

2018

Momentum: Research & Innovation for Fall 2018

University of Rhode Island

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Momentum

Research & Innovation

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FALL 2018



“URI is overflowing with creativity, novel insights, talent and research that have the potential to improve and protect our society and our planet. Likewise, the University is populated by dedicated educators and mentors, scientists, engineers, artists and scholars across nearly every conceivable academic domain.”

- Peter J. Snyder, Ph.D.

Asterionellopsis in Red, by Cynthia Beth Rubin.

FROM THE VICE PRESIDENT

Several weeks ago, President Dooley recommended a book for me to read, titled *The University. An Owner's Manual*, by Professor Henry Rosovsky. Published in 1990 (New York: W.W. Norton & Co.), Rosovsky reflects on his 11 years of service in a position that has been described as one of the most important jobs in American higher education, as Dean of the Faculty of Arts and Sciences at Harvard University. Rosovsky provides wonderful insight into the organizational and management challenges faced by all research universities, and his book systematically catalogs the important vested interests of faculty, students, staff and administrators that collectively breathe life and purpose into our nation's major research universities.

I safely assumed that President Dooley's book recommendation would be well worth the \$4.95 purchase price of a used copy, and it even came with highlighting and liner notes provided by a previous owner. Although this volume is replete with good advice and amusing anecdotes culled from Rosovsky's career, there is one quote early in the book that I, and apparently a previous owner of my book, both found to be particularly compelling. In introducing the core mission of our major research universities, Rosovsky states that, "These institutions are the cutting edge of our national life of the mind. They determine the intellectual agenda of higher education. They set the trends...they are important to us in the United States and to the world" (p. 36).

Rosovsky's point is that major research universities have unique roles and obligations to frame debates, to advance our understanding across disciplines, and to serve as catalysts for action for the betterment of our society and world. Although it is extremely important for a research university to support the advancement of knowledge, irrespective of whether such activities lead to immediate utility, it is also the case that much of our research activities do have critically important and immediate applications. For this latter type of scientific enterprise, it is our responsibility ensure that such knowledge directly impacts public understanding, political discourse, policy decisions and — when necessary — calls to action. With nearly \$100 million in total external grant funding this past year, our own university is part of a cadre of institutions that, as Rosovsky describes, "are the cutting edge of our national life and mind."

In this issue of *Momentum* we are pleased to highlight impactful scholarly work, ranging from major contributions to the cultural richness of our local community, to the discovery and testing of new medicines to treat human diseases, to supporting those who are at the front-end of caring for our rapidly aging population, to the restructuring of educational methods to improve digital literacy for our children. We also showcase the extraordinary work of four faculty, from two colleges, in partnership with NASA to understand the fundamental role of phytoplankton in supporting the ocean's food web and in carbon sequestration. This groundbreaking work is necessary, to predict, plan for, and to hopefully mitigate some of the massive environmental changes we all face as a result of global warming over just the next two decades.

Several of the stories presented within this issue describe research and findings that are important to share with the public, legislators, policy makers, and our students without bias. As scientists, and consumers of scientific findings, we must convey often complex ideas and data in a manner that is accessible to all, uncensored and free of biased reporting for partisan gain. To that end, URI and its Metcalf Institute for Marine & Environmental Reporting recently held an important national symposium on the advancement of inclusive public engagement in science. This symposium, with participation by scholars, teachers, reporters, television and radio producers, bloggers, and students served as a profound demonstration of the University's commitment to public engagement in science. Rest assured, this symposium will be repeated, and it will grow in both size and scope as the University meets its commitments to fostering public understanding and involvement in what we do here. An inspiring keynote talk from this year's symposium can be viewed at www.inclusivesciomm.org.

Finally, in this issue of *Momentum* you will find a new section of the magazine that contains our annual report for URI's Division of Research and Economic Development. I believe that, as a state land- and sea-grant institution that receives significant support from both federal and state agencies to advance our research and creative activities mission, we have a responsibility to metric our progress and successes — and even our limitations — with transparency. We plan to publish our annual report, for your inspection, with each fall semester issue of this magazine. I hope you'll agree that, with the conclusion of this prior fiscal year, we are most certainly heading in the right direction!



Peter J. Snyder, Ph.D.

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Momentum
Research & Innovation

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INNOVATION AND ENTREPRENEURSHIP

"I intend to ensure that our University meets its mission of advancing scholarship and pushing the boundaries of knowledge – that we further translate our advancements into the services, products, therapeutics, policies, arts and perspectives that will benefit the citizens of our state and broader communities."

- Peter J. Snyder, Ph.D.

Momentum

Research & Innovation

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Cover photo: Aerial view of diatoms and phytoplankton, (NASA).





EXPORTS OCEANOGRAPHIC CAMPAIGN

written by **AMY DUNKLE**



R/V *Sally Ride* departs for the North East Pacific research cruise to support the NASA/NSF EXPORTS research expedition. Photo by Susanne Menden-Deuer.

National Aeronautics and Space Administration (NASA) satellites routinely circle the Earth, taking images of the oceans to gather a wide array of information, ranging from temperature and salinity to the abundance of tiny plant-like organisms.

Although easily overlooked because of their microscopic size, these phytoplankton are essential — they supply half the oxygen we breathe, form the foundation of the marine food web, and play a critical role in removing carbon from the atmosphere in a process scientists call the *biological pump*. Yet, the sensors on these satellites, collecting reams of data for NASA, do not penetrate the ocean's surface. Consequently, critically important information contained below the surface, needed to fully understand the biological pump, remains unknown.

What happens below the surface, in the deep ocean? How many phytoplankton are eaten and passed through the food web? How many die off and sink, taking carbon to the deep ocean where it can stay for centuries? How much carbon can the ocean take up and how much gets returned to the atmosphere?

In what is being hailed by NASA and the National Science Foundation (NSF) as the first coordinated science campaign of its kind to study the role and fate of plankton, the EXport Processes in the Ocean from RemoTe Sensing (EXPORTS) program seeks to answer these and other questions — a monumental effort to yield greater understanding of the oceanic biological pump and its role in the Earth's carbon cycle.

Notably, the campaign features 16 projects, four led by University of Rhode Island (URI) scientists. Professors Susanne Menden-Deuer (article page 14) and Tatiana Rynearson (article page 10) and Assistant Professor Melissa Omand (article page 22) are at the Graduate School of Oceanography. Professor Bethany Jenkins (article page 18) is at the College of the Environment and Life Sciences. Their projects also provide an invaluable experiential learning platform for graduate students Melanie Feen and Kristofer Gomes as well as postdoctoral fellows Heather McNair, Françoise Morison and Ewelina Rubin (article page 24).

Paula Bontempi, program scientist for ocean biology and biogeochemistry in the Earth Science

Division at NASA headquarters, says the number of URI faculty chosen is phenomenal. While other institutions are represented by multiple people and projects, to land four is unusual and speaks to the high caliber research and innovative approaches the URI scientists bring to the program. The entire EXPORTS campaign involves 55 principle investigators and 29 institutions.

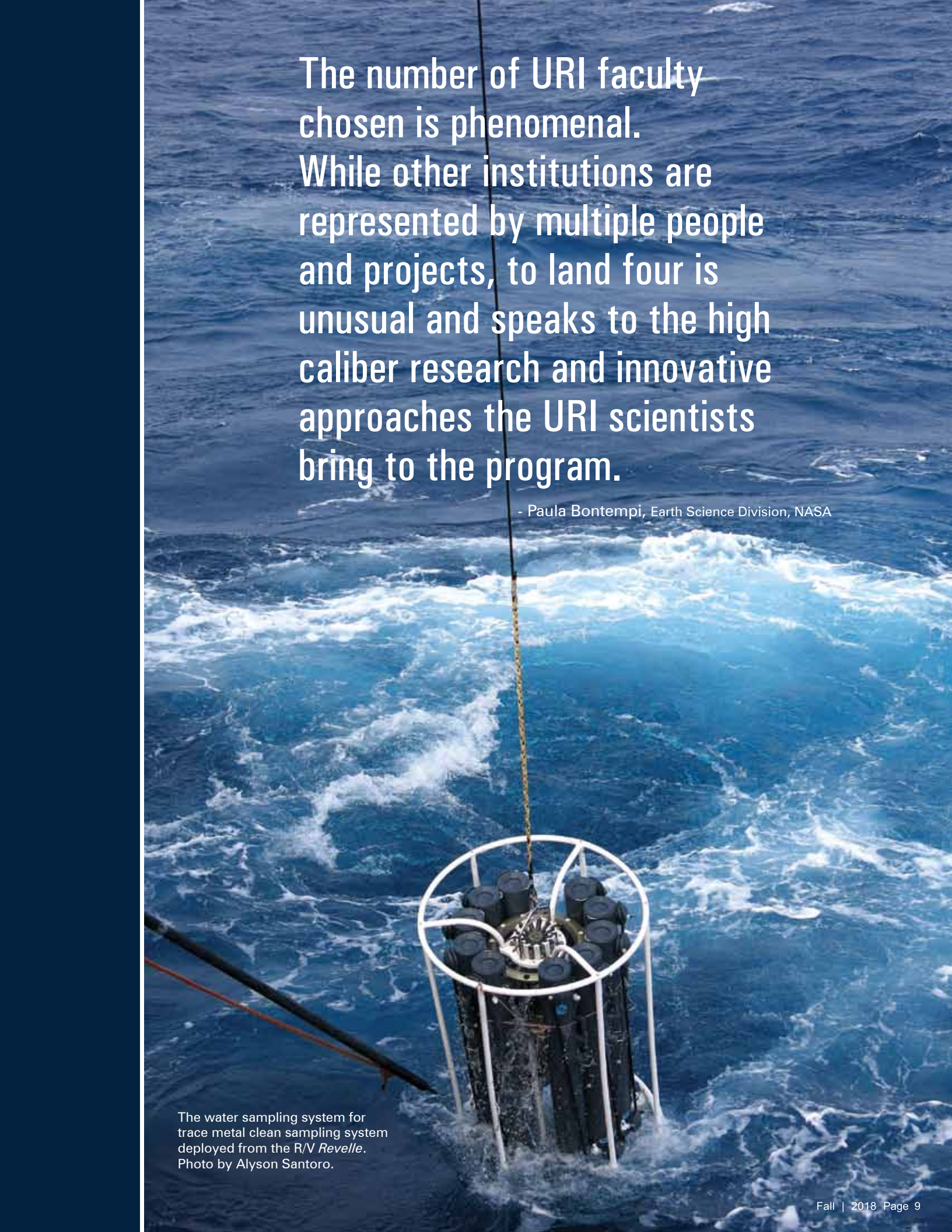
"Obviously, there is a clear and strong synergy with what NASA was planning for the EXPORTS field campaign, and the expertise and ideas brought forward by the URI faculty members, which was obvious to the peer reviewers and the agency," says Bontempi, a URI alum who earned her Ph.D. in oceanography in 2001. "There's also a nice blend of exploration-driven science with what we're studying in EXPORTS."

Speaking to the broader aims of the campaign, Mike Sieracki, program director in the NSF Division of Ocean Sciences, notes in an agency press release: "The carbon humans are putting into the atmosphere is warming the Earth. Much of that carbon eventually finds its way into the ocean and is transported to the deep ocean, where it is sequestered and will not return to the atmosphere for a long time. This project will help us understand the biological and chemical processes that remove the carbon, and establish a foundation for monitoring these processes as the climate changes."

EXPORTS cuts across multiple disciplines and took seven years to come to fruition. NASA selected Jenkins and Menden-Deuer to serve on the campaign's scientific definition team that conceptualized the scope and established the framework. From August 11 to September 15, 2018, more than 100 scientists and crew members sailed out of Seattle on two research vessels, operated by the Scripps Institution of Oceanography, the R/V *Revelle* and R/V *Sally Ride*. The first round of field experiments in the EXPORTS campaign was conducted about 1,000 miles west of Seattle, in the open ocean.

In a critically important report released this past October, the Intergovernmental Panel on Climate Change sounded a global alarm. The panel concluded that, unless a worldwide massive effort is marshaled to slow global warming in the next 20 years to keep the overall temperature rise to less than 1.5 degrees Celsius, substantial consequences will result with severe impacts across ecosystems and throughout human communities around the world. The EXPORTS team at URI is working tirelessly to improve the understanding of phytoplankton's key role in driving the ocean food web and carbon sequestration — at a time in history when mankind desperately needs the information.



A photograph showing a water sampling system being lowered into the ocean. The system consists of a white metal frame with several black cylindrical containers. A yellow rope is attached to the top of the frame and extends upwards. The water is a deep blue with white foam from the ship's wake. The background is a dark blue sky.

The number of URI faculty chosen is phenomenal. While other institutions are represented by multiple people and projects, to land four is unusual and speaks to the high caliber research and innovative approaches the URI scientists bring to the program.

- Paula Bontempi, Earth Science Division, NASA


The water sampling system for trace metal clean sampling system deployed from the R/V *Revelle*. Photo by Alyson Santoro.

An aerial photograph of a coastline. The land is a mix of brown, tan, and grey tones, showing a complex network of roads and natural terrain. A large, irregularly shaped body of water is highlighted in a vibrant teal color, contrasting sharply with the natural landscape. The water's edge is jagged and follows the contours of the land.

EXPORTS

TATIANA RYNEARSON

written by **AMY DUNKLE**



University of Rhode Island (URI) Professor of Oceanography Tatiana Rynearson likens her research technique to that of police officers using forensics when investigating crimes, finding similarities between her expertise in the microscopic world of phytoplankton and the collection of DNA.

“I use genetic techniques to investigate plankton, single celled marine organisms that float with tides and current,” Rynearson says. “I want to know who is there and what are they doing.”

Knowing the answers to these questions can tell us how well plankton might respond to climate change. These are crucial details for organisms that form the base of the marine food web, make the ocean ecosystem run, and provide every other breath we draw in. Plankton affect nutrient levels, species shifts, fisheries, and atmospheric oxygen levels.

Using genetic and molecular techniques allows Rynearson to understand not only the sequence of events taking place today, but also what the future might hold as the effects of climate change play out.

Rynearson joined the URI Graduate School of Oceanography (GSO) in 2005 as part of a \$3.5 million National Science Foundation (NSF) ADVANCE grant. The funding allowed URI to hire nine female faculty members in physics, oceanography, engineering and life sciences. Rynearson also serves as director of GSO’s long-term plankton time series in Narragansett Bay, which, at nearly seven decades old, is one of the world’s longest time series on plankton abundance and composition.

A large winter phytoplankton bloom is seen in the Gulf of Aden on Feb. 12, 2018. (NASA)



Plumbing the deck-board incubators to get them ready for measurements of phytoplankton growth and mortality.

Rynearson brings her considerable expertise to the EXPORTS science campaign as a co-principal investigator with URI oceanography Professor Susanne Menden-Deuer (article page 14). Their project — Quantifying plankton predation rates, their effects on primary production, phytoplankton community composition, size spectra and potential for export — launched sampling in August 2018 aboard the R/V *Revelle* about 1,000 miles offshore of Seattle with postdoctoral fellows (article page 24) Ewelina Rubin (Rynearson lab) and Françoise Morison and Heather McNair (Menden-Deuer lab). URI Professors Bethany Jenkins (article page 18) and Melissa Omand (article page 22) are also part of the EXPORTS research expedition.

