2016

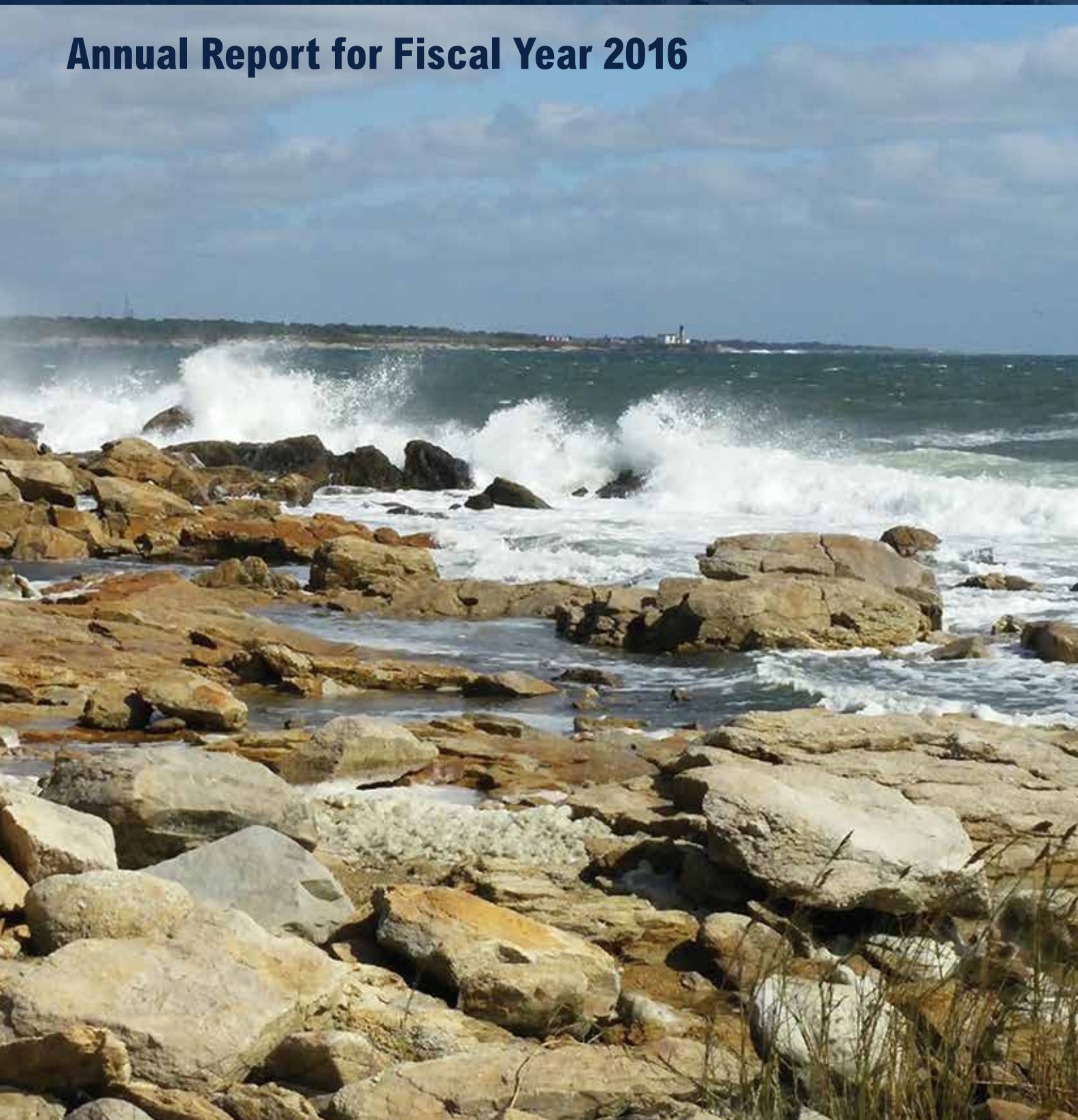
Graduate School of Oceanography Annual Report for FY2016

URI Graduate School of Oceanography

THE
UNIVERSITY
OF RHODE ISLAND

Graduate School of Oceanography

Annual Report for Fiscal Year 2016



Journalists aboard the R/V *Endeavor* during the Metcalf Institute's 18th Annual Science Immersion Workshop.

Cover: Perspective from Whale Rock in Narragansett, R.I. Beavertail Light in Jamestown can be seen in the distance across Narragansett Bay.

PHOTOS: COVER, TERESA CREAN; INSIDE COVER, GRETCHEN ERTL

GRADUATE SCHOOL OF OCEANOGRAPHY LEADERSHIP 2015–2016

DEAN'S OFFICE

Bruce Corliss	Dean, Graduate School of Oceanography
Thomas Miller	Director, Graduate School of Oceanography/Administration
David Smith	Associate Dean, Graduate School of Oceanography
Barbara Braatz	Director of Development, Graduate School of Oceanography, URI Foundation

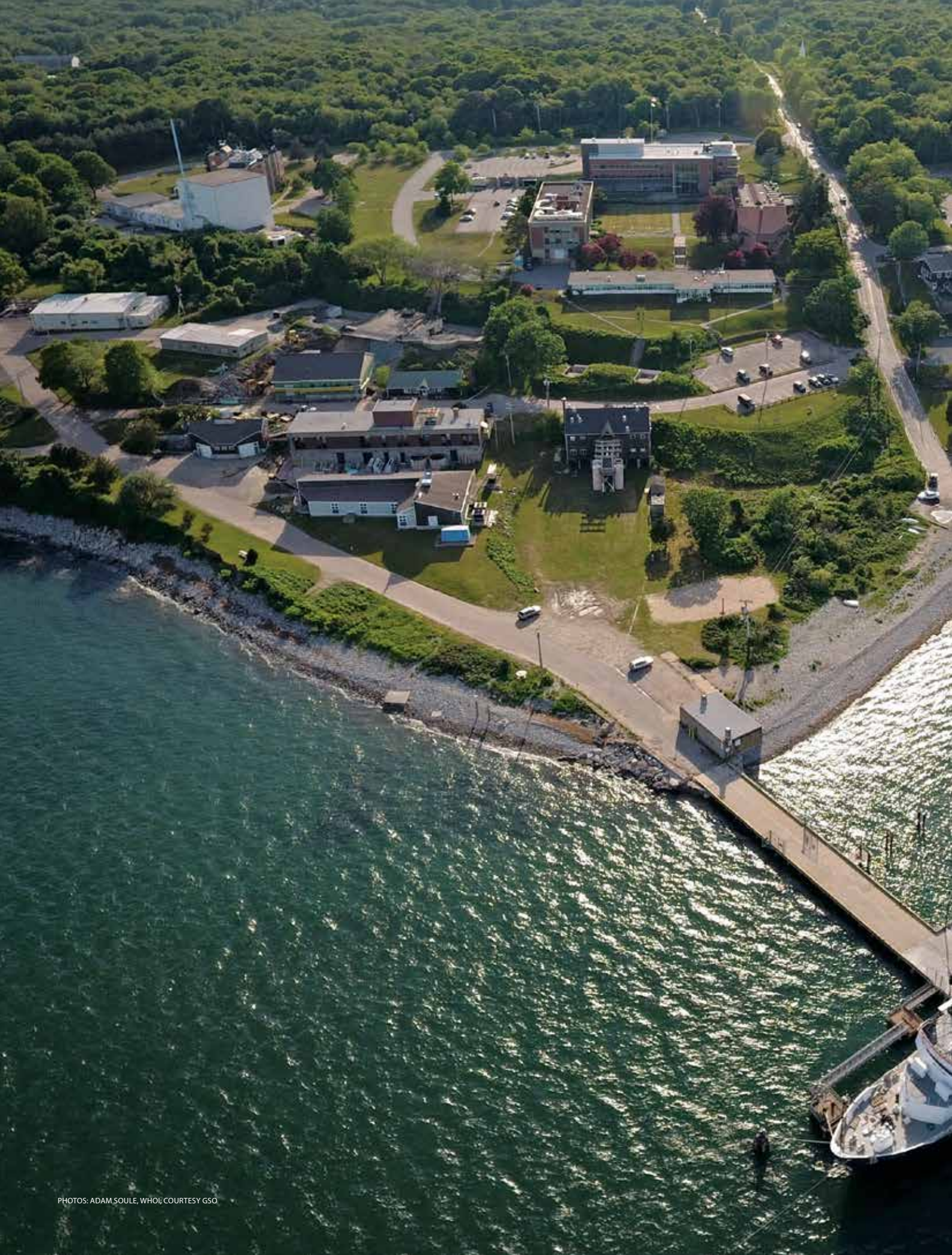
SENIOR ADMINISTRATORS AND DIRECTORS

David Palazzetti	Director of Facilities and Operations
Thomas Glennon	Director of Marine Operations
Robert Ballard	Director, Center for Ocean Exploration
Dwight Coleman	Director, Inner Space Center
Gail Scowcroft	Associate Director, Inner Space Center
Anton Post	Director, Coastal Resources Center
Sara Hickox	Director, Office of Marine Programs
Sunshine Menezes	Executive Director, Metcalf Institute, and Associate Director, Office of Marine Programs
Dennis Nixon	Director, Rhode Island Sea Grant
Alan Desbonnet	Assistant Director, Rhode Island Sea Grant
Jon Alberts	Executive Secretary, University National Oceanographic Laboratory System (UNOLS)
Annette DeSilva	Deputy Executive Secretary, UNOLS
Judith Swift	Director, Coastal Institute

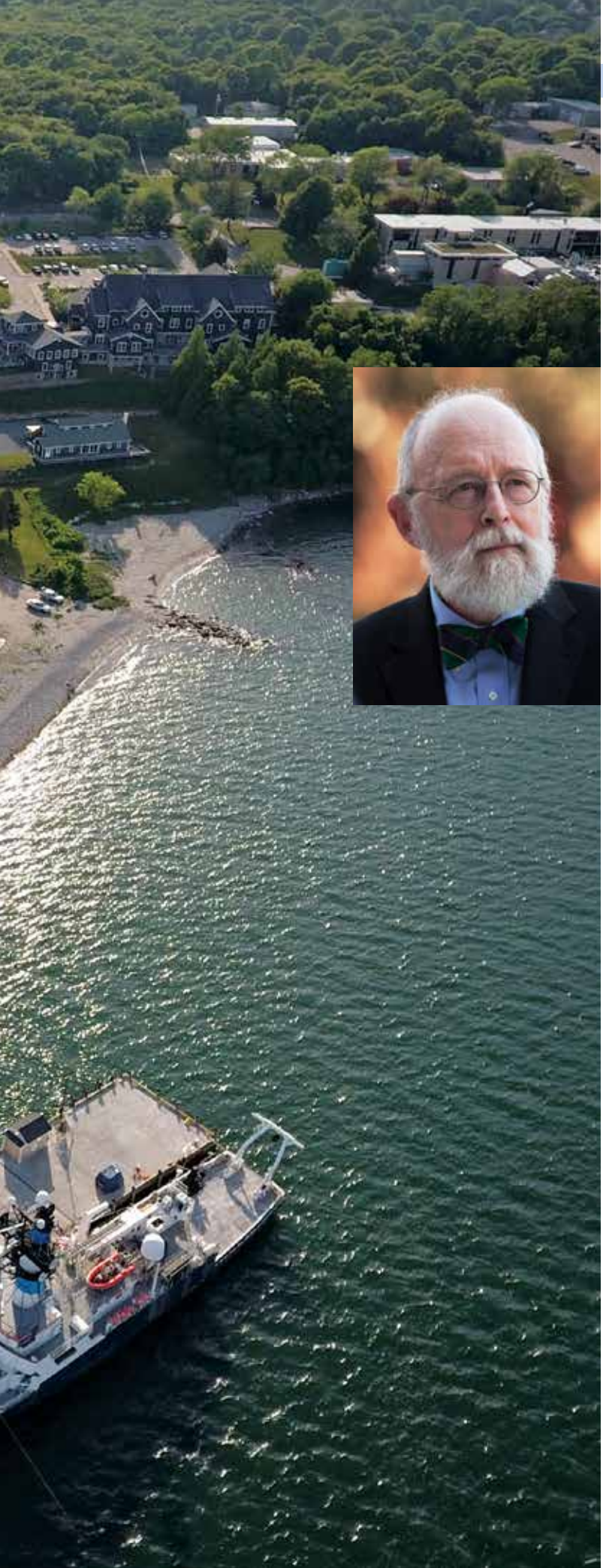
CONTENTS

Annual Report for Fiscal Year 2016

PHOTO: COURTESY GSO



PHOTOS: ADAM SOULE, WHOI; COURTESY GSO



Year in Review

This annual report provides an overview of an eventful and productive year for GSO. We highlight the activities of GSO scientists, staff, and students, and their research on a wide range of topics.

We are known nationally and internationally for cutting-edge research and exceptional graduate education. Basic research on the ocean has contributed to a better understanding of oceanic and Earth processes and is the foundation for much of the applied research being carried out here and throughout the world. The importance of basic research seems to be lost in some conversations, but in oceanography, as in other areas of science, investment in basic research is critical and yields both short-term and long-term results.

Outreach activities are also important at the Graduate School of Oceanography. One of the profiles in this report highlights the Coastal Resources Center's (CRC) work in Ghana—part of a $24 million grant to develop management strategies for Ghanaian marine fisheries. This is but one example of a long list of CRC projects in developing countries over the years that have had a significant effect on management of fisheries and coastlines throughout the world.

One of the high points of this last year was the development of a Narragansett Bay Campus Master Plan. The campus has evolved over the last 50 years in a somewhat haphazard manner as funds became available for individual buildings. Many of those buildings have run their course, are in poor condition, and need replacement. The infrastructure needs of the campus have also changed, as our research, education, and outreach programs have evolved. In response to the need for campus renewal, stronger interdisciplinary collaborations, and the growth of all programs, a strategic approach to campus planning was recognized as important for the University of Rhode Island. We engaged the architectural firm Ellenzweig to carry out a planning process, and a new Master Plan was concluded in late spring 2016. This comprehensive and ambitious plan—the largest ever undertaken at URI—will transform the Narragansett Bay Campus over a 10-year period and provide state-of-the-art facilities for GSO and Ocean Engineering, allowing GSO to maintain its position as a premier oceanographic institution.

In the coming year, we will create and initiate a plan to achieve the goals outlined in the Master Plan. Of equal importance will be our continued efforts to improve our educational programs and to hire new faculty to carry out GSO's mission over the next several decades.

These are exciting times at GSO, and I hope you enjoy this annual report and some of the highlights of the 2015–2016 year.

With best wishes,

Bruce H. Corliss
Dean

Trending Upward

Thomas Miller, Director of Administration

GSO's commitment to ocean and coastal research, academics, outreach, and education remains its highest priority.

$31.1 million
in research and grant awards in fiscal year 2016

22%
increase over fiscal year 2015 results

RESEARCH AND GRANT AWARDS

The Graduate School of Oceanography, like many other institutions, continues to face financial pressures associated with generating the annual research and grant revenues from year to year to produce sufficient overhead returns to sustain operations. However, despite the challenging ocean sciences funding environment of the past few years, GSO is trending upward with another very productive year. GSO received $31.1 million dollars in sponsored research and grant awards in fiscal year 2016 (FY16), achieving a 22 percent increase from last year. This success builds upon the 10 percent increase achieved during fiscal year 2015. Figure 1 demonstrates GSO's performance over the last decade, and further highlights the FY16 achievement that nearly matched the level attained in fiscal year 2010 ($32.4 million) when a sizeable majority of the funds associated with the American Recovery and Reinvestment Act of 2009 (ARRA) were distributed.

SUMMARY

GSO's commitment to ocean and coastal research, academics, outreach, and education remains its highest priority. GSO recognizes that the funding challenges of the 21st century demand innovation, risk-taking, and an accelerated expansion into new, cutting-edge research and academic arenas to keep pace with the institution's long-term goals and rising operating costs. In this regard, the Master Plan completed this past spring to recapitalize the Narragansett Bay Campus over the next decade establishes a broad foundation for success in facing these challenges as GSO sets course for its journey into the next half century.

FIGURE 1. ANNUAL RESEARCH AND GRANT AWARDS

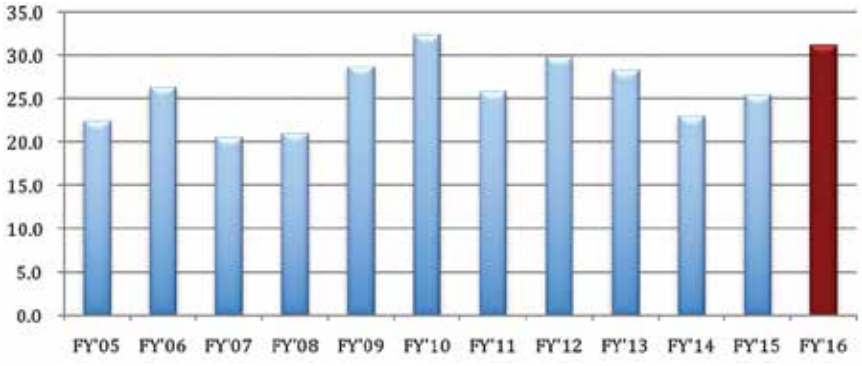


FIGURE 2.
FY16 REVENUE SOURCES
Revenue sources remain consistent year to year.

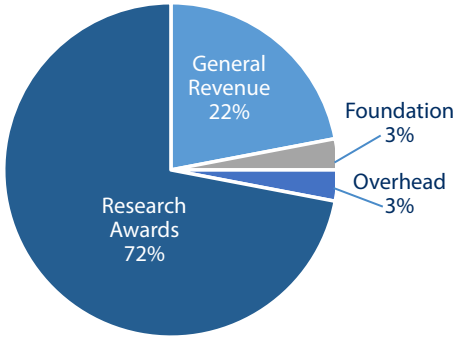


FIGURE 3.
FY16 REVENUE IMPACT
Annual revenues are used to support operations at GSO.

