed just 20 years ago.

have them be part of the policy- and decision-making process to help the fisheries recover."

The approach is working well. "A co-management system has been established so the fishermen can caucus among themselves and decide to protect a certain area of the ocean on their own, and the government has to honor that," Lazar said. "That's a system that hasn't been in place anywhere else in West Africa. We're quite proud of that."

This participatory process is vital to the success of the projects in both countries because achieving sustainability in the fisheries almost certainly will require a decision to control entry to the fisheries.

"Ultimately, they'll have to cap the number of vessels and the number of people fishing, and that's a sticky problem," Crawford said. "In these countries, fishing is a way of life, it's part of their culture, and communities depend heavily on it. They often don't want to stop fishing. It's going to be a matter of getting them to fish less and to have other sources of income."

Last year the Senegal parliament passed a major revision to its fisheries management legislation, thanks to years of work by Lazar, project leader James Tobey, and other CRC staff. Crawford and others in Ghana are working toward a similar legislative framework.

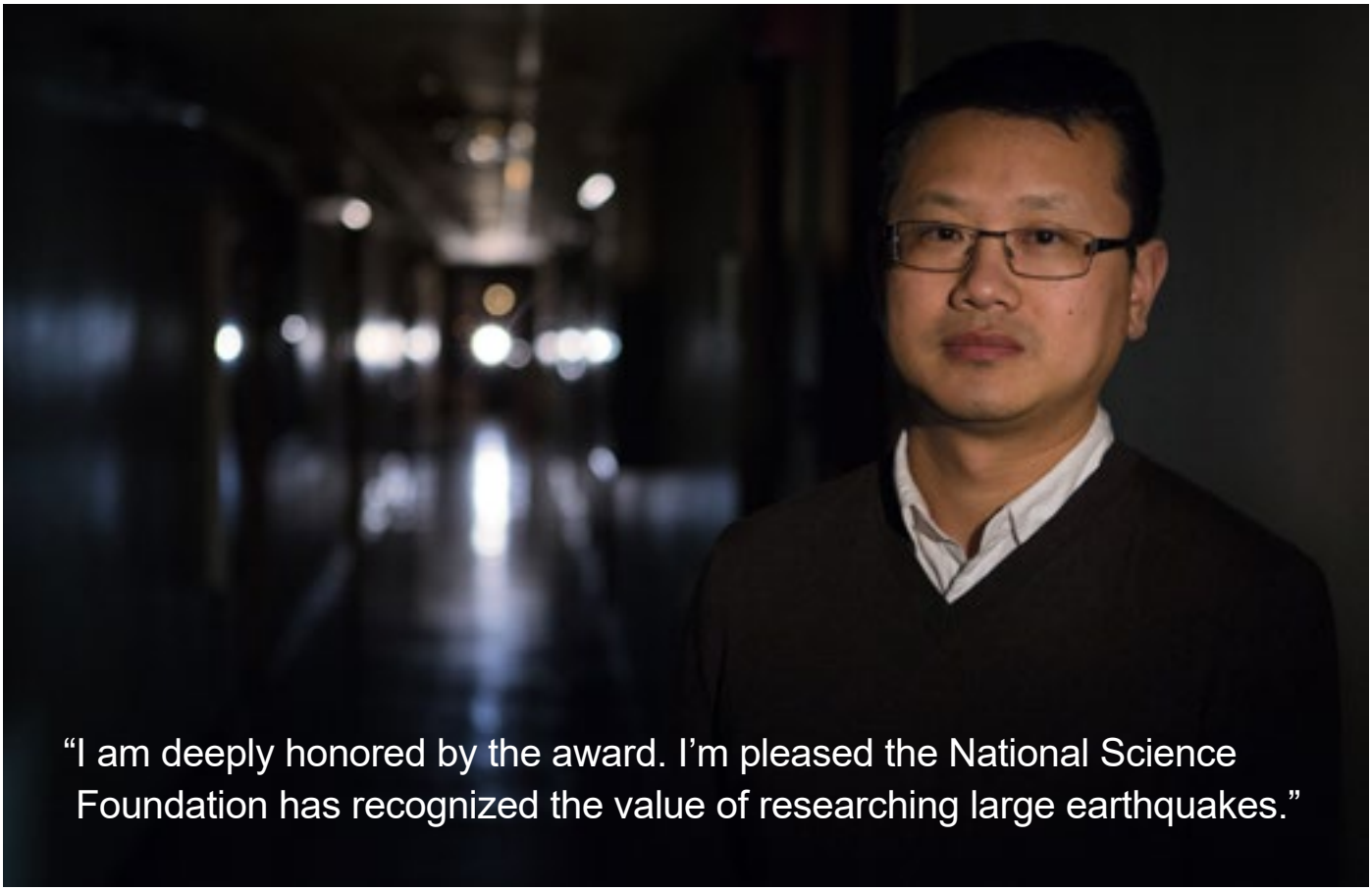
Their work, however, is not just about making the fishery sustainable. It also involves helping strengthen the post-harvest supply chain, which is mostly controlled by women.

"The men do the fishing, but the women do the processing and the marketing," Crawford said. "If the fishery collapses, it won't just be the men who will be affected. The fish supply for the processors will also be affected. The women are becoming strong advocates of sustainable fishing because if there's no fish, they'll be out of business too."

Most of the fish is smoked, and much of the wood to fuel the ovens comes from mangroves and other critical habitats. So the CRC-led project collaborated with local institutions in Ghana to design a smoker that uses less fuel wood, enabling the processors to increase their profitability and reduce their impact on the environment. Project partners are even providing guidance and training so local companies can properly build the new oven, while also working with rural banks to secure financing so the processors can afford to purchase them.

> "We use a bottom-up approach. We mobilize the communities, educate them, try to get them to use the best fishing methods and the best management methods. …This participatory process is vital to the success of the projects in both countries." —*Najih Lazar*

"A lot of the time, when we think about fisheries, we just try to manage the harvest. But we're looking at developing the whole supply chain," Crawford said. "It starts with managing the harvest. Then, if we get the oven manufacturers connected to the processors and the processors connected to the banks, it will be a sustainable system that will continue to operate over the long run." —TODD MCLEISH



Finding Answers on the Ocean Floor

Professor Earns NSF’s Early Career Development Award

Matt Wei’s research received a significant boost this fall when he was awarded a $600,000 research grant from the National Science Foundation (NSF) through its Faculty Early Career Development Program, the most prestigious NSF grant program supporting junior faculty members in the country. The program supports early-career faculty who have the potential to be academic role models in research and education.

Wei, 36, a geophysicist who joined GSO in 2013, is taking on these enigmatic events by studying earthquakes beneath the ocean bottom to learn more about earthquakes on land.

“I’m deeply honored by the award,” said Wei. “I’m pleased the National Science Foundation has recognized the value of researching large earthquakes. Ultimately, our goal is to better forecast them and save lives.”

A native of Xiangyang, China, Wei received his bachelor of science degree in geophysics from Peking University in Beijing in 2004 and his doctorate in Earth sciences in 2011 from the Scripps Institution of Oceanography at the University of California, San Diego. He first joined GSO as an assistant marine research scientist, lured by its excellent international reputation. He was appointed assistant professor in 2016.

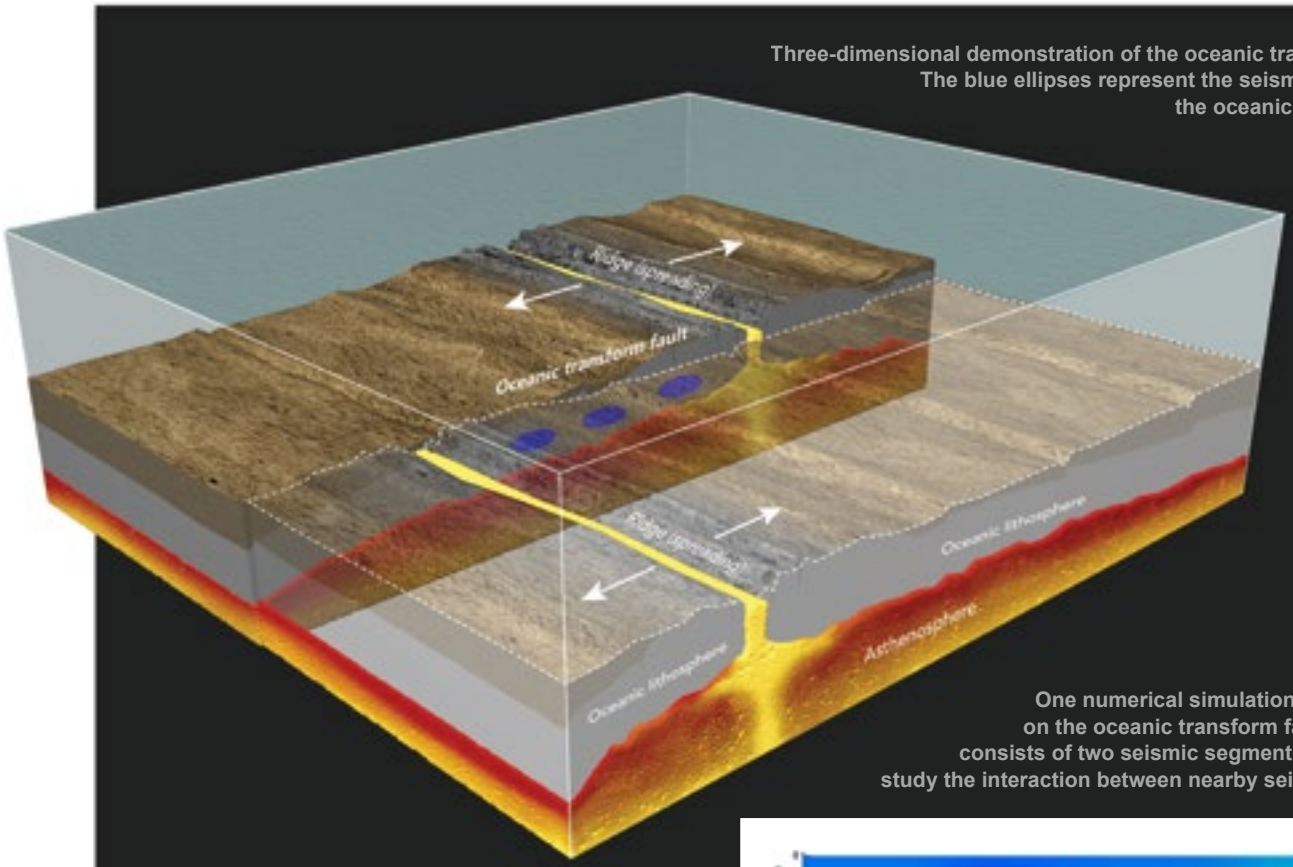
Earthquakes are natural occurrences caused by the planet’s constantly changing landscape. They happen when the Earth’s outer crust moves in pieces over melted rock, coming together and spreading apart to reshape the geological landscape.

They can cause immense destruction, but, unfortunately, they are not easy for scientists to study, much less predict. Studying powerful earthquakes on land is difficult for scientists because they can happen infrequently on the same fault line, said Wei.

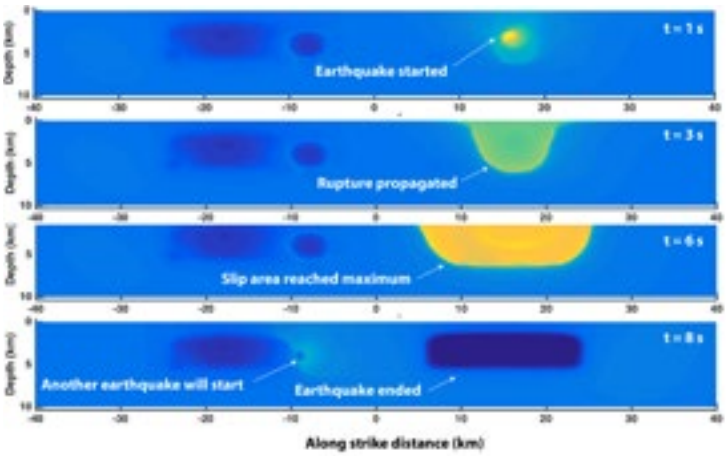
“There are some faults on land that rupture every few thousand years,” he said. “In 2008, for example, there was a big earthquake in Sichuan Providence, China, and scientists have estimated that the last one on that fault was 4,000 years ago.”