“One of the things we’re trying to do is develop novel genetic sensors to look at grazing and food web dynamics,” explains Rynearson. “With traditional

methods, the work is very labor intensive and time consuming.”

Developing a new method to measure grazing at multiple locations and depths would help scientists assess the impact of predation across environmental gradients more quickly, easily and less expensively.

“For example, a traditional grazing experiment requires about 30 bottles and involves creating replicates by diluting the samples with filtered seawater and monitoring how much grazing takes place in the different dilutions,” she says. “The most you can do is once per day at one spot in the ocean.”

A pilot project with Menden-Deuer and physical sciences Professor Sarah Knowlton of Rhode Island College used newly acquired transcriptomics data to examine gene expression of predators under varying grazing conditions providing new insights into their metabolism.

“We want to know where that carbon goes. The genetic tools will help us to understand ecosystem function. And, what we’re learning in EXPORTS is directly applicable to the kinds of studies we’re doing in Narragansett Bay.”

- Tatiana Rynearson

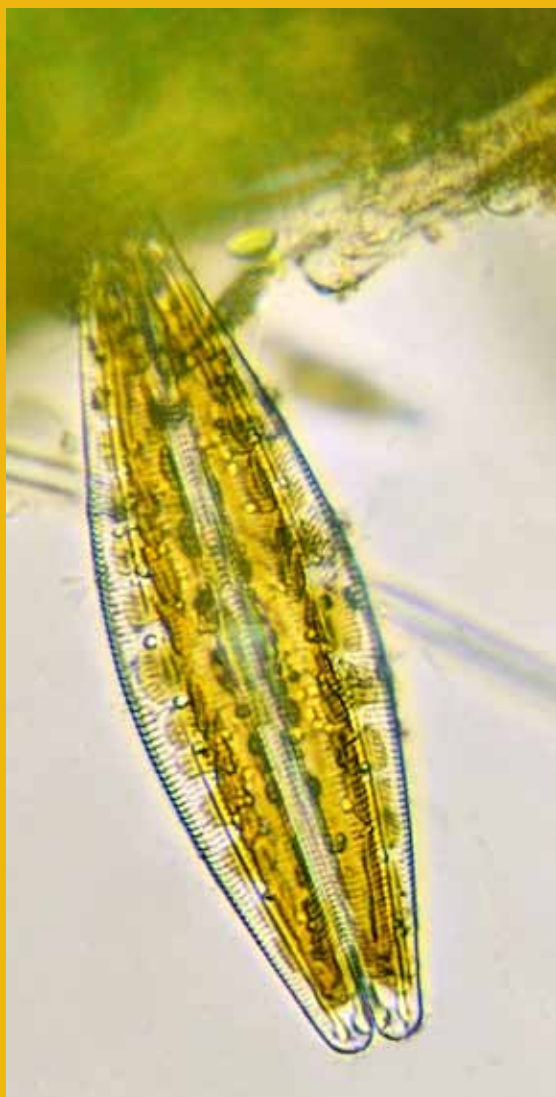
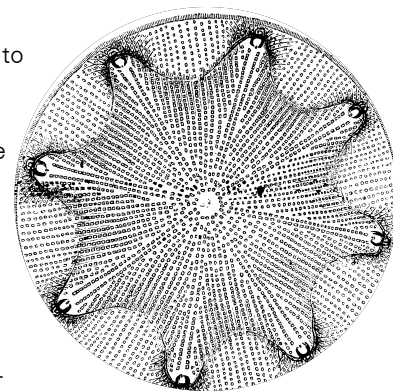


Photo of diatom.



Tatiana Rynearson
Professor
Oceanography

As part of the EXPORTS project, the URI team aims to identify genes expressed by the grazers of the phytoplankton to determine whether they are starving or well fed, details that will shed light on who is eating how much in the water column. Rynearson says scientists know little about this activity in the so-called “twilight zone” — the barely lit ocean layer where carbon gets digested through the food chain, respired back into the atmosphere, or is buried in the ocean floor.



“We want to know where that carbon goes,” she adds. “The genetic tools will help us to understand ecosystem function. And, what we’re learning in EXPORTS is directly applicable to the kinds of studies we’re doing in Narragansett Bay.”

The EXPORTS campaign also offers a unique platform for working across teams and sharing data as all of the projects fall under the umbrella of quantifying the export and fate of upper ocean net primary production.

“This is really exciting and offers the chance for close collaboration” Rynearson says. “NASA’s investment in this campaign is like a science multiplier. We’re doing things together that we couldn’t do alone.”



The R/V *Roger Revelle* prepares for the NASA/NSF research expedition departing from Seattle. Photo by Susanne Menden-Deuer.

EXPORTS

SUSANNE MENDEN-DEUER

written by **AMY DUNKLE**

“Our campaign will directly inform measurements made with NASA satellites. One major attribute of the NASA satellites is that they can measure the surface of the entire world’s ocean in a few days. No ocean measurement tool gives this kind of global perspective.”

- Susanne Menden-Deuer



For all of the importance ocean health has for humans, much about the marine ecosystem remains unknown.

“The more time I spend at sea,” says University of Rhode Island (URI) oceanography Professor Susanne Menden-Deuer, “the more I understand how big, complex and vastly unknown the ocean is.”

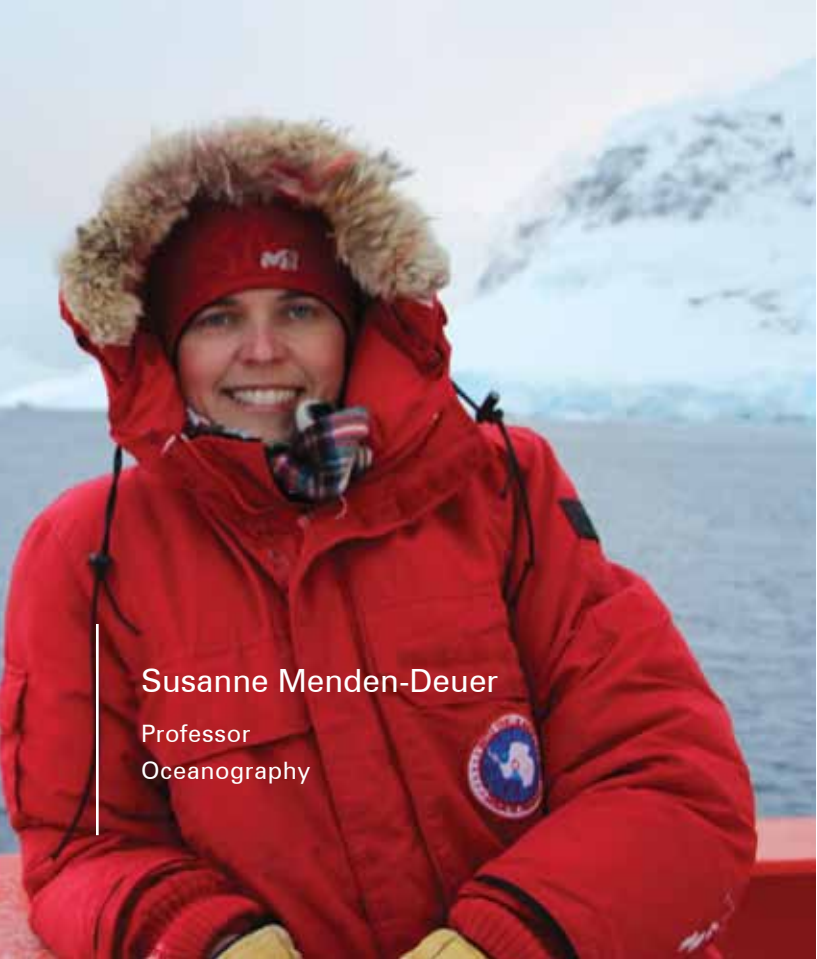
As part of a National Aeronautics and Space Administration (NASA) groundbreaking field campaign in concert with the National Science Foundation (NSF), Menden-Deuer aims to fill in some of these critical blanks.

Her project, Quantifying plankton predation rates, their effects on primary production, phytoplankton community composition, size spectra and potential for export, was funded through NASA's EXPORTS program in August 2018.

“NASA is really visionary in not only studying outer space, but also studying planet Earth,” Menden-Deuer explains. “It is a tremendous opportunity to help define a NASA mission that addresses fundamental processes in the Earth’s ecosystem to which the ocean is intricately linked.”

Menden-Deuer and URI Professor Tatiana Rynearson (article page 10) are part of the effort to link NASA satellite’s remote observations of the ocean’s surface with the activity that takes place deep below. The new project they lead primarily focuses on the grazing of microscopic, single-celled predators that eat phytoplankton.

The abundance of these predators affects the amount and species composition of phytoplankton, organisms that help regulate the global carbon cycle by absorbing carbon dioxide from the



Susanne Menden-Deuer

Professor
Oceanography

“The involvement of URI faculty at both the planning and research level underscores the depth of expertise at the institution. It shows that URI and GSO are at the forefront of sea going oceanography and are involved with, what I believe to be, the largest oceanographic campaign recently funded.”

- Susanne Menden-Deuer

A better understanding of the ocean is essential to dealing with the implications of a changing climate.

atmosphere. If phytoplankton get eaten, the predators breath CO₂ back into the atmosphere, however, if phytoplankton die, the carbon sinks to depth and gets removed from the atmosphere possibly for hundreds or thousands of years.

“That’s why grazing is so important,” Menden-Deuer says. “Grazing is pivotal in the global carbon cycle, it determines where the CO₂ goes. Death by grazing is what happens to most phytoplankton. When we measure grazing rates, we measure the fate of phytoplankton carbon. Does the carbon return to the atmosphere as CO₂ or does it remain available for export? Our involvement in EXPORTS is to gain an understanding of how grazing sets the stage for the amount and type of organic material in the surface of the ocean that is exported to the deep ocean.”

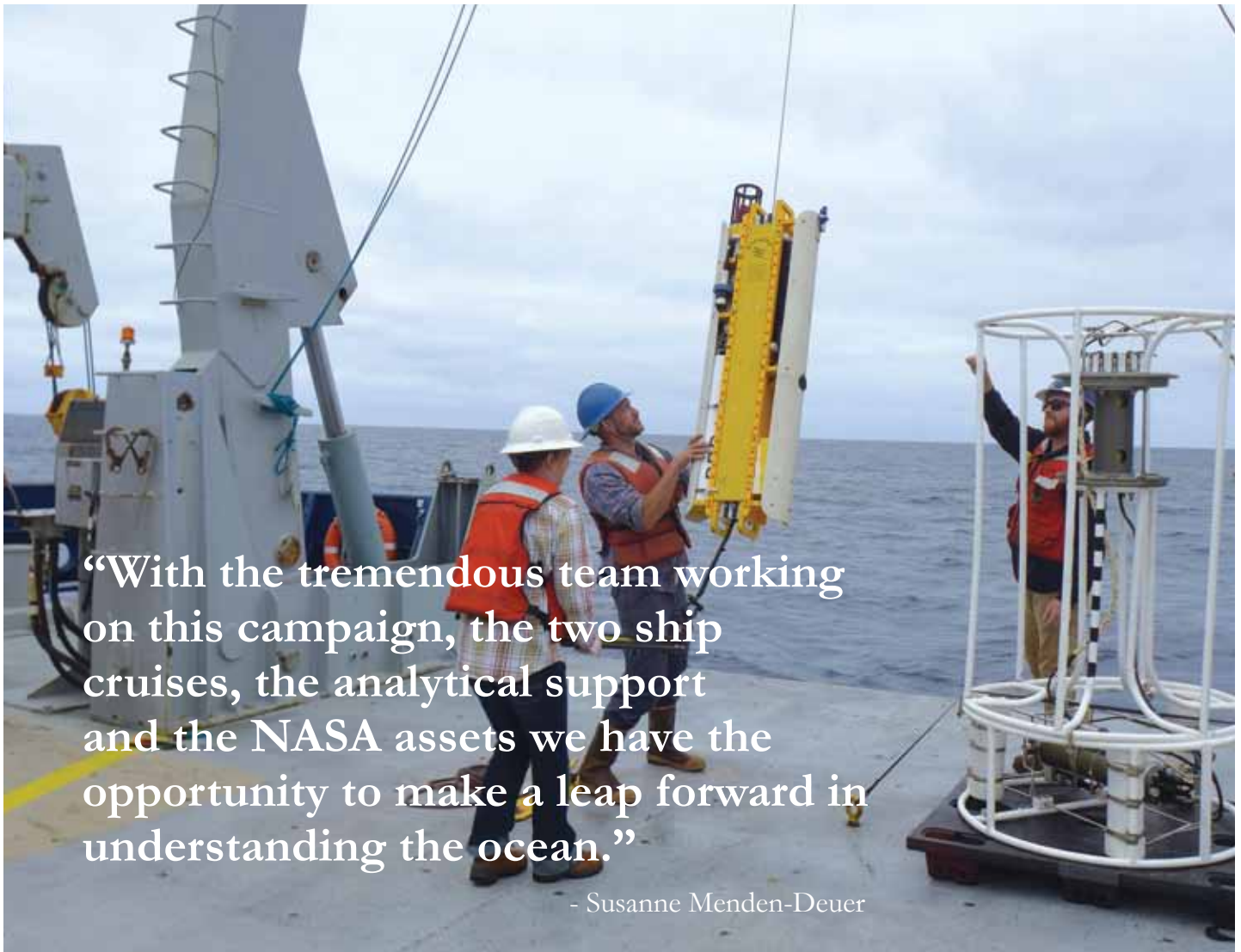
Methods to measure grazing, however, demand an extremely labor intensive effort and involve a lot of people and time, which led to Menden-Deuer’s collaboration with Rynearson to test a more efficient molecular approach that identifies genes expressed by grazers.

“Our campaign will directly inform measurements made with NASA satellites,” Menden-Deuer says. “One major attribute of the NASA satellites is that they can measure the surface of the entire world’s oceans in a few days. No ocean measurement tool gives this kind of global perspective.”

At the same time, although only able to go so far, so fast, ships can give scientists what satellites cannot, she adds: “Our in-water measurements will be linked to observations made by satellites. By combining research cruises that probe both the ocean surface and interior with satellite observations, we can gain unprecedented insights into how the ocean works both on the surface and in the deep. This fascinating expedition improves our understanding from the local to a global scale.”

As the major driver of climate, the ocean plays a pivotal role in how the Earth responds to climate change. Consequently, says Menden-Deuer, a better understanding of the ocean is essential to dealing with the implications of a changing climate. Scientists don’t yet know fundamental aspects of how much energy and matter from the ocean surface make their way to the deep — information necessary to predict future conditions.

“With the tremendous team working on this campaign, the two ship cruises, the analytical support and the NASA assets we have the opportunity to make a leap forward in understanding the ocean,” says Menden-Deuer.



“With the tremendous team working on this campaign, the two ship cruises, the analytical support and the NASA assets we have the opportunity to make a leap forward in understanding the ocean.”

- Susanne Menden-Deuer

Melissa Omand and Pat Kelly are recovering the Wirewalker after an eight-day drift. Photo by Bethany Jenkins.

