THE
UNIVERSITY
OF RHODE ISLAND
DIVISION OF RESEARCH
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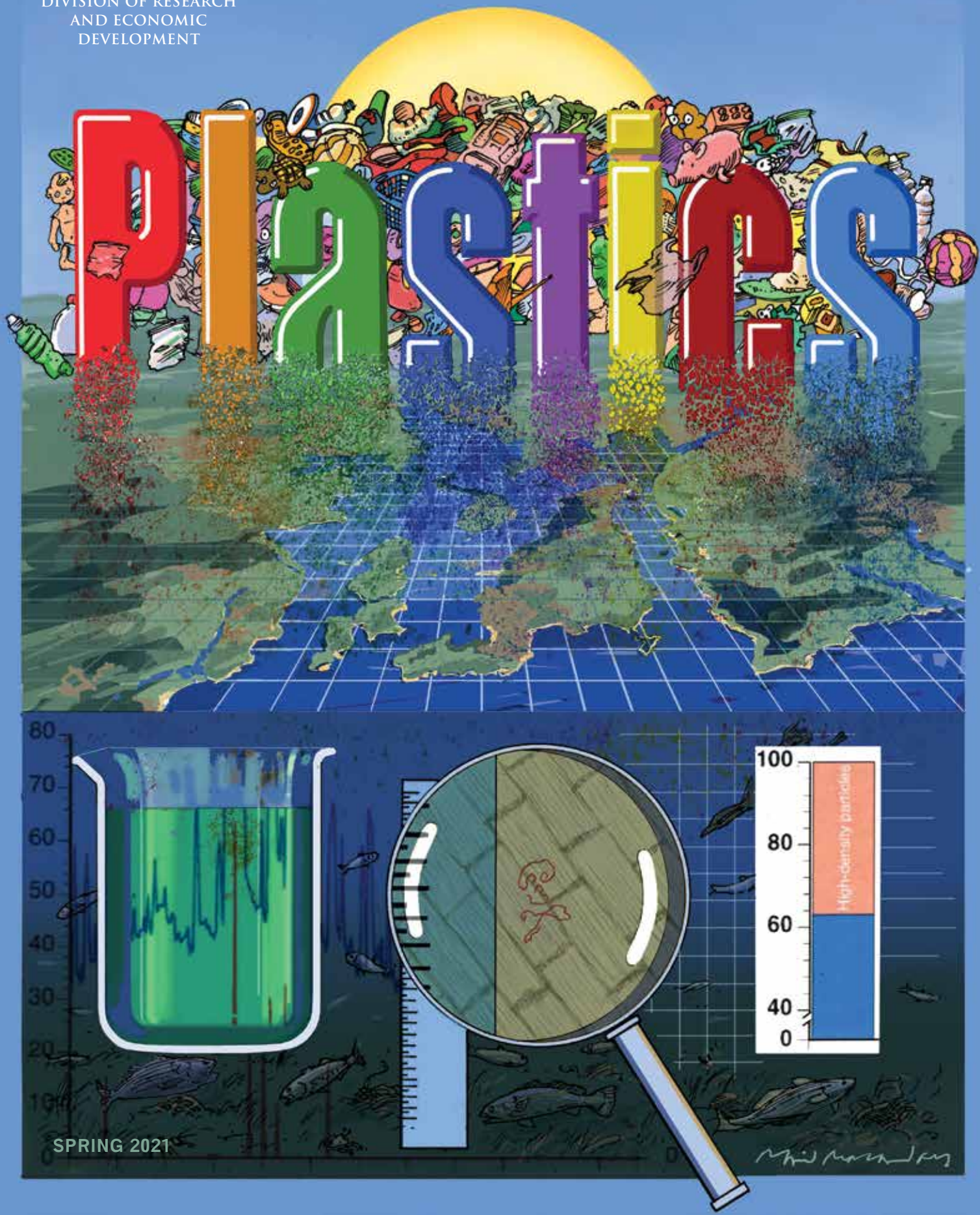
DEVELOPMENT