As a result of the long intervals, modern instruments have only captured a snapshot of the earthquake cycle on land, said Wei. With limited data, he says, scientists have trouble validating models of the earthquake cycle.

The ocean provides better data. Some faults in the ocean rupture much more frequently, sometimes every five years. Many



Three-dimensional demonstration of the oceanic transform system. The blue ellipses represent the seismic segments on the oceanic transform fault.



One numerical simulation of earthquakes on the oceanic transform fault. This model consists of two seismic segments and is used to study the interaction between nearby seismic segments.

of those quakes are off the coast of Mexico in the Pacific Ocean—a region that Wei studies.

"Because these earthquakes occur more often, we're able to gather information that may detect patterns in earthquake occurrence," said Wei. "This data is important to validate our three-dimensional computer model."

His results, he says, might help scientists better understand faults on land, such as the San Andreas Fault in southern California—long overdue for a major earthquake that could impact more than 20 million people.

"It could be tomorrow—it could be 30 years from now. We don't know. That's why we need to do more studies to improve our understanding of what causes these faults to rupture." *—Matt Wei*

The San Andreas fault extends about 750 miles through California. Many cities and towns along the fault have been hit by earthquakes over the years, and scientists predict that another big one in southern California could happen soon.

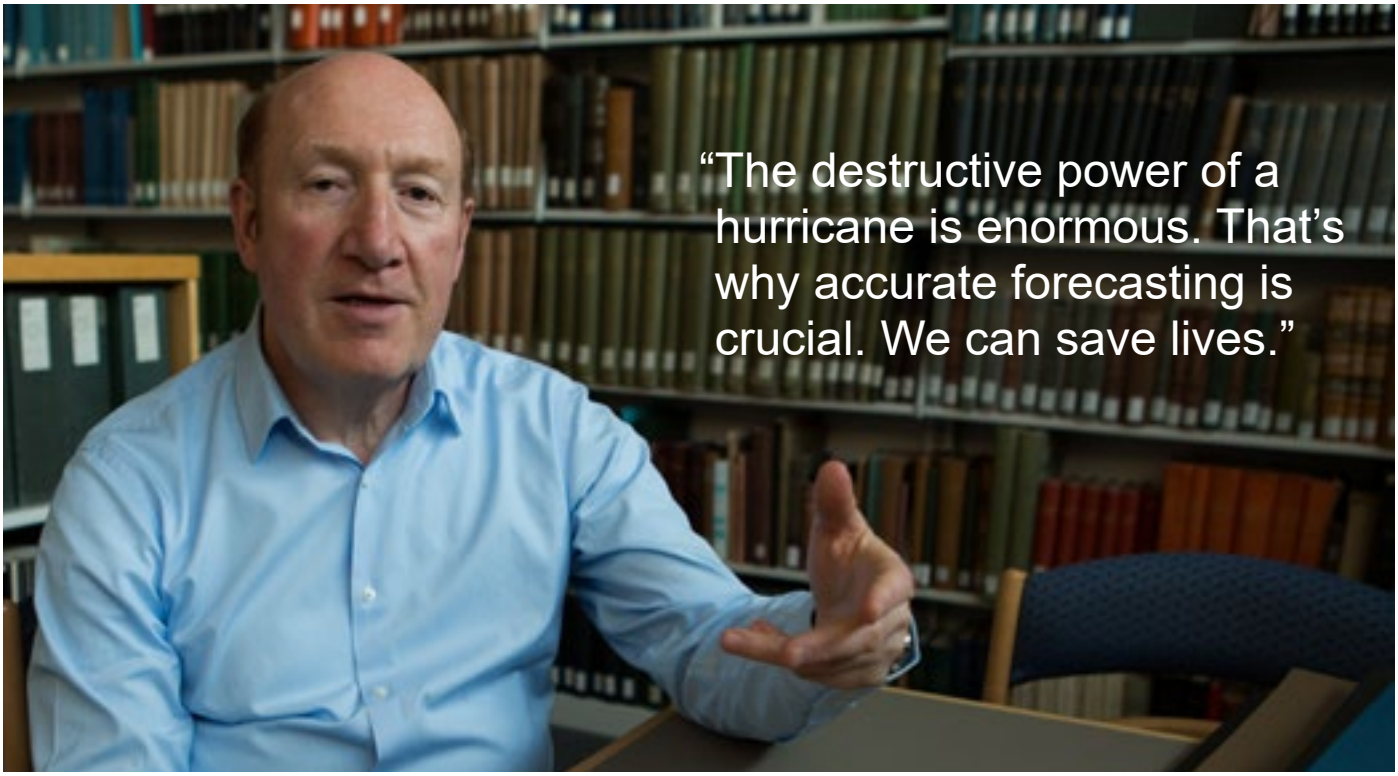
"It could be tomorrow—it could be 30 years from now," said Wei. "We don't know. That's why we need to do more studies to improve our understanding of what causes these faults to rupture."

Wei's grant will also support outreach activities to educate college and high school students, as well as the public. A software package that simulates earthquakes will be available to all for viewing.

"I'm very lucky to be around excellent colleagues and an intriguing and supportive academic environment," said Wei. "I expect my research on earthquakes to continue in the coming years and make useful contributions to this important field."

—ELIZABETH RAU

PHOTO BY AYLA FOX. GRAPHICS COURTESY OF *RESEARCH FEATURES*.



Predicting the Path and Power of Hurricanes

Media Turns to Isaac Ginis When Storms Approach

URI oceanographer Isaac Ginis makes it his business to predict the ominous power of hurricanes with a computer model so successful it was adopted by the National Weather Service.

Ginis is one of the first scientists worldwide to show the role the ocean plays in hurricanes, specifically, that ocean temperature is the most important factor in hurricane intensity and power.

Officials in Rhode Island and beyond turn to him when a hurricane is bearing down on the coast. His procedure is also used worldwide—forecasters applied the model to Typhoon Haiyan in the Northwest Pacific in 2013—and nationally. He is now leading a project, funded by the Department of Homeland Security, at the Coastal Resilience Center of Excellence at the University of North Carolina, Chapel Hill.

As Ginis continues his work, his forecasting might improve even more. He is exploring whether the height of waves might also be linked to a hurricane’s power. Those studies should be completed next year.

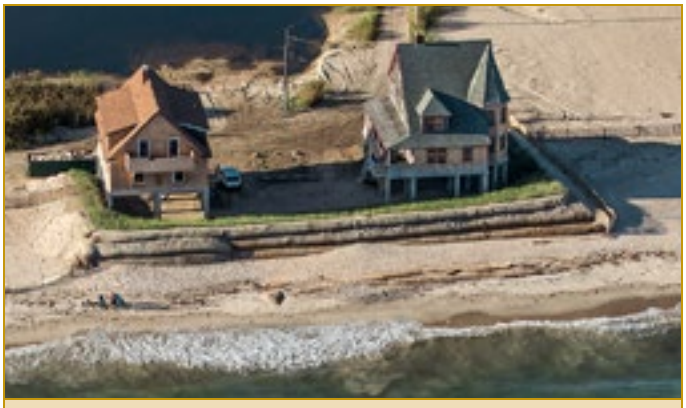
The media turns to Ginis often for his insight, and with three category 4 hurricanes to make landfall in the United States in 2017—in Texas, Puerto Rico and Florida—that knowledge is crucial. He’s often asked if he expects more intense and frequent hurricanes as climate change brings warmer temperatures. His answer: yes and no. Modeling studies suggest that hurricane intensity might increase because of warmer sea-surface temperature. It’s uncertain, however, if there will be more hurricanes.

“We do think there will be a significant increase in rainfall,” he said. “And that could lead to more inland flooding during hurricanes. The destructive power of a hurricane is enormous,” said Ginis. “That’s why accurate forecasting is crucial. We can save lives.”

His passion for hurricanes started when he was an undergraduate studying math in his homeland of Russia. He recalls a scientist’s talk about research ships tracking how typhoons interact with the ocean—a project that highlighted the ocean-atmosphere connection and steered Ginis to mathematical modeling.

After earning his doctorate in geophysics in Russia, he landed at GSO, where his research caught the attention of the National Oceanic and Atmospheric Administration (NOAA). Impressed with the accuracy of his hurricane predictions, NOAA adopted Ginis’ ocean coupling methodology more than a decade ago. The honors, including a prestigious certificate of appreciation award from NOAA in March, have been pouring in ever since.

Mercifully, Ginis has never experienced a hurricane’s rage, but he was part of a team that surveyed the damage from Hurricane Katrina in 2005. The startling image of casino barges washed ashore is still vivid in his mind.



Above: Wickford, R.I., during "Superstorm Sandy"—the deadliest, most destructive hurricane of 2012. Right: ongoing efforts to preserve historic cottages in their original, Matunuck, R.I., locations have included elevated foundations and reinforced berms.

AN OUNCE OF PREVENTION

Protecting the state's coast has taken on greater urgency as threats from climate change become real—and expensive. URI's Coastal Resources Center is now offering a free online tool that will help community planners prepare for sea-level rise, flooding and other climate-related challenges.

Providing Resilience Education for Planning in Rhode Island, or **PREP-RI,** offers guidelines about how to protect the coast in a self-guided, six-lecture program that looks at issues such as climate change, flooding, the impact on infrastructure, mapping tools, stormwater and adaptation.

"It's been a pleasure to work with the region's best minds on this topic," said project manager Pamela Rubinoff. "Publishing their knowledge to benefit the entire state has made our efforts all the more worthwhile."

The Rhode Island General Assembly funded the project. "Rhode Island must be more proactive in planning for flooding and sea rise," said Rhode Island State Rep. Lauren Carson, D-Newport, who spearheaded the effort to fund the program. "The devastating toll of human loss and suffering in Texas, Florida, and Puerto Rico must remind us of the high stakes involved."

You are one of the first scientists to show the ocean's role in hurricane intensity. Explain your discovery.

From a physics standpoint, a hurricane is a heat engine. It's a massive natural machine for converting heat energy into mechanical energy—in this case, wind. That heat energy is derived from the ocean. Recognizing this relationship between the ocean and the atmosphere allowed us to build computer models that can more accurately predict the strength of hurricanes. But hurricanes are complex, and there are many ingredients in the recipe for any given storm.

If you don't fly into a hurricane, how do you get your data?

We have many observational platforms to gather data in the atmosphere and ocean that help predict hurricanes. Most important, of course, are the measurements made by reconnaissance aircraft. In their absence, satellites are the primary platform for hurricane observations, but critical measurements are also taken at sea by ships and buoys and on land by radars and other coastal monitoring systems.

As temperatures increase due to climate change, do you expect more frequent and intense hurricanes in the Northeast?

Recent scientific evidence and modeling studies suggest that hurricane intensity may be increasing and will continue to increase due to warmer sea-surface temperature, but the connection to Atlantic hurricane frequency is less conclusive. In addition to intensity, models predict significant rainfall increases that will lead to inland flooding.

Why is it important to be a hurricane source for the media?

Simple. My job is to discern when, and if, a hurricane will make landfall. It's crucial for me to provide that information to the media. My models give state and town officials time to prepare for a storm and save lives.

Any advice for students who want to study hurricanes?

Don't get a pilot's license to fly into the eye of a storm. Take courses in physics, mathematics and computer science. Computer models are the future of hurricane prediction. You can do groundbreaking research sitting at your computer.
—ELIZABETH RAU

PHOTOS: (LEFT) AYLA FOX, (ABOVE) MELISSA DEVINE, (RIGHT) JOHN SUPANCIC.