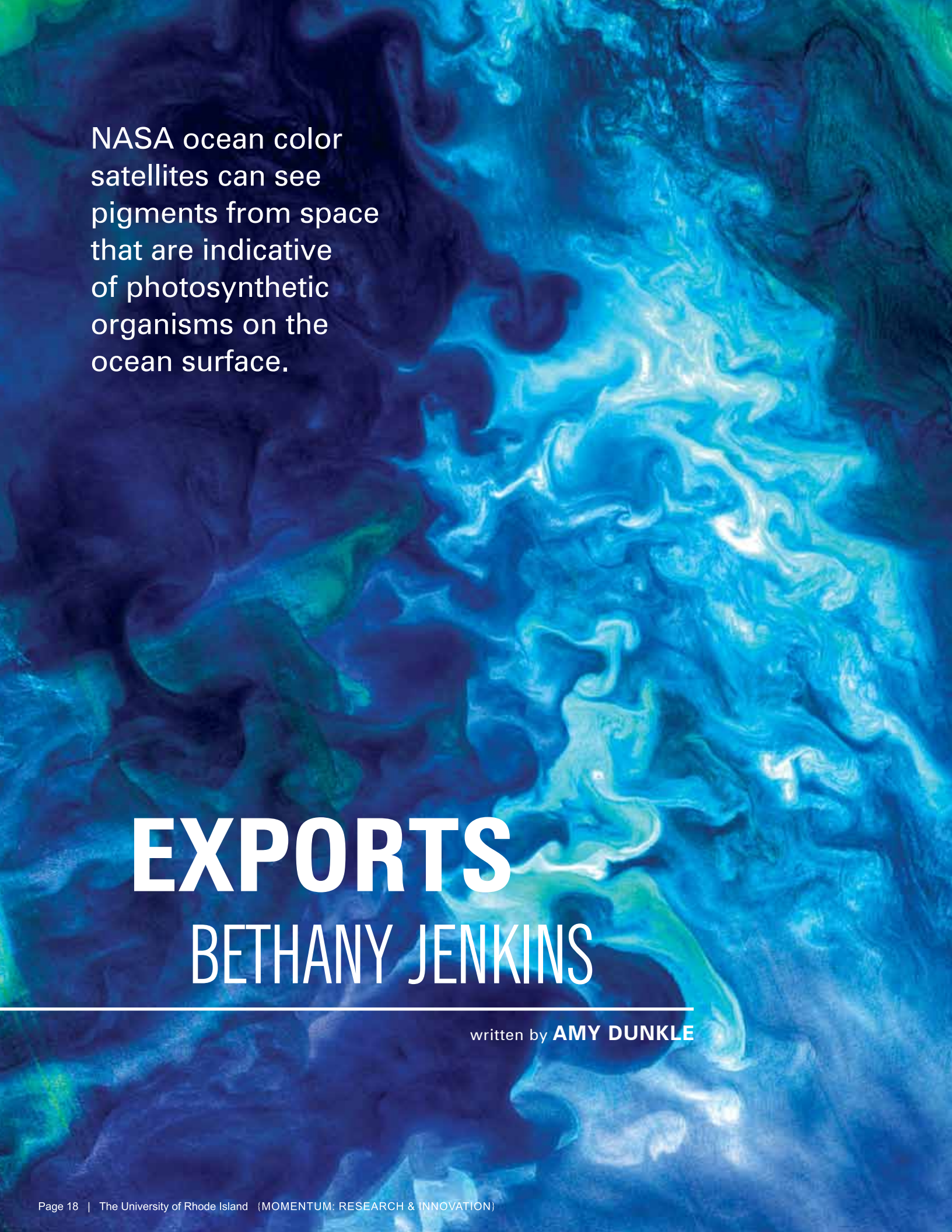
Menden-Deuer marvels at the scope of EXPORTS, from gaining critical insight of the biological pump functions to providing unparalleled experience for the URI team and featuring the unusual event of two research vessels working in tandem at sea. She says she, Ryneerson, and Jenkins (article page 18) enjoy a longstanding collaboration as teachers, researchers, and mentors. And Omand, (article page 22) a recent addition, bolsters the tradition of an inspiring and thriving institution.

“The involvement of URI faculty at both the planning and research level underscores the depth of expertise at the institution,” says Menden-Deuer. “It shows that URI and GSO are at the forefront of sea going oceanography and are involved with, what I believe to be, the largest oceanographic campaign recently funded.

“This is a great milestone for URI and GSO to be involved in an absolutely magnificent oceanographic campaign, with extraordinary colleagues,” she says. “I am particularly pleased for the postdoctoral fellows and graduate students. Through this campaign, our early career colleagues collaborate with a significant slice of the oceanographic community and are part of an instant network, working on an exceptional oceanographic campaign that will propel the field and their careers forward.”



Jellyfish and Krill in Antarctica
by Cynthia Beth Rubin.




NASA ocean color satellites can see pigments from space that are indicative of photosynthetic organisms on the ocean surface.

EXPORTS

BETHANY JENKINS

written by **AMY DUNKLE**

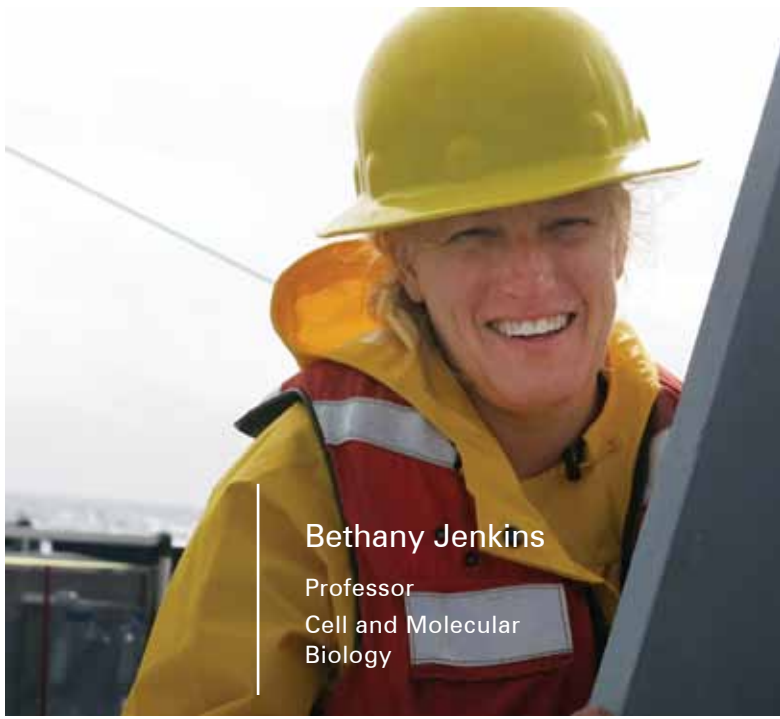


Since the beginning of her career, University of Rhode Island (URI) Professor Bethany Jenkins has worked to understand how photosynthetic organisms that live in the ocean both cope with low nutrients and respond to pulses of nutrient input — especially in ocean ecosystems with low iron levels.

In particular, she studies diatoms, a type of plankton with cell walls made of silica or glass. Diatoms are the floating, single-celled plants of the ocean. These organisms, through photosynthesis, use the energy from sunlight and carbon dioxide to create food. They act as the base of a food web that sustains other animals in the ocean. When fueled by iron, these microorganisms increase their activity, turning carbon dioxide into organic carbon and generating oxygen. If diatoms run out of iron or other required nutrients, they stop growing and sink below the ocean surface, if not eaten by a predator first.

“When they sink, that’s a good thing,” explains Jenkins. “Because the carbon gets sequestered in the ocean floor, they’re fueling the food web, which is also good. I’m trying to understand the relation of iron and silica to diatom growth and sinking.”

During the summer 2018 EXPORTS campaign in the Subarctic Pacific Ocean, Jenkins studied these ocean processes and resulting changes in ocean chemistry. She and URI colleague Susanne Menden-Deuer (article page 14) also served on NASA’s scientific definition committee, which established the framework for the campaign and resulted in a cross-section of projects that pools expertise in the movement of organisms and nutrients from the surface into the ocean deep and marine food web.



Bethany Jenkins

Professor
Cell and Molecular
Biology

Photo by Alyson Santoro.

NASA ocean color satellites can see pigments from space that are indicative of photosynthetic organisms on the ocean surface, Jenkins says. Scientists don't know the fate of the organisms, from how many sink into the deep ocean and sequester carbon to how many enter the food web and get respired back into the atmosphere.

"We want to understand the fraction that goes down and the fraction that gets grazed," Jenkins says. "Modeling and algorithmic corrections with the satellites will give us a better understanding of carbon burial and food web dynamics."

The Subarctic Pacific Ocean is an ideal place for her project — Diatoms, Food Webs and Carbon Export - Leveraging NASA EXPORTS to Test the Role of Diatom Physiology in the Biological Carbon Pump. The Subarctic Pacific is one of the oceans with the lowest amount of iron on the planet, posing significant challenges for any organism that requires iron, a key ingredient for photosynthesis. This ocean, Jenkins says, gets little pulses of iron from rain and other atmospheric sources and the biology responds quickly. She uses genome-based methods under controlled experimental conditions to understand how the diatoms respond to environmental variability.

One of her collaborators, Associate Professor of chemical oceanography Kirsten Buck, University of South Florida, added her expertise in the chemistry of iron to the project. The team built clean rooms on the research vessel with two-by-fours, plastic, and HEPA filters to avoid contamination of seawater samples that might throw off iron levels.

In their experiments, the scientists manipulated iron and silica concentrations in flasks and used flowing seawater incubators to measure the biological response. Jenkins' other EXPORTS collaborator, University of

"The EXPORTS campaign is providing a professional pipeline for the Ph.D. students and postdoctoral fellows. They are getting a chance to be a part of that team, a part of that conversation, early in their career. They are getting plugged into a network of the top people in their field and have 40 days at sea to see how different groups do their science. It's a great opportunity."

- Bethany Jenkins

California Santa Barbara Professor Mark Bzezinski, biological oceanography, is one of the world's experts on silicon cycling in the ocean. He conducted parallel incubation experiments to measure rates of silicon uptake and phytoplankton growth.

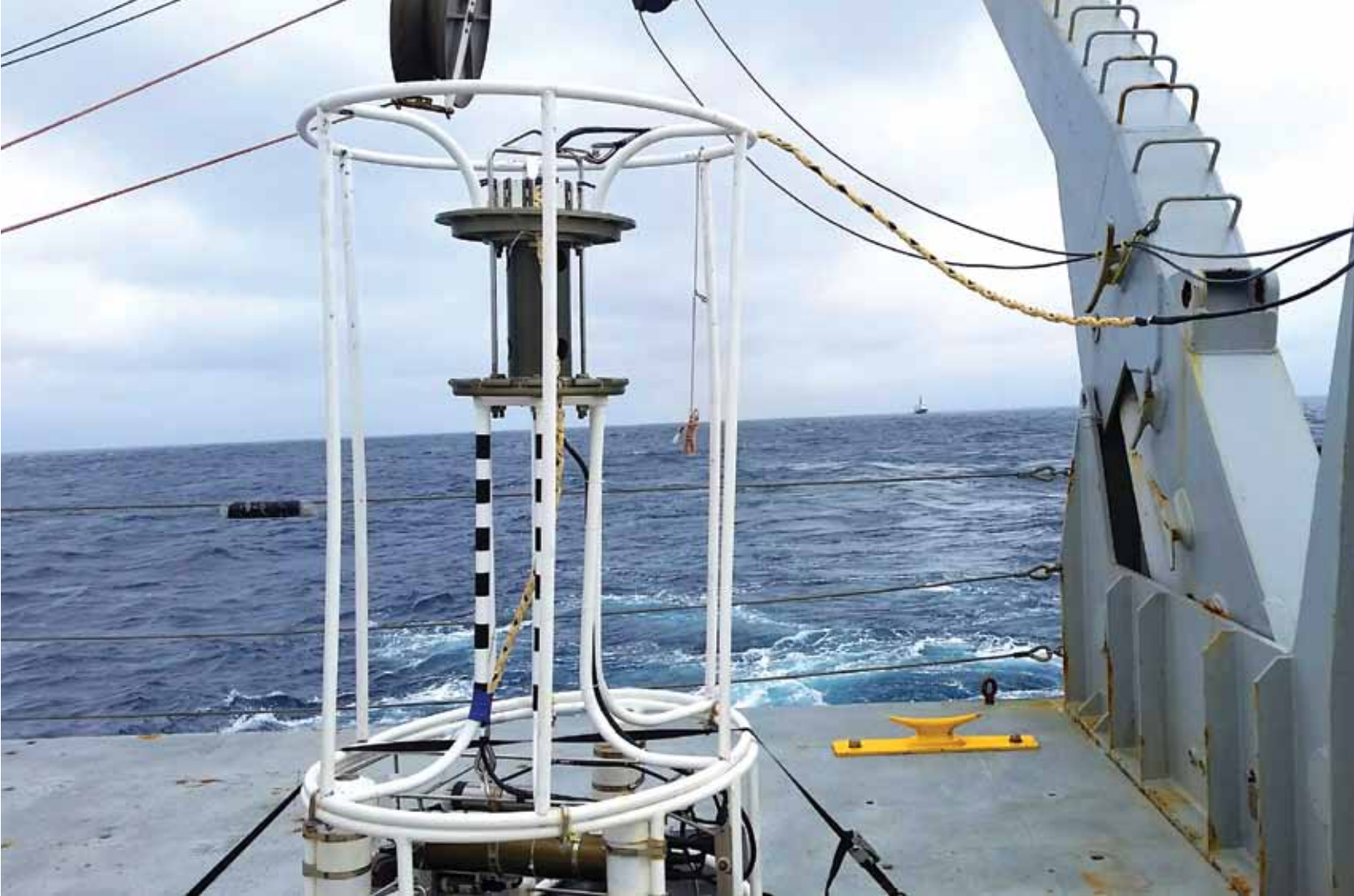
"This will give us a better understanding of that diatom response to changes in iron and silicon concentration, and if the carbon is more likely to be exported into the deep ocean," says Jenkins, whose Ph.D. student Kristofer Gomes (article page 24), also participated in the research cruise.

When the EXPORTS teams head back to sea for the 2020 field research season, they will go to the North Atlantic to catch the annual, big spring plankton bloom. The data collected from both trips will allow researchers to pair the information with real-time imagery from the NASA satellites, bringing greater clarity to expectations of what will happen as carbon levels continue to rise.

"As a group of scientists, we know what's happening in terms of human contribution to rising carbon levels in the ocean," Jenkins says. "There is no debate. This is why the oceanography community is trying to help the public understand the ramifications of climate change.

"Linking remote sensing technology with the dynamics that connect the surface to the interior of the ocean will tell us more about what we can expect for longer periods of time."

Ultimately, she adds, as ocean circulation changes and waters grow warmer and more stratified, scientists anticipate changes in iron cycling, which will cause cascading effects that reverberate throughout the marine ecosystem. That URI researchers constitute a significant part of this novel effort to catalogue what is taking place showcases the depth of the institution's talent in the field.



A trace metal clean instrument, on the stern of the R/V *Revelle*, measures salinity, temperature and depth. Photo by Heather McNair.