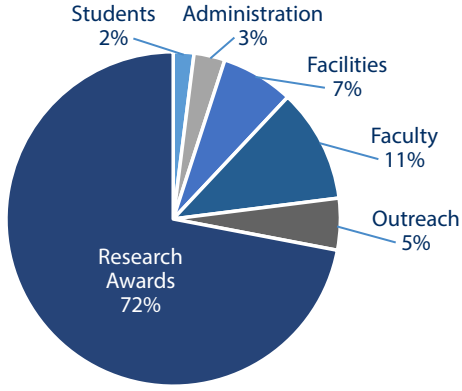


PHOTO: ALEX DECICCIO


INNER
SPACE
CENTER
Touch to Begin
THE
UNIVERSITY
OF RHODE ISLAND
GRADUATE SCHOOL
OF OCEANOGRAPHY
NOAA

Phytoplankton—From the Ocean Surface to the Deep Sea

Every spring, billions of microscopic plants called phytoplankton bloom in the ocean. But their lives are short-lived. They are eaten by zooplankton, sink to the bottom of the sea, or are transported into the dark ocean by swirling eddies.

By Elizabeth Rau

These ubiquitous natural processes are the focus of Assistant Professor Melissa Omand's groundbreaking research at the Graduate School of Oceanography. Her study of how phytoplankton—as well as dissolved organic materials—get from the ocean surface to the deep sea is key to understanding the ocean's carbon cycle and role in the global climate.

Phytoplankton are important players in regulating levels of carbon dioxide on our planet. During photosynthesis, phytoplankton consume dissolved carbon dioxide, and when the plants die, the carbon in their cells drifts to the sea bottom. This "biological carbon pump" is how an enormous amount of carbon dioxide—or greenhouse gas—is removed from the atmosphere.

"Global warming is a huge issue today," says Omand. "My work is motivated by the need to address the ways in which small-scale interactions between physics and biology can ultimately impact our climate system."

Her work is so accomplished that she received the Outstanding Young Scientist recognition from the acclaimed *Science* magazine this year. She was among 10 selected from a pool of young scientists nominated by Nobel laureates and members of the National Academy of Sciences.

"In describing this year's recipients, nominators spoke of exploratory, deep and transformative work," Eva Emerson, editor-in-chief of *Science*, wrote in Omand's acceptance letter. "They described the recipients as passionate, driven and brave, and as researchers who come along only once in a generation."

Omand's journey to ocean sciences started when she was an undergraduate studying physics at the University of Guelph in Ontario, Canada, where she wrote software that simulated X-ray emissions from Mars rocks measured by the rovers *Spirit* and *Opportunity*. Her "aha" moment came when she realized that she wanted to combine physics and Earth science to "improve our understanding of the planet and our impact on it."

Omand went on to earn her doctorate in physical oceanography at Scripps Institution of Oceanography in San Diego, examining how currents and tides influence the movement and distribution of phytoplankton. As a postdoctoral researcher at Woods Hole Oceanographic Institution, she studied an enormous plankton bloom that appears every year south of Iceland.

Since joining GSO in January 2015, she's been exploring new methods to observe where and how particulates and dissolved organic materials go from the sea surface to the deep ocean.

"There are a lot of exciting, cutting-edge tools for doing this research, from submersible microscopes to underwater gliders," she says. "These tools give us a high-resolution image of what's happening from the surface to the sea floor—and provide us with new windows into the fate of carbon in the deep ocean."

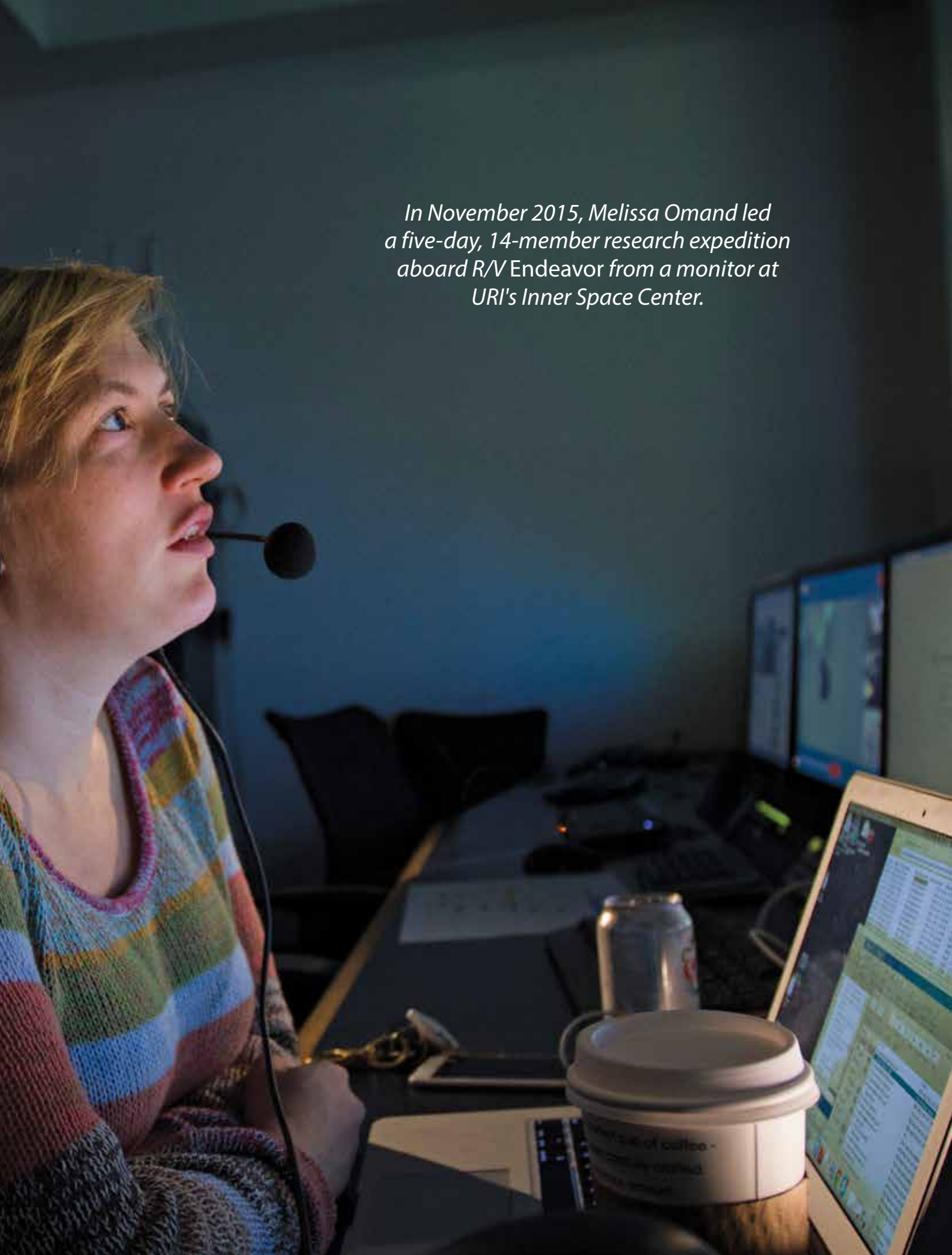
Omand said that some of the vast quantity of anthropogenic—or human-induced—carbon in the atmosphere could be stored away for thousands of years if it sank or was transported into the ocean's interior. Her studies of marine snow—phytoplankton and decaying organic matter raining down in the ocean—could help determine whether that carbon makes it deep enough to matter.

"The size of marine snow particles has a lot to do with their sinking rate, and the processes that lead to the break-up of those particles is not well understood," Omand says. "My lab is developing a time-lapse camera that will image these particles as they land in a sediment trap. We can see the particle size and type, and degree of degradation."

Omand is also making a mark at GSO's Inner Space Center. Last November, she led a five-day, 14-member research expedition aboard URI's *Endeavor* without leaving shore. Thanks to telepresence technology on the vessel, the then-pregnant Omand was able to work from GSO's Narragansett Bay Campus, where she communicated with scientists and viewed live streaming video of their work 100 miles south of Rhode Island at the edge of the continental shelf. The team tested new oceanographic tools to measure carbon export over small space and time scales.

"I was so grateful there was an alternative to being at sea—and energized to be involved in something so pioneering," says Omand. "For nearly a week, I led this expedition from a stool at the Inner Space Center. That's amazing."

PHOTO: ALEX DECICCIO



In November 2015, Melissa Omand led a five-day, 14-member research expedition aboard R/V Endeavor *from a monitor at URI's Inner Space Center.*

Unraveling the Complexities of Climate Change

Jaime Palter, the newest member of the GSO faculty, says ocean circulation can help answer questions about Earth's changing climate.

By Todd McLeish

"More than 90 percent of the heat trapped by man-made greenhouse gasses has warmed the ocean," says Palter, a Massachusetts native who worked as a camp counselor at URI's W. Alton Jones Campus long before she imagined becoming a Graduate School of Oceanography professor. "And a quarter of the carbon dioxide emitted to the atmosphere is taken up by the ocean. It's a huge carbon and heat sink, and depending on the region and atmospheric conditions, it can take up or give off heat and carbon. So the ocean is a huge player in our climate system."

Her studies in the North Atlantic are helping to answer questions about how the ocean affects the climate in Europe and why, in some cases, its impact is hidden.

"Europe gets its mild climate from the neighboring ocean," Palter explains. "It's much warmer than the United States because the maritime westerly winds bring warm air from the North Atlantic. Fluctuations in ocean temperature manifest themselves in the air temperatures in Europe in spring, summer, and fall. But these fluctuations are missing in winter."

In winter, a shift in the wind direction during decades-long cycles of warm and cool ocean temperatures brings cool air from the north when winter ocean temperatures are warm. In decades when sea surface temperatures are cool, winds from the west extract heat from the central Atlantic before arriving in Europe.

"One likely reason for these fluctuations in sea surface temperature is variability in the Atlantic overturning circulation, the conveyor belt that brings heat to the North Atlantic," says Palter. "Climate models predict that global warming will slow this ocean conveyor belt, which could lead to colder winters in Europe. But if the atmosphere has this dynamic shift in winds, like we think it does, then it could hide the winter cooling.

"The influence of the ocean and atmosphere on each other are filled with these sorts of surprises," she adds.

This ocean conveyor belt plays a key role in another of Palter's research projects, this one in the Labrador Sea between Greenland and Canada's Labrador Peninsula. There, the ocean absorbs carbon dioxide faster than anywhere else on Earth because deep mixing permits the exchange of surface water with water from the deep ocean.

"In a winter storm somewhere off the coast of Rhode Island, the surface of the ocean might get mixed down to a few hundred feet," Palter says. "But in the Labrador Sea, it could mix down a mile or more. That's a huge volume of ocean water that comes into contact with the atmosphere. And that translates to a big potential for rising CO_2 concentrations in the atmosphere to mix deeply into the ocean."

Palter used two decades of data collected by profiling floats to better understand the circulation in the Labrador Sea. She and her colleagues also deployed a pair of oceanographic gliders—neutrally buoyant floats with wings that can collect data on salinity, temperature and oxygen. They are also experimenting with using the gliders to measure carbon in the ocean.

Closer to home, Palter has proposed an expedition aboard the R/V *Endeavor* to study nitrogen fixation in the Gulf Stream. And she is thinking more about how she teaches about global warming after her first semester of teaching an undergraduate course on climate and the oceans revealed that some of her students weren't certain about the realities of human-caused climate change.

"I thought I was preaching to the choir at first, but when we did an exercise to explore some of the alternative realities, it turned out that some of my students were really confused and undecided," she said. "When I realized that some were foggy on the basics, it made me teach in a much more focused way."

That focus will come in handy as she looks to the future and sees that scientists may have to rethink their climate and oceanographic predictions if nations succeed in dramatically reducing their emissions in coming decades.

"If we look 30 years into the future, it will really be interesting to try to project climate and biogeochemistry in a zero-net-emissions world," Palter concludes. "Under a business-as-usual scenario, we're headed to a slowdown of the conveyer belt. But if we come in with much more positive change, it will have a different impact on ocean circulation. Even the basics of monitoring the oceans will be a challenge. It's not going to be a dull 30 years."

Palter's master's student Tara Howatt gathers data on the oceanographic glider project.

PHOTO: ROBIN MATTHEWS

"The ocean is a huge player in our climate system."

–Jaime Palter

The New Frontier for Volcanology

When Mount Tambora in Indonesia erupted in 1815, the impact rippled around the world. Spewing gas and ash into the air, the volcanic explosion blocked sunlight and ushered in a spell of global cooling. In North America, 1816 became the "year without a summer," as newspapers reported frost into July and extensive failed crops.

By Todd McLeish

"Explosive volcanic eruptions impact the global climate and human populations," says Steven Carey, University of Rhode Island geological oceanography professor. "They can trigger the spread of disease and cause famine."

Although alarming, the destruction these eruptions cause is not uncommon. Carey spent the first 20 years of his career studying how and why volcanoes erupt, a practice he calls forensic volcanology.

"A detective goes to a crime scene and tries to unravel what happened," Carey explains. "That's exactly what we do. We look for clues about what the volcano did in the past to try to figure out what it will do in the future." Forecasting eruptions is also critical, he added. If experts make the right predictions, they can save lives.

Carey was part of a team of scientists that traveled to Mount Vesuvius in the late 1980s to study the eruption that destroyed the Italian city of Pompeii in 79 AD and killed about 15,000 people. By reconstructing the timing of the hot blasts of gas and ash that struck the city, the researchers were able to explain how the city became entombed and why so many people died.

In recent years, Carey has begun taking his expertise in new directions—to underwater volcanoes. Many people are surprised that a landmass at the bottom of the ocean could affect terrestrial ecosystems and human lives and economies. But they can. Explosive blasts from submarine volcanoes can cause tsunamis, which can be devastating to the large numbers of people who live in coastal communities.

Carey said that the most exciting thing about underwater volcanoes is that so little is known about them. "Our understanding of land volcanoes is sophisticated," he says, "but the ocean is the new frontier for volcanology."

To perform his research on these volcanoes, Carey has teamed with URI oceanography professor Robert Ballard, who is best known for discovering the remains of the RMS *Titanic* in 1985. Carey, Ballard and their colleagues use remotely operated vehicles to explore the ocean floor and collect rock samples, which they bring back to URI to study.

Carey's interest in underwater volcanoes has led him to investigate nearby hydrothermal vents as well. Hydrothermal vents are cracks in the ocean floor, where water escapes after being heated inside the Earth. Terrestrial versions of these vents produce hot springs and geysers, while underwater vents can host exotic organisms like giant tube worms and clams, which are of great interest to researchers for their ability to survive in extreme conditions.

These vent systems usually occur at divergent boundaries where tectonic plates are separating near volcanically active regions. But they are also present at subduction zones where plates are colliding, such as around the Ring of Fire in the Pacific Ocean. In addition to the unusual biological communities they host, hydrothermal vents also contain mineral deposits rich in gold, silver, and copper.

According to Carey, these deposits are creating a new frontier of economic opportunity and are likely to become the basis for an entirely new industry. He worries, however, about the methods used for mining these minerals; some could wipe out entire vent communities before the vents can be studied.

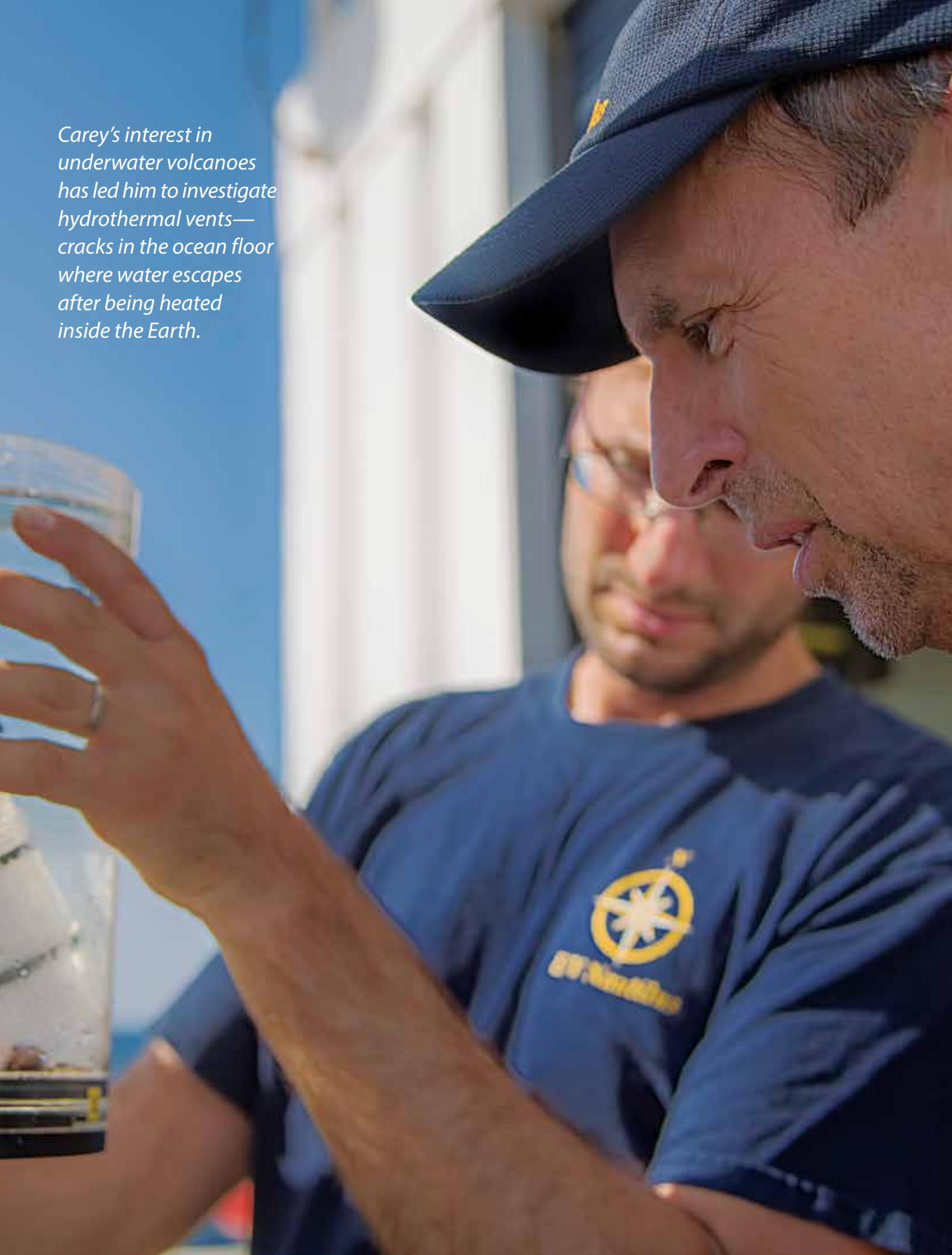
Hydrothermal vents also provide insight into how climate change will affect our planet in years to come. Water around the vents is often highly acidic, which allows researchers to study how marine life has adapted to this unique environment.