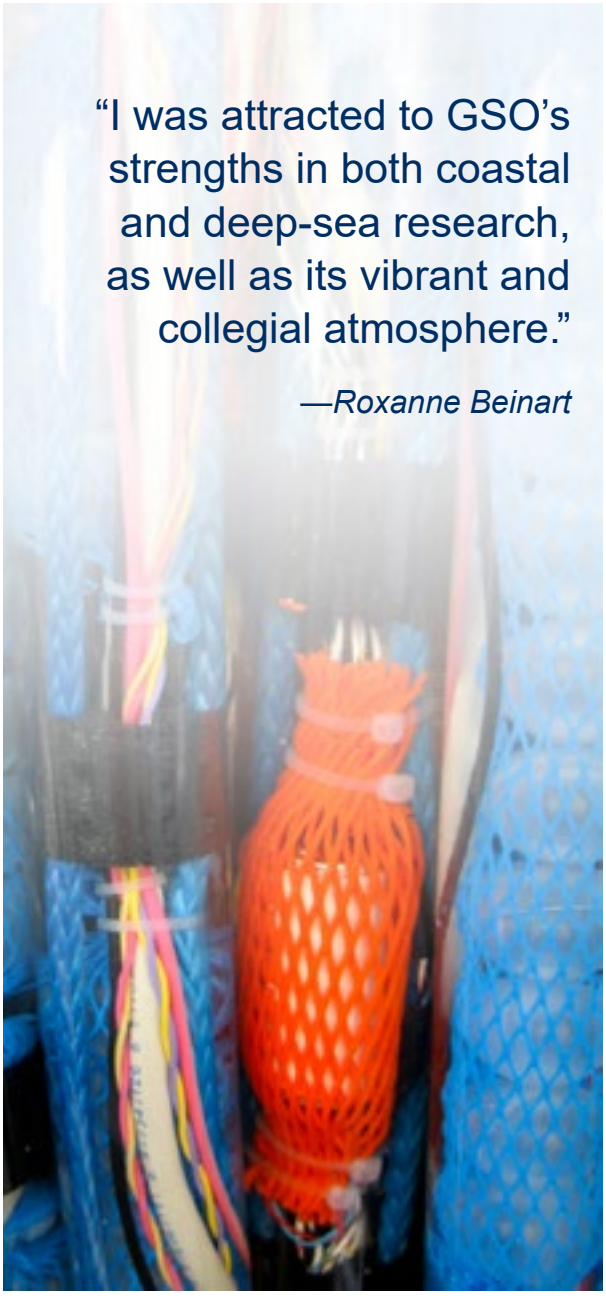
NEW FACULTY

Roxanne Beinart

Beinart joined GSO this fall as an assistant professor and senior fellow at the Coastal Institute.

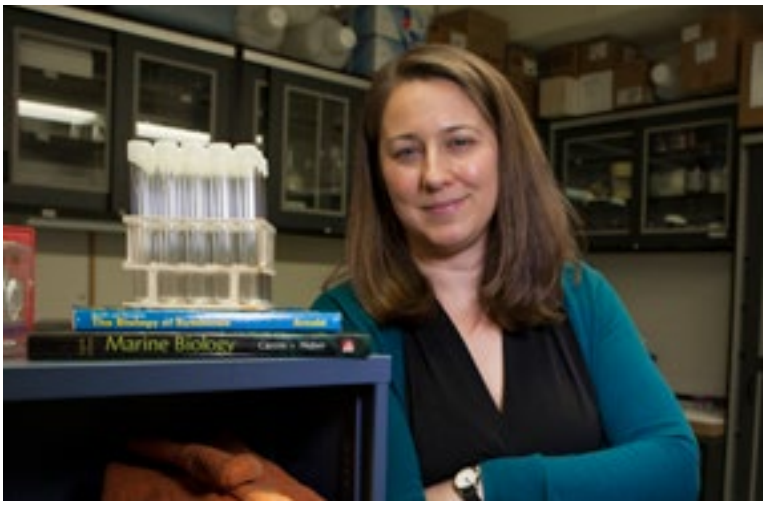
She received her bachelor of science in biology from Cornell University in 2006 and a doctorate in biology from Harvard University in 2014. Since then, she has carried out postdoctoral work at the Woods Hole Oceanographic Institution as a National Science Foundation Ocean Sciences Postdoctoral Fellow and as a Coastal Ocean Institute Woods Hole Oceanographic Institution Scholar.

All organisms host symbiotic microbes in or on them, and these symbionts can provide important, beneficial services for their hosts, such as acting as a food source, defending against pathogens or removing toxins. Beinart is interested in how symbiotic microbes affect marine ecosystems.



"I was attracted to GSO's strengths in both coastal and deep-sea research, as well as its vibrant and collegial atmosphere."

—Roxanne Beinart



Beinart's research characterizes the ways in which symbiont-provided services impact how the host interacts with other organisms and the environment. She uses ecological approaches to survey host organisms and their symbiotic microbes and genomic methods to investigate symbiont diversity and traits.

In addition, Beinart conducts physiological experiments to assess the function of symbiotic microbes and to estimate their impact on host ecology and the environment. She has focused her work on symbioses in which the microbial partner is critical to the success of the partnership. Animals that inhabit deep sea hydrothermal vents, for example, farm bacteria in their tissues that can feed on hydrothermal fluids, allowing the animals to survive despite the extreme lack of food available at depth.

Beinart's work has shown that the symbionts of these animals have the potential to influence the types of habitats their hosts can survive in and that symbiont metabolism can significantly alter water chemistry.

At GSO, Beinart's lab is working on the symbiotic microbes associated with animals from deep-sea hot springs and cold seeps and will also begin to look at the functioning of microbe-microbe symbioses from local Rhode Island habitats.

PHOTOS: (LEFT) DAVID SMITH, (ABOVE AND RIGHT) ALEX DECICCIO.

Kelton McMahon

McMahon joined GSO this fall as an assistant professor and senior fellow at the Coastal Institute.

The McMahon Ocean Ecogeochemistry Lab is researching the sources and cycling of organic matter in the ocean. His team is particularly interested in how climate change and human-environment interactions influence the function and resilience of marine ecosystems through food webs.

The foundation of the work is the development and application of cutting-edge molecular geochemistry tools. The work couples controlled laboratory studies with large-scale studies to examine a wide range of questions, from individual nutritional ecology and population dynamics to ecosystem-scale food web structure and the functioning of the carbon cycle in the ocean.

McMahon got his start in oceanography growing up in coastal Connecticut. He received a bachelor of science in biology from Bates College in 2005, studying the impacts of climate change-mediated shifts in ice algae and phytoplankton on the Arctic benthos.

He received his doctorate in biological oceanography from the Massachusetts Institute of Technology-Woods Hole Oceanographic Institution Joint Program in Oceanography in 2011. There, he developed molecular isotope geochemistry tools to identify nursery habitats and migration pathways for coral reef fish.

McMahon completed two postdoctoral scholar positions, first at the King Abdullah University of Science and Technology in Saudi Arabia, studying coral reef food web dynamics, and then at the University of California, Santa Cruz, studying millennial-scale changes in phytoplankton community dynamics and nutrient cycling in the North Pacific Ocean.

McMahon and his team are building a molecular isotope geochemistry lab at GSO to study food web structure in the past, present and future, both at home in Narragansett Bay as well as around the world. He is co-teaching “You, Me and the Sea,” a new “Grand Challenge” course this spring with new GSO assistant professor Beinart. The course will explore the relationships between humans and the amazing biodiversity of the ocean.

John “J.P.” Walsh

Walsh is the new director of URI’s Coastal Resources Center and a professor of oceanography.

He is a geological oceanographer with a doctorate in oceanography from the University of Washington, a master of science in marine environmental science from Stony Brook University, and a bachelor’s degree in geology from Colgate University.

His research focuses on coastal sedimentary processes and related phenomena, such as coastal erosion and the identification of sand resources and beach nourishment strategies. He uses sediment characteristics, oceanographic measurements, and geophysical methods to understand the processes shaping the shoreline and seafloor.

Before joining GSO, he was a professor at East Carolina University and a program head for coastal processes at the University of North Carolina Coastal Studies Institute.

Over the last few years, he has spearheaded efforts to evaluate estuary and barrier-island dynamics and sand resources offshore of North Carolina. Internationally, Walsh is also well known for his research investigating how materials discharged by rivers are dispersed and accumulate in the ocean.

He has conducted research around the world, including in Papua New Guinea, Puerto Rico, New Zealand, California and the Gulf of Mexico. His work is important to understanding geochemical cycling, evaluating ecosystem changes, defining coastal hazards and managing natural resources.

In 2017, Walsh was a Fulbright Research Scholar at the Université de Bordeaux, where he conducted research in southwest France on coastal changes related to storm events and human activities over the last several decades. —ELIZABETH RAU

R/V *ENDEAVOR* AT SEA

Thomas Glennon
Director of Marine Operations

Oceanography in Action

In 2017, *Endeavor* was at sea for more than 200 days and sailed about 30,000 nautical miles.

EN590, the first cruise of 2017, was sponsored by the National Oceanic and Atmospheric Administration (NOAA) and guided by principal investigator Dr. Al Plueddemann of Woods Hole Oceanographic Institute (WHOI). The *Endeavor* crew recovered and deployed pressure inverted echosounders (PIES) at several sites off Guadeloupe. Science crews changed out in San Juan, Puerto Rico, then *Endeavor* departed for St. Georges, Bermuda.

EN592 enabled completion of a leg of the Bermuda Atlantic Time Series, a long running study on temporal variability of the ocean. The cruise was directed by Dr. Nicholas Bates of the Bermuda Institute of Ocean Sciences.

EN594 was a multi-ship cruise with R/V *Neil Armstrong,* and R/V *Hugh B. Sharp* and sponsored by the Office of Naval Research (ONR). A multidisciplinary team with expertise in acoustics, oceanography, signal processing, and sediment processes assessed the propagation of acoustics in shallow waters overlying soft sediment.

EN595 introduced undergraduate students to oceanography under the direction of Dr. Melissa Omand of GSO. Work was live-streamed back to URI via *Endeavor's* telepresence system.

EN596 supported a six-day science mission — "Gulf Stream Nitrogen Fixation Experiment" — directed by principal investigator Dr. Jaime Palter of GSO. The mission contained educational activities and included collection of samples for analyses and other data.

EN597 began after a layover in Morehead City, N.C., during which the Palter group departed and the next science team

PHOTOS: (TOP AND LEFT) COURTESY OF *ENDEAVOR* CREW, (RIGHT) ALEX DECICCIO.

boarded. During this six-day mission, under the direction of principal investigator Dr. Rainer Lohmann of GSO, persistent organic pollutants and other organic contaminants were measured in both the ocean and atmosphere.

EN598 was guided by principal investigator Dr. William Johns of the University of Miami, who joined *Endeavor* at Port Everglades, Fla. To detect changes in conductivity and temperature of the water column relative to depth, "CTD" casts of over 5,000 meters were regularly done during a three-week period. 4,800-meter moorings were serviced and the PIES recovered.

EN600 set out from Gulfport, Miss., on a Gulf of Mexico Research Initiative (GoMRI) cruise directed by principal investigator and chief scientist Dr. Joseph Montoya of Georgia Institute of Technology. GoMRI's goal is to understand the impact and signatures of natural hydrocarbon seepage on the Gulf's ecosystem. Research and measurements reveal impacts of, and recovery from, the Maconda/BP Deep Water Horizon blowout.

At the end of June during its return voyage to Gulfport, *Endeavor* rode out tropical storm *Cindy.*

EN601 deployed and tested "Minions," miniature isopycnal-following floats, under the watchful eye of chief scientist Dr. Melissa Omand of GSO. The Minions were built by Dr. Omand's students enrolled in the Summer Undergraduate Research Fellowship in Oceanography program.