Momentum

Research & Innovation



SPRING 2021

Momentum Spring 2021 Cover Artist David Macaulay His Toolkit:

Curiosity, Common Sense, and Technical Skill

Written by Judith Swift, director of the Coastal Institute and professor of Communication Studies

A big act of generosity led David Macaulay, a world-renowned illustrator and writer, to provide his artistic representation of the plastics crisis now confronting the world's oceans for the cover of the spring 2021 issue of *Momentum*. The creator of the books *Cathedral, Castle, Motel of the Mysteries, Black and White, The Way Things Work,* and *The Way We Work*, has provided our audience with this view of his exceptional talent that begins with curiosity, common sense, and technical skill – the trifecta that launched his career.

Macaulay, whose childhood began in the lush countryside of Lancashire, England, graduated from Cumberland (RI) High School and then journeyed 15 miles down the road where, as a student of architecture, he entered the funky world of the Rhode Island School of Design (RISD). In his fifth year at RISD, the school's European Honors Program opened the door to vistas his artist's eye longed to capture.

"There I was," said Macaulay, "the Colosseum in front of me, the whole Rome experience, but I couldn't make a decent drawing. It was all too overwhelming."

Macaulay realized he had no interest in becoming an architect. Eventually, he dared to apply his artistic toolkit to creating his first book, *Cathedral*.

"I wanted to decipher how a cathedral got there and why after 800 years, it was still standing," he recalled. "I mean it was piling one stone on top of another, which led me to ask what type of stone? How did they cut and stack one on the other, 80 feet, 100 feet into the sky?"

Macaulay said he began to deduce how things came to be, gleaning clues from his meticulous reimagining of the process: "I aim to put the readers, the viewers, in a place they've never experienced, standing on a beam 80 to 90 feet off the ground with two walls 50 to 60 feet apart as they assemble the timber trusses… then I tilt the drawing ever so slightly to hint at potential danger."

The book launched Macaulay's style.

His link to URI's new signature research initiative, *Plastics: Land to Sea*, plastics project began with Macaulay talking with Vice President for Research and Economic Development Peter J. Snyder, who originally proposed and is leading the launch of this initiative.

"I was on board with 'plastics are bad'," said Macaulay, "but my reasons might be because I associate them with garish colors. Then I find out that they're in fish and damaging the planet irreparably and in our internal systems – our gut, and I begin talking to experts and reading."

He wanted to contribute and to recognize URI's efforts to addressing plastics pollution. His interest in working with the University was further sweetened by a large crate of his favorite Hershey's chocolate from Snyder.

Macaulay has a process – he calls it mining people's brains – developed throughout the years, and its effectiveness lies in its respect for experts. When Macaulay began *The Way We Work*, he met an anatomy teacher at the University of Massachusetts, Worcester. She was intrigued enough to help him develop a visual interpretation of her knowledge.

"It's basically a translation job," explained Macaulay. "I was at the mercy of anyone with information. I talk all the time about the importance of being aware and had paid no attention to the workings of my own body."

When first working on the plastics topic for a poster, which then expanded to a new URI website https://plastics.uri.edu that will be the digital "home" for this initiative, Macaulay noted, "I was choosing the most 'plasticky colors', overselling the plastics threat, like the *Jaws* poster. I couldn't find where else plastics would go but into the water, and once it's in the water, it's in all water, which turns out to be truer than I even imagined. So, I needed to create imagery that provides a visual entre into the information. That imagery was in the disintegrating plastic letters."

Plastic letters – off the front of millions of refrigerators and into our world's oceans.

FROM THE VICE PRESIDENT

Photo by Beau Jones

There are moments when an entire institution needs to clearly define what it stands for and what the central questions or concerns are that it will devote time, effort and precious resources. Over the past one and a half years, URI has placed an overriding priority on doing everything possible to protect our community during the COVID-19 pandemic. The last issue of this magazine was dedicated to those many impactful and effective efforts. We are now dedicating this issue of *Momentum* to an entirely different concern, and one that this research university has chosen to commit our talents and energies toward.