“Right now, we have a critical mass of scientists and most of us happen to be women who are really interested in processes in the surface of the ocean,” Jenkins reflects. “We have a very cooperative working spirit — everyone is individually successful and we are also vested in each other’s success.”

She notes that both she and URI Professor Tatiana Rynearson (article page 10), also involved with EXPORTS, arrived at the University in 2005 as part of a group of women brought in by the NSF ADVANCE initiative to recruit women into science faculty positions. All of those women are full professors today and provide a professional support network at URI.

“The ADVANCE program created an atmosphere that helped women become more visible so younger colleagues can see, oh, this is a place where I can do science,” says Jenkins. “It has added value to the University.”

Similarly, the EXPORTS campaign is providing a professional pipeline for the Ph.D. students and postdoctoral fellows, adds Jenkins: “They are getting a chance be a part of that team, a part of that conversation, early in their career. They are getting plugged into a network of the top people in their field and have 40 days at sea to see how different groups do their science. It’s a great opportunity.”



“As a group of scientists, we know what’s happening in terms of human contribution to rising carbon levels in the ocean. There is no debate. This is why the oceanography community is trying to help the public understand the ramifications of climate change.”

- Bethany Jenkins



EXPORTS

MELISSA OMAND

Marine snow catcher being deployed. Photo by Heather McNair.

Preparing equipment for a month at sea, Melissa Omand sits back and grins as she recalls the moment she first thought about joining the University of Rhode Island (URI) faculty.

Omand, then just starting her postdoctoral position at Woods Hole Oceanographic Institute in Massachusetts, was invited in fall 2011 to give a talk at the Narragansett Bay Campus about her Ph.D. work at the Scripps Institution of Oceanography in California. She studied coastal phytoplankton blooms, looking specifically at the nutrient supply for red tide events.

When Omand returned a few years later to give a talk on her postdoctoral research, she knew that if a job opening arose she would apply. In the meantime, with NASA's EXPORTS on the horizon, she shaped her work in anticipation of how her expertise — observational oceanography, physical-biological interactions, and

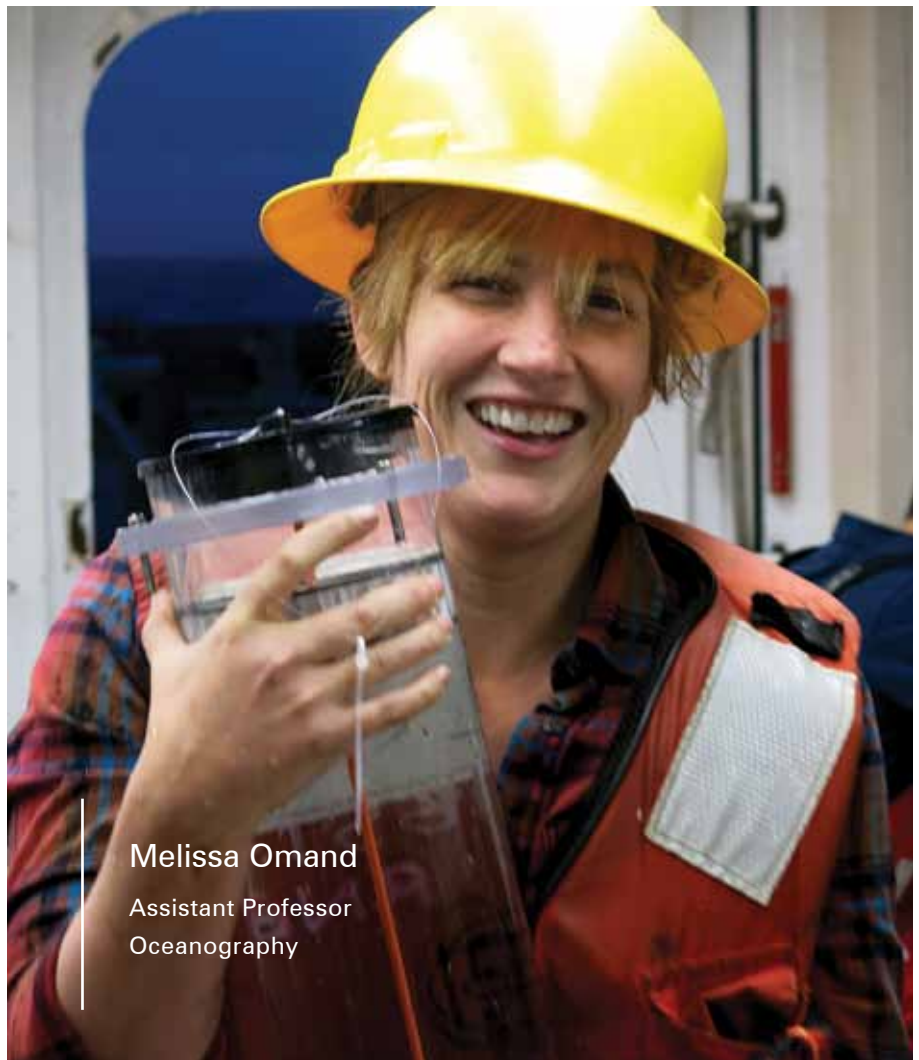
submesoscale processes — could complement the science campaign.

Omand joined the URI Graduate School of Oceanography (GSO) faculty in 2015 and continues to teach and conduct research. She says the collaboration between disciplines makes GSO special as do the opportunities of having a research vessel housed at the Bay Campus. The existing R/V *The Endeavor* will be replaced in 2021 by a \$125 million regional class research vessel.

The prominence of female scientists also played a key factor in her decision, Omand adds: "Susanne [Menden-Deuer] (article page 14) and Tatiana [Ryneronson] (article page 10) were the only two faculty I knew at GSO before I came here. That they were here, the quality of their science, and the stage they were at — I knew this was where I wanted to be. I knew this was a place where I could be successful."

“THE EXPORTS CAMPAIGN WILL ALLOW US TO QUANTIFY AND UNDERSTAND THE PATHWAYS FOR CARBON SO THAT WE CAN BEGIN TO PREDICT THIS PROCESS BY SATELLITE.”

- MELISSA OMAND



Melissa Omand
Assistant Professor
Oceanography

Photo by Alyson Santoro.

Omand serves as co-principal investigator for two EXPORTS projects. The first: Linking sinking particle chemistry and biology with changes in the magnitude and efficiency of carbon export into the deep ocean. Her second project is: Autonomous investigation of export pathways from hours to seasons.

She explains that the biological pump serves as one of the most important pathways for carbon to become sequestered for long periods of time. Phytoplankton take in carbon dioxide, and when they die, they can form detrital particles. These particles, also known as ‘marine snow,’ sink, transported down by ocean circulation, carrying the carbon into the ocean depths. Carbon removed from the upper few hundred meters of the ocean doesn’t recirculate back into the atmosphere for decades to thousands of years.

“The EXPORTS campaign will allow us to quantify and understand the pathways for carbon so that we can begin to predict this process by satellite,” says Omand.

To study sinking particle fluxes, a project led by principal investigator Margaret Estapa, assistant professor

of geosciences at Skidmore College, Omand used a Wirewalker, a wave-powered platform that can collect measurements without constant monitoring from a ship. Clipped to a 500-meter long wire, weighted to stay vertical, and powered by the bobbing motions of waves, the Wirewalker propels itself down the wire, then rises through buoyancy back to the top.

“We expect this will give us a complete profile at least every hour,” says Omand, who was at Scripps as a graduate student when the technology was developed. “To get this quantity of data, if we were doing it on a ship, this would maybe have to be the sole operation.”

Continually spanning the ocean depths, the Wirewalker obtains detailed information on changes in attributes such as particle abundance, chlorophyll, salinity, temperature, oxygen, and sunlight. The ability to traverse 500 meters deep into the ocean’s twilight zone, below where sunlight reaches, allows Omand to study the export processes that drive the biological pump and remove organic carbon from the surface.

Omand’s second project will take longer term

The big-picture goal for Omand lies in helping make the connections from the biological processes that happen on microscopic particle scales all the way to the vast coverage provided by NASA satellites.



Bethany Jenkins (right) hauling in the trace metal sampling rosette from the stern of the R/V *Revelle*. Photo by Alyson Santoro.

measurements to connect field sampling to NASA's satellites. Under the direction of project lead, oceanography Professor Craig Lee, University of Washington, next summer the team will rely on autonomous gliders and floats that will stay at sea for about six months, transmitting data back to the scientists on the shore and ships. These robotic vehicles are designed to track a patch of water and measure how the water changes over time to provide important biological rates and seasonal context in support of the cruise's intensive observation period.

The big-picture goal for Omand lies in helping make the connections from the biological processes that happen on microscopic particle scales all the way to the vast coverage provided by NASA satellites. Although satellites can extract substantial information about the properties of phytoplankton and abundance in the ocean, Omand says EXPORTS will yield details about how that organic material gets sequestered.

Data collected and lessons learned could help create a satellite-based index for the biological pump, providing global parameters of its strength or efficiency in different regions and seasons, and ultimately what changes in climate will mean for this important aspect of the global carbon cycle.



THE EXPORTS

Experience for the Next Generation

As part of a novel campaign with the National Aeronautics and Space Administration (NASA) and National Science Foundation (NSF), a group of University of Rhode Island (URI) postdoctoral and graduate student researchers are gaining access to an unparalleled opportunity to conduct groundbreaking research, contribute to a compelling body of science and network with experts in their fields.

Four of the five postdoctoral fellows left Seattle in August aboard two research vessels for more than a month at sea. They discuss their project role, expectations for the work and excitement to participate in the venture.

MELANIE FEEN, OMAND LAB, PH.D. CANDIDATE

Role: While her peers worked on the vessel, Feen monitored progress from the shore. She uses a Wirewalker, which is a wave-powered autonomous sensor platform that profiles the water from the surface to 500 meters, about once per hour. She hopes to use the oxygen data the team collects as a measure of phytoplankton productivity. Also known as net community production, this productivity is quantified as the amount of organic carbon – organic matter produced during photosynthesis, minus the amount recycled during respiration available for export into the deeper ocean where it will be stored for months to a millennium. Feen also will be comparing her results from the Wirewalker to estimates from satellite observations.

Expectations: "I won't be going out to sea," Feen says before the mission. "I am preparing to send all of the sensors and equipment that I will be using data from to the ship before it is being deployed from Seattle."

Outlook: "I am excited to be able to contribute to this collaborative project and honored to be able to learn from the many great scientists who are involved," Feen adds. "Being able to better quantify carbon export from space will be an amazing contribution to the scientific community."



Professor Susanne Menden-Deuer, Françoise Morison, Heather McNair, Kristofer Gomes, Professor Bethany Jenkins, Assistant Professor Melissa Omand, Professor Tatiana Ryneerson, Ewelina Rubin, not pictured, Melanie Feen and Pat Kelly.

KRISTOFER GOMES, JENKINS LAB, PH.D. CANDIDATE

Role: The lab is interested in determining the effects of differing nutrient levels, including iron and silica, on carbon export associated with a group of photosynthesizing cells in the surface ocean known as diatoms.

Expectations: “While at sea, we will perform culturing experiments using natural communities of microscopic organisms found in the surface waters of the Subarctic North Pacific,” he says. “Using the culturing experiments, we will investigate both short and long-term diatom responses to the differing nutrient conditions that can occur within the region. We will collect DNA and RNA samples, which will allow us to determine not only which diatom species are present, but also the different genes they are expressing in response to the different conditions. The results from these experiments will provide insight into how these organisms respond, and also what the fate of their fixed carbon may ultimately be.”

Outlook: “EXPORTS represents an amazing opportunity to investigate an important facet of the marine ecosystem,” he says. “This collaborative effort, with scientists from a multitude of fields, will provide us with the means to tackle the question of carbon export from many angles, and at an amazingly fine scale.”

FRANÇOISE MORISON, MENDEN-DEUER LAB, POSTDOCTORAL FELLOW

Role: Morison is bringing her expertise in performing dilution experiments, experiments she has already done ~200 times as part of the North Atlantic Aerosols and Marine Ecosystem Study (NAAMES) campaigns, that are used to measure phytoplankton mortality due to herbivorous organisms called microzooplankton.

“I also will run the flowCAM, a bench top imaging instrument, to characterize plankton species composition at different depths, and possibly also some mesozooplankton communities from zooplankton tows performed by other groups, as well as size distribution of sinking particles, also from another group project,” she says.

Expectations: “This is an exciting project due to the breadth of inquiry and the many measurements that will be made by the numerous teams,” says Morison. “The goal is to put a number on the proportion of plant-like matter (phytoplankton) produced in the surface ocean that escapes being eaten by microzooplankton. If not consumed, this production has a chance to be exported deeper into the ocean. This is important because phytoplankton production removes CO₂ from the water, and if it sinks that carbon can be isolated from any exchange with the atmosphere for a very long time, with ramifications for the earth climate.”

Outlook: “I am excited because I have never worked in Pacific waters, and because of all the cool people alongside whom I will be able to work,” she adds.

HEATHER MCNAIR, MENDEN-DEUER LAB, POSTDOCTORAL FELLOW

Role: McNair is part of the team looking at how single cell herbivories affect the fate of primary production and the amount of carbon that makes it to the deep ocean.

Expectations: “I’m excited to get out on the water, there are always unexpected things that happen at sea and challenges to think through, which is what makes it so fun,” she says.

Outlook: “I am beyond grateful and excited to be a part of this NASA project as well as part of the Menden-Deuer team,” McNair adds. “This project has been in the works for a long time and it’s amazing to see it come together; it’s amazing to feel like you’re contributing to this huge goal and helping tease apart these big ideas.”

EWELINA RUBIN, RYNEARSON LAB, POSTDOCTORAL FELLOW

Role: As part of EXPORTS, Rubin is working on the development of molecular markers to measure grazing by microzooplankton. She will collect and filter seawater samples, filtering cell biomass so it can be used for nucleic acid extractions and next generation sequencing from which she will learn about microzooplankton metabolism and diversity.

Expectations: “This is only my second research expedition at sea and I am looking forward to observing and learning how the experts study the life of tiny organisms in the ocean.”

Outlook: “I cannot wait to be back in the lab processing the samples that were collected and analyzing the data, so I can make my personal contribution to gaining knowledge about the EXPORTS processes,” says Rubin.