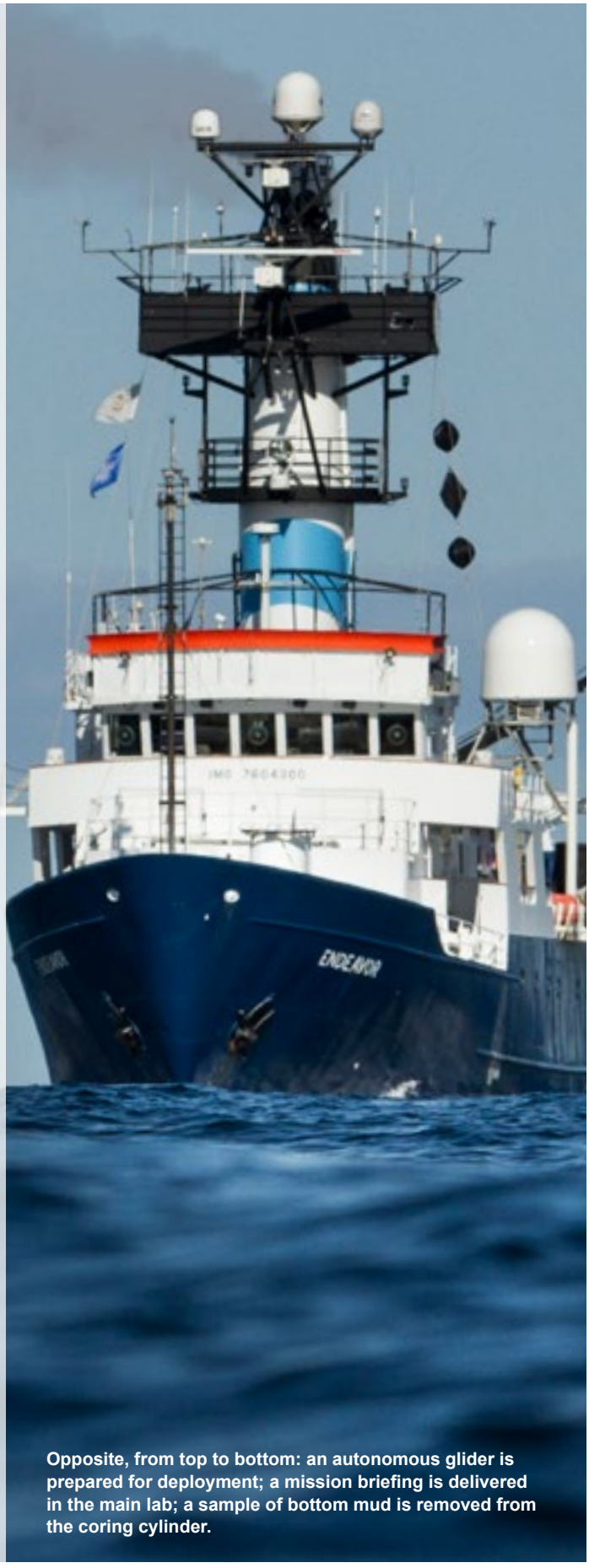
EN602 featured another principal investigator from GSO, Dr. Brice Loose. An underwater mass spectrometer was towed from Gulfport, Miss., to Narragansett, R.I., to measure underwater oxygen and argon levels along the way.

EN603 was a three-day instructional expedition for the Rhode Island Teacher-At-Sea program and the last RIEP cruise of 2017. Nine teachers recruited by GSO's Office of Marine Programs worked with chief scientist David Smith of GSO. In Rhode Island Sound, near the edge of the continental shelf, they deployed oceanographic equipment and instruments, logged data and analyzed samples.

EN604 concluded in August. The 10-day mission led by Colleen Hansel of WHOI visited eight stations along a transect from Cape Cod to Cape Hatteras to measure reactive oxygen species, mercury, and ancillary biological and geochemical measurements.

EN606 *Endeavor's* final cruise of 2017 was conducted off Halifax, Nova Scotia, in late November and early December. Dr. David Hebert from the Bedford Institute of Oceanography directed the servicing of moorings, CTD casts and net tows. The 27-day cruise was challenged by steady winds of 25 to 35 knots. Gusts reached 66 knots.

[Editor's note: Transit missions EN591, EN593, EN599 and EN605 repositioned Endeavor *for her next cruises.]*



Opposite, from top to bottom: an autonomous glider is prepared for deployment; a mission briefing is delivered in the main lab; a sample of bottom mud is removed from the coring cylinder.

MAINTENANCE AND DRY DOCK

R/V *Endeavor* began 2017, her 41st year in service, after a 75-day stint at Senesco Ship Repair Yard, followed by dock and sea trials. The following work was done:

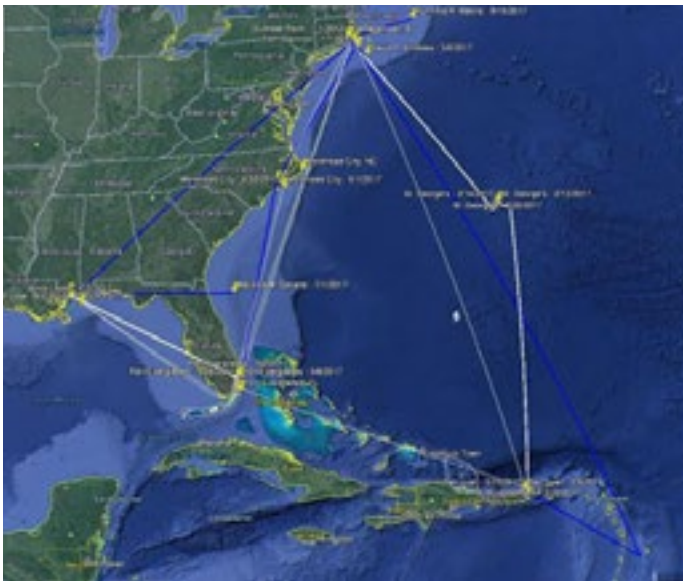
— A and J frames removed and fully overhauled

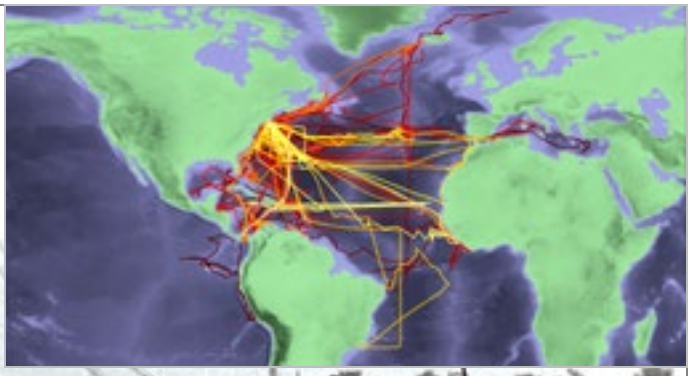
— Main-deck tonnage openings and hatches removed, rebuilt, and reinstalled

— Winches, anchor windlass, aft-deck capstan, and main propulsion system reconditioned

— Hull and exterior decks sand-blasted and painted

— Half of ballast tanks sand-blasted and recoated



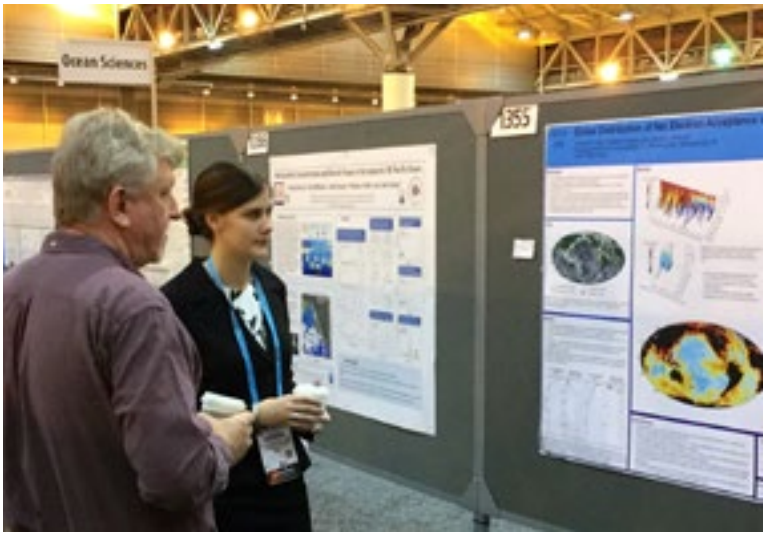


Clockwise from above: R/V *Endeavor* scientists and crew at sea; a plot of *Endeavor's* cruises in 2017; shiptracks plotted by GSO's Chowder and Marching Society in 2017 show *Trident's* cruises from 1962 to 1976; *Trident,* the school's first research vessel.

PHOTOS COURTESY OF ENDEAVOR CREW.

ACADEMICS AND EDUCATION

David C. Smith
Professor and Associate Dean for Academic Affairs



In another successful academic year, URI's Graduate School of Oceanography (GSO) awarded 12 graduate degrees.

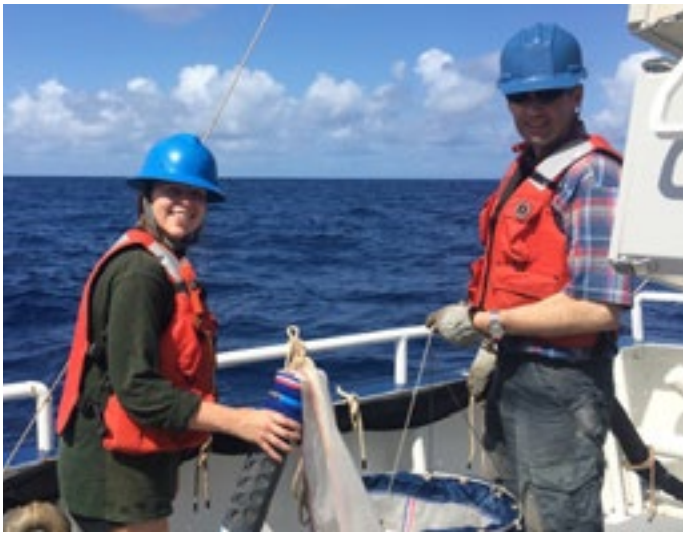
Four students—all of whom were undergraduates at URI—earned Master of Oceanography (MO) degrees and have begun careers in ocean modeling, marine conservation and entrepreneurship. When they first entered the fledgling "5th-year MO" program, the students completed graduate-level core courses in oceanography during their senior year. After earning bachelor's degrees, they matriculated at GSO.

Three students earned MS degrees and are now working as as environmental scientists.

GSO's five newest Ph.D. graduates have found homes across the country, from Woods Hole Oceanographic Institution on Cape Cod to CalTech on the West Coast. They'll continue the long tradition of this school's presence in, and influence on, the oceanography community.

In the 2016–2017 academic year, 22 new students arrived at GSO—one of the largest incoming classes in decades. This class includes 11 doctoral students, three MS degree students, and eight students enrolled in the Master of Oceanography program, two of whom are also pursuing the University's Blue MBA. Professor Art Spivack has been making clear progress in his efforts to increase enrollment of students seeking the MO.

The academic program at GSO is being expanded to include more non-traditional students. This year marked the inaugural offering of a core oceanography course to employees at Raytheon. Via remote video technology, professional engineers in Raytheon's Middletown, R.I., office participated in "Physical Oceanography." Professor Melissa Omand completely revised the course to blend in-class and online study. Graduate student Ali Johnson was instrumental in helping convert the instructional content and implementation of online-educational technology. The courses offered in this manner are being increased and GSO is reaching out to other entities to expand the program.



Our graduate students are gaining real-world experience. From top to bottom: Victoria Fulfer presents her research results at the fall 2017 meeting of the American Geophysical Union; Sean Scannell conducts a beach survey after a storm; Anna Robuck and Patrick Kelly (MS 2001) deploy sampling gear from R/V *Endeavor.*

PHOTOS COURTESY OF OFFICE OF ACADEMIC AFFAIRS

Field Experience Gets Grad Student's Feet Wet

Helping to Solve a Real-World Problem is Next-Level Learning

She got the email in early August: Do you want to go to Aruba to find out why a resort is plagued by mucky beach sediment? "Count me in!" Nicole Brennan fired back. A few weeks later, the 22-year-old GSO student, decked out in flip flops and a bucket hat, was collecting water and sediment samples at Playa Linda Resort on the Caribbean island's northwest shore.

Not only was she doing fieldwork for her Master of Oceanography (MO) degree, she was also working side-by-side with two accomplished scientists: Arthur Spivack, a GSO oceanographer who specializes in the ocean's chemistry, and Elin Torell, director of international programs at GSO's Coastal Resources Center.

"I was overjoyed and grinning ear-to-ear," said Brennan. "It was such a great opportunity."

> The team took numerous sediment and water samples and shipped them back to GSO for analysis. "The water was murky, and we also found a slimy, mucky, gooey layer on the ocean bottom," observed Brennan.

PHOTOS: (LEFT) AYLA FOX, (ABOVE CENTER) ELIN TORELL.

Ocean science has intrigued Brennan since high school, when she saw the destruction Hurricane Sandy brought to her grandparents’ neighborhood on the Jersey shore.

A college search led her to URI, with its renowned oceanography and marine science programs, and last spring she graduated with a bachelor’s degree in geology and geological oceanography. As far back as her freshman year, she knew she wanted to pursue the 5th-year MO program, so she completed the undergraduate requirements and was interning at a water-quality nonprofit in New Jersey when the email arrived from David Smith, associate dean of GSO.

GSO first heard about the resort’s murky water in July when the resort’s board reached out for help, resulting in the three-member GSO team. Once in Aruba, the team took numerous sediment and water samples and shipped them back to GSO for analysis. The team also met with the resort’s manager, as well as tourism and environmental officials from Aruba.