"When you go to these submarine volcanoes, you get a sense of how species are impacted by the acidic water," Carey says. "Many organisms can't survive the toxic conditions."

Revelations like these provide a window into what may happen as the oceans continue to acidify from the buildup of greenhouse gases in the atmosphere. They also elevate the importance of Carey's research to better understand the mysteries of volcanoes above and below the water's surface.

Right: Professors Steven Carey (foreground) and Christopher Roman examine a sample taken by the remotely operated vehicle Hercules at the submarine volcano Kick'em Jenny off the coast of Grenada.

PHOTO: JULYE NEWLIN



Carey's interest in underwater volcanoes has led him to investigate hydrothermal vents—cracks in the ocean floor where water escapes after being heated inside the Earth.

Uncertain Future for Ocean Ecosystems

The world's oceans are experiencing rapid changes—sea levels are rising, temperatures are fluctuating, storm patterns are intensifying, and biogeochemical cycles are being altered—and climate change is the root cause, promising an uncertain future in and out of the water.

By Todd McLeish

Tatiana Rynearson, University of Rhode Island biological oceanography associate professor, hopes to bring a better understanding of how the changing climate is affecting the oceans through her research on diatoms, a group of photosynthetic plankton that drift with the ocean's tides and currents. Covered in beautiful, delicate glass-like houses, these microscopic organisms are much more than a pretty shell.

"Diatoms are comprised of thousands of species and generate about 20 percent of all photosynthesis on Earth—more than all of the world's tropical rainforests," says Rynearson. "They generate the oxygen in every fifth breath of air that we breathe, so they have a large impact on the composition of our atmosphere. In addition, they supply about 40 percent of all the energy and food that form the base of the marine food web."

Their critical role in the food chain means that any changes in the productivity of diatoms can have significant repercussions. And yet, the effect of climate change on this keystone species is not yet fully known.

"The balance of prey—like diatoms—and their predators can significantly influence how much food is available for commercially important marine life, like fish and shellfish," says Rynearson. "We are really at the beginning of trying to understand how climate change affects diatom populations genetically."

To better gauge what will happen to the inhabitants of Rhode Island waters as ocean and bay temperatures warm, Rynearson has collaborated on interdisciplinary studies with colleagues across the Ocean State.

"One of our recent studies showed that diatoms subjected to a few months of projected ocean acidification underwent rapid evolutionary change," she says. "In essence, there was a change in their genetic composition, and this led to a change in their growth rates."

In that project, diatom growth rates increased by 30 percent in response to ocean acidity, a rate high enough to upset the delicate balance of marine ecosystems. In other instances, diatom populations decreased as a result of climate change stressors. Often, Rynearson said, it is difficult to tell which way the population will go.

"That's the challenge of climate change research—it's ultimately a multi-stressor event, and that is very hard to simulate in the lab under controlled conditions," she explains.

Rynearson and her colleagues aim to make such changes easier to anticipate by trying to understand the predictability of the evolutionary response and whether it can be incorporated into models of environmental change.

Her research also takes her beyond Narragansett Bay to look at the effects of climate change on a global scale through work to design a national network to monitor marine diversity. In April 2013, Rynearson and her colleagues published an article in the journal *BioScience* calling for a national network to monitor the diversity of marine life as a means to assess ocean health.

In response, the National Oceanographic Partnership Program made $17 million available for regional test networks in the Florida Keys, the California coast and the Arctic Ocean. After this five-year test period ends, Rynearson hopes a national network will be created. Such a network, she explained, would track marine diversity at all levels of the food chain—from microbes to whales—and link changes in diversity to physical changes in marine ecosystems, such as a rise in ocean acidity.

Her future research will include studying the effects of climate change on plankton in the Southern Ocean and creating new tools to aid in understanding complex organisms and food webs. She and her colleagues, including URI Associate Professor Bethany Jenkins, have developed and are applying a new metabolic fingerprinting technique that requires cutting-edge genomics and bioinformatics methods to look inside the plankton and ask questions about their health, especially in response to stress.

"This will give us new insights into what influences the engine that ultimately keeps marine food webs running," she says.

PHOTO: BEAU JONES


"Diatoms are comprised of thousands of species and generate about 20 percent of all photosynthesis on Earth—more than all of the world's tropical rainforests."
–Tatiana Rynearson

Studying a Small Life Form Has Led This Researcher on Big Adventures

Ted Durbin recounts sea life, lab work, and other adventures as retirement approaches.

By David Lavallee

He's studied menhaden in Narragansett Bay, right whales in the North Atlantic, snapper and French grunt fish in mangrove and seagrass beds in the Caribbean, and zooplankton DNA. But Edward "Ted" Durbin's primary research focus during his 41-year career at the University of Rhode Island has been food.

Durbin during his trip to the Antarctic.

The professor of oceanography, however, has not been in search of the next great pizza or his next gourmet meal, but rather the life of plankton and its role in food webs in polar regions, Narragansett Bay, and many other areas.

As the 70-year-old Durbin eyes retirement, he talked about his 40 years of continuous grant funding from the National Science Foundation (NSF) and the $12 million in grants he has brought in from NSF, the National Oceanic and Atmospheric Administration (NOAA), the U.S. Environmental Protection Agency, Sea Grant, and several other groups.

"What's been most fun about my career has been the opportunity to do research in many different areas and not being afraid to try new things. You have to keep trying new things to keep moving forward," he said.

Durbin's research began in 1975 just after he earned his doctorate from URI's Graduate School of Oceanography. Not yet a professor, he worked with his late wife, Ann, to develop a proposal to study menhaden and plankton in Narragansett Bay.

"GSO's late dean, John Knauss, did not insist that a faculty member be a part of the research team," said Durbin.

"It was pretty amazing that he allowed a husband-and-wife team to submit a proposal to NSF for the grant. When we were awarded the grant, we brought a bottle of champagne to Knauss' office, and there we popped the cork to celebrate."

That project led to several others that examined the feeding process of Atlantic menhaden, a fish belonging to the herring family. "We looked at feeding efficiency in menhaden," Durbin said. "They feed on phytoplankton and zooplankton, which are the base of the food chain."

They also demonstrated for the first time that Atlantic menhaden were optimal foragers, adjusting their voluntary swimming speeds to the availability of plankton food in the water. If food is not present, the swimming speed and respiratory rate of Atlantic menhaden are low. Numerous scholarly articles on that research by the Durbins can be found on the NOAA website.

From those studies, he moved on to examine the transfer of saxitoxin, produced by a red tide phytoplankter, in planktonic food chains in the Gulf of Maine. His team found that zooplankton feeding on the phytoplankton in this region have extremely high levels of toxicity. These, in turn, are fed on by the highly endangered North Atlantic right whale.

"By examining the diving behavior of whales and concentration of plankton in the water, we could estimate the ingestion of toxic zooplankton by the whales," Durbin said. "The amounts were high, but not enough to kill the whales. But we believed that the influence of toxins could be affecting breeding of the whales since they were producing fewer calves and they appeared to have less blubber than right whales in the South Atlantic."

His team, together with many other collaborators, also spent six years looking at the effects of ocean currents on plankton in Georges Bank and the resulting impact on cod and haddock larvae. "We had six scientific cruises a year over five years for this project. It was a big project," he said.

In the last six years, his scientific ocean cruises have taken him to some of the coldest regions in the world. He and his second wife, Maria Casas, a marine research associate at GSO, conducted a study of zooplankton in the ice-covered northern Bering Sea in late winter. At this time of year, phytoplankton grow in a very dense layer on the underside of sea ice and they wanted to determine if zooplankton were feeding on this.

"We were the first to quantify the different species of prey DNA in the guts of zooplankton and found that almost all of it came from the underside of the ice," he said.

"That was fun, and even though we made some mistakes, we learned plenty. Doing something totally new and learning to use DNA to identify prey species was exciting."

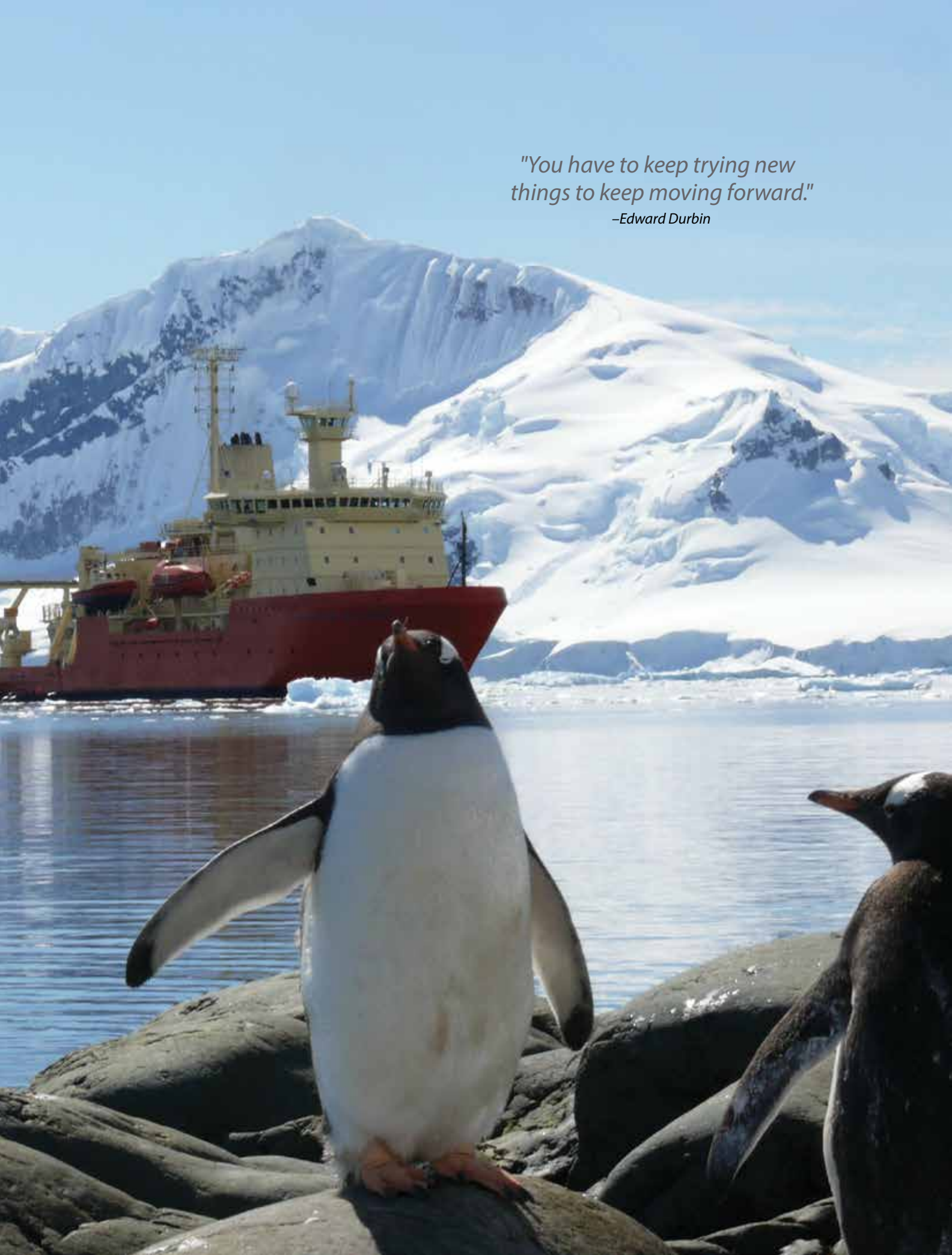
Durbin also led two month-long cruises in Antarctica with students and faculty, one in May–June 2013 and another in December 2014, to study krill, a crustacean that is key to the food chain in the Southern Ocean.

"The two expeditions provided many insights into how the ecosystem is functioning and what new questions should be asked. The more we know about krill behavior and their life history, the more we'll understand how the system will be affected by climate change," Durbin said.

In his spare time, Durbin is a hiker and runner, and Casas has joined him in climbing all 48 peaks of 4,000 feet or higher in the White Mountains of New Hampshire. Five years ago, they walked the Pilgrim Trail that runs 750 kilometers over the Pyrenees Mountains from France to Santiago de Compostela, Spain.

The former native of New Zealand, who earned his bachelor's and master's degrees from the University of Auckland, hopes to spend more time there in his retirement to see family members who still live there.

PHOTO: CELIA GELFMAN



"You have to keep trying new things to keep moving forward."

–Edward Durbin

Rebuilding Ghana's Fisheries

Above: Brian Crawford in Ghana; below, Ghanaian fishermen tend their nets.

Marine fisheries in Ghana are on the verge of collapse, and that could be catastrophic for the coastal country that gets more than 60 percent of its animal protein from fish.

By Dave Lavallee

Senior Coastal Resources Manager Brian Crawford is in Ghana as part of a U.S. Agency for International Development (USAID) $24 million grant—the largest in URI's history—to lead a five-year sustainable fisheries project. URI's Coastal Resources Center (CRC) was the grant recipient. The objective of the USAID-Ghana Sustainable Fisheries Management Project (SFMP) is to rebuild key marine fisheries stocks through responsible fishing practices. The project aims to set up a legal framework to protect the fisheries, develop more effective management plans and educate policymakers and the public.

"This will be a very challenging and ambitious project," says Crawford, who joined the CRC in 1988 and is the project director.

"If successful, our work with the Ghana Ministry of Fisheries and Aquaculture Development will reverse the trend in declining fish catches."

Crawford, who moved to Accra, Ghana, in January 2015, has more than three decades of experience working in international development in Africa, Asia and Latin America in the fields of marine conservation, sustainable fisheries and integrated coastal management.

Explaining why Ghana was chosen for this initiative, Crawford says it was a good opportunity to make progress quickly—there are many talented individuals who understand the issues at stake, and officials in senior levels of government and stakeholders are ready to turn the fishery around.

Bowls of sardinella at the Axim landing site in Ghana's Western Region. Sardinella is vital to the nation's food security and is severely overfished. The USAID-funded, CRC-led SFMP project is working to reverse this negative trend.

"The marine fisheries here are on the verge of collapse—10 years ago they were harvesting 130,000 metric tons of fish per year and now they are catching only about 30,000 metric tons per year," Crawford says. "In Ghana, fish play an important role in food security.

"A substantial portion of this fish food supply comes from the small pelagic fisheries—herring, sardines, anchovy. These fish have excellent nutritional qualities in terms of protein, micronutrients and omega-3 fatty acids. It is also a relatively cheap food source. These fish are caught, smoked and dried and travel long distances in the food supply chain, including into the northern part of Ghana and other Sahel countries where poverty and low nutrition rates among the population are high."

A former Peace Corps volunteer who served in Malaysia and the Philippines, Crawford has focused on small-scale fisheries in West Africa, where he oversaw the implementation of several USAID initiatives, such as empowering women through improvements in the fisheries value chain and establishing collective use rights for women oyster harvesters in Gambia.

"Many of these women are angry that poor management of the fishery is now impacting their businesses due to reduced fish supply," he says. "Many believe that some of the illegal practices employed in harvesting also land poorer quality fish, further impacting their business. In other parts of Africa, such as in Senegal, we have seen women refuse to buy illegally caught fish or juvenile fish, forcing fishers to adopt better practices that will help return the fishery to a healthier state. We hope that by working with the women to improve their businesses, we will also empower them as advocates of sustainable fishing practices."

Part of the Feed the Future initiative, a federal government effort to boost food resources in developing countries, the USAID-Ghana SFMP aims to benefit more than 100,000 people involved in the local Ghanaian fishing industry. The project's goals include helping to secure the jobs of tens of thousands of women involved in the processing and marketing of smoked fish, and efforts to reduce child labor and trafficking in the fisheries sector in the Central Region of Ghana.

The grant also provides for working with the University of Cape Coast (UCC) to improve its applied research and extension services in coastal and fisheries management.