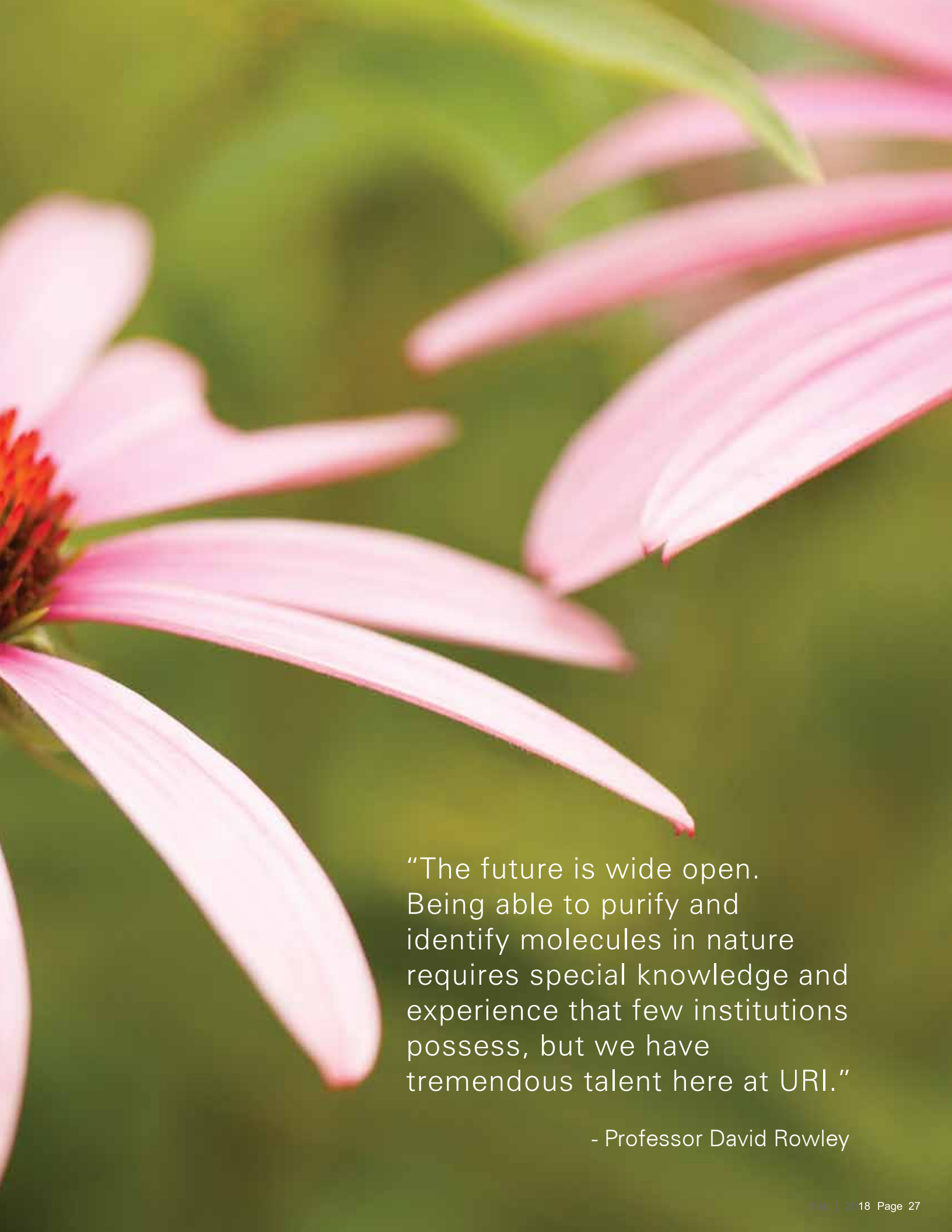
DEVELOPING

Natural Products

into New Drug Therapies

written by **TODD MCLEISH**



A close-up photograph of a pink flower, likely a coneflower, with several long, narrow petals extending from a central brown and red core. The background is a soft, out-of-focus green, suggesting foliage. The lighting is natural, highlighting the texture and color of the petals.

“The future is wide open. Being able to purify and identify molecules in nature requires special knowledge and experience that few institutions possess, but we have tremendous talent here at URI.”

- Professor David Rowley



Professor Rowley is seeking marine microbes with antibiotic properties to address what he says is one of the world's biggest health threats — the growing number of bacterial infections that are resistant to antibiotics.

When Ocean Spray sought to discover additional and unknown health benefits of cranberries, the company turned to Professor David Rowley at the University of Rhode Island's (URI) College of Pharmacy.

Similarly, when the Federation of Quebec Maple Syrup Producers wondered if maple syrup contained anti-oxidants, the organization called on URI Professor Navindra Seeram — another member of the Natural Products Research Group — to investigate. What Seeram found surprised even the maple syrup producers. Dozens of anti-oxidant compounds were identified, several of which have anti-cancer, anti-bacterial and anti-diabetic properties.

Both companies continue to collaborate with these world-renowned leaders in natural products on long-term research; and new patents and other intellectual properties from this work are now leading to new medicinal products.

"The whole discipline of pharmacognosy — the discovery of drugs from nature — is regarded as the mother of pharmacy," explains Seeram. "The idea is to isolate and identify compounds produced by natural

organisms, including plants and marine organisms, that could be used for biomedical and pharmaceutical purposes, like antibiotics and anti-cancer agents."

The discipline is one that the College of Pharmacy has pioneered since its earliest days.

When established by the Rhode Island General Assembly in 1956, the college enrolled all of the students from a shuttered private institution, the Rhode Island College of Pharmacy and Allied Sciences, which opened in 1902. The pharmacy college hired as its first dean, Heber W. Youngken Jr., described by current dean Paul Larrat as "an international research superstar" who traveled the world looking for interesting plants he could study for their medicinal value.

During his 25 years as dean, Youngken came to realize that the next frontier of drug discovery would come from the world's oceans, and he hosted the country's first conference on marine natural product chemistry in 1967. Two years later he hired the University's first faculty member to study the subject, Professor Yuzuru Shimizu, who pioneered the search for anti-cancer agents in marine microalgae.



URI Natural Products Research Group.

Seeram, Rowley, and the newest member of the Natural Products Research Group, Assistant Professor Matthew Bertin, are continuing the legacy established by Youngken and Shimizu.

“Our strength is that we are able to find molecules that can solve problems for biologists, pharmaceutical companies and food companies,” says Rowley. “Human

health is the central theme to most of what we do, but we do research that is more ecologically relevant as well.”

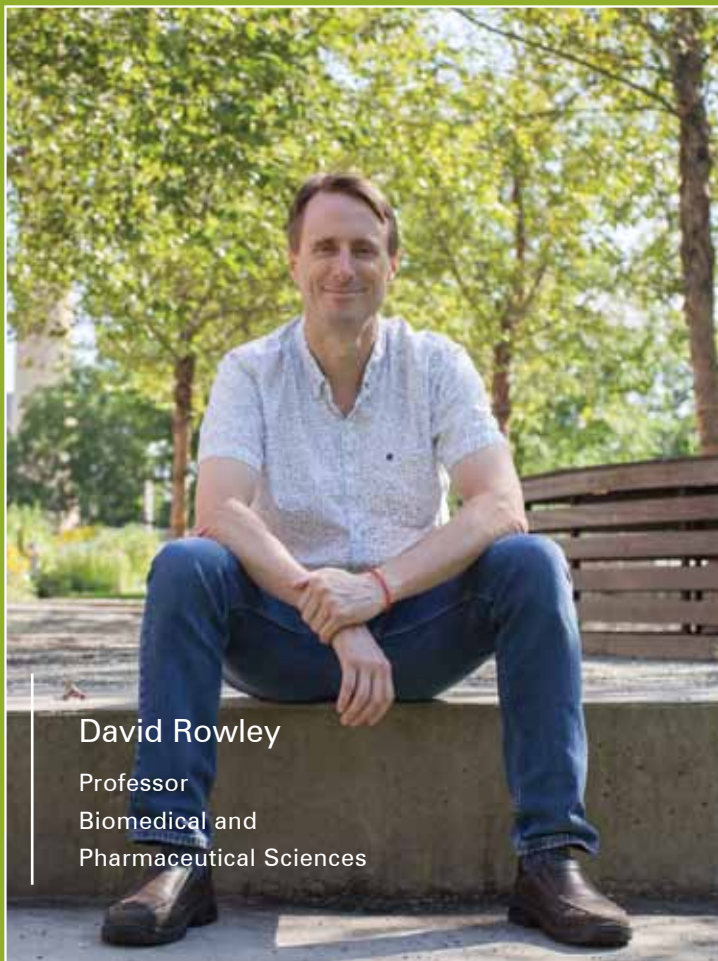
The medicinal garden on URI’s Kingston campus, established by Youngken and now bearing his name, features 400 different medicinal plants from which many natural products research studies are conducted. The scientists also maintain a seed repository for medicinal plants. In their laboratories, they extract medicinal compounds from these plants, analyze their chemistry, and test molecules for their ability to prevent infection, kill bacteria or provide health benefits.

But pharmacognosy is not the only area in which URI College of Pharmacy researchers excel. Faculty also have tremendous expertise in pharmaceutical development — taking pharmaceutical compounds and turning them into tablets, capsules, solutions, injectables and other drug delivery devices. In addition, researchers have made breakthroughs in the development of a drug to combat alcohol addiction, alternative antidepressants with reduced side effects, and many other areas.

A major research advance occurred in 2001 when Professor Zahir Shaikh was awarded an \$8 million grant from the National Institutes of Health to establish a statewide biomedical research network. Since then, more



Professor David Rowley, Professor Navindra Seeram, Assistant Professor Matthew Bertin



David Rowley

Professor
Biomedical and
Pharmaceutical Sciences

“Our strength is that we are able to find molecules that can solve problems for biologists, pharmaceutical companies and food companies.”

- David Rowley

patients around the country to gain insights into what therapies are working and whether one medication may be more effective than another.

“We’re also investing in precision medicine,” Larrat says. “In the future, we’ll be able to create medicines based on your genetic makeup that will work better than taking a cookie cutter approach. We don’t look at your genetic makeup now; we just give you a tablet and hope it goes down and does the trick. But if we account for your genes and lifestyle, we can better tailor medicines that will work better for individuals.”

Yet, as all of these efforts continue and the college breaks into the top 11 in the nation in federal research grant funding, the Natural Products Research Group continues to garner the most attention.

than \$50 million in additional funding has followed to create core research facilities, train young scientists and advance the state’s biomedical research agenda.

“The core laboratory is filled with instrumentation that is shared by biomedical researchers throughout the state,” says Larrat. “We can synthesize medicinals from chemicals to create drug products, perform toxicology tests to determine if there are any negative effects of particular compounds, and we conduct considerable biologic analyses looking at the DNA of whatever organism we’re working with.”

Neuroscience research also is growing at the College of Pharmacy through the University’s George & Anne Ryan Institute for Neuroscience, established five years ago. Faculty members are studying such subjects as pharmaceutical treatments for neurological disorders, environmental risk factors for Alzheimer’s disease, and the underlying reasons for the accumulation of the protein that causes Alzheimer’s. Researchers from private drug development companies share space at the college in public-private neuroscience research collaborations.

As all of these efforts continue, the college is also investing in emerging disciplines. As part of the University’s Big Data Initiative, several pharmacy faculty members are already mining data from millions of



Hang Ma

Research Associate
Biomedical and
Pharmaceutical Sciences



URI Natural Products Research Group.

Seeram's studies of maple syrup have expanded into an examination of the whole maple tree, including the bark and the leaves. He has become the leading researcher in the world on the medicinal benefits of maple.

"Red maple is our state tree. It's a niche plant found only in the Northeast, and the indigenous people utilized various parts for medicinal purposes, though it isn't exactly clear what they were used for," he says. "We found that it contains bioactive compounds in its tissues, so we have produced an extract from the leaves that can be used as a cosmetic, for anti-aging, anti-wrinkling, anti-inflammatory and skin lightening. It's sort of like a plant-based Botox."

The extract has been licensed to Verdure Sciences, which hopes to find a market for the formulation in the cosmetics sector or even as a dietary supplement.

Seeram, who earned his doctorate in Jamaica, says the chemistry of maple is very much like that of cannabis, with hundreds of compounds present, many of which are thought to have medicinal benefits that are waiting to be discovered.

"Shifting medicinal research interest to cannabis would be right up our alley, in terms of expertise," he says, noting that two of his former graduate students are already working in the medicinal cannabis industry, and the plant has very complex chemistry with much more left to discover. So, Seeram and colleagues are poised to advance this line of investigation next, noting that the FDA has just recently approved the use of *Epidiolex* (a cannabinoid oral solution) to treat two forms of seizure disorders.

Additionally, Dr. Peter J. Snyder, URI's vice president for research and economic development, who also is an internationally renowned expert in Alzheimer's disease, notes, "There are exciting new data suggesting a therapeutic use for tetrahydrocannabinol (THC) in reducing the toxic neuroinflammatory cascade associated with brain damage in Alzheimer's disease, in addition to the plant's other current medical uses that range from the treatment of neuropathic pain to glaucoma."

Meanwhile, Professor Rowley, whose work focuses primarily on marine organisms, is seeking marine microbes with antibiotic properties to address what he says is one of the world's biggest health threats – the growing number of bacterial infections that are resistant to antibiotics. He is collaborating with a pharmaceutical corporate partner to study a molecule from a marine bacterium that shows particular promise.

"With our current challenge of trying to overcome drug resistance, it would seem that the marine environment is one area we need to explore more fully," he says.





Navindra Seeram

Professor
Biomedical and
Pharmaceutical Sciences

“There are exciting new data suggesting a therapeutic use for tetrahydrocannabinol (THC) in reducing the toxic neuroinflammatory cascade associated with brain damage in Alzheimer’s disease, in addition to the plant’s other current medical uses that range from the treatment of neuropathic pain to glaucoma.”

- Peter J. Snyder, URI Vice President for Research and Economic Development and Professor, Biomedical Research and Pharmaceutical Sciences

Bertin, who joined the faculty two years ago, works with a number of academic and industrial partners to study the toxins and other compounds produced by blooms of marine cyanobacteria. He is seeking to isolate new molecules from those blooms and test them for potential use as therapeutics against a wide range of diseases. He has already identified more than two dozen new molecules and began testing some of them against cancer cells.

Bertin is also examining the genetic architecture responsible for the production of these chemical compounds to gain a better understanding of how the cyanobacteria produce them. This approach could help move his research into the realm of genetic engineering by enabling scientists to stitch together uniquely structured genes to build entirely new therapeutic compounds.

“The future is wide open,” concludes Rowley. “Being able to purify and identify molecules in nature requires special knowledge and experience that few institutions

possess, but we have tremendous talent here at URI. We get approached often to assist in this type of endeavor, and we’re open to whatever opportunities present themselves.”