“The water was murky, and we also found a slimy, mucky, gooey layer on the ocean bottom,” said Brennan. “For tourists to be stepping in this goop isn’t ideal, especially since tourism is so important in Aruba.”

Brennan took sediment and water samples at nearby resorts, which were clearer. It was apparent, she says, that the problem was largely confined to the Playa Linda Resort. Test results also showed that the water was not contaminated by pollutants, she said.

After further study, the team determined that the muck was decomposing seaweed that had settled on the ocean bottom. When the resort was built, the hotel dredged the beach, making it deeper and allowing the seaweed to accumulate after storms.

The solution? The team suggested sediment screens at the outer edges of the swimming areas to block the silt and dead seagrass.

“I learned so much about field sampling, collecting data and putting it into a report,” said Brennan. “To work with two great scientists was an incredible opportunity.”

For her MO project, Brennan plans to expand her report to examine water quality throughout the island and its desalination efforts to turn saltwater into drinking water.

She credits the Aruba project with helping her get two job offers from environmental consulting firms, even though she doesn’t graduate until the spring. “It’s all about experience,” said Brennan. “Employers want to see that, especially in the ocean and marine sciences. I sure got that in Aruba.” —ELIZABETH RAU

A Master of Oceanography Degree Put Steven Tadros to Work

Opportunites Abound in Fisheries, Coastal Systems, Ocean Technology and Data, and General Oceanography

Just a few weeks after graduating with a Master of Oceanography (MO) from GSO, Steven Tadros was placed in the wonderful position of deciding between not one but two job offers.

After a weekend of deliberation—and talks with his parents—he went with RPS, a global environmental consulting firm whose office in South Kingstown, where he works, specializes in ocean science.

PHOTOS: (LEFT) ALEX DECICCIO, (ABOVE) AYLA FOX.

"I wouldn't be where I am today without the master program," said Tadros, 23, who lives in Narragansett. "It provided a great beginning for me—someone who isn't ready yet to get a Ph.D., but wants to stay in the field and work."

Overhauled in 2016, the MO degree program, creates lucrative career opportunities for men and women interested in fields such as fisheries, coastal systems, ocean technology and data, and general oceanography.

The program was appealing to Tadros because it does not require a thesis, unlike the traditional master of science degree in oceanography. But what really closed the deal for Tadros is that he could enter the program as an undergraduate at URI, earning a bachelor of science degree and MO in five years.

"That was amazing," he said. "I knew I wouldn't be able to get the job I wanted with just a bachelor's, so doing one more year of work for an advanced degree put me in a great position for employment."

David Smith, associate dean of GSO, says the number of students enrolled this year in the MO program has doubled over last year, and he expects those numbers to keep rising as word gets out that the program gives students a distinct advantage in the job market.

"The students entering the program this year have diverse backgrounds," said Smith. "They range from senior URI students in the 5th-year option to students that have been in the workforce and are now focused on obtaining a graduate degree to either change fields or become more knowledgeable about the field they are in."

A 10-day high school trip to Costa Rica to study sea turtles inspired Tadros to study marine biology in college. After Ashland High School in Massachusetts, he enrolled at URI, and by his sophomore year, the MO program was on his radar, thanks to academic advisors who supplied him with information about its merits.

As an undergraduate, Tadros made sure he met all the program's requirements: a grade point average above 3.2 (Tadros had a 3.4); a grade of B or better in each of four prerequisite courses, including physics and chemistry; and completion of 60 undergraduate credits by graduation.

Undergraduates in the 5th-year MO program typically take one graduate level oceanography course during the fall of their senior year and two oceanography classes in the spring. That's what Tadros did, and when he joined GSO he was fully prepared.

Not only did he appreciate the option of taking classes that appealed to him—ecological statistics, marine affairs and fisheries—he also enjoyed working in the field, once researching damaged coral reefs in the British Virgin Islands, another time collecting weekly plankton samples in Narragansett Bay.

> "Students entering the program this year have diverse backgrounds.… from senior URI students in the 5th-year option to students that have been in the workforce and are now focused on obtaining a graduate degree."
>
> *—David Smith, associate dean*

"GSO was a great experience for me," he said. "It's a community filled with wonderful faculty and students, and they're all working together to help students succeed."

This July, a few weeks after Tadros received his MO, Smith called with two job prospects. "I applied to both jobs, got interviews at both, and was accepted at both," Tadros said. "Incredible." At RPS, he is a junior scientist, creating oil spill models for companies considering drilling for oil in the ocean.

"I love coming to work every day," he said. "I'm right where I want to be in my life."

Is a doctorate in oceanography in the future, possibly at GSO? "Maybe," he said. "If I get one, it will be there. For sure."
—ELIZABETH RAU

BAY CAMPUS CHRONICLE

Center Directors Report
Highlights of 2017

Coastal Institute

Judith Swift, Director

Senior Fellows

From its inception the Coastal Institute (CI) has fostered and supported interdisciplinary collaborations in all facets of its mission. CI Senior Fellows are the heart and soul of these endeavors and come from a variety of disciplines (e.g., oceanography, ecology, economics, business, the arts, the humanities, etc.) and represent a diversity of institutional settings, such as academia, public agencies, the private sector and citizens. Senior Fellows convene once a year to observe cutting-edge research on compelling challenges in coastal resilience, explore new dimensions of coastal and watershed management, garner feedback on CI endeavors, and provide researchers an opportunity to interact and discuss potential future collaborations.

Grants-in-Aid, Catalyst Grants, and Leveraging Grants

Once discussions spark a proposal concept and identify a source, the CI provides input and staff or financial support during grant development, application and maintenance. The first of these grants was the 2005 $3.2 million National Science Foundation (NSF) Integrative Graduate Education and Research Traineeship under principal investigator Peter August. This year, the CI collaborated with GSO professor Rainer Lohmann and a team from colleges across URI, Harvard School of Public Health, and the Silent Spring Institute and was awarded an $8 million National Institute of Environmental Health Sciences Superfund Research Program grant *[See article, page 9]*. The CI also collaborated with researchers from URI College of Pharmacy on an National Institutes of Health/NSF grant that will be decided in early 2018, and researchers from URI College of the Environment and Life Sciences on a NOAA grant that was not selected for funding. While successful funding is always the goal, the CI invested in fostering collaborations that will only strengthen future grant applications.

PHOTOS: (LEFT) ALEX DECICCIO, (TOP) COASTAL INSTITUTE.

Lecture Series

The CI's annual Scott W. Nixon Lecture Series honors this highly accomplished GSO professor who made wide-ranging contributions to the study of estuaries, lagoons, marshes, and other coastal ecosystems. In 2017, Dr. Susan Lozier of Duke University spoke of changing ocean circulation patterns and how new methods of data collection and analysis are closing information gaps in this field. Her remarks added to those of past Nixon Lecture speakers who carry on the Scott Nixon tradition of deep thinking and not shying away from paradigm shifts.

R/V Endeavor: Science and the Sea by Eric Lutes

Outreach Activities

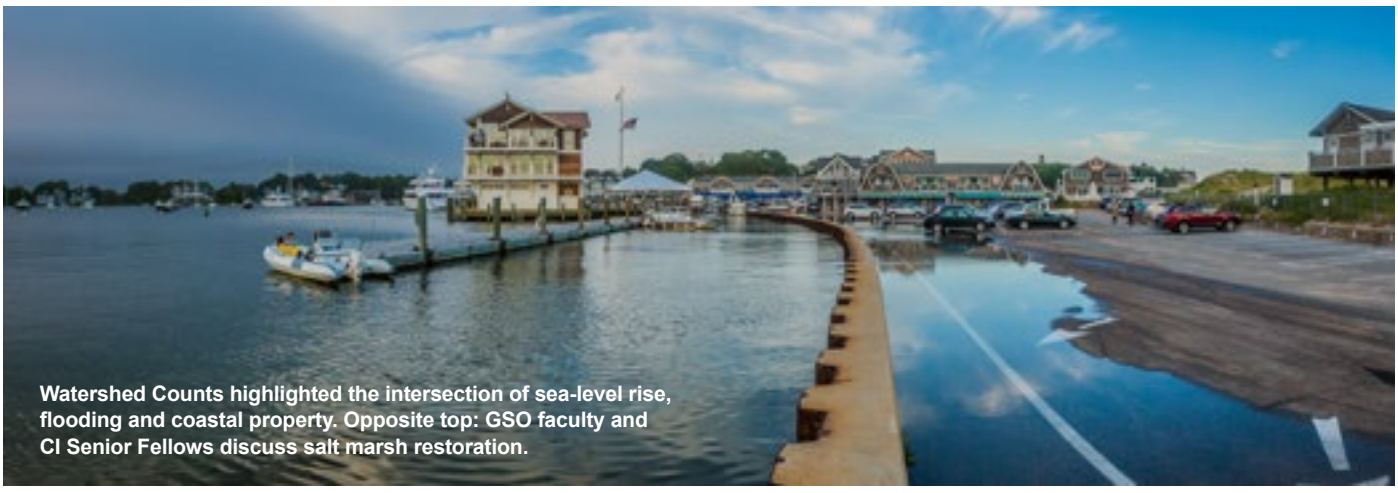
In addition to supporting primary research, the CI is also dedicated to translating science and delivering it to a broad audience through innovative digital and aesthetic platforms.

This year, as part of GSO's *Endeavor Day,* the CI hosted an art exhibit, *Coastal Images: The Work of Eric Lutes,* featuring a showing of "Science and the Sea," a painting of R/V *Endeavor* (above, right). Lutes, a CI Senior Fellow, grew up in an art-friendly home in Rhode Island and now balances his passion for art with his career as an actor in Los Angeles. Lutes also donated his on-camera talent to development of a trilogy of films focused on the geology, ecology and community engagement of the CI Demonstration Site at Napatree Point, one of three sites defined as natural, mixed-use, and urban ports.

The CI developed an alternative way to reach scientific experts and neophytes with *It's a Shore Thing: A Coastal Cabaret,* compiled of original songs with both lyrics and genre focused on environmental dimensions of coastal zones. The cabaret has been performed over 30 times at local to regional to national conferences, most recently to over 200 people from across the country at the Coastal and Estuarine Research Federation in Providence. This piece was created and directed by co-lyricists CI Director Judith Swift and Charles Cofone, composer and musical director, with the support of the URI Foundation.

The 2017 edition of CI's annual publication co-coordinated with the Narragansett Bay Estuary Program on *Watershed Counts,* featuring the role of climate change in challenges to and successful innovation for Narragansett Bay's coastal areas including personal property, oyster aquaculture and salt marshes. The publication also includes original graphics to better explain complex ecological ideas such as spring phytoplankton blooms, salt marsh accretion, and ways for homeowners to respond to sea-level rise.

This snapshot of the CI's work in 2017 illustrates ongoing support of interdisciplinary and innovative teams at GSO, throughout URI, and beyond as well as our commitment to disseminating scientific information for a range of audiences in an easily digestible and memorable manner.



Watershed Counts highlighted the intersection of sea-level rise, flooding and coastal property. Opposite top: GSO faculty and CI Senior Fellows discuss salt marsh restoration.

PHOTOS: (TOP) COURTESY OF COASTAL INSTITUTE, (ABOVE) AYLA FOX AND COURTESY OF WATHERSHED COUNTS.

Coastal Resources Center

Jennifer Critcher, Acting Director

Strategic Planning

The Coastal Resource Center (CRC) has begun implementing several elements of an ongoing strategic planning initiative. Three Strategic Plan Working Groups were formed and charged to focus on issues surrounding staffing, information technology and management information systems, and marketing/branding/communications. Each group recommended several near-term action items to strengthen CRC's capacity and better position the new director for success.

Leadership Transition

CRC is delighted to report that the search for a new director successfully concluded with the appointment of Dr. J.P. Walsh, a coastal geoscientist and professor at East Carolina University's Department of Geological Sciences. Dr. Walsh is a Fulbright Scholar who explores how sedimentation and marine processes affect the coast and its resources. *[See story, page 21.]* He began his watch at CRC's helm in January of 2018.

Telling the CRC Story

To make a consistent, compelling case to peers, partners, and potential clients, the fundamental components of the Center's story—the vision statement, mission statement, and portfolio of programs—were updated and revised. For the portfolio, **"safe, local, abundant, and sustainable seafood," "thriving coastal communities,"** and **"vibrant, well-managed oceans, coasts, and watersheds"** are phrases that put a fine point on both the areas in which CRC investigators and practitioners are at work (in Rhode Island and around the globe) and the center's long-term objectives. Similarly, the vision and mission statements present organizational aspirations, professional expertise, and methodologies. Those statements appear on www.crc.uri.edu and, along with the portfolio of programs, are being delivered in presentations and literature.