Why a focus on plastics contamination in our environment? First, one of the lasting legacies of President David M. Dooley has been his conviction that the great resources of the University of Rhode Island be used to address the rapid and dramatic threats to our planet and civilization, resulting from the onset of the Anthropocene Age beginning in 1950 (only 71 years ago!). I came to the University a little more than three years ago, in part because of his vision and leadership, and I want to take this moment to thank President Dooley for his support and dedication to advancing the research mission of URI. It has been my honor to work for him, and all of us in the Division of Research and Economic Development wish that both David and his wife Lynn enjoy an exciting, happy and healthy retirement with their wonderful family.

Second, this topic rose to the surface during a faculty academic summit in January of 2019, and then further explored during an October 2019 "think tank" meeting, hosted by the Division of Research and Economic Development and attended by 30 faculty and 30 engaged partners from NOAA, the EPA, Woods Hole Oceanographic Institute, U.S. Senator Sheldon Whitehouse, several non-profit organizations and industry.

As academics we understand that the challenges facing our world are too complex to tackle without broad multidisciplinary efforts. We must collaborate and communicate to protect and build a better quality of life on Earth. With substantial faculty involvement in its planning, my office has launched a new approach for the University to rise to these challenges: the co-laboratory or COLAB. A COLAB is intended to accelerate bold new research and creative activities to address a complex societal issue. The venture does this by aligning resources, encouraging collaboration across colleges and disciplines and delivering compelling communications that are accessible to everyone.

With this issue of *Momentum,* and with the launch of a new website by the URI Coastal Institute, that will support this initiative going forward (https://plastics.uri.edu) we are showcasing our first University COLAB, *Plastics: Land to Sea*. The rate of plastics pollution has been climbing tremendously. It is now time to harness our resources and talent across the sciences, arts and humanities to discover new approaches to mitigate this looming crisis.

Throughout this issue you will discover more about the URI COLAB approach and its five targeted "thrust areas" in plastics research, beginning with our formal position statement on pages 6-11. With this position statement we clearly define our commitment to addressing this looming crisis and how this University can deliver impactful research and novel solutions. Each of the five thrust areas are already populated by multi-disciplinary teams of URI scientists who are engaged in funded research to discover and establish new knowledge and to build scalable solutions. From sink to sea, our teams explore the behavior of micro- and nano-plastics from their originating sources to wastewater systems, through our watershed, and into our bay and oceans. This research will determine the impact of plastics on our ecosystems and the coastal communities that rely upon them, measuring impact on human and environmental health. This sink to sea narrative will raise awareness and understanding, and ultimately lead to new solutions to slow and to mitigate this planetary crisis.

There will be many opportunities for you to join with the Coastal Institute to provide support for these efforts and to learn how you can do your part at home, at work, and in your local communities. We encourage you to regularly check our website https://plastics.uri.edu for new projects, educational materials, successes and adventures along the way. We remain in this together and collectively we can achieve remarkable solutions to sustain an amazing and thriving world.

Peter J. Snyder, Ph.D.
Vice President for Research and Economic Development
Professor of Biomedical and Pharmaceutical Sciences
Professor of Art and Art History
University of Rhode Island

Scholar-in-Residence
Rhode Island School of Design

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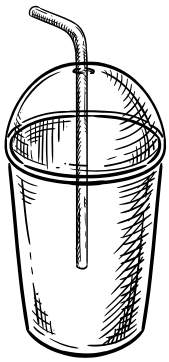

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Photo by Jason Jaacks

Plastic particle found in the Great Shearwater.

THE UNIVERSITY OF RHODE ISLAND

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PLASTICS: LAND TO SEA

URI's POSITION PAPER

THE UNIVERSITY OF RHODE ISLAND (URI) IS LAUNCHING AN INSTITUTION-WIDE SIGNATURE RESEARCH INITIATIVE

to align capacity and capabilities across all of URI's colleges to address the environmental, societal and health impacts of land-to-sea plastics pollutants. This initiative will support bold new research and creative activities that draw on the diverse array of specialties and expertise, and encourage collaboration with non-profit, corporate, government and academic peers. URI aims to establish these collaborations to address this complex and global issue with the goal of accelerating the development of scalable and innovative solutions.