Cassie Chartier
Undergraduate student
Chemistry

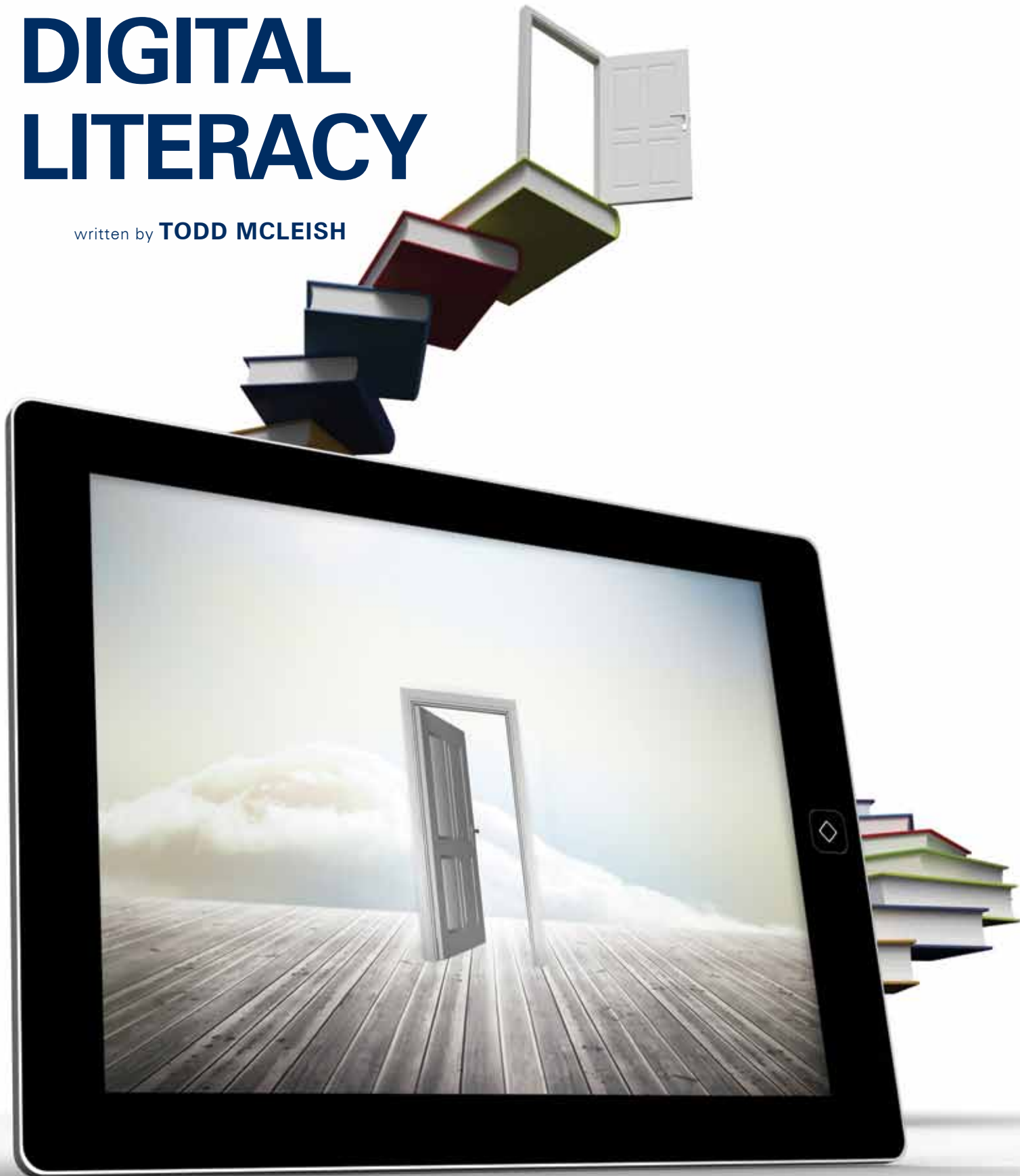
“We’re also investing in precision medicine. In the future, we’ll be able to create medicines based on your genetic makeup that will work better than taking a cookie cutter approach.”

- Paul Larrat

Building

DIGITAL LITERACY

written by **TODD MCLEISH**





Digital literacy is a *moving* target.

Julie Coiro

Associate Professor
Education

In a world of fake news and alternative facts, it is crucial that people learn to use the Internet and other digital media sources effectively and reliably.

Associate Professor Julie Coiro says the concept of digital literacy is a moving target. What it is, how it should be taught, and how it should be measured remain open questions in many people's minds. At the University of Rhode Island's School of Education, Coiro, a reading comprehension expert, argues that reading and writing on the Internet differ from reading and writing on paper.

She defines online reading comprehension as an inquiry process that involves identifying important problems and using search engines to locate relevant information. Online readers also must evaluate for accuracy and reliability, synthesize information across text, images, videos and social media, and determine how to communicate digitally to others.

"Most of the early work I did was helping the reading community understand that what was then considered computer skills was actually a reading issue. It's not just something for the computer teacher to understand," says Coiro, who has taught in preschool, elementary and middle schools and served as a consultant on literacy and technology while earning her doctorate at the University of Connecticut. "All my work since then has focused on helping teachers, administrators and parents understand why we need digital literacy and figuring out how to help educators teach it and assess it in meaningful ways."

From 2009 to 2014, she served as co-principal investigator on the Online Reading Comprehension Assessment project, funded by the U.S. Department of Education, which aimed to develop three formats of valid and reliable assessments of online reading comprehension. In 2016, she began a new project funded by the National Assessment of Educational Progress's Survey Assessments Innovation Lab focused on measuring the quality of online reading and collaboration as students engage in online inquiry with a partner.



The URI Summer Institute in Digital Literacy



“We’ve learned how to teach digital literacy, but we still don’t have a way to measure it, to show people that we’ve made progress,” she explains. “I hope to use assessments, to provide teachers with daily feedback about how their students are doing, how their teaching is making a difference, and what they should be focusing on next.”

Her research resulted in a book, *Planning for Personal Digital Inquiry in Grades K-5*, to be published in 2019, that provides a framework for how teachers might use technology to their students’ advantage in inquiry-based learning. The framework comprises four overlapping phases of inquiry: wonder and discover, collaborate and discuss, create and take action, and analyze and reflect.

“It seeks to help teachers understand how to build a culture of inquiry in their classroom and school, to identify what purposeful role digital technologies should play,” Coiro says. “Where in the classroom do you create opportunities for learners to wonder and discover? Where in the learning space can students collaborate and discuss – with or without technology – or turn their knowledge into action, or reflect on what impact it has?”

“When I go into classrooms, even where teachers don’t have technology, if these opportunities for inquiry are happening, then often there’s room for magic to happen,” she adds. “But if these things aren’t in place and you put technology in and nothing great is happening, it’s probably because some of these core elements are missing.”

Coiro’s research and her personal digital inquiry framework were incorporated into The Summer Institute in Digital Literacy, which she and URI Professor Renee Hobbs established six years ago. A collaboration between the University’s Alan Shawn Feinstein College of Education and Professional Studies and the Harrington School of Communication and Media, the Summer Institute started as a week-long digital literacy workshop for classroom teachers seeking to explore how digital media is changing the teaching and learning landscape. It has evolved into a program that attracts teachers, administrators, library media specialists and others from around the world, many of whom return year after year to expand their understanding and share their own experiences.

“We make a big deal at the Summer Institute to remind teachers that it’s not really about the computer,” Coiro says. “Teaching and learning is mostly about people, their relationships and building new ideas together. Sometimes the computer gets in the way; sometimes it helps.”

In 2014, the Summer Institute spawned a 12-credit graduate certificate program, graduate certificate program that has begun to attract prospective graduate students to enroll at the University.

“Sometimes we think that if we just change the teacher or the test or the principal or throw a little money their way, it’s all going to quickly result in better schools,” says Coiro. “But teachers know they need professional development, they need time and a safe space to try things out, they need research to say what’s going



Everything is
about literacy;
everything is
about reading
and learning.

to work, they need assessments for demonstrating progress to others. This Summer Institute is informed by research in each of these areas, and it gets educators pretty revved up.”

For Coiro, the most important lesson stems from the idea that everything revolves around literacy; everything is about reading and learning.

“Whether it’s high-level thinking, deep conversation, or reflection, it’s all reading. It’s all about meaning making, how people make sense of things,” she says. “Learners are responsible for actively making sense of what they read and experience as opposed to just passively receiving information.”

She notes that online reading comprehension isn’t just an issue for English and language arts teachers. “Literacy looks different in science and math and social studies classes, but to me it’s all meaning making. It’s generating conversations, asking questions, sharing new ideas, and then asking more questions.”



“It seeks to help teachers understand how to build a culture of inquiry in their classroom and school, to identify what purposeful role digital technologies should play.”

- Julie Coiro

CARING FOR an Aging Population

written by **ALLISON FARRELLY '16**



Steven Cohen
Assistant Professor
Health Studies

“Rhode Island has an older population relative to most other states. But we also have some of the highest quality health care services and opportunities for health promotion in the country. ”

- Steven Cohen

This year, the U.S. Census predicted the year 2030 as an “important demographic turning point” when all Baby Boomers will be older than 65, meaning that one in every five U.S. residents will be retirement age. For the next 11 years, each and every day, approximately 10,000 Baby Boomers are turning 65 years old within the United States.

University of Rhode Island’s (URI) Steven Cohen, assistant professor of health studies, hopes his research can influence better policies to support an aging population and the people who will care for them.

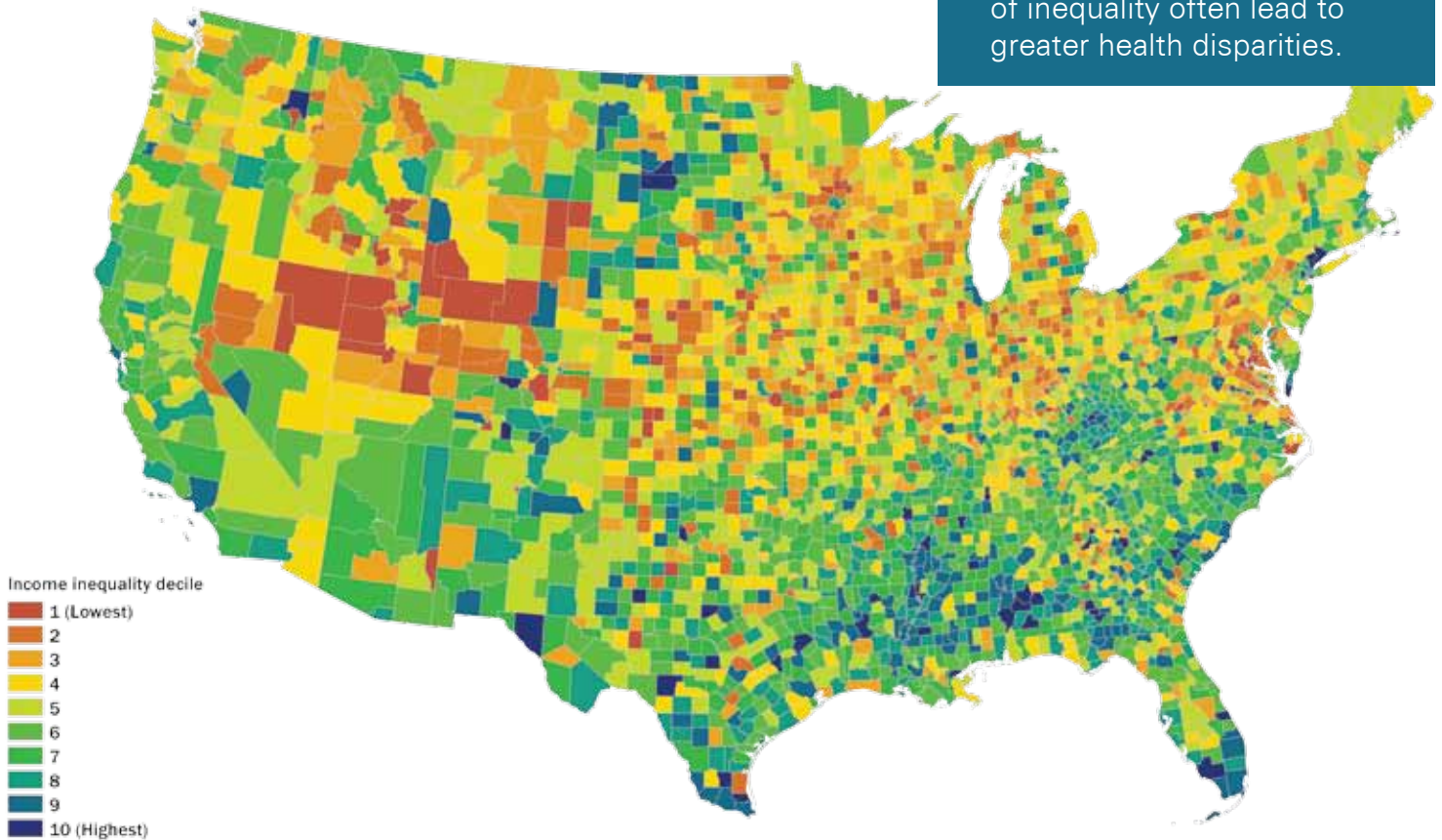
Cohen is comparing aging populations in rural and urban areas, examining factors that influence life expectancy, and exploring the impact these factors have on caregivers’ lifestyle.

He was inspired by his own family to examine the impact that caring for an elderly person can have on unpaid caregivers, in most cases a family member of the care recipient.

After his grandmother’s debilitating stroke, and observing the impact of caring for her had on his mother,

Income Inequality Map

This map depicts the level of income inequality in each U.S. county. Higher levels of inequality often lead to greater health disparities.



Cohen was left with questions about how aging can affect those who provide care to people 65 and older.

To capture a fuller picture of a caregiver's experience, Cohen explores a number of factors including caregiver intensity – the number of hours a week the individual provides care, and the caregiver level – what type of care they're providing – and how this affects the caregiver's quality of life. Cohen also studies factors of sex, race, and career disparities among caregivers.

By examining data from the National Study of Caregiving, a nationally representative study unique in its depth and breadth of questions, Cohen has been able to piece together a more holistic understanding of how different individuals are impacted.

Over the last 20 to 30 years, Cohen says, there has been a trend in the United States toward urbanization. Adults 65 and older tended to stay in rural areas, while younger people and resources have migrated into urban areas. This population shift has created challenges for an aging population remaining in rural areas because there are fewer services, poorer quality health care, fewer people to provide care, lower socioeconomic status and sometimes even geographic barriers.

Cohen is comparing aging populations in rural and urban areas, examining factors that influence life expectancy, and exploring the impact these factors have on caregivers' lifestyle.

Cohen is examining data from the Behavioral Risk Factor Surveillance System, an annual survey collected by the Centers for Disease Control to glean what specific aspects are contributing to disparities in health in urban and rural areas.

"We tend to think people in rural areas are sicker, they tend to be obese, have poorer diets, have fewer preventative health behaviors, or get a physical exam,"

For the next 11 years, each and every day, approximately 10,000 Baby Boomers are turning 65 years old within the United States.

Cohen says. “But there’s one kind of twist to this. We actually found in the most rural areas that’s where the healthiest people are.” He hypothesizes this disparity could be caused by a sort of “reverse causation” where if people are able to live in extremely rural areas they are inherently healthier.

Cohen is currently working to combine these two research interests into a bigger project – examining rural urban health disparities in caregivers to older adults and is applying for federal grants that would give him access to new data on caregivers’ geography.

This summer, Cohen was awarded a \$13,000 grant from the URI Council for Research to look at similar place-based characteristics in Rhode Island that affect life expectancy.

“Rhode Island has an older population relative to most other states. But we also have some of the highest quality health care services and opportunities for health promotion in the country. The issue is that within Rhode Island itself, like many other states and regions across the U.S., there are wide disparities in health outcomes. That shouldn’t happen in a state like Rhode Island,” he says.

By looking at Rhode Island Department of Health data, he can figure out where people are most likely to die prematurely and what social characteristics could predict life expectancy. He hopes to use this first grant as a pilot study to generate even deeper information on Rhode Island life expectancy.

“I’m really interested in practical, applied research so I really want to see if there is something systematic that we could be doing – whether it is reducing income inequality, or providing certain services – whatever it is that cities and towns may be doing, I’m hoping to influence that policy through this research,” he adds.


For Cohen, URI seems to be a perfect place to conduct his research.

“I found my home here,” Cohen says. “What’s been really nice is finding people at URI to collaborate with. When I came here I knew that URI is a great school, but what I was really thrilled with is there are so many people here who are fantastic researchers who are genuinely interested in moving the needle in terms of improving population health and helping people live long and healthy lives.”