Block Island Wind Farm: Effects on Recreation and Tourism

Documentation of Block Island Wind Farm's effects on recreation and tourism, and subsequent indicators, will help the U.S. Bureau of Ocean Energy Management (BOEM) work with the public to quantify impacts of offshore renewable energy facilities. The Center, in collaboration with Rhode Island Sea Grant, is facilitating the social-science effort with other partners including URI's Department of Marine Affairs, College of the Environment and Life Sciences, and Harrington School of Communications.

In December, the Southern New England Offshore Wind Energy Science Forum convened scientists, stakeholders and the community at the Bay Campus.

Wind-farm research and observed effects on animal and human activities was presented. This was the first major examination of science issues since the turbines became operational. Forum hosts and sponsors included CRC, GSO, Rhode Island Sea Grant, the Rhode Island Coastal Resources Management Council, the U.S. Bureau of Ocean Energy Management and wind-farm owner Deepwater Wind.

Clockwise from above: the Block Island Wind Farm, storm damage along the southern coast of Rhode Island; harvesting kelp in local waters.

PHOTOS: (LEFT) ALEX DECICCIO, (ABOVE) MONICA ALLARD.

Launch of PREP-RI

Officially launched in July, PREP-RI is for municipal decision-makers and elected officials seeking technical assistance with climate-change adaptation from a planning perspective. Six online modules, from basic climate-change science to managing stormwater to mapping tool tours, expand on knowledge provided by local practitioners and promote resiliency at the community level. Funded by the Rhode Island General Assembly and supported by Rhode Island Sea Grant, the program is expected to secure additional state dollars for further training enhancements.

In Central America

CRC is pursuing a long-term strategy to re-establish its presence in Latin America and the Caribbean. This includes continuing a collaboration with distinguished scholar, Professor Maria Gonzalez of the University of Cienfuegos, Cuba.

CRC will be making inroads into Central America through a new five-year regional coastal and marine biodiversity project funded by the United States Agency for International Development. The project, a partnership led by the International Union for the Conservation of Nature, will focus on fisheries management and conserving mangroves, seagrass beds and coral reefs, which are subject to overexploitation, habitat change, pollution and climate change. The project will be implemented in Nicaragua, Honduras, Guatemala and El Salvador.

In August, a three-person team—a principal investigator from CRC, a professor from GSO, and a student in the school's Master of Oceanography program—conducted research and stakeholder consultations in Aruba to investigate nearshore water-quality issues at the Playa Linda Resort. *[See story, page 26.]*

Bringing Kelp and Scup to Market

New data and information about growing and selling kelp in New England is being captured and organized. Similarly, a detailed analysis of how scup moves from the ocean to the dock to local sellers is taking shape. Significant interviews, surveys and information analysis over the past several months should fill large gaps in the state's understanding of the potential for these products to be integrated into Rhode Island's food strategy.

PHOTOS: (ABOVE) MELISSA DEVINE, (RIGHT) CINDY WEST.

Coastal Resources Center *(continued)*

On the African Continent

Several ongoing projects position CRC as a valued catalyst for research, planning, and management of sustainable fisheries and coastal environments, especially in West Africa.

In The Gambia, a Sole Fisheries Improvement Project Workplan was signed that details specific commitments to mutually agreed and publicly posted objectives, activities, timelines and resources for implementation. The workplan promotes growth of participatory, rights-based co-management of the sole fishery. This milestone builds on achievements of the CRC-led USAID/BaNaFaa Project and helps secure follow-on grant funding.

In Ghana, the USAID/Ghana Sustainable Fisheries Management Project is entering its fourth year. Work continues on multiple fronts to end over-fishing and reverse the severe decline of marine small pelagic fish stocks by engaging fisherfolk, governance, industry and trade associations. *[See story, page 14.]* These stocks are of high importance for food security and employment in Ghana and all of West Africa.

The Malawi FISH project, in collaboration with the University of Malawi, completed applied research projects that studied the usipa fishery, efficacy and impacts of brush parks, deep-pool refugia in Lake Chilwa, and an early-warning drought model for Lake Chiuta.

Top: The staff crest of the chief fisherman from Keta, Ghana, is displayed at World Fisheries Day. Above: In Senegal, fisherfolk work at a landing site.

In Senegal, COMFISH Plus supported the Sub-Regional Fisheries Commission as it convened a Ministerial meeting in Dakar. Ministers of Fisheries from Senegal, Mauritania, The Gambia, Sierra Leone, Cape Verde, Guinea and Guinea Bissau discussed their work on shared concerns, such as illegal, unreported and undocumented fishing.

West-Africa Regional ASSESS completed a performance evaluation for USAID/West Africa's Sanitation Service Delivery Project and has presented preliminary findings to USAID. The findings will shape design and implementation of the three-year scale-up.

Rhode Island Sea Grant

Dennis Nixon, Director

Rhode Island Shellfish Initiative

On April 24, Rhode Island Sea Grant and the URI Coastal Resources Center spearheaded Governor Gina Raimondo's celebrated launch of the Rhode Island Shellfish Initiative. Representatives from state agencies, industry, academia and the community turned out to recognize the economic and cultural value of local shellfish. The initiative mirrors a larger national program of the National Oceanic and Atmospheric Administration. It leverages Rhode Island's ability to collaborate and create opportunities to sustainably manage local shellfish stock, to promote economic growth and jobs, and to celebrate the state's unique food cultures.

Aquidneck Island Resilience

Rhode Island Sea Grant and the Coastal Resources Center have worked for more than a decade on implementing planning programs, such as the state-administered Aquidneck Island Special Area Management Plan, for the management, use and protection of coastal and ocean resources that anchor the island's economic, social and environmental health. Most recently, a collaboration that included an array of government, private sector and community partners helped the island's four communities—Middletown, Newport, Portsmouth, and Naval Station Newport—apply best-available science and public input to development of a strategy that guides preparation for coastal flooding and storm damage, key aspects of climate change.

PHOTOS: (TOP) NII ODENKEY, (CENTER) NAJIH LAZAR.

Shellfishing on Naragansett Bay.
Below: a bustling Misquamicut Beach.
Bottom: a segment of R.I.'s salt ponds.

BAIRD SYMPOSIUM

Ronald C. Baird Sea Grant Science Symposium

On December 6, the 16th annual Baird Symposium assembled 200 resource users, regulators, and scientists and provided a forum for thoughtful dialogue. The symposium's theme, "Changes in Narragansett Bay: A Conversation Among Citizens and Scientists," helped attendees focus on changes to chemical inputs, temperature, species, habitats and ecosystems in Narragansett Bay. The exchange of viewpoints and knowledge helped shape research questions to guide the next era of bay science. *[See page 6.]* The Graduate School of Oceanography, Rhode Island Sea Grant, the URI Coastal Resources Center, and the van Beuren Charitable Foundation sponsored the symposium.

Design Studios for Coastal Resilience

Building on successful studios in landscape architecture and ocean engineering, Rhode Island Sea Grant supported a new integrated coastal resilience senior capstone project in the spring semester, adding URI's senior resource economics class into the mix. More than 50 students from the three classes focused on the Misquamicut Beach area of Westerly, R.I. They provided recommendations from the perspectives of engineering, design and economic analysis.

Public Aquaculture Meeting

On June 7, Rhode Island Sea Grant and Coastal Resources Center provided an education program and meeting at the Kettle Pond Visitor's Center in Charlestown that was attended by more than 125 people. "The State of Aquaculture in Rhode Island's Salt Ponds" helped answer the growing need for conversation between the shellfish farming industry flourishing in the ponds and the communities hosting this enterprise. The meeting enabled farmers, scientists, regulators and community members to engage in a frank, science-informed discussion about sharing and balancing use of pond resources.

PHOTOS: (TOP) COURTESY OF R.I. SEA GRANT, (RIGHT) JOHN SUPANCIC.

Inner Space Center

Dr. Dwight Coleman, Director

Research Support

The Inner Space Center (ISC) technical team demonstrated how scientists and engineers working on a project funded by the National Aeronautics and Space Administration could utilize mission control to interact with the team onboard the E/V *Nautilus* during one of the cruises off Mexico in November. During the multi-year SUBSEA (Systematic Underwater Biogeochemical Science and Exploration Analog) project, the NASA team plans to integrate the Exploration Ground Data Systems (xGDS) into ISC mission control to simulate remote space operations. They are planning to participate in E/V *Nautilus* missions in 2018 and 2019 to experiment with high-latency telepresence operations.

Arctic Project

ISC received funding from the National Science Foundation and the Heising-Simons Foundation to support an innovative expedition into the Arctic's Northwest Passage with a team of natural and social scientists, students and a professional film crew. The project aims to enhance awareness of the changing Arctic and increase public understanding of the scientific process.

Telepresence Support

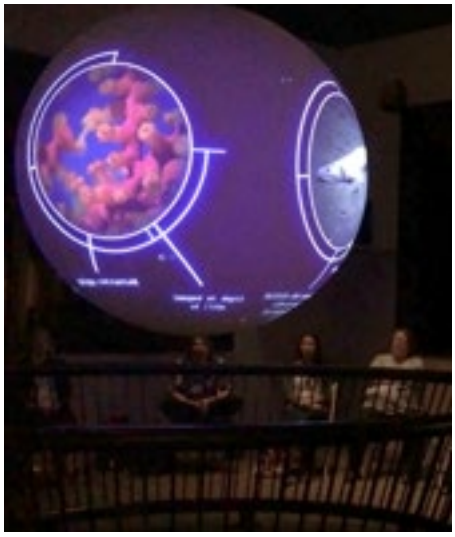
ISC continues its robust telepresence activities aboard research vessels and ships of exploration including the R/V *Endeavor,* National Oceanic and Atmospheric Administration (NOAA) Ship *Okeanos Explorer* and E/V *Nautilus*. The ISC receives live video from the vessels and streams it to YouTube, where the feeds can be shared with the science community and general public.

Video Production

Production specialists Alex DeCiccio and Lew Abramson traveled to Kongsberg

Top, from left: ISC's mission control room on the Bay Campus, deep-sea exploration is shared in real time through telepresence technology, a spherical screening of "Exploring the Unknown Ocean." Below, from left: the beauty of Arctic ice, testing an autonomous surface vessel in Norway, a science mission briefing is delivered aboard R/V *Nautilus*.

PHOTOS: (BOTTOM LEFT) KEN BURTON, (TOP AND ABOVE) ALEX DECICCIO.



Maritime's headquarters in Horten, Norway, to film the University of New Hampshire Center for Coastal and Ocean Mapping XPRIZE team and testing of their new autonomous surface vessel. The Shell Ocean Discovery XPRIZE is an international competition to incentivize the next evolutionary step in seafloor mapping.

Expedition Support

ISC Director and geologist Dr. Dwight Coleman served as expedition leader during four *Nautilus* expeditions, NA085 in the Cordell Bank National Marine Sanctuary, NA087 off the coast of central Oregon, NA090 in North Guaymas Basin and NA091 in Pescadero Basin, both in the Gulf of California. These missions utilized the ISC for telepresence-based ocean exploration with the Hercules/Argus ROV system.

Rhode Island *Endeavor* Project

In April, the R/V *Endeavor* embarked on a cruise led by professor Melissa Omand, during which University undergraduate students examined the physical dynamics of the Rhode Island shelf break and how they influence marine life. The ISC supported telepresence activities during this cruise, including live broadcasts to a global audience. ISC staff also assisted the students with creation of videos about the research.

Hurricanes: Science and Society, Special Act Award

ISC staff, Christopher Knowlton and Holly Morin (members of URI/GSO's Hurricanes: Science and Society [HSS] Team), received the National Hurricane Conference Special Act Award during the April 2017 National Hurricane Conference in New Orleans, LA. The HSS Team was recognized for its work in organizing and promoting hurricane science webinars for 5th grade students. Since 2012, the HSS Team has partnered with the National Hurricane Center on providing hour-long interactive live-webinars to teachers and their students in hurricane vulnerable areas of the United States. The webinars have reached approximately 33,000 students over the last five years.