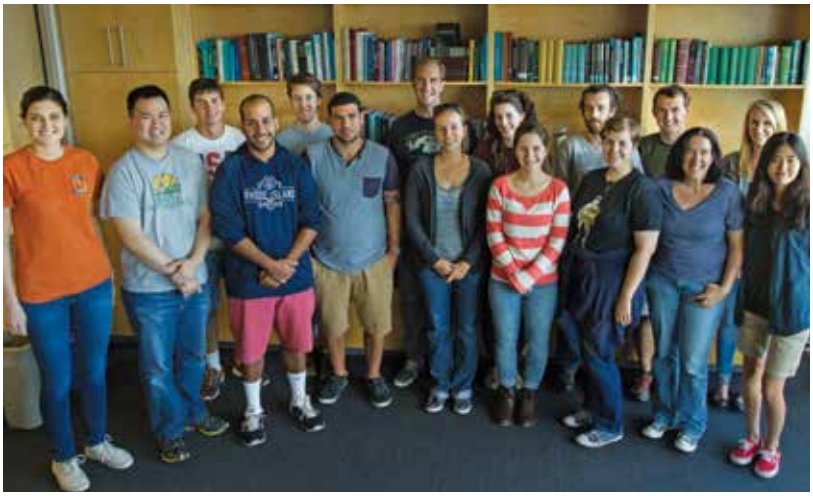
Crawford is enthusiastic about the partnership. He notes that the universities are working together to benefit coastal communities and assist the government in making more informed policy choices regarding the fishery and coastal development.

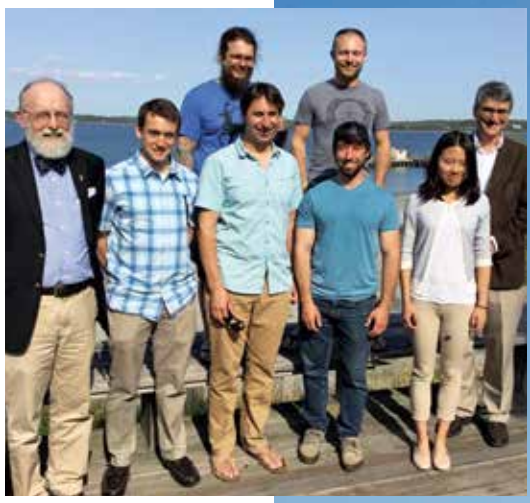
"We have already had several UCC faculty members visit URI to learn about our Land and Sea Grant models of applied research and extension and how they might be adapted in a Ghana context," Crawford said. "Over the life of the project we expect that there will be faculty and student exchanges— UCC faculty and students visiting Rhode Island to learn from our experiences locally, and URI faculty and students visiting Ghana."

PHOTOS: CHARITO CRAWFORD; COURTESY COASTAL RESOURCES CENTER

Excellence in Oceanographic Education

David Smith, Associate Dean for Academic Affairs





The 2015–16 academic year at the Graduate School of Oceanography was very successful. Fourteen students earned graduate degrees in oceanography with theses and dissertations covering topics including hurricanes, sediments, pollutants, and tropical mangroves. Their research was carried out around the globe. Some of our Ph.D.s headed off to begin postdoctoral positions at Harvard, Princeton, and Rutgers, and one has a U.S. Geological Survey Mendenhall Fellowship at Menlo Park, Calif. Some of our master's graduates are continuing in our doctoral program or graduate programs elsewhere, while others are starting careers in research and industry.

Current GSO students are being recognized as they are working on their degrees. Doctoral student Mary Dzaugis received the 2016 Graduate Student Research and Scholarship Excellence Award from URI's Division of Research and Economic Development. Joseph Langan, a doctoral student, received the 2015 George Burlew Scholarship. Brennan Phillips, Ph.D. '16, was awarded a National Geographic Expedition Council grant as well as a National Oceanic and Atmospheric Administration/Office of Exploration and Research grant.

GSO alumni continue to impress year after year. Of the 105 scientists named by President Barack Obama to receive the Presidential Early Career Awards for Scientists and Engineers, two are GSO alumnae. Jennifer Miksis-Olds, Ph.D. '06, and Colleen Mouw, M.S. '03, Ph.D. '06, both received this honor in 2015.

Left: Members of the fall 2015 incoming class of GSO graduate students in the new Challenger Room. From left to right: Stephanie Anderson, Kenny Lew, Sean Duffey, Steve Tadros, Chris McAleer, Ben Grassian, Spike Stone, Anna Robuck, Corrine Truesdale, Rebeccca Stevick, Jason Dumond, Colleen O'Day, Joe Langan, Rachel Miller, Sierra Davis, and Sylvia Kim.

Right: Six of the 14 spring 2016 graduates of GSO on the deck at Mosby Center with Dean Corliss and Associate Dean Smith. First row from left: Dean Corliss, Brandon Reichl (Ph.D.), Brennan Phillips (Ph.D.), Brian Caccioppoli (M.S.), Coaxin Sun (M.S.), Associate Dean Smith. Back row from left: Ashton Flinders (Ph.D.) and Kellen Rosburg (M.S.)

John Farrington, Ph.D. '72, was elected a Fellow of the American Geophysical Union. Barclay Collins, M.S. '74, Ph.D. '78, received the 2015 URI GSO Dean's Distinguished Achievement Award. Collins recently retired as general manager of Anadarko Petroleum Corporation after a successful career.

GSO faculty members were also recognized for their excellence this year. Professor Candace Oviatt, Ph.D. '67, received the Bostwick H. Ketchum Award from the Woods Hole Oceanographic Institution. Professor Oviatt also received the 2015 Lifetime Achievement Award from Save The Bay. Associate Professor Susanne Menden-Deuer was awarded the 2015 Hunter Prize from the International Society of Protistologists for her research, which has led to significant advances in understanding the importance of protists in plankton.

PHOTOS: ALEX DECICCIO

MASTER OF OCEANOGRAPHY AND BLUE MBA

MASTER OF OCEANOGRAPHY (MO)

Flexible two-year, non-thesis program with four tracks:

- Coastal Ocean
- Fisheries
- General Oceanography
- Ocean Data and Technology

BLUE MBA, *a dual-degree program*
Master of Business Administration (MBA) *and* Master of Oceanography (MO)

For students with a physical science, natural science, or engineering undergraduate degree. Prepare for management careers in:

- Energy
- Fisheries
- Hazard Risk Management
- Ocean and Human Health
- Ocean Technology and Engineering
- Marine Navigation and Tourism
- Water Resources

gso.uri.edu/professional

401.874.6246

R/V *Endeavor* Operations

Thomas Glennon, Director of Marine Operations

Top: The trawl winch and traction head enable *Endeavor* to send scientific equipment and instrumentation to ocean depths of 10,000 meters. Above: *Endeavor* loading science gear and stores for her next cruise. Below: R/V *Endeavor* passes Beavertail Lighthouse as she departs Narragansett Bay for another science cruise.

Once again *Endeavor* had a robust and productive year with over 200 sea days and scheduled vessel maintenance in between.

The start of FY16 found *Endeavor* off the coast of Iceland with William Hodgkiss of Scripps Institute of Oceanography (SIO) investigating mid-frequency noise range by deploying a 128-element vertical line array of hydrophones.

In August, we continued our Rhode Island *Endeavor* Program (RIEP) cruise schedule with co-PIs David Smith and Christopher Roman. This "Teacher at Sea" cruise included eight K–12 teachers and four graduate students learning various techniques for studying the biology, physics, chemistry, and geology of the sea. Next, John King gathered a diverse group—including a high school educator, graduate and undergraduate students, scientists, technicians, and observers from both the Narragansett and Shinnecock tribes. King and his group obtained a suite of long vibracores for paleoenvironmental studies. Then Thomas Rossby and Dwight Coleman collaborated to research fish tags and test *Endeavor*'s new telepresence systems while exploring wrecks off the coast of Block Island.

In September, *Endeavor* headed to Virginia for a U.S. Navy Office of Naval Research (ONR) acoustics cruise and then to Florida to assist William Johns of the University of Miami with his multi-decadal monitoring of the meridional overturning circulation at latitude 26.5N.

Upon returning to Rhode Island, *Endeavor* completed her last cruise of 2015 with PI Melissa Omand of the Graduate School of Oceanography, along with several graduate and undergraduate students. Participants on this RIEP cruise researched particle export and sinking rates utilizing a wire walker, sediment traps, and CTD casts.

Endeavor spent the winter completing much-needed maintenance tasks, including deck painting, tank repairs, deck crane overhaul, American Bureau of Shipping (ABS) hull and machinery tests, and a complete overhaul of her main engine.

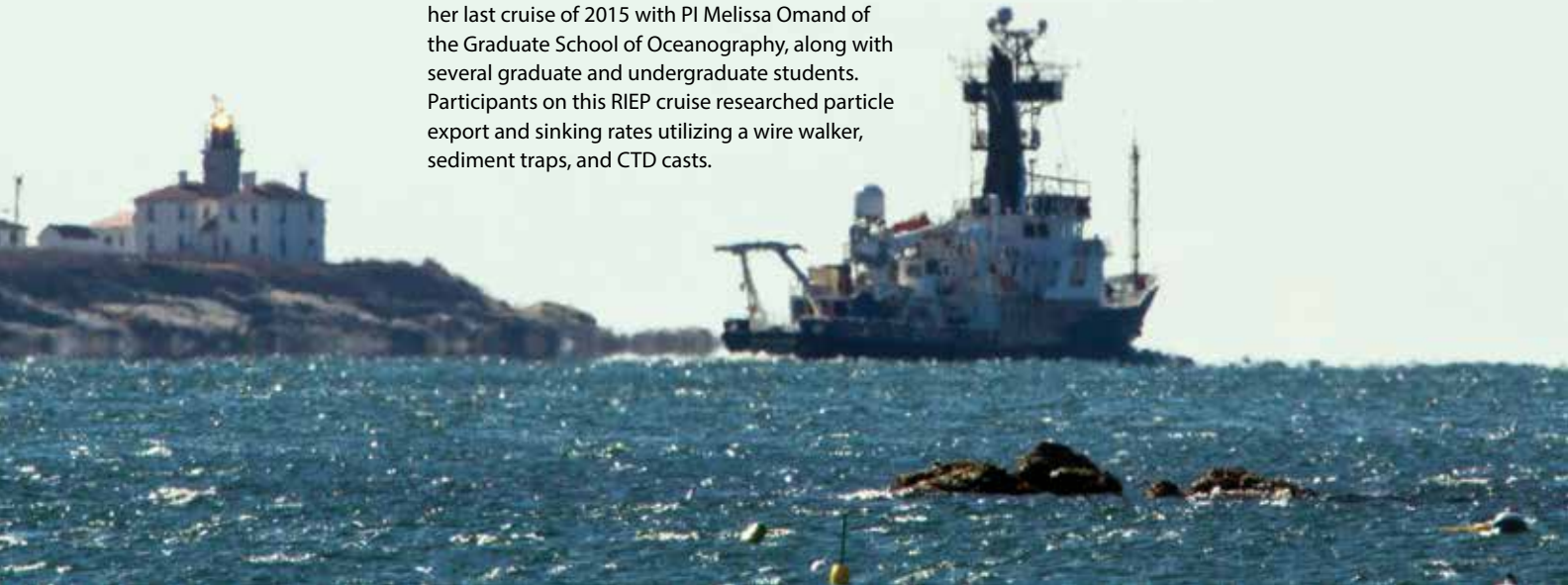
On January 25, *Endeavor* departed from GSO bound for an area offshore of Guadeloupe under the direction of Albert Plueddemann, Woods Hole Oceanographic Institution (WHOI), and Uwe Send, SIO, to investigate the Northern Tropical Atlantic Station/Meridional Overturning Variability (NTAS/MOVE). This was followed by the Western Boundary Time Series (WBTS) cruise under the direction of PI Molly Baringer, National Oceanic and Atmospheric Administration (NOAA), to study climate variability and predictability.

In February, *Endeavor* departed Florida with PI Brice Loose and seven GSO graduate students. Scientists conducted measurements of oxygen and argon using a mass spectrometer attached to a SeaSoar Triaxus tow sled.

After a month-long maintenance period at the newly refurbished GSO pier, *Endeavor* conducted a high-profile coring cruise for the National Science Foundation (NSF) and ONR to evaluate several synthetic tension members.

In May, we conducted four 2016 RIEP cruises starting with one that further investigated acoustic fish tag technology developed by Rossby and Godi Fischer here at GSO. Up next was another Teachers at Sea cruise, followed by a coring cruise with King and Chief Scientist David Robinson, and finally, Susanne Menden-Deuer's marine particles/plankton study.

On June 21–22, *Endeavor* successfully completed her biennial NSF inspection, which included a full day of dock and sea trials. Lastly, we transited to Morehead City, N.C. to begin what we hope will be another outstanding year in support of oceanographic research.



R/V *ENDEAVOR* CRUISES

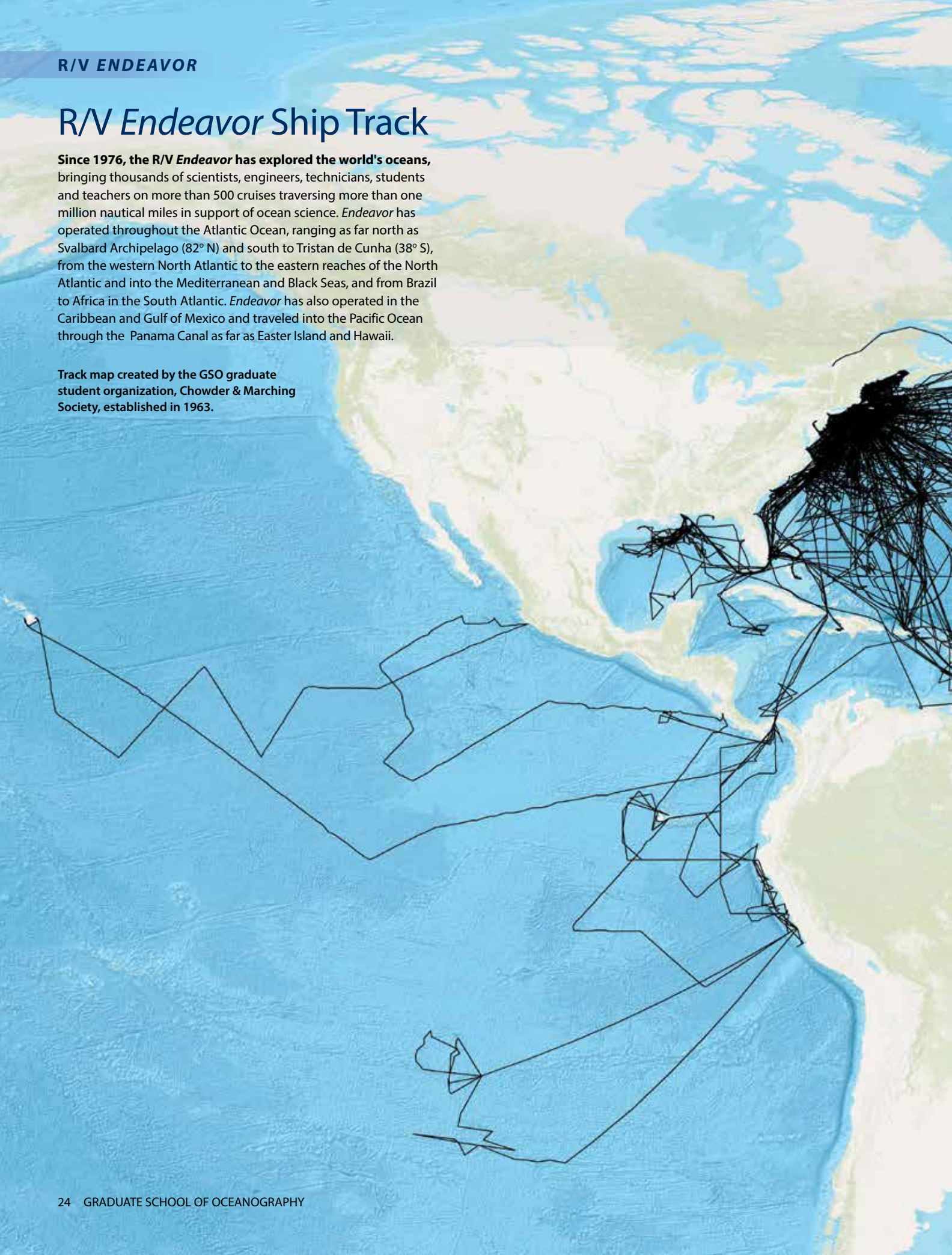
CRUISE NO.	DATES	WORK AREA	INSTITUTION	PORTS
EN-561	July 6–16	North Atlantic	Transit to	Reykjavik, Iceland
EN-562	July 19–August 1		Hodgkiss | SIO	Reykjavik, Iceland
EN-563	August 3–13		Transit to	Narragansett, RI
EN-564	August 16–19		Smith | URI-GSO	Narragansett, RI
EN-565	August 23–28		King | URI-GSO	Narragansett, RI
EN-566	September 2–6		Coleman | URI-GSO	Narragansett, RI
EN-567	September 9–11	Mid-Atlantic	Transit to	Norfolk, VA
EN-568	September 13–25		Gibson | NWSC-PCD	Norfolk, VA
EN-569	September 27–30		Transit to	Port Everglades, FL
EN-570	October 3–20	SW North Atlantic	Johns | RSMAS	Port Everglades, FL
EN-571	October 23–29	Mid-Atlantic	Loose | URI-GSO	Port Everglades, FL
NARRAGANSETT, RI				
EN-572	November 3–5		Omand | URI-GSO	Narragansett, RI
EN-573	Jan. 22–Feb. 10	SW North Atlantic	Plueddemann | WHOI	Narragansett, RI
SAN JUAN, PR				
EN-574	February 13–26	SW North Atlantic	Baringer | NOAA	San Juan, PR
PORT EVERGLADES, FL				
EN-575	Feb. 29–March 8	SW North Atlantic | North Atlantic	Loose | URI-GSO	Port Everglades, FL
NARRAGANSETT, RI				
EN-576	April 18–22	NE Shelf	Trask | WHOI	Narragansett, RI
EN-577	April 30–May 13		Becker | Navy-ONR	Narragansett, RI
EN-578	May 19–23		Rossby | GSO	Narragansett, RI
EN-579	May 28–30		Smith | GSO	Narragansett, RI
EN-580	June 5–8		King | GSO	Narragansett, RI
EN-581	June 13–18		Menden-Deuer | GSO	Narragansett, RI
EN-582	June 21–22	At Pier / North Atlantic	NSF Inspection	Narragansett, RI
EN-583	June 24–26	N. Atlantic | West Central N. Atlantic	Transit to	Morehead City, NC
EN-584	June 29–30	West Central North Atlantic	Arnosti | UNC-CH	Morehead City, NC