Photo by Gwen Emery

Position Statement by The University of Rhode Island

VISION: A land-to-sea plastics research initiative to accelerate the implementation of long-term solutions to dramatically reduce plastics pollution.

MISSION: A dynamic research network to convene, communicate, collaborate and accelerate ideas and strategies that inform society, guide public policy and reduce land-to-sea plastics pollutants.

INTRODUCTION: Today, nearly everyone, everywhere, every single day comes into contact with plastics. They are durable, light-weight, affordable and effective materials that provide innumerable packaging and fabrication solutions for an enormous range of engineered products and uses that serve people in everyday life and also save lives. However, in a period of just a few decades, this vital invention has emerged as a serious environmental, social, technological and economic problem across the globe. In 2017 alone, approximately 430 million metric tons of plastics were produced worldwide, and production is expected to triple by 2050. The U.S. recovers less than 10% of its annual plastics production, and it is the fastest growing component of municipal waste. A landmark study by Jambeck et al. (2015) estimated that 8 million metric tons of plastics waste entered the oceans from land inputs during the year 2010 alone. As of 2020, it is estimated that about 5.25 trillion macro- and microplastics are circulating in our oceans. All studied ecosystems on Earth contain plastics. We are breathing nanoplastics in our air, even in some of the most remote places on the planet. Recent field work by faculty at URI's Graduate School of Oceanography found micro-plastics frozen within ice cores in the Arctic. The adverse effects of all of this, on human, marine and animal health and on the integrity of the food web that we depend on for life, are currently unknown.

The COVID-19 viral pandemic has unfortunately led to a substantial increase in production and waste, with the dramatically increased need for gloves, visors, hospital gowns, masks and many other types of medical supplies. Likewise, city and town plastic policies and regulations have been paused or abandoned; volunteers are less likely to pick-up plastic waste on streets and beaches; and, single-use plastics are back in fashion. Although the current public health crisis is a top priority, the world needs to consider the implications of these trends over the long term. The proliferation of plastic and plastic waste and the massive difficulties inherent in source reduction and

management require attention, coordination, collaboration, and the development of meaningful and effective solutions.

The University of Rhode Island (URI) is launching an institution-wide signature research initiative to align capacity and capabilities across all of URI's colleges to address the environmental, societal and health impacts of land-to-sea plastics pollutants. This initiative will support bold new research and creative activities that draw on the diverse array of specialties and expertise, and encourage collaboration with non-profit, corporate, government and academic peers. URI aims to establish these collaborations to address this complex and global issue with the goal of accelerating the development of scalable and innovative solutions.

APPROACH: Building on strengths as a land- and sea-grant research university in the Ocean State, URI is positioned to build a global network relying on the University's mission and its breadth of disciplines, expertise and collaborations. URI's collaborative teams from civil engineering to chemistry to oceanography to fisheries, animal and veterinary sciences are contributing to the growing body of research focused on the occurrence, fate, transport and impact of plastics. URI's teams also leverage Rhode Island's scale, diverse physical landscape, engaged population, and collaborative public-private efforts to provide URI and its partners access and resources to support field studies, testing centers and experiments that lead to new ideas, policies, approaches and innovations. The initiative's approach has four core goals.

Photo by Melissa McCarthy

Convene: Increase connectivity.

Harnessing the convening power of a public research land- and sea-grant institution, URI will bring together stakeholders from governments, academia, philanthropic organizations, business and civil society to build meaningful relationships and shared agendas at local-to-global levels.

Communicate: Expand reach.

Working with the public, scientists, journalists and other science communicators, the URI teams will translate plastics research and make it accessible with research-based communication strategies and educational techniques to inform and engage diverse audiences for individual and collective action.