Science on a Sphere

The ISC, in partnership with 42° North Media and NOAA's Office of Ocean Exploration and Research, developed and produced a new Science on Sphere (SOS) program—"Exploring the Unknown Ocean"—to highlight ocean exploration technologies, the people that operate them, and the scientists who use them. Deep-sea discoveries, scientists' commentaries, and imaginative visualizations and animations, all linked via inventive, sphere-based storytelling, are featured. The program is included in the international SOS Catalogue and available to any of the approximately 140 institutions currently in the global SOS Network.

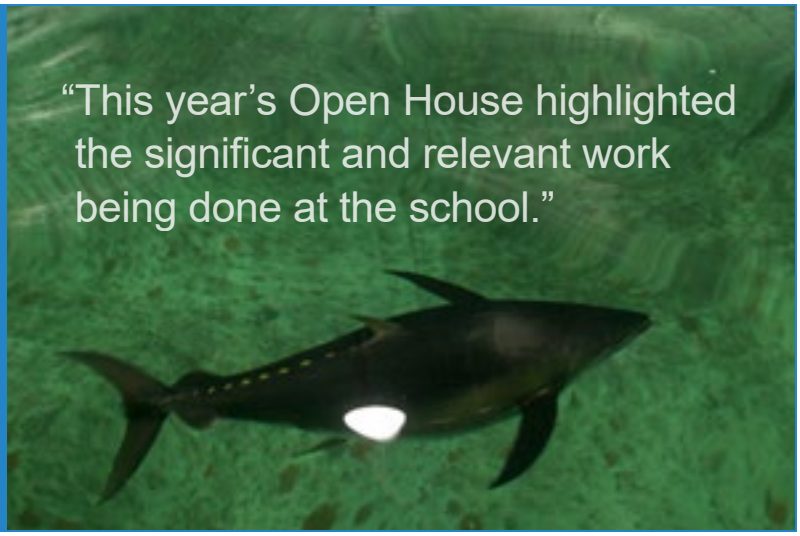
Education and Outreach

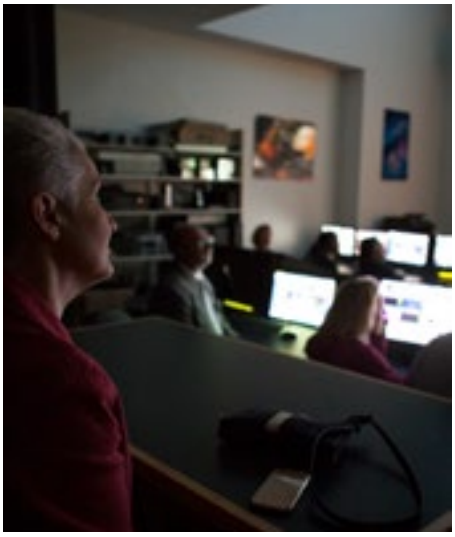
The ISC brings the excitement of ocean discoveries to onshore audiences. Using cutting-edge technology, students at Samuel Slater Junior High in Pawtucket (RI) were able to interact, in real-time, with GSO scientists and students aboard the E/V *Nautilus* during a November expedition. More than a dozen students prepared questions that they were able to ask scientists on board.

Through the ISC tours, education programs, and camps, more than 1,000 people were engaged with the school in 2017. We hope programs like these will inspire the next generation of ocean explorers.

PHOTOS: (TOP LEFT) COURTESY OF NOAA OCEAN EXPLORATION AND RESEARCH, (TOP RIGHT AND ABOVE) ALEX DECICCIO.

LIFE ON CAMPUS





GSO Open House Welcomes the Public

On a rainy Saturday in October, more than 3,000 Rhode Islanders enjoyed a day of family fun and learned about what's happening on the Bay Campus.

"This year's Open House highlighted the significant and relevant scientific work being done at the school," said Sarah Gaines, chair of the organizing committee. "The event was expanded to feature exhibits on the main quad as well as by the dock and to include a celebration of URI's 125th anniversary."

The Open House was an opportunity for the public to get an up-close look at URI's world-renowned oceanographic institution. Exhibits and activities included: a campus aquarium; a marine life touch tank for kids; interactive ocean science labs; local food trucks; a maritime art exhibit by Rhode Island artist Eric Lutes; and tours of the Inner Space Center, Marine Geologic Samples Lab and Rhode Island Nuclear Science Center. Of course, the perennial favorite is to take a tour of R/V *Endeavor,* which has carried thousands of scientists, students and teachers throughout the world's oceans on research missions.

GSO faculty, graduate students and staff shared their knowledge and passions for rocks from the ocean floor, pollutants in the oceans, zooplankton, hurricanes, oyster aquaculture, scuba diving, deep-sea ocean exploration, whale sightings, changes in local fisheries, and climate change demonstration sites in Rhode Island, such as Napatree Point in Westerly.

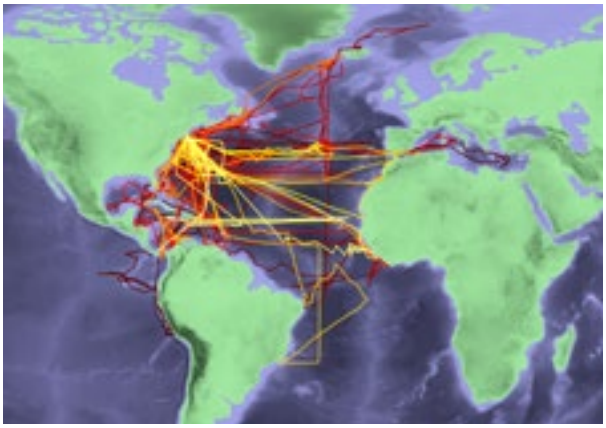
"Our guests put on a virtual reality headset to see microscopic plankton at 1,000 meters below the surface," said Melissa Omand, assistant professor at GSO. This virtual reality visualization of oceanographic data wasn't the only "cool" thing to see. There were demonstrations of remotely operated vehicles, opportunities to use oceanographic sampling equipment, and examples of how pressure impacts deep-sea animals.

While kids of all ages went on two scavenger hunts, one on the *Endeavor* and the other around the entire Bay Campus, there were opportunities to check out an outdoor tank experimenting with lobsters, a low-profile wind turbine, and a tuna-raising facility. The Environmental Protection Agency's research vessel and its staff was on hand to demonstrate sampling techniques.

Local historian Wayne Durfee illuminated the history of the Bay Campus, and GSO students reprised their "Bay Informed" lecture series—giving brief talks about their research, on topics such as climate change, pollution and wind farms.

"The school has played a critical role over the last 50 years, contributing to an understanding of the ocean and coastal environments and has been an asset to our state and the nation," said GSO Dean Bruce Corliss. "We appreciate the support we have received from Rhode Island and are delighted that Rhode Islanders are always eager to learn more about our activities and the *Endeavor.*" —SARAH GAINES and ELIZABETH RAU

PHOTOS BY ALEX DECICCIO.



Chowder and Marching Society Reaches Out

GSO students know how to do research in exotic places like Antarctica, insert a big tube in the deep seafloor to collect sediment samples, and study the eating habits of krill.

They also know how to make a mean pot of chili and throw a Halloween bash dressed like plankton, thanks to their student-led social group with a long tradition and fancy name, the Chowder and Marching Society.

Created years ago to help GSO students navigate their academic and social lives on campus, the organization is experiencing a boost of energy to get more students involved and expand community outreach.

"We have about 70 graduate students, and they've all participated in at least one event over the last year," says Joseph Langan, the group's outreach coordinator and a third-year GSO doctoral student. "This is a great way to build a sense of community among students and get us out of the lab, talking to each other. As graduate students, it's easy to live in a research bubble."

The events are mostly fun—and sometimes serious.

In the fall, students and professors gathered on South Ferry Beach for the annual "Boat Burning" festival to kick off the school year and welcome new students. Started in 1964 by a GSO student who wanted to get rid of his old wooden sloop, the evening has evolved into a celebration with food, volleyball and music.

The good times continued throughout the year: chowder and chili cook-offs; the Halloween party; clamming; ice skating; hiking; bowling; cookouts on the GSO Quad; and beach cleanups for Save The Bay. Students also organized a holiday coat drive and met with professors to talk about publishing in academic journals.

Marathon sessions with pizza in the Nautilus Galley produced a digital map of research expeditions of the M/V *Trident* over many decades. *[Below left and page 24.]* The students used their laptops and old ship log books to plot the courses.

"It's valuable to see the reach of the science at GSO," says Langan. "The map our group created shows that GSO research extends well beyond Rhode Island. Many GSO students were on those expeditions."

The group also started the "Bay Informed Discussion Series" as a way for young scientists to inform the community about important marine issues and ocean science research at GSO. The monthly talks have been a hit, with at least 60 people at each discussion.

Topics have been timely and compelling: climate change, challenges to fisheries, hurricanes, carbon cycling in the ocean, the Block Island Wind Farm, recent Antarctica expeditions and paleoceanography—study of the ocean's history. The series runs throughout the year.

Clockwise, from above: Shiptracks of M/V *Trident,* Halloween fun with family and friends at the Mosby Center, GSO professor Jeremy Collie delivers remarks at the Boat Burning Festival, Society members pause for a group photo on South Ferry Beach, the well-attended Bay Informed Discussion Series.

PHOTOS COURTESY OF CHOWDER AND MARCHING SOCIETY.

GSO students will continue to give the presentations to ensure that the discussions are casual and easy for the public to understand. “To engage with the public about what we’re studying and why it’s important is rewarding,” says Langan. “Our research at GSO has global implications, and we want the public to know and appreciate our work.”

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Next year, the Chowder and Marching Society hopes to expand with a YouTube channel, a podcast, outreach to local schools, and “Bay Informed” presentations off-campus, including one at the worldwide Volvo Ocean Race stopover in Newport in May.

“This is billed as the premier offshore sailing race in the world,” says Langan. “We’re helping with educational programs for people who come see the race. That’s quite an honor.”

And what’s behind the group’s decidedly non-nautical name? It’s a phrase for social gatherings that dates back at least a century and is now a popular name for informal social groups at colleges. “We don’t march,” says Langan. “But we do eat chowder.” —ELIZABETH RAU

DEVELOPMENT

Ellen Anderson
Managing Director of Development,
Marine and Environmental Sciences
URI Foundation

Setting Priorities, Embracing Momentum

In 2017, we asked our students why they love the URI Graduate School of Oceanography. Their responses ranged from the heartfelt, "your professors are your mentors *and* your friends," to the powerful, "you solve ocean systems puzzles that no one has ever considered."

At GSO, you—our alumni and friends—are an important reason "why" we can conduct ground-breaking research and discovery. Your support bolsters the school's ability to develop innovative solutions to the challenges facing Narragansett Bay, to serve as the academic hub of Rhode Island's Blue Economy, to research hurricanes and coastal resiliency, and to educate and mentor generations of students who will become well-equipped to explore the oceanographic and coastal issues of their time.

Since coming on board as director of development, I have witnessed the impact of your generosity and am honored to be joining the GSO team at a time of tremendous activity and momentum.

In September, I first met the advisory board and witnessed their partnership with Dean Bruce Corliss. Together with the URI Foundation, they laid down a strategic course, which includes an ambitious plan to dramatically transform the functionality and potential of the Narragansett Bay Campus.

The legacy of GSO's founding Dean, John A. Knauss, was his recognition that institutions evolve over time; they cannot remain unchanged. Our strategic objectives underscore the importance of that legacy. This comprehensive campus revitalization will provide state-of-the-art facilities for the Graduate School of Oceanography, the Department of Ocean Engineering, and the College for the Environment and Life Sciences.

The current facilities, worn by weather and time, are pressed to keep pace with URI's rising academic prominence in oceanography, coastal policy and technological innovation. An independent analysis of the campus's physical plant revealed that nearly 60 percent of the buildings and laboratories are at or beyond the end of their productive life cycle. With the 60th anniversary of GSO's founding on the horizon in 2021, our goal is to engage everyone in supporting this leader among oceanographic institutions as it expands world-class programs and meets the needs of Rhode Island and nations around the globe.

The following goals for private investments in research, teaching, outreach and infrastructure will allow GSO to maintain and advance its position, continue to attract the best faculty and brightest students, and serve as a resource to all who value ocean science in the Ocean State.