For the next 11 years, each and every day, approximately 10,000 Baby Boomers are turning 65 years old within the United States.



MARVIN'S ROOM



 by Scott McPherson

COMPANY

 Directed by Paula McGlasson Musical Direction by Lila Kane

 Choreography by Kristen Quartarone

 Music & Lyrics by Stephen Sondheim

 Book by George Furth

 Originally Produced and Directed on Broadway by Harold Prince

 Orchestrations by Jonathan Tunick



November 29 - December 1 & December 6 - 8, 2012 at 7:30 pm

 December 2 & 4, 2012 at 3:00 pm

 300 South Main, UR Fine Arts Center

 Box Office: 401-874-5843

 Tickets available on-line at

www.ur.edu/arts

 For disability assistance, please call

 401-874-5843 at least 72 hours in advance.





THE PLAY'S THE THING: But Not Without the Production

written by **ALLISON FARRELLY '16**

After 33 years working behind the scenes of University of Rhode Island (URI) theatre productions, Paula McGlasson knows when an audience connects with a performance.

"When you direct a show, it's really fun to stand in the back of the theatre or step out into the hallway where you can still hear without seeing," she says, referencing the moments when an audience gasps, laughs, or cries. "You can feel whether the audience gets it or not."

The URI theatre professor estimates she has been witness to more than 130 theatre productions, on URI's two stages, over her 18 years as department chair and 15 years as a faculty member.

Though she enjoys performing on stage, it's the production's bigger picture that intrigues McGlasson.

"Somewhere along the way I discovered that I had some skills that other people didn't seem to have – I like producing art, managing art more than playing a character in a play."

Unlike theatres where the director selects the season's productions, URI's shows are chosen by a play selection committee comprised of student representatives, staff, and tenured faculty – a format that McGlasson attributes largely to the season's unique character.

"It's a blend of what the students, faculty, designers and the technicians want to do, and I think because of that we come out with a season where there is something for everyone and everyone is invested in the work we have to do because they've had a hand in choosing it," she explains.

During the spring semester, the selection committee will read play submissions before selecting four main stage shows: a musical, a cutting-edge or contemporary piece, a classic like Shakespeare, and a grab bag production such as a comedy, mystery, children's show, or poetic drama.



Professor Paula McGlasson (center) with URI theatre students.

The big book musical each season is a tradition McGlasson takes pride in having helped facilitate during her years at URI.

A month before auditions, McGlasson staffs the show with set, costume, and lighting designers. Auditions for URI Theatre are open to the public, and once a company of students, faculty, staff and community members is cast, rehearsals begin. Five and a half weeks later (six and a half for a musical,) the curtain opens.

The weeks leading up to a show are grueling not only for McGlasson as production manager or director, but also for the musical director, choreographer, technical director, designers, managers, electricians, publicity director, run crews and company. The cast of each show works on the Equity Standard of rehearsals – a standard set by Broadway where rehearsals are held Tuesday through Friday nights, and much of the day on both weekend days.

"This is all in addition to 19 credit class loads," McGlasson says of the student commitment.

In her time, McGlasson has seen her fair share of theatre successes and stresses but holds seasoned faith and pride in the URI Theatre community's talents.

"Our quality of production work has grown over the years," she says. "I'm proud of the collaboration between students, faculty, guest artists, staff and the way the department pulls together when it needs to."

Outside the department, McGlasson is involved in the production of URI's TEDx series, and plans to continue working this year as the show's artistic director.

Now that McGlasson has stepped down from her longtime post as theatre department chair, she looks forward to dedicating more of her time to producing or directing shows in other venues, and if the right show comes up, maybe even some acting.

McGlasson's Favorite Shows

MARY POPPINS 2018

"Everyone knows she's going to fly – you can't do Mary Poppins unless she flies," says McGlasson. "But the first time she raised up and flew across the 50-foot-wide stage you could hear a gasp."



McGlasson says of sharing that feeling with an audience, the feeling people

get before laughing or crying — "that's the best part of doing theatre."

SINGIN' IN THE RAIN 2012

When URI Theatre decided to do Singin' in the Rain, McGlasson knew immediately what question she was going to be asked: "Are you really going to have it rain on stage?"

Yes, they did. The technical director, Jake Richards-Hegnauer, built a set piece designed by Cheryl deWardener that would allow the lead to literally sing in the rain on stage.



"When he needed to be outside on that street corner singing in the rain, rain was pouring down on his head," McGlasson says. "Audiences just absolutely loved it."

THE ROCKY HORROR SHOW 2010

McGlasson admits that people may have thought the risqué musical was "a bit raucous, out there, and nutty" from her usual selections. The show was hosted in J-Studio, URI's so-called black box theater as a more intimate setting for the raunchy show.



"I think a lot of people could not figure out what I was doing being interested in

directing that kind of show," she says. "It was one of the most interesting musicals I've ever worked on, and to see how audiences responded to it was amazing."



Paula McGlasson

Professor
Theatre

BEAUTY AND THE BEAST 2004

When McGlasson thinks of the URI production of this Disney classic – "Oh, I do love my Disney," she says – her mind turns to the special effects.



"That play had a lot of technical challenges to it, and it was just fun to see how we all collaborated and worked together, we could make all those things happen in that show," she says.

ASSASSINS 2000

"It was one of the most exciting, challenging pieces of musical theatre I've ever directed, and I think one of the best productions I've ever delivered as well," McGlasson says of the Sondheim musical featuring a dark cast of famous assassins, like John Wilkes Booth and Lee Harvey Oswald.



"The company of actors I was working with were some of the most adventuresome, inventive group of young actors," she adds. "It's a brilliant, brilliant show."

David Howard, URI theatre department chair, played the narrator and guided the audience through the show.



Brandon Lovejoy, 2019

For a show to fully captivate an audience in the theatre, a lot has to happen behind the curtain, the lights must go on, the microphones have to work, actors need to find the right places to stand on the stage, and any tricks have to flow seamlessly.

The person behind the scenes who is responsible for making sure all these wheels are turning is a stage manager, says University of Rhode Island (URI) senior Brandon Lovejoy.

"Going into URI theatre, I knew I was going into a pre-professional training program," says Lovejoy.

A public relations, history, and theatre triple major, also pursuing a minor in leadership studies, Lovejoy has been cutting his teeth under the watchful eye of theatre director Paula McGlasson since he arrived on campus three years ago.

"Paula was one of the first professors I remember starting to talk to my peers and I as adult professionals - that really made a difference to me," Lovejoy says.

"I took her stage management class and she looked at me and said, 'You know, you're going to be a stage manager one day. Just trust me on it.'"

As McGlasson predicted, Lovejoy became fascinated with how the back of a theatre operates. He has learned first hand through working URI's stage production, box office, lights and sound box. After graduation this spring, he hopes to pursue a master's degree in theatre or arts management.

This summer, Lovejoy was awarded an undergraduate Fulbright fellowship, which meant he was one of three people from the United States who traveled to London to study at the famous Globe Theatre. He says the award would not have been possible without the help of the URI theatre faculty, and especially McGlasson.

"I'm incredibly inspired by her professionalism and mentorship more than anything," Lovejoy says. "A lot of theatre departments are cut throat and competitive and vicious, but we have a familial environment where students hang out in the lobby and faculty interact with students by name, and that's because of Paula."





INNOVATION AND ENTREPRENEURSHIP

written by **AMY DUNKLE**

היהודה לארכיאולוגיה ימית
ברשות העתיקות



Israel Maritime Antiquities Director Jacob "Koby" Sharvit and archaeologist Dror Planer pose next to URI's Digski 2.0 in Caesarea.

“The University’s goal is to move technology from the lab to the market by connecting faculty inventors with companies.”

- Michael Katz

A peptide used for targeting cancer with imaging and therapeutic agents, forward looking sonar for cruise ships and high-end yachts, and jet skis retrofitted to dredge sediment in an ancient harbor — none of these ventures sound remotely like the other.

And yet, a common thread weaves through the distinctly different pursuits at the University of Rhode Island (URI) — strong institutional support for faculty research and discovery as well as securing avenues to access innovation and maximize a broader societal impact.

Michael Katz, vice president for intellectual property and economic development with the URI Division of Research and Economic Development, works with faculty to achieve these aims. Also executive director of URI Research Foundation, Katz says, “The University’s goal is to move technology from the lab to the market by connecting faculty inventors with companies.”

URI faculty have created innovative technologies that span across such disparate fields as biomedicine, computer science, nanotechnology, energy, defense, sensors, materials, composites, marine engineering, to name a few.

Katz says faculty definitely should pursue bringing their inventions to market: “Researchers should be enthusiastically involved — it enhances the likelihood that their discovery will have an impact on society.”

Katz notes that although faculty members typically are identified as the lead inventor, new disclosures often result from the important contributions from students. When students contribute significantly to a novel disclosure, they receive credit with co-inventorship on the patent application. These activities lead to a variety of exciting and unique research and commercial opportunities for URI postdoctoral fellows, graduate students, and undergraduate students.

“It’s a great opportunity for students to be involved in the research process and potentially work with business to impact our society beyond the university itself,” says Katz.



pHLIP® is a transport vehicle for either imaging cancer cells or delivering a therapeutic agent.

Detecting and Treating Diseases

URI physics professors Oleg Andreev and Yana Reshetnyak know from firsthand experience the trials and tribulations of discovery, invention, patents, and forming a company.

The pair, along with Professor Donald M. Engelman, Yale University, and Professor Jason Lewis, Memorial Sloan Kettering Cancer Center (MSKCC), founded their company pHLIP, Inc in 2014. They signed licensing agreements in 2015 with URI and Yale, and have 23 patents. The universities own the patents, but the company was granted the exclusive rights for development and commercialization of pHLIP® technology.

pHLIP® stands for pH (Low) Insertion Peptide, and Reshetnyak and Andreev say the peptide is a transport vehicle for either imaging cancer cells or delivering a therapeutic agent. The company is awaiting approval from the Food and Drug Administration (FDA) and then will embark on clinical trials at MSKCC in 2019.

The partners anticipate injection of two pHLIP® agents into humans for diagnostic imaging and fluorescence-guided surgery in 2019. The agents will be first in the classification for imaging of tissue acidity in the body. Also, pHLIP®-based therapeutic agents are underway to clinical trials for delivery of therapeutics specifically to cancer cells


for the enhancement of treatment efficacy and reduction of side effects.

Reshetnyak says, “The bench-to-bedside transition is very challenging. It all starts with innovation and discovery, and then it takes years of testing, refining, and development before an agent may be injected into humans.”

Andreev adds, “No doubt, it is extremely rewarding for us and for everyone working in our labs to monitor progression of the technology, which potentially might make a difference in diagnosis and treatment of cancer and other diseases.”



(left to right) Professor Yana Reshetnyak, Dr. Dhammika Weerakkody, Hannah Visca, Dr. Anna Moshnikova, Professor Oleg Andreev, and Gregory Slaybaugh.

An underwater photograph showing the wreckage of a ship, likely a bomber, resting on the seabed. The scene is dimly lit with blue water, and various pieces of metal and debris are visible.

**Because
your radar
can't see
underwater.**

- FarSounder

The Tulsamerican B24 bomber lost off the island of Vis, Croatia, in 1944. Photo by Bridget Buxton.

Preventing Disasters at Sea with Sonar

URI Ocean Engineering Professor James Miller echoes the critical nature of institutional support for faculty innovation and discovery. In 2001, he co-founded his company FarSounder with then graduating URI senior Matt Zimmerman.

FarSounder, headquartered in Warwick, RI, provides forward looking sonar to high-end yachts, cruise ships, and commercial vessels around the world.

"The venture began with the idea of preventing another Exxon Valdez," says Miller, referring to the 1989 disaster when the oil ship ran into a reef and spilled 10.8 million gallons in Alaska's Prince William Sound. At the same time, the researchers figured they might be able to help prevent ships from running into whales and rocks.

"From the start URI stepped up with funding to help FarSounder form and get off the ground," Miller says. "It was a very supportive environment and people believed in what I was doing. My bosses, the dean, the vice president of research — they all said go for it and asked, 'What do you need?'"



He laughs and adds, "It was a crazy professor's idea that turned into reality."

Today, the privately held FarSounder enjoys a successful and global reach. Co-founder Zimmerman, vice president of engineering, continues to lead the company. Two of his friends from URI, electrical engineer Matt Coolidge and software engineer Evan Lapisky, were early hires and remain with the company today.

Creative Solutions in Archeology

URI Associate Professor Bridget Buxton, ancient history and archaeology, followed a different path of discovery, collaborating with ocean engineering Associate Professor Stephen Licht and his students to utilize a jet ski for underwater dredging.

The need for such a contraption grew from Buxton's frustration over how to uncover a 2,000-year-old harbor built by the Biblical King Herod the Great. A trained classical archaeologist who can read Latin and Greek texts, Buxton believed Josephus, a first century writer, did not make a mathematical mistake when he described Herod's harbor as being 20 fathoms deep, but rather there was a mistake of translation from Roman to Greek measurements.

If her theory was correct, Buxton explains, then the lost foundations of Herod's harbor were six fathoms below sea level, and many times bigger than previously suspected. But reaching the original foundations through almost 20 feet of sand posed an enormous task.

"At the end of the summer of 2017, I realized that if we were going to try to dig a trench that deep, we were going to be here 100 years," she says. "I thought, if only we had jet skis ... we could keep working in rough weather and launch off the beach."

Buxton drew up what she envisioned, raised the funding needed from private donors, and turned to Licht for help. Licht, in turn, created a capstone course for his students, they produced a prototype, the "Digski."

"The Digski is designed to be a rugged, low-cost replacement for a coastal archaeological research vessel: running sidescan, multibeam, and subbottom acoustic surveys, ferrying gear and scuba divers to and from underwater sites," explains Buxton. "It serves as a surface hub for DGPS localization, diver tracking, and communications. Its primary excavation function is to power an underwater dredge system directly from the jetski engine, eliminating the need for a large boat to carry a conventional high-pressure pump."

Especially useful in a place with a dynamic surf zone and few natural harbors, the Digski can be launched manually from just about anywhere, and handle much rougher sea conditions than a dive boat.

In May, the prototype went to work in King Herod's harbor and Buxton presented the results of the excavation at an international conference in October 2018.



Buxton and team test a prototype University of Girona 3DVR camera system on an ancient shipwreck in Croatia. Photo by Bridget Buxton.

"One of the biggest obstacles to marine research is the cost and logistics of operating a research vessel," Buxton observes. "By adapting the Digski as a viable low-cost replacement for coastal survey and excavation, and making everything open-source, we are helping to democratize ocean science."

"Michael Katz got it immediately, and I am so grateful to Professor Licht and his very talented capstone class."

Buxton hopes to raise further private funding to develop the Digski prototypes and use them for marine archaeology in both Rhode Island and Israel, but emphasizes that profit is not the motive: "At a public university, sometimes it's not how much we are bringing in, but how much we contribute to society."