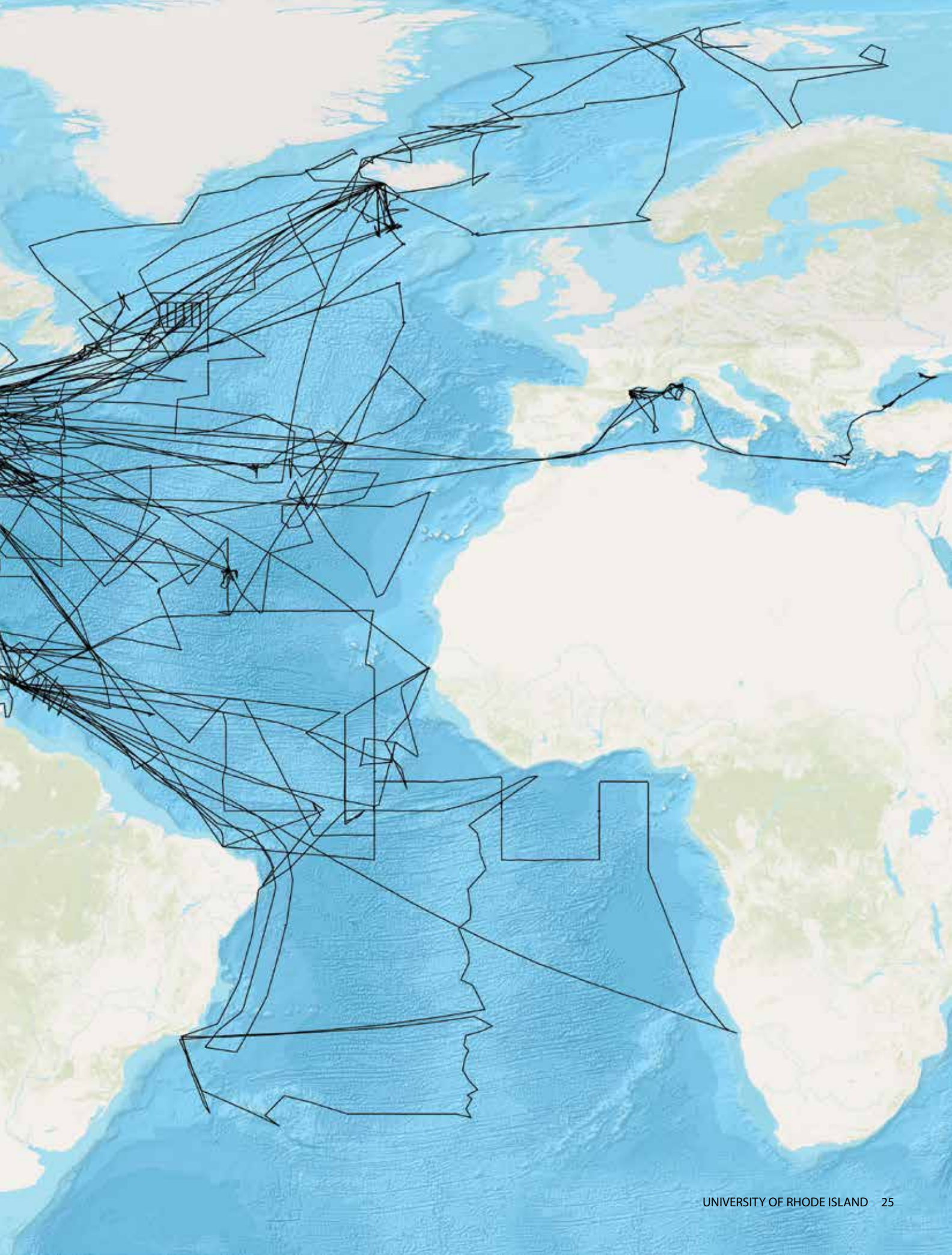
PHOTOS: DANIEL ALEXANDER; ALEX DECICCIO

R/V *Endeavor* Ship Track

Since 1976, the R/V *Endeavor* has explored the world's oceans, bringing thousands of scientists, engineers, technicians, students and teachers on more than 500 cruises traversing more than one million nautical miles in support of ocean science. *Endeavor* has operated throughout the Atlantic Ocean, ranging as far north as Svalbard Archipelago (82° N) and south to Tristan de Cunha (38° S), from the western North Atlantic to the eastern reaches of the North Atlantic and into the Mediterranean and Black Seas, and from Brazil to Africa in the South Atlantic. *Endeavor* has also operated in the Caribbean and Gulf of Mexico and traveled into the Pacific Ocean through the Panama Canal as far as Easter Island and Hawaii.

Track map created by the GSO graduate student organization, Chowder & Marching Society, established in 1963.





A New Vision for the Narragansett Bay Campus

David Palazzetti, Director of Facilities and Operations

In 2015, we embarked on a major master plan effort, supported by funds from the University of Rhode Island's Office of the President, Office of the Provost, Graduate School of Oceanography, and College of Engineering, and by the Carnegie Foundation.

The Narragansett Marine Laboratory was founded in 1936 and was the basis for the Graduate School of Oceanography that was created in 1961. Only the North Laboratory (later renamed the Mosby Center) and the Fish Building existed at that time. Since then, the campus has evolved in an opportunistic and somewhat haphazard manner, with buildings constructed as funds became available. "Temporary" buildings, including trailers and Butler buildings, have, in some cases, lasted more than 40 years. The campus had buildings totaling 8,000 square feet in 1960. That grew to 171,000 square feet by 1978, and is now approximately 330,000 square feet, including the new Ocean Science and Exploration Center and Pell Library.

GUIDING INPUT

The last master plan for the Narragansett Bay Campus (NBC) was done in 2000. A new master plan is needed for the following reasons:

- Deferred maintenance on existing buildings must be done
- Campus facilities are being used more frequently by expanding populations, including new faculty, undergraduate ocean engineering (OE) students, and College of the Environment and Life Sciences (CELS) researchers (who use the seawater labs)
- Outreach and education programs are growing
- A demand for stronger interdisciplinary collaborations requires more working space
- Campus renewal and a more strategic approach to campus planning are necessary

Ellenzweig, an architectural firm in Cambridge, Mass., with extensive planning experience, including work at the Woods Hole Oceanographic Institution, did a comprehensive review of the current state of the campus, analyzed existing and future needs, and developed an integrated plan to:

- Support, expand and respond effectively to current and future research and teaching (graduate and undergraduate) needs/requirements
- Provide enhanced outreach and education facilities
- Promote regional development to support technology innovation and economic development
- Enhance campus resiliency and ecological function
- Provide a cohesive approach to energy, landscape, and building location to optimize campus function

Input from faculty, staff, and students from GSO, OE, and CELS was gathered over a two-month period to form the basis for the plan.

Programming goals also helped focus the planning process. These included enhancing flexibility and collaboration of GSO's research activities, improving research facilities for OE, creating a campus commons focused on teaching, and creating an ocean technology initiative between GSO and OE to focus on robotics, incubation space and equipment development. Additionally, a renovated, more capable and enlarged dock and new marine support facility are important for GSO's effort to replace the R/V *Endeavor* with a new regional class research vessel (RCRV).

ASSESSMENT

With these guiding inputs, a detailed analysis of the NBC was completed in three major categories—building condition and use, energy use and needs, and landscaping and campus flow.

Building Condition and Use

The assessment of the existing buildings indicated that many are outmoded, inefficient or of poor quality. Many temporary buildings have gone beyond their life cycle and other buildings have aging infrastructure and failing building envelopes. This information helped drive the recommendations for building removal, renovation, or new construction.

Energy Use and Needs

The energy assessment indicated that many buildings and associated systems are inefficient or in need of replacement to most effectively and efficiently meet campus energy needs. Energy costs are high in some buildings and most buildings were not designed for flexibility. Recommendations were made to consider different energy options for new buildings, utilize photovoltaic arrays, and develop a strategy for becoming a zero-net-energy campus.

Landscaping and Campus Flow
The landscaping and campus flow assessment identified the presence of myriad invasive plant and tree species; large impervious areas (e.g. paved parking lots, sidewalks, and roadways); and inefficient roadway, pathway, and parking schemes. This led to recommendations to return low-maintenance native vegetation to the campus and revise the roadway, parking and pathway systems.

Overall, Ellenzweig's analysis identified great opportunities to improve land use planning; establish a stronger sense of "campus"; optimize pathways, lighting, roadways and parking; eliminate ad hoc building location and appearance; improve the efficiency and flexibility of offices, labs and support facilities; and work toward becoming a zero-net-energy campus.

RECOMMENDATIONS

The NBC Master Plan outlines work that will be fully implemented over 10–11 years. Highlights include the recommended removal of 199,000 square feet of buildings, and construction of 271,000 square feet of new buildings. Specific recommendations include:

- Removing the existing Horn Lab, Fish Lab, Center for Atmospheric Chemistry Studies (CACS), South Lab, Ocean Technology Center, and eventually Watkins Lab
- New buildings to replace Horn Lab; the Rock and Core Facility; the OE office, labs and teaching spaces; and Watkins Lab
- New buildings including a Teaching Commons, an Educational/Coastal Outreach Building, a Marine Support Facility, a Maintenance Building, and a second new GSO Laboratory Building
- Renovating OSEC and the Coastal Institute Building, including repurposing two floors of the Coastal Institute to include residences for visiting scientists and students
- Pursuing a zero-net-energy campus designation and optimizing campus landscaping to increase resilience and minimize maintenance
- Moving the campus entrance westward up the hill to provide additional space for the new buildings (the circle road that presently exists would be maintained)
- Creating new consolidated parking west of the entrance road and new parking on the north side of South Ferry Road to accommodate the education and outreach buildings
- Consolidating public areas (education/outreach) on the north side of South Ferry Road and URI research and education on the south side

These plans will continue to be reviewed and revised as we proceed, but they provide an important overview of the campus plan that will inform campus development over the next several decades. Funding and marketing strategies are being developed to effectively execute the plan.

These are exciting times for GSO and the Narragansett Bay Campus. This vision builds on Dean John Knauss' early work and seems a fitting legacy to his contributions to the Graduate School of Oceanography and the University of Rhode Island.

RENDERING: COURTESY ELLENZWEIG

GSO is home to unique outreach expertise in the fields of science communication, coastal policy and management, and marine education.

These nationally and internationally recognized programs offer training; convene scientists, journalists, stakeholders, and policymakers; work to advance sound decision-making about resource use; and help diverse audiences better understand the world's coastal and ocean environments. Annual training programs and an array of public programming are a key component of the Graduate School of Oceanography's extensive outreach portfolio.

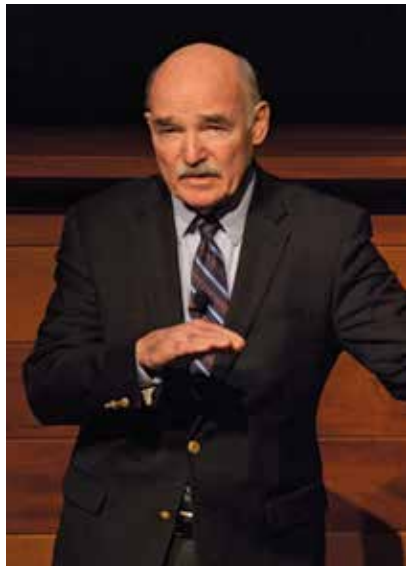
Green Boats and Ports for Blue Waters III

The international workshop facilitated communication and collaboration among academia, government agencies, and private industry.

The University-National Oceanographic Laboratory System (UNOLS), GSO, the National Science Foundation, the Office of Naval Research and 11th Hour Racing hosted the Green Boats and Ports for Blue Waters III workshop on April 5–6, 2016—the third in the biennial series. The international workshop, spearheaded by GSO Dean Bruce Corliss, demonstrated common interests among academia, government agencies, and private industry in pursuing and implementing sustainable operations to preserve our oceans, as well as the maritime transportation and recreation system that our economy and citizenship depend upon.

Workshop highlights included poignant presentations representing the full spectrum of vessel and port operations. Keynote speakers included Dennis V. McGinn, assistant secretary of the Navy for energy, installations and environment; Rear Admiral Bruce Baffer, assistant commandant for engineering and logistics, U.S. Coast Guard; and Gregory Marshall, president and CEO of Gregory C. Marshall Naval Architects, Ltd. Workshop topics included ports and infrastructure, power and propulsion, coatings and lubricants, behavior change, corporate social responsibility, and fiberglass recycling.

Marshall pointed out that the reality of greening is sometimes in direct conflict with what people, companies and agencies want or need with respect to their operations. He cited examples of his experiences with the mega-yacht industry and with owners' desires for all the "bells and whistles." But he noted that his company has been able to offer some innovative and unique sustainability options to the yachting world. "We have a long way to go in this industry," said Marshall, "but there are real options—not inexpensive options, but options nonetheless —and we are making progress."



With 85 in attendance and a live-stream via URI's Inner Space Center to hundreds of additional audience members, this workshop was a tremendous success and further entrenches GSO's leadership on this very important topic.

Special thanks to the workshop sponsors as well as to Annette DeSilva, Caitlin Mandel, Karen Besson, Jon Alberts and Amy Smith. The Green Boats and Ports for Blue Waters IV workshop will be held in Spring 2018.

Above, left: Rear Admiral Bruce Baffer participated on a ports and shore facilities panel following his presentation. Right: Dennis McGinn, assistant secretary of the Navy for energy installations and environment.

Right: Carleen Lyden-Kluss, co-founder and executive director of the North American Marine Environment Protection Association.

PHOTOS: ALEX DECICCIO ; CAITLIN MANDEL

Workshop topics included ports and infrastructure, power and propulsion, coatings and lubricants, behavior change, corporate social responsibility, and fiberglass recycling.

Inner Space Center

Dwight Coleman, Director

The Inner Space Center (ISC) is an international hub for ocean science exploration and education. Through its advanced facilities, the ISC expands the number of scientists engaged in live expeditions and inspires the next generation of ocean explorers. It is an international leader in ocean science education and outreach, promoting ocean literacy in diverse audiences. It is home to some of the largest ocean science education and outreach initiatives in the country, and serves as the hub for the National Consortium for Ocean Science Exploration and Engagement Network and the Climate Change Education Partnership Alliance. The ISC also offers a variety of tours, field experiences and interpretive programs for students, educators, and the public. Highlights of this past year included:

Actively supported telepresence projects on many ships this year including the *Nautilus, Okeanos, Endeavor, Atlantis, Armstrong,* and *Alucia*

Assisted the team from WHOI and National Transportation Safety Board (NTSB) in finding the voyage data recorder from the cargo ship, *El Faro*

Hosted a National Science Foundation (NSF) funded workshop for "Establishing Community Standards for Underwater Video Acquisition, Tagging, Archiving and Access"

Published University-National Oceanographic Laboratory System telepresence guidelines for scientists and ship operators

ISC Director Dwight Coleman delivered a lecture to UNOLS Deep Submergence early career scientist meeting at AGU

Live-streamed the Green Boats and Ports for Blue Waters III workshop to a global audience

Hosted a booth and contributed presentations at the 2016 Ocean Sciences Meeting

PHOTO: ALEX DECICCIO


Welcome to the
NOAA MIDWATER REBROADCA

Coastal Resources Center

Anton F. Post, Director

Above: A delegation from University of Cape Coast in Ghana visits GSO.

Right: CRC has worked to improve post-harvest fish handling and processing practices in Ghana.

The Coastal Resources Center (CRC) played a leadership role in University of Rhode Island President David M. Dooley's first trip to West Africa, which culminated in forging a new education tie between URI and the University of Cape Coast.

We also continued to lead a global effort to significantly build the capacity of the world's ocean planning network to be more skilled and confident: Following the 2015 "International Marine Spatial Planning (MSP) Symposium—Sharing Practical Solutions," more than 75 percent of attendees reported being more empowered to employ MSP tools and techniques.

We piloted a training course aimed at encouraging shellfish farmers to practice safe food handling and convinced the state to require the course for new shellfish farmers and aquaculture lease owners.

We provided tailored training so Rhode Island cities and towns could put new data and tools to work in daily efforts to plan for flooding, a key impact of sea-level rise and strong storms.

We investigated whether fishermen in Gambia could benefit from investing in ice coolers on board their vessels to keep fish fresh and reduce post-harvest loss.

At Africa's Lake Malawi, we gathered data needed for the creation of a management strategy to help guide a long-term plan for the viability of the surrounding usipa fishery.

Finally, we led a safety effort in Senegal that used cell phone weather alerts to reduce at-sea fishing fatalities by as much as 30 percent in the first year of the program.

PHOTOS: NORA LEWIS; COURTESY CRC


SUFF

Office of Marine Programs

Sara Hickox, Director

The Office of Marine Programs (OMP) strives to improve science communication and increase public understanding of science and the natural world.

OMP efforts reach audiences in Rhode Island, the United States and throughout the world, including scientists and decision-makers, educators and students, journalists and media representatives, and the general public. OMP's Narragansett Bay Classroom hosts marine and environmental professional development opportunities, field trips, interpretive programs, special events, lectures, and tours for people of all ages, and the Rhode Island Teacher at Sea program (RITAS) offers educators from Rhode Island shipboard training experiences.