Transformational Research Facilities ($25M)

- Expansion of the Inner Space Center to provide telepresence services to all U.S. research vessels, supporting undersea research worldwide, and to enable live, real-time broadcasts to K-12 students across the nation
- New construction of research and teaching laboratories for GSO faculty to replace the aging Horn building, originally constructed in 1969, now well past its useful life
- New construction of an Ocean Technology facility where GSO and Ocean Engineering faculty collaborate on technological innovations such as autonomous underwater vehicles, gliders and robotics

Excellence in Oceanographic Research Fund ($5M)

- Establish an endowed fund to underwrite support for innovative faculty and to help generate the competitive start-up packages that attract and retain new faculty members conducting cutting-edge research.

Education and Outreach ($20M)

- The purchase of a new Narragansett Bay coastal educational research vessel; a floating classroom on which students will collaborate and immerse themselves in the interdisciplinary aspects of study and conducting coastal research
- Development of state-of-the-art teaching facilities to enhance educational resources for students
- Increased community outreach for public education including a revitalized visitor center and a significantly expanded 250-seat auditorium for hosting timely and critical public forums.

Renewal of the Narragansett Bay Campus is an exciting and transformative vision for the Graduate School of Oceanography and its URI partners, ensuring GSO's reputation as one of the world's leading oceanographic institutions. When fully realized, GSO will be well-positioned with the infrastructure necessary for oceanographic research and education for decades to come.

The Importance of Annual Giving at GSO

All of 2017's achievements would not have been possible without the generosity of the GSO community. Current-use dollars are as important as ever. The GSO Fund, the recently renamed annual fund, enables the school to advance groundbreaking research and discovery immediately while maintaining fundamental support for the priorities and progress of the Graduate School of Oceanography. Gifts of all sizes enable travel to conferences for our graduate students (giving them incomparable opportunities to present research and build professional networks), initiation of innovative research, purchase of scientific equipment, hosting of educational workshops, and more.

To make a gift, please visit *URIFoundation.org/GSOFund* or use the enclosed envelope, should you prefer.

I invite you to contact me about this exciting agenda. On behalf of the faculty, staff and students, thank you for your friendship and advocacy.

TAKING THE LEAD

We thank our Advisory Council members, under the direction of Dean Bruce Corliss, for their role in developing and sharing this vision of funding for infrastructure to support oceanographic research and education for decades to come.

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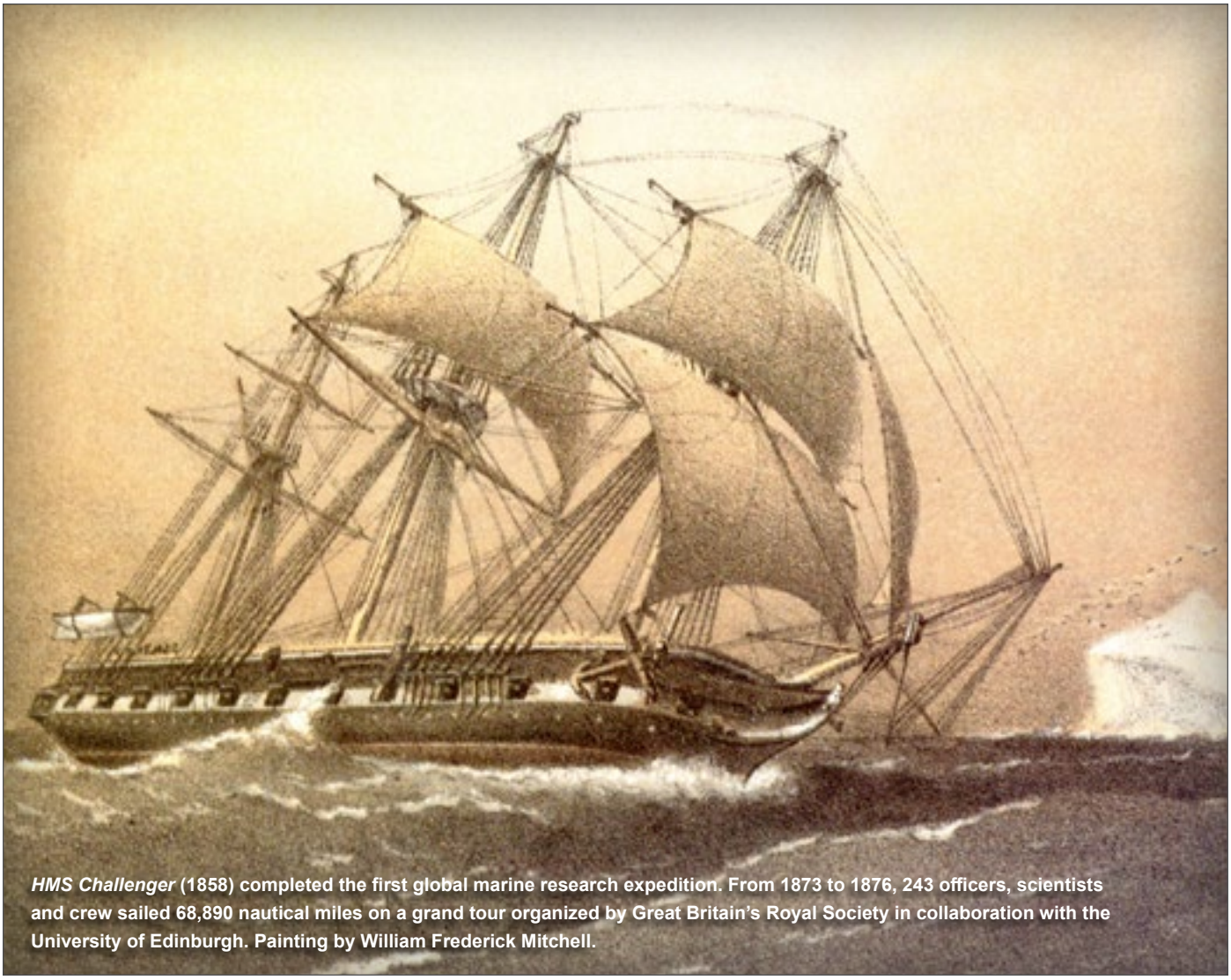

HMS Challenger **(1858) completed the first global marine research expedition. From 1873 to 1876, 243 officers, scientists and crew sailed 68,890 nautical miles on a grand tour organized by Great Britain's Royal Society in collaboration with the University of Edinburgh. Painting by William Frederick Mitchell.**

New Societies Recognize Giving at Every Level

Every gift to GSO makes a difference, and we are grateful. To better acknowledge supporters at every level of giving, we are proud to announce our new giving societies, effective now for fiscal year 2018. GSO alumni, individuals, foundations and corporations who have given are friends of GSO and recognized in our Honor Roll.

Challenger Society	$10,000 and greater
Endeavor Society	$5,000 to $9,999
Beagle Society	$2,500 to $4,999
Trident Society	$1,000 to $2,499
Nautilus Society	up to $999

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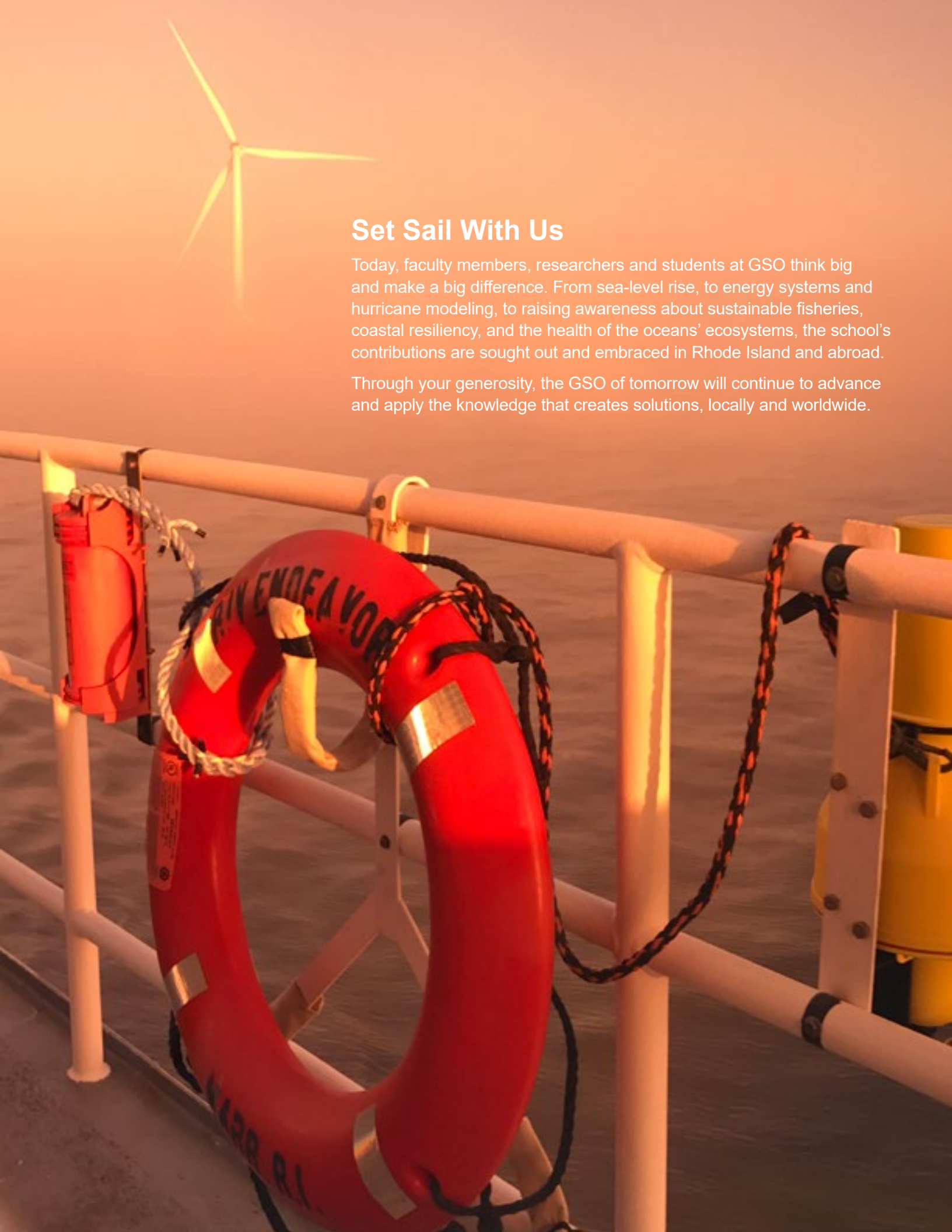
Celebrating Achievements

Our community of alumni and friends is filled with outstanding individuals who have made impactful contributions to GSO and ocean science. For 2017, we focus on two in particular who were recognized or their achievements—
Dennis Costello, (right, with Dean Bruce Corliss) received the URI 2017 Distinguished Achievement Award and GSO alumna **Veronica Berounsky '81,** (above) was awarded the Distinguished Service Award at the Coastal and Estuarine Research Federation's (CERF) 2017 24th Biennial Conference.

Costello is a Managing Partner at Braemar Energy Ventures, a leading energy venture capital firm. The Distinguished Achievement Award honors those who personify URI's tradition of excellence in achievement, leadership and service. This year's awards events included a Saturday breakfast at the Bay Campus Mosby Center, in conjunction with the GSO Open House, followed by a private tour of the R/V *Endeavor* for award recipients, led by Dean Corliss, and a visit to the Inner Space Center, led by GSO alum, Robert Ballard.

In early November, Dr. Berounsky was cited by CERF for her outstanding volunteer service, which spans over three decades of critical roles within the organization and also by the New England Estuarine Research Society. She is a Senior Fellow at the URI Coastal Institute and has spent her career studying the diverse ecosystems of coastal zones including Narragansett Bay and New England coastal ponds. Dr. Berounsky is a tireless volunteer and ambassador for GSO.

PHOTOS: (TOP) COURTESY OF CERF, (ABOVE) JOE GIBLIN, (RIGHT) COURTESY OF *ENDEAVOR* CREW.



Set Sail With Us

Today, faculty members, researchers and students at GSO think big and make a big difference. From sea-level rise, to energy systems and hurricane modeling, to raising awareness about sustainable fisheries, coastal resiliency, and the health of the oceans' ecosystems, the school's contributions are sought out and embraced in Rhode Island and abroad.

Through your generosity, the GSO of tomorrow will continue to advance and apply the knowledge that creates solutions, locally and worldwide.

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Yellowfin broodstock feed in the tuna research facility on the Narragansett Bay Campus.

PHOTOS:
(FRONT COVER) BRUCE CORLISS,
(BACK COVER) ERIC SAVETSKY.