**“AT A PUBLIC UNIVERSITY,
SOMETIMES IT’S NOT
HOW MUCH WE ARE
BRINGING IN, BUT HOW
MUCH WE CONTRIBUTE
TO SOCIETY.”**

- Bridget Buxton

Katz says both URI and its non-profit research foundation, URI Ventures, are enormously proud of the discoveries and ventures launched by faculty and students who imagine big ideas and partner with companies to bring them to market.

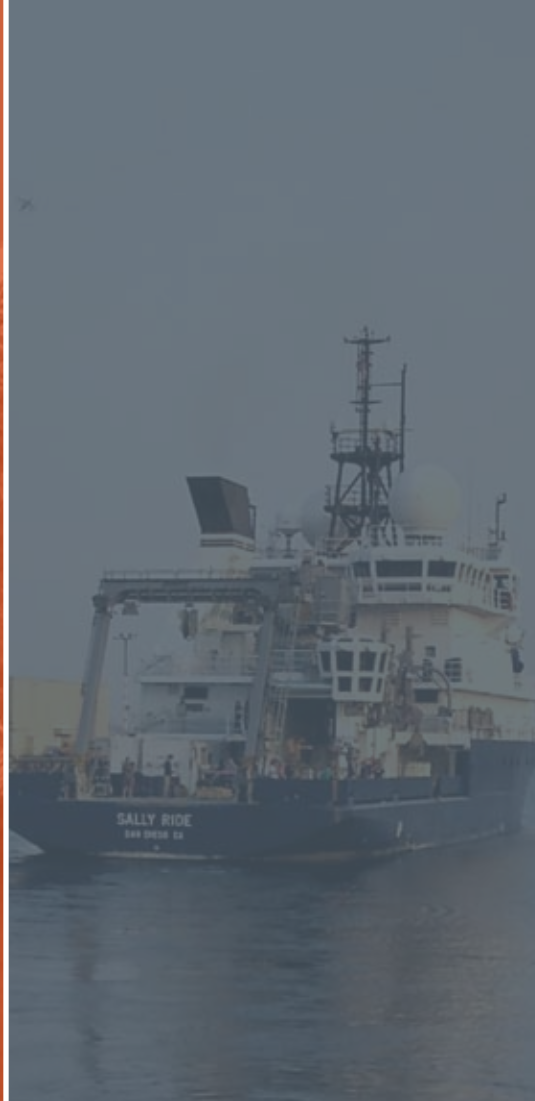
“A key mission of URI is to translate discoveries from laboratories, workshops, studios, stages, libraries, research vessels, and offices into the services, products, and policies that benefit our society and the world.”



Buxton holds one part of one of five larger-than-life bronze statues recovered from a 4th century AD Roman wreck in Israel.

Photo by Bridget Buxton.





ANNUAL REPORT FISCAL YEAR

2018

The Division of Research and Economic Development

ANNUAL REPORT 2018

TOTAL AWARDS TREND FY2008 - FY2018 in Millions

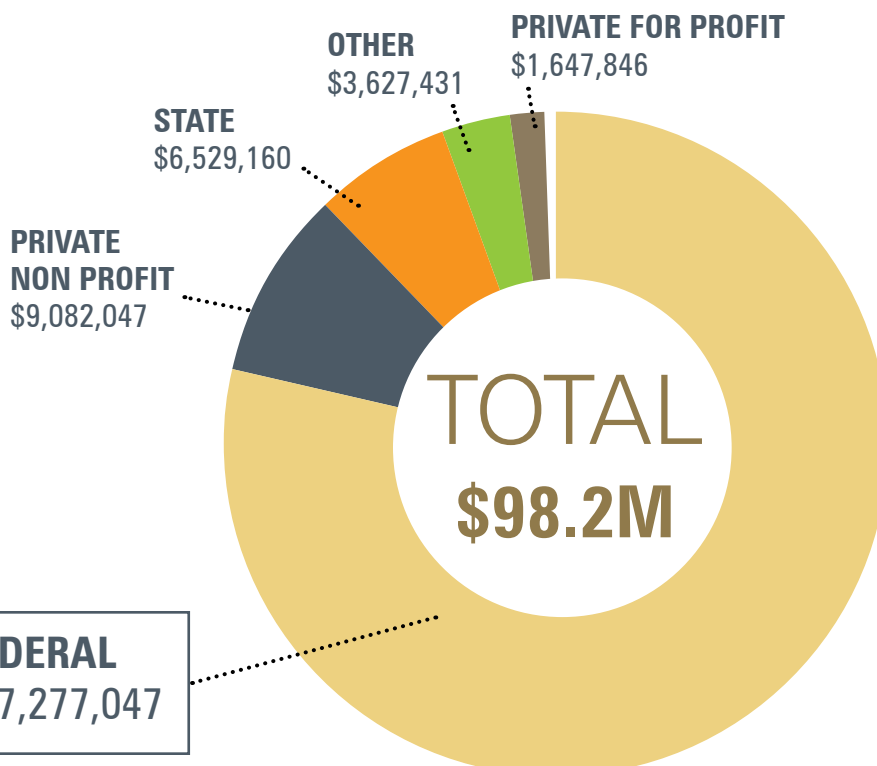


Research Proposals
Submitted FY2018

\$363 Million

Expenditures FY2018

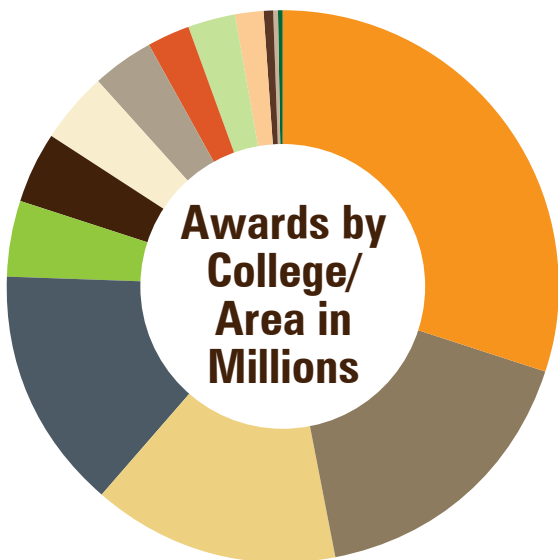
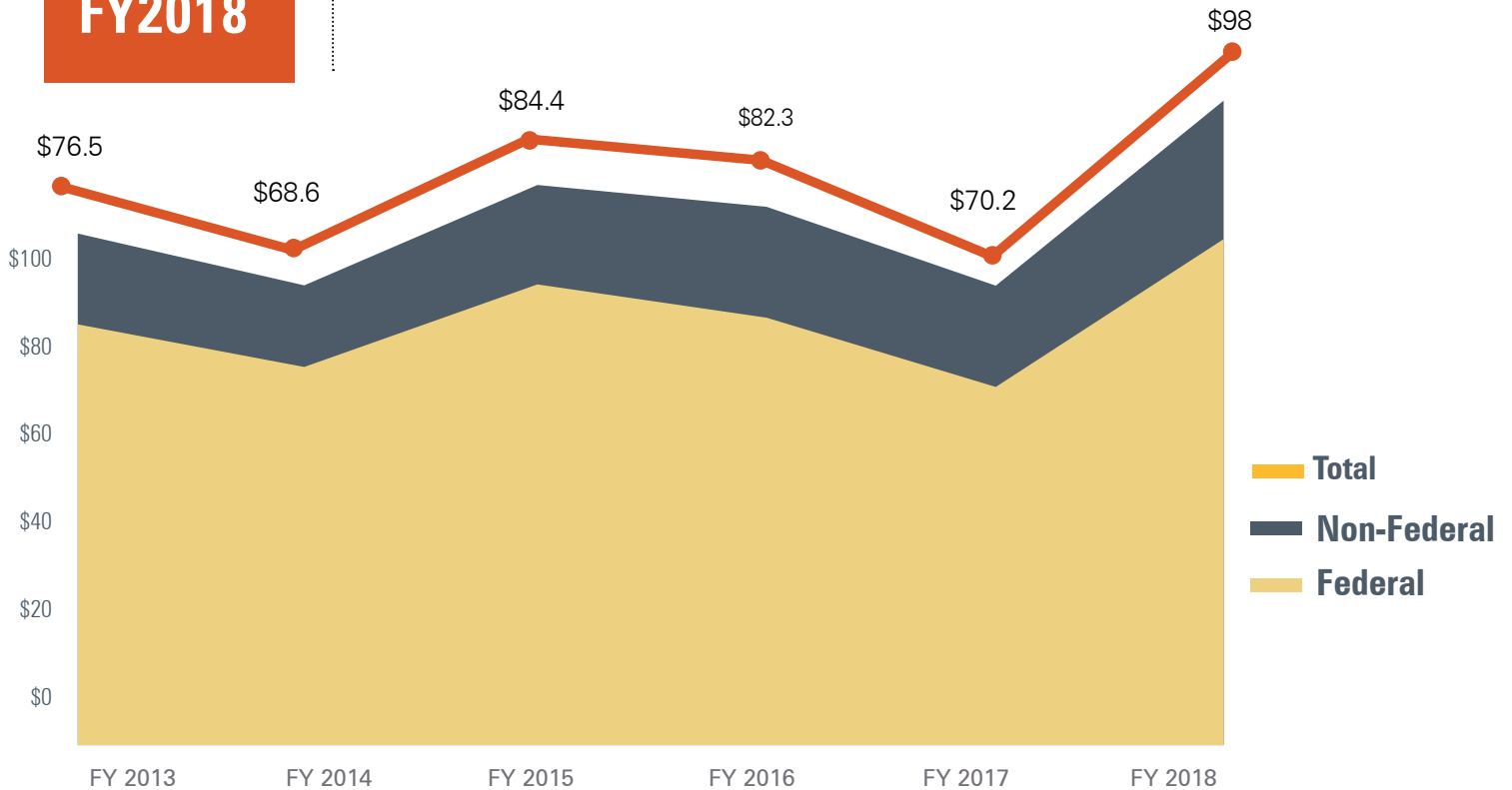
\$80.8 Million



The University of Rhode Island's goal is to reach \$125 million in sponsored research funds by FY2022

**FY2013
to
FY2018**

Sponsored Awards in Millions



**Awards by
College/
Area in
Millions**

- Graduate School of Oceanography
- Environment and Life Sciences
- Pharmacy
- Engineering
- Health Sciences
- URI Research Foundation
- Arts and Sciences
- Academic Health Collaborative
- Vice President for Research
- University Library
- URI Foundation
- Education and Professional Studies
- Nursing
- Business
- Provost

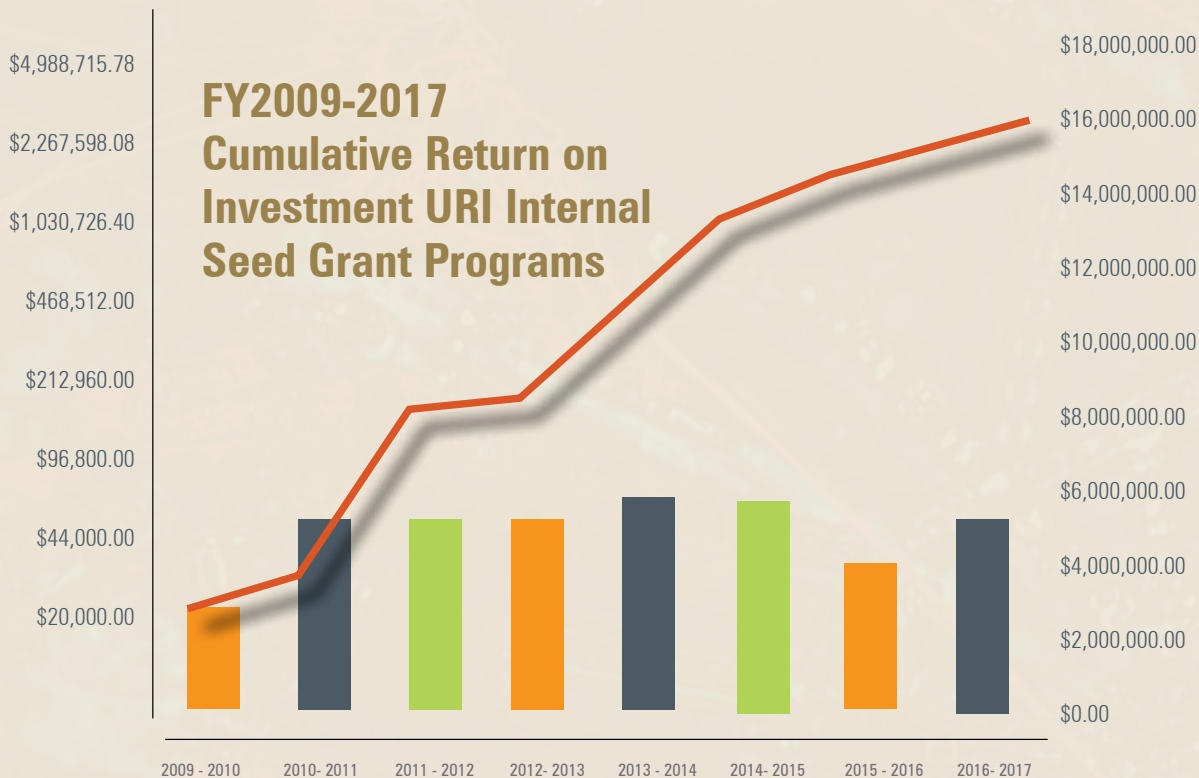


**FY2018
Awards by
Agency**

- HHS
- NSF
- OTHER/MISC
- AID
- USDA
- STATE
- DOD
- OTHER / FED
- DOC
- NONPROFIT
- INTERIOR
- FOR PROFIT
- NASA
- ENERGY

**Total
\$98.3M**

**College/Area
in Millions**



**“In FY2019
the Annual
Internal
Seed
funding
will triple
in size.”**

- Peter J. Snyder, Ph.D.
URI Vice President for
Research and Economic
Development

RISBDC-POLARIS-IP

IMPACTING THE RHODE ISLAND ECONOMY

URI INTELLECTUAL PROPERTY FY2011-FY2018

- 91 U.S. and Foreign Issued Patents
- 290 Patent Applications
- 159 Invention Disclosures
- 6 Companies Formed: CREmedical, pHLIP, Velobit, Burbank, Labonachip, and Plant Advancement

URI IMPACTING RHODE ISLAND BUSINESS POLARIS MANUFACTURING EXTENSION PROGRAM (MEP) FY2018

- Engaged with more than 200 Rhode Island manufacturers during the past year
- \$27.6 Million total increased or retained sales
- \$551,000 in cost savings
- 138 jobs added or retained
- \$4.5 Million new client investments
- For every \$1 of federal investment, Polaris MEP generates \$17.9 in new sales growth for manufactures.
- For every \$1,501 of federal investment, Polaris MEP creates or retains one manufacturing job.
- 1 Manufacturing job = 2.5 Local Service Jobs

RHODE ISLAND SMALL BUSINESS DEVELOPMENT CENTER

- Total number of clients served: 533
- Total number of counseling/prep hours delivered by the counseling staff: 5,511
- Total number of counseling sessions: 3,001
- Total capital formation (this is the amount of money RISBDC counselors have helped business owners to access through loans, investors, etc.): \$13,339,526

THE
UNIVERSITY
OF RHODE ISLAND

DIVISION OF RESEARCH
AND ECONOMIC
DEVELOPMENT

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