Above: RITAS educators use microscopes to examine plankton collected from a plankton trawl on R/V *Endeavor*. Left: RITAS educators prepare a water sampling rosette for launch on R/V *Endeavor*.

RHODE ISLAND TEACHER AT SEA PROGRAM

Opportunities abounded this year for educators to sail aboard R/V *Endeavor*. RITAS develops sustainable partnerships between ocean scientists, researchers and educators who live and teach in Rhode Island. As a training component of the Rhode Island *Endeavor* Program, which is funded by the state of Rhode Island, 26 Rhode Island educators participated in six cruises. Graduate School of Oceanography scientists involved in training educators onboard *Endeavor* included Dwight Coleman, Christopher Kincaid, John King, Susanne Menden-Deuer, Melissa Omand, Anton Post, Christopher Roman, Thomas Rossby, and David Smith.

CHARLES AND MARIE FISH LECTURE IN OCEANOGRAPHY

During the past year, the OMP celebrated a quarter century of bringing noted scientists, policymakers, explorers, authors, and journalists to GSO for the annual Charles and Marie Fish Lecture in Oceanography and associated roundtable discussions. Capacity crowds enjoyed the December 2015 public lecture by Barbara Block, a marine biologist from Stanford University. Her talk, "Saving our Blue Serengeti," described how her research team uses electronic tagging technology to reveal the hidden life of ocean predators, such as the bluefin tuna. In May 2016, just before hurricane season, Chris Landsea, science and operations officer for the National Hurricane Center, presented "Inside the Eye: Improving Hurricane Forecasts."

NARRAGANSETT BAY CLASSROOM

Over the past year, OMP's Narragansett Bay Classroom engaged more than 20 marine science, geoscience, and environment-focused URI graduate students as outreach scientists to present more than 70 educational programs. The programs reached 2,500-plus students and their teachers, who visited the rocky shores of Jamestown and the salt marshes and coastal ponds of Charlestown and Narragansett to learn about Rhode Island's coastal environments. The outreach scientists also presented in-school interpretive programs covering topics from marine mammals to volcanoes to marine ecology. Free family beachcombing and historic walking tours of South Ferry Road gave residents and visitors a chance to learn about the coast.

PHOTOS: COURTESY GSO OFFICE OF MARINE PROGRAMS

Metcalf Institute for Marine and Environmental Reporting

Sunshine Menezes, Executive Director

The Metcalf Institute for Marine and Environmental Reporting provides a specialized type of outreach to the news media. Metcalf's unique combination of innovative training programs and scientifically vetted resources for journalists, as well as its customized science communication training for researchers, builds understanding between journalists and scientists, expanding accurate environmental news coverage to build a deeper public understanding of science and the environment. Highlights of the past year include:

- Communication training opportunities for scientists and other science communicators have attracted ever-greater interest, with organizations across the nation reaching out to request Metcalf programs for their staffs.
- The Annual Science Immersion Workshop for Journalists, Metcalf Institute's oldest training program, attracted record numbers of applicants, including journalists from 25 countries.
- Our Climate Change and the News Initiative is helping journalists gain new scientific contacts—and context. And since limited newsroom budgets can make it difficult for journalists to attend in-person training, Metcalf offers webinars as part of this initiative.

Journalists from all over the world attend Metcalf Institute training programs.

Above: Fellows at Metcalf Institute's 18th Annual Science Immersion Workshop for Journalists participate in the GSO fish trawl aboard the R/V *Cap'n Bert*. Left: Researchers from universities throughout Rhode Island engage in lively discussions during one of Metcalf Institute's science communication workshops sponsored by RI NSF EPSCoR.

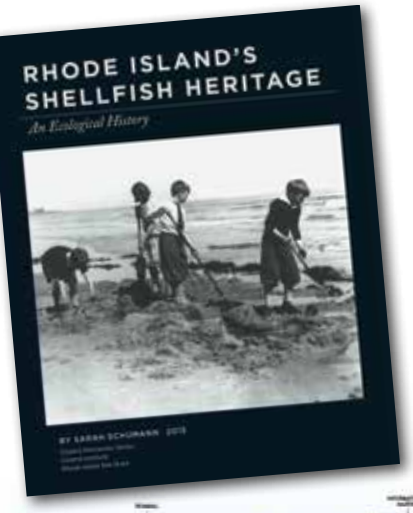
PHOTOS: GRETCHEN ERTL; KAREN SOUTHERN

Rhode Island Sea Grant

Dennis Nixon, Director

Above: Extension efforts by Rhode Island Sea Grant and the URI Coastal Resources Center (CRC) are helping coastal communities, including North Kingstown's historic Wickford Village, address sea-level rise, flooding, and other impacts of climate change. Below: A recently published book, *Rhode Island's Shellfish Heritage*.

Bottom: Student landscape architecture rendering done as part of a URI junior landscape architecture studio, supported by Rhode Island Sea Grant and CRC.



Rhode Island Sea Grant, located at the University of Rhode Island Graduate School of Oceanography and part of a 33-member network of Sea Grant programs around the country, supports research, outreach, and education programs as well as a legal program at Roger Williams University (RWU) School of Law.

BUDGET

Rhode Island Sea Grant has a $3.2 million annual program budget, comprised of $2.1 million in federal funding and 50 percent match. Of that, 50 percent is directed to research, 30 percent to extension, and the rest to education, communications, and program administration. For the 2016–2018 grant period, the program awarded nearly $1.5 million to research projects focused on topics from local seafood consumption, shellfish disease, and population dynamics to the impacts of climate change on commercially important species in Narragansett Bay, beach erosion, and the ecological and human implications associated with the Block Island Wind Farm.

STUDENT SUPPORT

In the past year, Rhode Island Sea Grant has supported 54 students—19 bachelor's degree candidates, 13 law students (RWU), 18 master's degree candidates, and four doctoral candidates.

Undergraduates are primarily supported through the URI Coastal Fellows program; law students are supported through the Rhode Island Sea Grant Law Fellows program, which provides low-cost legal research (supervised by a Rhode Island Sea Grant staff attorney at RWU) to clients ranging from small nonprofit organizations and Rhode Island municipal governments to state agencies and private businesses. Other fellowships based at URI include the Master's in Environmental Science and Management Fellowship and the Marine Affairs Fellowship. Most of the education budget supports graduate research fellows, who are embedded in Sea Grant-funded research projects, thus increasing the portion of the Sea Grant budget that effectively supports research.

Rhode Island Sea Grant also has the opportunity to nominate qualified graduate students to national fellowships, such as the prestigious Dean John A. Knauss Marine Policy Fellowship.

STUDIOS

As part of its support for education and in partnership with the Coastal Resources Center, which houses Rhode Island Sea Grant's Extension Program, Sea Grant supports junior and senior landscape architecture studios and a senior ocean engineering studio. These studios, coordinated with extension efforts in local communities, address coastal issues such as sea-level rise and erosion impacting infrastructure and historic districts, managing flooding and storm water discharge, and preserving open space and public shoreline access.

SHELLFISH HERITAGE

Rhode Island Sea Grant, the Coastal Resources Center, and the Coastal Institute collectively published *Rhode Island's Shellfish Heritage: An Ecological History* in November 2015 to help Rhode Islanders better appreciate and understand the state's iconic shellfish resources and the people who harvest and grow them. The book also looks at shellfish as the inspiration for art, for their role in healthy aquatic ecosystems, and for their importance to Native Americans. Author Sarah Schumann and individuals profiled in the book toured libraries and other venues around the state to share their stories. The book is free, and may be read online or ordered at shellfishheritage.seagrant.gso.uri.edu.

PHOTOS: COURTESY OF RHODE ISLAND SEA GRANT/CRC; RENDERING: COURTESY URI DEPARTMENT OF LANDSCAPE ARCHITECTURE

Coastal Institute

Judith Swift, Director

The Coastal Institute (CI) works to increase understanding of the relationships between human activity and the condition of the coastal environment and its resources. The CI works with local, state, federal, and international agencies to use this understanding to help solve the complex problems of human use and development in coastal environments. The CI is a neutral setting in which new approaches are encouraged, knowledge is advanced, issues discussed, information synthesized, and solutions developed for the sustainable use and management of coastal ecosystems.

SCOTT W. NIXON LECTURE

The CI sponsored the 4th Annual Scott W. Nixon Lecture, "Getting Rid of Hypoxia in a Warming World," in April 2016. Daniel Conley, professor of biogeochemistry at Lund University in Sweden, spoke about increasing hypoxic conditions in the Baltic Sea and potential solutions, including nutrient reductions and geoengineering. Conley discussed research and potential collaborations and provided career advice to graduate students. Joined by the Graduate School of Oceanography, Boston University, and U.S. Environmental Protection Agency (EPA) researchers, Conley explored insights and theories on hypoxia. He also enjoyed Rhode Island by kayaking Narrow River, walking Moonstone Beach, and exploring Trustom Pond National Wildlife Refuge. Every meal was a Rhody seafood feast with a side of lively scientific discussion.

HEALTHY COMMUNITIES

The CI, partnering with the R.I. Department of Environmental Management, was awarded an EPA Healthy Communities grant to analyze and report on environmental monitoring data. Through this grant, the CI will investigate the interaction between freshwater flow from major rivers into Narragansett Bay and hypoxia in the upper bay, build a new website for the R.I. Environmental Monitoring Collaborative (which is chaired by the CI) to demonstrate the importance of long-term monitoring, and bring together local experts to discuss current monitoring gaps that need to be filled in order to make effective management decisions.

RHODY STATS

Recognizing the increasing necessity for data analysis expertise in all disciplines, the CI partnered with the U.S. EPA's Atlantic Ecology Division to support a hands-on, two-day workshop at GSO for approximately 50 students, staff, and faculty to learn the essential programming language, "R," which is used for statistical computing and data science and employed for data visualization and spatial analysis. To provide ongoing community access to "R" programming discussions, the CI and U.S. EPA also established a "rhodyRstats" Mozilla science lab study group, which holds regular work sessions on coding issues.

RESOURCE STEWARDSHIP

Through the North Atlantic Coast Cooperative Ecosystem Studies Unit (NAC CESU), scientists, managers and students work together to understand how ecosystems are affected by increasing urban development, climate change, and other stressors, and to devise management strategies for preserving and restoring coastal ecosystems, cultural resources, and maritime heritage. The NAC CESU is part of a national network of 17 regional CESUs and is among the largest collaborative research partnerships addressing natural and cultural resource stewardship in the United States. It provides quality science, usable knowledge for resource managers, responsive technical assistance, education opportunities, and cost-effective research. As a national leader in coastal and marine ecosystems studies, the University of Rhode Island was once again selected through a competitive process as the host for the NAC CESU. The director of the CI serves as the director of the NAC CESU. Since its founding in 1999, the NAC unit has expanded to include 24 non-federal partners (e.g., universities and research labs), nine federal partners, and one tribal partner. As an example of NAC CESU's role, following Hurricane Sandy, the National Park Service awarded millions of research dollars to URI and other NAC CESU partners to determine how best to restore and manage threats to sites of environmental and cultural significance. The NAC CESU recently added the Bureau of Indian Affairs to its list of non-federal partners and is currently managing the addition of three others.

Above: Daniel Conley (far right), guest speaker for the 4th Annual Scott W. Nixon Lecture, is joined by (right to left) Troy Hill and Autumn Oczkowski, EPA; Courtney Schmidt, Narragansett Bay Estuary Program; and Veronica Berounsky, GSO, for a kayaking tour of upper Narrow River, where hypoxic conditions are similar to the Baltic Sea region where Conley works. Oczkowski, Schmidt, and Berounsky are all GSO alumni who share the distinction of having been advised by the late Professor Scott Nixon, who served as major professor to all three of them.

PHOTO: AYLA FOX

Building international relationships creates opportunities for collaboration, as well as new populations of prospective students.

The Graduate School of Oceanography has been involved in expanding its reach globally since its inception nearly 55 years ago. But our efforts have increased due to changing political, environmental, societal and funding climates. Funding agencies and foundations want to see collaborative research, outreach and education to leverage prior institutional work, varied perspectives, and other funding sources (domestic and international). Building international relationships creates opportunities for collaboration, as well as new populations of prospective students. The new Professional Master of Oceanography degree program, for example, is perfectly tailored for students from government agencies in Ghana, Cuba, Indonesia, Vietnam and the like, because of the scientific expertise and subsequent professional development brought back to the agencies they work for, thereby improving the ocean and coastal programs, policy and preservation efforts within their respective countries.

CUBA

MarCuba Conference

Cuban marine scientists hosted the 10th international marine conference, MarCuba, in November 2015 in Havana. GSO Dean Bruce Corliss, accompanied by Nancy Stricklin from the University of Rhode Island Office of the Provost, Gail Scowcroft from the Centers for Ocean Sciences Education Excellence (COSEE), Pamela Rubinoff and Donald Robadue from the Coastal Resources Center (CRC), and Richard Rhodes from the URI College of the Environment and Life Sciences (CELS) Dean's Office, participated in the symposium.

Dean Corliss gave a plenary talk on oceanography at GSO, highlighting the partnership in ocean exploration between NOAA, the Ocean Exploration Trust and GSO, concluding with the idea of URI being the "Ocean University." The audience included Kathy Sullivan and Holly Bamford from NOAA, who were in Havana for a signing of the first environmental agreement between the United States and Cuba. Presentations (in Spanish) by Rubinoff and Robadue were well received, and Scowcroft generated interest for the Inner Space Center, as well as for the COSEE program. There was a great deal of interest in collaboration with GSO and URI, and in organizing an *Endeavor* cruise into Cuban waters. "Cuba is facing many of the same environmental concerns that we are—climate change, sea-level rise, erosion of beaches, ocean acidification, hurricanes—and we have expertise in all of these areas," said Corliss. He envisions faculty and student exchanges, research collaborations, and joint oceanographic expeditions aboard the R/V *Endeavor*. To this end, the CRC was awarded funds for hosting Maria Elena Castellanos Gonzalez from the University of Cienfuegos Center for Environmental Studies of Cienfuegos (CEAC) and the Ministry of Science, Technology, and Environment of Cuba, as a Distinguished Visiting International Scholar for fall 2016 in collaboration with CELS and the College of Arts and Sciences.

Future collaborations in Cuba will create important opportunities for scientific advances and strengthen ties between the two countries. GSO is planning a series of marine science partnerships with the University of Havana, the National Aquarium of Cuba and the Cuban Institute of Oceanology.

PHOTOS: ISTOCKPHOTO.COM

INDONESIA

Partnerships

GSO has continued its long-running relationship with Indonesia through a variety of activities. GSO faculty and staff met with Mars Symbioscience, of parent company Mars Incorporated, which is a technology-based health and life sciences business focused on evidence-based product development. They were specifically interested in partnering with URI to conduct monitoring and evaluation programs for their artificial coral reef structures being tested in Indonesia. There was much interest in the work conducted by GSO in Indonesia with potential for future collaborations, including building the capacity of the Symbioscience staff in community development and coastal planning. CELS faculty will help evaluate the effectiveness of the artificial reefs.

An interesting opportunity arose through the USAID-Indonesia Sustainable Higher Education Research Alliances (SHERA) Program. SHERA's goal is to improve the quality of scientific research and publications related to Indonesia's development challenges, which include coastal and marine issues. In collaboration with Richard Rhodes (CELS), the CRC is submitting a proposal for a U.S.-Indonesia marine research networking program.

GSO has been working with Brook Ross, who is on contract with URI to make connections with Indonesian universities. He guided a URI delegation to Indonesia to meet with leading coastal and marine faculty and assisted GSO in understanding the SHERA landscape. Ross will help GSO engage with marine research institutions.

In May, a delegation of government officials from the Indonesian Ministry of Marine Affairs and Fisheries visited GSO to explore opportunities for their staff to enroll in degree programs and short courses. The Indonesian government has a World Bank loan to support capacity development related to coastal coral reef governance and management. The first group of Indonesian graduate students arrived in 2015 to study at GSO and CELS. A second group joins us this fall. The CRC will deliver a short course on coastal resources governance.

GHANA

Sustainable Fisheries Management Project

The principle goal of the CRC's five-year, $24 million USAID-Ghana Sustainable Fisheries Management Project (SFMP), is to rebuild marine fisheries stocks and catches in Ghanaian waters within the Guinea Current through adoption of responsible fishing practices and improvements to the small-scale fisheries value chain. The SFMP contributes to the Ghanaian government's fisheries development objectives as well as USAID's global "Feed the Future Initiative." The SFMP's Chief of Party, Brian Crawford, and CRC Director Anton Post, recently hosted URI President David Dooley, whose visit strengthened relationships with CRC partners at the University of Cape Coast (UCC) and the Kwame Nkruma University for Science and Technology (KNUST). A second visit by URI college deans and other administrators served to further strengthen those relationships. URI accepted a doctoral candidate from the UCC in January 2016 and four master's degree students this fall.

CRC works closely with the Ministry of Fisheries and Aquaculture Development as well as the Fisheries Commission to implement the new Marine Fisheries Management Plan, ensure its wide distribution, and enforce the first closed season for the industrial trawler fleet. Crawford helped draft a national policy proposal to introduce fisheries co-management to Ghana. The SFMP is also sponsoring research and development to improve the safety of fish smoking, which can generate high levels of PAH in the fish as well as the work area. A study tour to Rhode Island by the Ghana Industrial Trawlers Association, led by URI fisheries researcher Kathleen Castro, helped set the stage for leadership and cooperation between the fishing industry and the government to comply with and enforce fisheries policies.

CRC and its Ghanaian partners are addressing child labor and trafficking in the fisheries sector, which has been of urgent concern since the U.S. State Department put Ghana on the Tier 2 watch list for human trafficking. Hundreds of micro, small and medium scale enterprises in the fishing value chain, mainly led by women, are receiving capacity building training, technical assistance and some material support to improve fish handling and smoking practices to create higher value, healthier fish products using less energy and producing lower emissions. Efforts are being made to address gender issues and engage more women in fisheries management decisions.

Scientific and technical innovation has been another highlight of the SFMP. Christopher Damon of the URI Environmental Data Center conducted successful flights of a small unmanned aircraft to map fish landing sites highly vulnerable to flooding, coastal erosion and sea-level rise, providing high-resolution aerial photography and digital elevation information to local authorities. Professors Michael Rice and Rainer Lohmann hosted UCC technicians, who learned how to use chemical testing equipment that could potentially detect dangerous fish-handling chemicals and measure PAH levels in fish. Rice advised other UCC staff on aquaculture techniques. The Fisheries Commission is now using tablet computers for fisheries data collection, introduced by CRC and URI staff. SFMP partners have also focused on gathering local ecological knowledge for fisheries management.

PHOTOS: ISTOCKPHOTO.COM

VIETNAM

Nha Trang University Partnership

"This is a positive and timely step in GSO's efforts to form strong research connections in Vietnam."
–Igor Belkin

For over two years, GSO has been working through the U.S. State Department and the U.S. Embassy in Hanoi to establish formal research relationships within Vietnam. This effort grew out of U.S. Senator Sheldon Whitehouse's observations and subsequent identification of the environmental challenges in Vietnam that he felt GSO researchers could help address. On March 11, 2016, URI signed and executed an MOU with Nha Trang University to partner on the following activities:

- Academic programming for university faculty
- Exchange of faculty members
- Exchange of students on the baccalaureate and/or graduate level
- Joint research activities
- Participation in seminars and academic meetings
- Exchange of academic materials and other information
- Short-term academic programs
- Staff development projects

This a dynamic partnership that will grow and expand. Specific GSO research interests include typhoon forecasting and contaminant presence.

GSO marine research scientist Igor Belkin is working with the Institute of Marine Environment and Resources (IMER) on a study titled, "Study of Formation Conditions of Fronts and their Ecological Functions in the Coastal Zone of the Me Kong River Delta." "This is a positive and timely step in GSO's efforts to form strong research connections in Vietnam," says Belkin.

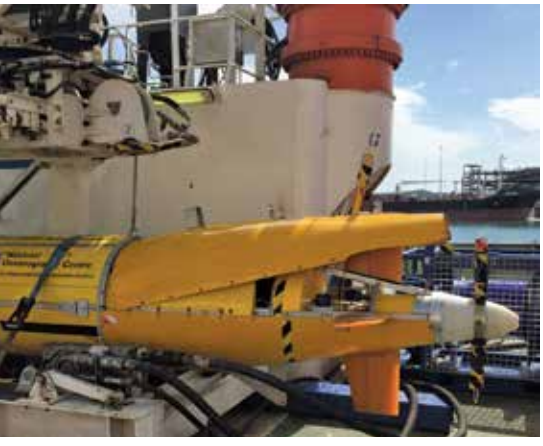
Future efforts will include expanding interaction with Nha Trang University and exploring potential collaborations with the Centre for Marinelife Conservation and Community Development, the Chief of Party, USAID Vietnam Forests and Deltas, and the Vietnam National Center for Hydro-Meteorological Forecasting.

UNITED KINGDOM

University of Southampton Partnership

Following visits by URI President David Dooley, Vice President for Research and Economic Development Gerald Sonnenfeld and GSO Dean Bruce Corliss, URI signed an MOU with the University of Southampton (UoS) to promote faculty exchanges and establish research collaborations. During FY16, two faculty exchanges were completed and a student exchange was scheduled for FY17.

Dwight Coleman, director of the Inner Space Center, traveled to Southampton in August 2015 to implement the telepresence paradigm at the UoS's National Oceanography Centre (NOC). That same month, Jon Copley, associate professor of marine ecology at the NOC, completed an exchange with GSO to continue the telepresence discussion. Several researchers at the NOC were familiar with the concept of telepresence through work onboard the NOAA Ship *Okeanos Explorer* and the Ocean Exploration Trust's E/V *Nautilus*, but for others, the telepresence concept was brand new. The NOC also operates several research vessels including the RRS *Discovery* and RRS *James Cook*, and the Isis ROV system (similar to the U.S.-based Jason II and Hercules ROV systems), in addition to several other deep-sea systems and technologies.



The GSO-UoS collaboration is helping expand the novel technologies and methodologies associated with bringing telepresence into England, leveraging new opportunities for funding and program development and leading to new and innovative technologies. Also, with NOC's unique advanced undersea technology, GSO's ISC will expand its reach to support different types of vehicle systems, such as, the unmanned autosub vehicle, gliders, and the towed ocean bottom instrument (TOBI), an instrument vehicle towed close to the bottom of the deep ocean that uses sound to form detailed images of the seafloor.

Top: Video systems inside the remotely operated vehicle (ROV) control van to support Isis onboard the RRS *James Cook*. Middle: The Autosub autonomous underwater vehicle (AUV) system being mobilized onboard the RRS *James Cook*. Bottom: The Isis ROV system inside a workshop at NOC.

In September 2015, GSO's Christopher Roman, associate professor of oceanography, completed a one-week exchange at the UoS. His visit was coordinated by physical oceanography modeling expert Robert Marsh. Roman presented a lecture and spoke with students and post-docs. He discussed potential collaborations and seafloor mapping technologies and instruments with post-doc Leigh Marsh and her supervisor, Veerle Huvenne. He also met with marine archaeologist Justin Dix, who expressed interest in GSO's mapping technologies and their applicability to sub-bottom imaging; marine archaeologist Fraser Stuart, who is interested in the use of laser systems on ROVs; and physical oceanographers Eleanor Frajka-Williams and Adrian Martin, both interested in the Wire Flyer developed by Roman. At the end of the week, Roman had dinner with UoS students, including Christian Buckingham, a former GSO student who studied with Peter Cornillon.

In May 2016, GSO hosted Rachel Mills, dean of the faculty of natural and environmental sciences at the UoS. Several GSO faculty members presented summaries of their research, and Mills received tours of the Inner Space Center, the R/V *Endeavor,* and the Narragansett Bay Campus. The visit was a success and GSO is continuing to forge stronger relations with our counterpart across the pond.

PHOTOS: COURTESY OF NOC SOUTHAMPTON

FRANCE

Consortium for Ocean Science Exploration and Engagement

GSO is paving the way for new international ocean science education partnerships and initiatives.

GSO is paving the way for new international ocean science education partnerships and initiatives through the Centers for Ocean Sciences Education Excellence (COSEE). The only global network of ocean science research and education institutions, COSEE's central office is at GSO. In June 2016, COSEE co-hosted the second Global Ocean Science Education Workshop, bringing together delegates from 19 nations at UNESCO Headquarters in Paris. During this three-day meeting, ocean scientists, education professionals, policymakers, and business leaders discussed issues of international concern, including the development of the 21st century ocean science workforce, new research connecting the ocean and human health, and the role of ocean science education in international ocean governance.

Gail Scowcroft, COSEE executive director and associate director of GSO's Inner Space Center, stands between her meeting co-chairs, Francesca Santoro, program director for the Intergovernmental Oceanographic Commission, and Peter Tuddenham, president of the College of Exploration.

PHOTOS: ANDREA GINGRAS; ISTOCKPHOTO.COM

THE AZORES

University of the Azores Partnership

GSO hosted representatives from the University of the Azores (UoA) in September 2015. Members of the Azorian delegation included Susana Mira Leal, pro-rector for external relations and cultural affairs, Society of Lifelong Learning, UoA; and Helder Guerreiro Marques da Silva, director of the Department of Oceanography and Fisheries, UoA. The day included briefings from GSO faculty and marine research scientists on topics ranging from the new Professional Master of Oceanography Program to geodetic observation of volcanic formation to the ecology of *Beryx splendens* in the Azorean Sea.

In November 2015, David Smith, GSO associate dean for academic affairs, and Marta Gomez-Chiarri, department chair of Fisheries, Animal and Veterinary Science (FAVS) in CELS met with UoA's Marques da Silva and Jorge Gabriel of the Luso-American Development Foundation (FLAD), and R.I. State Senator Daniel Da Ponte regarding aquaculture activities in the Azores.

Subsequently, five representatives from CELS traveled to the Azores in January 2016 to visit UoA's aquaculture facilities and to further explore collaboration on a demonstration project involving abalone, seaweed, and fish being farmed in land-based aquaculture systems.

As a direct result of these efforts, in March 2016, URI and UoA entered into a formal MOU to foster additional research collaborations and faculty and student exchanges. GSO also looks forward to taking advantage of *Endeavor's* sailing schedule, which may take researchers in close proximity to the Azores again. "This would be a great opportunity for a Rhode Island Endeavor Program (RIEP) cruise to explore the Mid-Atlantic Ridge with scientists and students from both institutions," said GSO Dean Bruce Corliss.

PHOTO: ISTOCKPHOTO.COM

WORLDWIDE

Deep Carbon Observatory

Above: Scientists from 18 countries who participated in the September 2015 DCO Early Career Scientist Workshop, organized, in part, by the DCO Engagement Team based at the GSO Office of Marine Programs, conduct fieldwork at the hydrothermal field in Furnas volcano on the island of São Miguel in the Azores.

The Engagement Team for the Deep Carbon Observatory (DCO), a 10-year international research initiative to study the quantities, movements, forms, and origins of carbon deep in the Earth, is based at GSO's Office of Marine Programs (OMP).

Funded proposals for OMP engagement efforts on behalf of DCO's 800 scientists from around the world totaled more than $1 million from the Alfred P. Sloan Foundation in FY16. Ongoing engagement and science communications activities included highlighting DCO science via *deepcarbon.net*, social media, and a monthly e-newsletter; working with partners such as Smithsonian Enterprises to produce videos and other media products associated with DCO research; expanding media relationships and international news coverage of deep carbon science; and expanding involvement of early career scientists in DCO activities. To this end, the Engagement Team played an active role in organizing and carrying out an Early Career Scientist Workshop in the Azores in September 2015 and planning for a DCO Summer School in Yellowstone in Summer 2016. The DCO Engagement Team also organized and hosted an international conference at the URI W. Alton Jones Campus in October 2015, bringing together deep carbon scientists and communications professionals from around the globe to initiate DCO's effort to synthesize discoveries and findings for broad dissemination at the program's 10-year mark in 2019. This conference officially launched DCO's synthesis effort in collaboration with the University of Cambridge (UK).

The Engagement Team will collaborate with a wide range of stakeholders to develop and disseminate products highlighting DCO discoveries and synthesis themes. In addition, at the American Geophysical Union meeting in San Francisco in December 2015, the Engagement Team created and launched the Carbon Mineral Challenge: A Worldwide Hunt for New Carbon Minerals, setting the stage for both professional and amateur mineral collectors to make their mark by discovering new carbon-bearing minerals. The Engagement Team continues to build and support 800-plus members of the DCO Science Network, recognizes and promotes their myriad scientific accomplishments, and builds new partnerships to amplify dissemination and reach of DCO findings.

PHOTO: KATIE PRATT

Development Summary

Development efforts in FY16 focused on alumni, Friends of Oceanography, corporations and foundations, and other organizations.

The Graduate School of Oceanography's donor base showed slight growth, increasing by nearly 10 percent over the previous two years. Although total donations were down from the previous two years, graduate and undergraduate alumni giving levels increased and we achieved an approximate 50 percent increase in donations from Friends of Oceanography compared to FY15—both very positive trends on which we intend to capitalize during FY17.

Private support from individuals, families, foundations, and corporations is critical to the continued success of GSO. These donations provide vital support to our graduate students, enable GSO to recruit the best faculty and research scientists, and fund informative and exciting outreach programs that reach not only our Narragansett neighbors, but also national and international audiences.

Private support from individuals, families, foundations, and corporations is critical to the continued success of GSO.

Maintaining GSO's development focus in these areas will continue unfettered—they are essential elements of our success. However, additional key priorities going forward include the following:

Narragansett Bay Coastal Research Vessel
GSO is in the process of identifying, soliciting and securing funding from a variety of private donors, academic and research institutions, as well as interested foundations.

Corporate Affiliates Program
$10,000 in corporate donations. GSO is working to identify 10 corporations to participate yearly in this program.

We are enthusiastically looking forward to a very productive year of fund-raising to enable the continued support of our historic programs as well as these new key initiatives, all of which are critical to GSO's continued success and growth.

Note: Donations reflected in this report cover the period July 1, 2015 to June 30, 2016.

PHOTO: ALEX DECICCIO

Thank you to all our donors—your support makes an enormous difference.

DONOR HONOR ROLL

TRIDENT SOCIETY

Dr. Craig A. Amerigian*
Ms. Stephanie G. Amerigian
Dr. Ronald C. Baird
Dr. Robert D. Ballard*
Dr. Linda E. Bireley*
Dr. Joceline M. Boucher*
Ms. Barbara V. Braatz
Mr. Andrew L. Brill
Dr. Barclay P. Collins*
Dr. Bruce H. Corliss*
Mrs. Teresa Lyons Corliss
Mr. Dennis R. Costello
Dr. Richard K. Edel*
Dr. Jennifer A. Francis
Rear Adm. David A. Gove
Mr. Stephen M. Greenlee*
Dr. Kathleen I. Gremel
Ms. Nancy E. Jamison
Ms. Diana M. Kennett
Dr. James P. Kennett
Ms. Kathryn C. Kilguss
Mr. Karl M. Knauss
Mr. William A. Knauss
Dr. Michael T. Ledbetter*
Ms. Margaret G. Leeson
Mr. Robert Leeson Jr.
Dr. Margaret S. Leinen*
Mr. Christopher H. Little
Ms. Maureen T. McConaghy
Dr. John T. Merrill
Ms. Lucy D. Metcalf
Dr. Theodore C. Moore
Ms. Janet K. Munroe
Mr. J. Terrence Murray
Prof. Dennis W. Nixon
Dr. James E. O'Reilly II*
Mr. Christopher T. H. Pell
Ms. Janet Alexander Pell
Mr. Carl E. Peterson
Mrs. Pancha Peterson
Dr. Michael E. Q. Pilson
Dr. James G. Quinn
Mrs. Vivian J. Quinn
Dr. Steven R. Ramp*
Mr. Frank Ray
Ms. Sarah Beinecke Richardson
Dr. Mark Richardson*
Mrs. Sylvia Z. Richardson
Dr. Henry M. Rines*
Dr. Jan E. Rines*
Ms. Janet Lynn Robinson
Mr. Jackson W. Robinson
Ms. Sarah Finnie Robinson
Mr. Christopher du Pont Roosevelt
Dr. H. Thomas Rossby
Dr. Raymond W. Schmitt*
Mr. Henry D. Sharpe Jr.
Ms. Peggy Boyd Sharpe
Mr. Henry D. Sharpe III
Ms. Julia Randall Sharpe
Dr. Barbara K. Sullivan-Watts
Dr. Robert C. Thunell*
Mrs. Pamela M. Thye
Dr. John H. Tietjen*
Mrs. Polly Morgan Timken
Dr. D. Randolph Watts
Mrs. Laura A. Webb, Estate of*
Ms. Judith Stern Weisman
Ms. Mary Baker Wiley*
Mr. Samuel T. Wiley
Ms. Ellen W. Yoder
Dr. James A. Yoder*
Dr. Herman B. Zimmerman*

TRIDENT SOCIETY (ORGANIZATIONS)

1772 Foundation, Inc.
Anonymous
Friends of Craft, Inc.
G. Unger Vetlesen Foundation
Island Foundation
J. King Consulting
Judith Fillmore Trust
Murray Family Charitable Fdn.
National Marine Sanctuary Fdn.
Ocean Exploration Trust Inc.
Ocean Research & Education Ltd.
Prince Charitable Trusts
Resources Legacy Fund
Rhode Island Foundation
Sharpe Family Foundation
Taco Incorporated
Fidelity Charitable Gift Fund
Schwab Fund for Charitable Giving
The Grantham Foundation
Van Beuren Charitable Fdn. Inc.
Vantage in Philanthropy Inc.

DONORS

Dr. Susan C. Adamowicz*
Mr. David A. Adelman*
Mr. Hisham Aharon
Rear Adm. Michael A. Alfultis*
Mr. Stuart Allison*
Mr. John Douglas Andren
Dr. Rebecca G. Asch*
Dr. Carin J. Ashjian*
Ms. Elizabeth Ayer*
Dr. W. Lloyd Balderston*
Mr. Michael Baldwin
Ms. Lorraine Barba
Mr. Randolph C. Barba*
Mr. David H. Baron
Ms. Ernestine M. Bash
Mr. John F. Bash
Dr. Lynn L. Beatty*
Mr. Robert Beatty
Ms. Rosalie F. Bell
Dr. Richard J. Bell*
Dr. Barbara J. Bergen*
Mr. Robert H. Bergen
Dr. Veronica M. Berounsky*
Ms. Maryanne Brennan Berry
Dr. Walter J. Berry*
Dr. Peter R. Betzer*
Dr. Susan B. Betzer*
Dr. James J. Bisagni*
Dr. Gustavo A. Bisbal*
Mrs. Ellen Balzer Boehm
Dr. Paul D. Boehm*
Dr. Edwin A. Boger Sr.
Dr. Paula S. Bontempi*
Ms. Taylor L. Booth
Ms. Karen A. Bordeleau
Dr. David G. Borkman*
Dr. Amy S. Bower*
Mr. Edward C. Brainard II
Mrs. Elizabeth H. Brainard
Mr. John W. Braitmayer
Dr. Christopher W. Brown*
Ms. Dale T. Brown*
Mr. Robert J. Brugman
Dr. Michael R. Bueti*
Mr. Thomas A. Buffum Jr.
Ms. Edith K. Buhs
Ms. Leslie Bulion*
Dr. Curtis M. Burney*
Dr. Heather Burton*
Dr. Edward J. Buskey*
Dr. Christopher J. Calabretta*
Dr. Robert G. Campbell*
Mrs. Constance Grove Carey*
Dr. Steven N. Carey*
Ms. Kathryn Barber Carlson
Ms. Josephine M. Carubia
Ms. Marianne Casey
Mr. Raymond P. Cassola
Ms. Marjorie Catanzaro
Mr. Robert S. Catanzaro
Mr. Allen H. Chatterton III
Ms. Donna T. Chellis
Ms. Xiu Chen*
Ms. Hannah M. Childs
Mr. James M. Childs Sr.
Dr. Richard A. Chinman*
Mrs. Rebecca L. Choiniere
Mr. Stephen R. Choiniere*
Dr. Thomas J. Coghlin
Dr. Dwight F. Coleman*
Ms. Trudy C. Coleman
Mr. Douglas B. Cone*
Mr. Charles A. Coolidge III
Ms. Elizabeth Copeley
Mr. Jeffrey M. Corbin*
Dr. Inge B. Corless
Prof. Peter C. Cornillon
Ms. Gertrude Coxe
Dr. David E. Crandall*
Dr. Katherine Croff Bell*

Dr. Meghan F. Cronin*
Mr. Jeffrey L. Cryan
Dr. Kiersten L. Curti*
Mr. Douglas Cwienk*
Mrs. Sophie Danforth
Mr. Geoffrey T. Davis
Mrs. Mary E. De Jong
Dr. Christopher F. Deacutis*
Ms. Cornelia Dean
Ms. Linda D'Iorio DeCiccio
Ms. Rosa F. Dee
Mr. Lloyd E. DeKay*
Ms. Loretta Sullivan DeKay*
Ms. Elizabeth Devitt
Ms. Harriet M. Diamond*
Mrs. Mariel Oakman Dickinson*
Mr. Stephen M. Dickson*
Mr. Harold J. Doebler*
Dr. Mary Worobec Doering*
Dr. Peter H. Doering*
Dr. Henry A. Donaldson*
Dr. Grace M. Donnelly
Dr. Kathleen A. Donohue*
Ms. Roberta E. Doran
Dr. Barbara A. Dorf*
Dr. Gregory S. Douglas*
Dr. Kathleen A. Duffy*
Dr. Dean A. Dunn*
Mrs. Bernice Anderson Durfee
Dr. Wayne King Durfee
Dr. Robert L. Dwyer*
Ms. Eleanor F. Earle
Mr. Nathaniel B.T. Eddy
Ms. Lola E. Ellis
Dr. William G. Ellis Jr.*
Dr. Jane A. Elrod*
Dr. Adria A. Elskus*
Ms. Ambar Espinoza
Dr. David L. Evans*
Ms. Rebecca Evans
Dr. Katherine C. Ewel
Dr. Mary C. Fabrizio*
Mr. John F. Fahey Jr.
Ms. Carol Price Fairfield*
Ms. Susan E. Farady
Mrs. Virginia K. Farrell*
Dr. John W. Farrington*
Mrs. Shirley G. Farrington
Dr. Ann W. Ferrante
Dr. Richard H. Fillon*
Dr. Michael L. Fine*
Mr. Bernard Finkel
Dr. Martin R. Fisk*
Ms. Colleen M. Fitzpatrick
Ms. Courtney Flatt
Ms. Kathie R. Florsheim
Mrs. Beverly A. Fogg
Dr. Thomas R. Fogg*
Mr. Carl S. Fontneau*
Dr. Kathryn H. Ford*
Mrs. Judith Cooley Foster*
Dr. Jeffrey B. Frithsen*
Dr. Robinson W. Fulweiler*
Mr. James P. Gaffney
Mr. Rick Gaffney
Dr. Arthur G. Gaines Jr.*
Mrs. Jennifer Stone Gaines
Dr. Jane Gallagher*
Dr. Newell Garfield*
Mr. Elbridge T. Gerry Jr.
Dr. Graham S. Giese*
Mr. James Robie Gilbert
Dr. Craig S. Gilman*
Dr. Sharon L. Gilman*
Prof. Isaac Ginis
Ms. Gail Ginnetty
Capt. Thomas J. Glancy Jr.*
Dr. Donald C. Gordon Jr.*
Dr. Deborah Hutchinson Gove*
Mr. Dennis K. Graham
Dr. Rebecca Robinson Graham
Dr. Helene M. Grall-Johnson*
Mrs. Dagny Hultgreen Griswold
Mr. Harrison R. Griswold
Mr. John T. Gunn*
Ms. Susan H. Gustafson
Dr. James H. Hain*
Mrs. Lynne Zeitlin Hale*
Mr. Stephen S. Hale*
Mrs. Audrey Barker Hallberg
Ms. Linda A. Hansen*
Mr. Kurt A. Hanson*
Mr. Jeffrey D. Harris*
Dr. Lora A. Harris*
Ms. Nancy Hays
Mr. Yuguang He*
Mr. Robert Charles Healey
Ms. Lorraine M. Hempe
Mr. Rudolph A. Hempe
Ms. Jacqueline B. Hermsen
Dr. Jerome M. Hermsen Jr.*
Dr. Charles F. Hickox
Ms. Sara Callaghan Hickox
Dr. Kenneth R. Hinga*
Dr. Kay T. Ho*
Mr. James A. Hopkins
Dr. Matthew G. Horn*
Dr. Stephan Dixon Howden*
Mr. John I. Howell Jr.
Dr. Steven G. Howell*
Mr. Bruce A. Huber*
Dr. Jeffrey E. Hughes*
Dr. Julia M. Hummon*
Dr. Kimberly J. W. Hyde*
Dr. Lloyd Irland
Dr. Ann E. Isley*
Ms. Krista A. Janigian
Dr. H. Perry Jeffries*
Ms. Mari N. Jensen
Mr. Donald O. Johnson
Ms. Karen L. Johnson-Young*
Dr. Benjamin R. Jordan*
Dr. Paul S. Joyce*
Dr. Norman M. Kahn*
Dr. Lloyd D. Keigwin*
Mr. Thomas S. Keller
Dr. John R. Kelly*
Mr. Roger P. Kelly*
Dr. Robert D. Kenney*
Ms. Margaret Kerr
Dr. Richard A. Kerr*
Ms. Roberta Kester
Dr. John A. Kiddon*
Ms. Josephine A. Kiernan
Ms. Rona Anne Kobell
Mr. John J. Kosmark*
Ms. Rebecca B. Kosmark
Ms. Rebecca Kramer
Dr. James N. Kremer*
Dr. Patricia M. Kremer*
Ms. Kelly A. Kryc*
Ms. Paula G. Kullberg*
Dr. David Y. Lai*
Ms. Betty Rawls Lang
Mr. Fraser A. Lang
Ms. Sarah A. Lawrence*
Mr. Lawrence A. Leblanc*
Dr. Cindy Lee
Mr. Jacob L. Leifman
Dr. Evelyn J. Lessard*
Ms. Noelle F. Lewis
Dr. Yaqin Li*
Mr. John L. Lillibridge III
Mr. Edward J. Linky, Esq.
Mr. Richard W. Lisle
Mr. Malcolm C. Long
Dr. Brooke A. Longval*
Mr. John Garnet Lord
Mr. George H. Lord
Dr. Ernesto Lorda*
Dr. Douglas H. Lowenthal*
Ms. Annie Sherman Luke
Ms. Jane L. MacIntyre
Dr. Andrew P. Mack*
Dr. William K. Macy III*
Mrs. Cynthia Hill Maran
Mr. R. Timothy Maran
Dr. Guy D. Marchesseault*
Dr. Arthur J. Mariano*
Dr. Hal B. Maring*
Dr. Cynthia Parmelee Maris*
Dr. Mark A. Maris
Ms. Barbara W. Mark
Dr. Elena B. Martin*
Ms. Catalina M. Martinez*
Dr. James T. Maughan*
Ms. Hope I. Mauran
Dr. Harry B. McCarty*
Mr. M. Conor McManus*
Dr. Gregory Allen Mead*

DONOR HONOR ROLL (CONTINUED)

Ms. Ellen L. Mecray*
Dr. Susanne Menden-Deuer
Dr. Sunshine Menezes*
Mrs. Kathy S. Menezes
Ms. Teresa D. Metcalf
Mr. James H. Metcalf Jr.
Mrs. Sandra Sayles Metcalf
Dr. Peter S. Meyer*
Dr. Philip A. Meyers*
Dr. Laurence L. Miller*
Dr. Gerard R. Miller Jr.*
Mrs. Susan C. Miller
Ms. Jane S. Miner
Ms. Melanie E. Mirande
Ms. Kendall Moore
Dr. Johnes K. Moore*
Dr. Robert W. Morton
Dr. Byard W. Mosher IV*
Dr. Colleen B. Mouw*
Dr. David R. Muerdter*
Ms. Louise M. Nadler
Mr. Brian A. Needham
Ms. Mary Ann Needham
Mr. Paul Coe Nicholson Jr.
Dr. Thomas P. O'Connor*
Dr. Guy W. Oliver III*
Ms. Felicia Olmeta-Schult
Dr. Candace A. Oviatt*
Mrs. Susan Bourassa Panichas*
Mr. Jonathan H. Pardee
Dr. Henry S. Parker III*
Mr. Anthony J. Paulson*
Mr. David R. Pedrick
Ms. Laura S. Pedrick
Dr. Kelly Pennell
Dr. Gerald G. Pesch*
Mrs. Carol G. Pesch
Ms. Molly Peterson
Mr. Jonathan T. Phinney
Ms. Donna Titzler Pignolet
Dr. Nancy A. Potter
Dr. Richard J. Pruell*
Dr. Alex A. Pszenny*
Ms. Ann M. Rabuse
Ms. Barbara J. Ray
Ms. Patricia M. Read
Dr. Steve Rebach*
Mrs. Linda Feeley Redmond
Ms. Nancy E. Reichley*
Ms. Ann K. Rheault
Dr. Robert B. Rheault*
Dr. Philip L. Richardson*
Mr. James M. Robb*
Mr. Colin L. Robinson
Mr. Hays H. Rockwell
Ms. Linda H. Rockwell
Dr. Bruce A. Rogers*
Dr. Deborah Westin Rogers*
Dr. Charles T. Roman
Mrs. Nancy Rooney Roman
Ms. Catherine D. Roques
Dr. Patrick F. Roques*
Mr. Jeffrey S. Rosen*
Ms. Lynne M. Rosen
Ms. Linda B. Rosenbloom
Dr. Dail Rowe*
Dr. Scott D. Rutherford*
Dr. John P. Ryan*
Dr. Tatiana A. Rynearson
Ms. Victoria Sacks*
Ms. Deborah S. Salamone
Mr. Richard L. Salit
Mr. William G. Saltonstall
Dr. Peter A. Sampou*
Dr. Whitley J. Saumweber*
Mr. Mark Schleifstein
Ms. Patricia McCann Schmidt
Mr. Richard F. Schmidt*
Dr. Stephanie Schollaert Uz*
Mr. Eric T. Schoonover
Ms. Cheryl L. Schroeder*
Mr. Matthew B. Schult*
Dr. David M. Schultz*
Ms. Kathy L. Schultz-Tokos*
Ms. Barinetta Scott
Dr. Sybil Putnam Seitzinger*
Ms. Laura Sellers
Mr. Robert B. Semple Jr.
Ms. Mary Lou Sevigny
Ms. Sarah A. Sharpe
Dr. Haiwei Shen*
Dr. Kenneth Sherman*
Mrs. Roberta R. Sherman
Dr. Frederick T. Short*
Mr. John P. Sifling*
Mr. Robert M. Silk
Mr. Alan M. Silverman
Dr. Bonnie Epstein Silverman*
Dr. Robert L. Singletary
Ms. Lisa Song
Dr. Malcolm L. Spaulding
Mr. Henry B. Spencer
Mr. Daniel M. Sprague
Ms. Norma L. Staley
Dr. Linda Stathoplos*
Dr. William W. Steiner*
Mr. Frederick W. Stolle Jr.
Mr. Peter C. Stone
Ms. Florence S. Stone
Dr. Lowell D. Stott*
Mrs. Margaret M. Stout
Mr. Prentice K. Stout
Mr. Konrad Streuli
Ms. Cynthia L. Suchman
Dr. Andrew J. Sweatt*
Dr. Alina M. Szmant*
Ms. Catherine Z. Taggart
Dean David G. Taggart
Ms. Dolores M. Tapia Lange*
Mr. Clive A. Tattersall
Dr. Paul R. Temple*
Mr. Peter P. Thomson
Mr. W. Nicholas Thorndike
Dr. Joseph J. Tokos*
Dr. Gregory A. Tracey*
Ms. Karen R. Tracey
Mr. James D. Turley
Dr. David C. Twichell*
Ms. Nancy P. Twichell
Dr. David S. Ullman
Dr. Chathuarveedu K. Unni*
Dr. Baris M. Uz*
Dr. Robert D. Vaillancourt*
Ms. Donna Van Keuren
Dr. Jeffrey R. Van Keuren*
Ms. Virginia Van Kluyve
Dr. Gabriel A. Vargo*
Dr. Sandra L. Vargo*
Dr. Douglas S. Vaughan*
Ms. Nancy Donovan Vaughan*
Dr. Jorge Vazquez*
Ms. Bina Venkataraman
Dr. Bruce E. Viekman*
Mr. Robert A. Viera
Ms. Jane Viera
Dr. Tracy A. Villareal*
Dr. Richard F. Viso*
Dr. Mary Voytek*
Dr. Terry L. Wade*
Ms. Chelsea T. Wald
Dr. Robert L. Wallace
Mr. Philip N. Warburg
Mr. Morris A. Ward
Mr. Godfrey Warren
Dr. Robert H. Weisberg*
Dr. Clifford P. Weisel*
Rear Adm. Richard D. West
Dr. William M. White*
Mr. Thomas E. White
Ms. Andrea Whitehead
Mr. Raymond J. Whitehead
Dr. Sandra T. Whitehouse*
Dr. J. Ross Wilcox*
Dr. Dixon W. Wilde
Dr. Mark Wimbush
Ms. Laura A. Windecker*
Ms. June S. Wing
Ms. Alexandra Witze
Ms. Christine G. Woodside
Dr. W. Redwood Wright*
Ms. Elizabeth G. Wylie
Mr. Dominick G. Yanchunas
Mr. Stephen K. Yokubaitis*

DONORS (ORGANIZATIONS)

Rhode Island Textile Co.
Thread Rolling, Inc.

** GSO Alumni*

PHOTO: ALEX DECICCIO

We obtain funding from a variety of sources to carry out research, education, and outreach

Making a Difference: Support GSO

The Knauss Terrace offers GSO and the Bay Campus community a beautiful location, overlooking Narragansett Bay, for lunch, studying, or just collecting one's thoughts. A very fitting tribute to GSO's founding dean, John A. Knauss.

Ms. Norma Smayda Staley, Professor H. Thomas Rossby, Professor Michael Pilson and Mrs. Joan Pilson reminiscing and enjoying the beautiful weather during the Knauss Terrace dedication ceremony.

GSO is a complex place. Faculty, marine research scientists, staff and graduate students write proposals, carry out research, and publish and present their findings in a variety of venues. The Coastal Resources Center, Inner Space Center, Office of Marine Programs, Rhode Island Sea Grant and the Coastal Institute have broad-reaching educational outreach programs that address regional, state, national and international needs. Staff members support all of these efforts and are the catalyst to make possible the things that we do. Officers, crew and shore support operate the R/V *Endeavor* with 10–12 research cruises each year, maintain the ship, and are ambassadors to the scientists and students who use the ship. An oceanographic institution, such as GSO, is a fascinating place because of the diversity of people and skills needed to accomplish our mission.

All of these activities take money. We obtain funding from a variety of sources to carry out research, education, and outreach, and they include but are not limited to the National Science Foundation, Office of Naval Research, National Oceanic and Atmospheric Administration, Sea Grant, Bureau of Ocean Energy Management, U.S. Agency for International Development, the State of Rhode Island, and numerous corporations and foundations. These sources provide the bulk of the funding that supports our activities.

But, in addition to these important funding sources, the GSO Annual Fund provides critical resources that enable us to do things that we would otherwise not be able to accomplish. We continue to use donations from the GSO Annual Fund to purchase equipment or for travel-related expenses for students to carry out research projects. These funds are also used to support student travel to scientific meetings, where they have opportunities to meet researchers in their fields and to begin to get their work known in the oceanographic community. This support and subsequent exposure are essential to our students' success and are a critical part of their graduate education. These funds have also been important for financing innovative pilot projects for faculty and obtaining scientific equipment not otherwise available, which is then used by faculty and students to support important and far-reaching research.

If you have given recently to GSO, we thank you. If you have not given recently, I hope that you will consider a gift. This is an exciting time at GSO with new initiatives, new faculty, and an ambitious Master Plan for the Narragansett Bay Campus. Your gift is an investment in the future of oceanography at URI. I hope you will consider supporting GSO and its mission to pursue comprehensive educational experiences for our students, address critical scientific research questions, and provide national and international outreach.

Please send the enclosed envelope with your check or credit card information to the URI Foundation or you can give online at urifoundation.org.

Thank you for your support.

Bruce H. Corliss, Dean

PHOTOS: ALEX DECICCIO

THE
UNIVERSITY
OF RHODE ISLAND

Graduate School of Oceanography
Office of the Dean
Narragansett Bay Campus
Narragansett, RI 02882
401.874.6222 | gso.uri.edu

Annual Report for Fiscal Year 2016

Sunset over the Harbor of Refuge, from the breakwater at Camp Cronin, Point Judith, R.I.

PHOTO: JOSHUA ARAUJO