Collaborate: Strengthen capacity and capabilities.

Leveraging and connecting URI's diverse expertise and resources and connecting with companies, communities, government agencies, not-for-profit organizations, as well as academia, URI will create a diversified, inclusive and creative research network to attract competitive funding and partnerships.

Accelerate: Advancing strategies and solutions.

Advancing research, strategies and commercializable solutions to address problems associated with current plastic production, use, end-of-life disposal and the development of alternative materials.

FIVE RESEARCH THRUST AREAS:

URI's research teams and its location in Rhode Island affords a unique opportunity to investigate the full life cycle of micro- and nanoplastics. We seek to explore the behavior of micro- and nanoplastics from land to sea, and from the originating sources to wastewater systems through our watershed and into our bay and the oceans beyond. This understanding will determine the impact of plastics on our ecosystems and the coastal communities that rely upon them, measuring impact on human and environmental health. It is the sink to sea narrative that will raise awareness and understanding, and ultimately lead to various types of interventions to mitigate the problem. From sink to sea, outlined below are the areas that URI research is focused on, leveraging its educational, research and outreach missions.

Microfibers and Textile Industry: More than 100 million tons of textile fibers are produced each year. The wear and laundering of textile items result in the continual shedding of microfibers into the environment. Unlike other plastics waste, these are released in micro form and are not obviously visible or retrievable. Other micro- and nanoplastics originate from diverse sources such as industrial plastic pellets, microbeads found in hygiene and personal care products (banned in the U.S. in 2015), and plastic particles worn or shredded from larger products like shopping bags and coffee cups. A single use teabag sheds up to 15 billion micro- and nanoplastic particles in a single cup of hot tea! Many of these microfibers/microplastics, both synthetic and natural, end up in the marine environment, where they form 85% of the microplastic pollution. As the birthplace of textile manufacturing in the U.S. the opportunity for Rhode Island's public research university to directly address this specific microfiber problem is especially poignant. Textile scientists in our Department of Textiles, Merchandising and Design are working alongside marine biologists, engineers, pharmacists and chemists, and in partnerships with the Rhode Island Textile Innovation Network (RITIIN) and its textile industry, like Darlington Fabrics in Westerly, to inform microfiber research programs and the future of both textiles and the treatment of the effluent wastewater as a result of washing these synthetic materials.

Plastics Tools for Collaboration: Detecting, identifying, quantifying and analyzing macro-, micro- and nanoplastics is essential to determining their prevalence and various adverse impacts. However, there are no standard methods, best practices or monitoring baselines for characterizing the very diverse physical, chemical and toxological characteristics of micro- and nanoplastics. There are a range of techniques, technologies and tools available at universities that bring researchers together. URI engineering's Material Imaging and Analytical core facilities provide not only access to state-of-the art equipment, but also a collaborative environment for researchers and their partners around the state looking at plastics around the globe, from ice in the Arctic to state waste treatment facilities to the Narragansett Bay.

Plastics Behavior: Micro- and nanoplastics are ubiquitous, traveling on clothes, food, and with rains, winds and waves into washing machines, sinks, wastewater, farmlands, down rivers and streams, along sandy beaches and into seabeds. In each environment, the variety of micro- and nanoplastics materials behave differently. Some observable behaviors from research include: absorption of other pollutants including heavy metals; attaching to and collecting on animals and plants; traveling on land, sea and in cells, individuals and populations; floating and accumulating on surfaces; and, transforming and degrading with different conditions and light exposure. URI researchers across the state and around the world are observing, collecting and analyzing these behaviors to understand the impact and contribute to global strategies to inform decisions about plastics.

Plastics Impacts: The pathways and interactions of micro- and nanoplastics exposures are numerous. It is still unclear what the long-term impacts of these are on human and environmental life. To understand, URI researchers across disciplines are studying how shellfish, seaweed, insects, human cells, microzooplankton and a variety of other living organisms interact with microscopic plastics pollution. This knowledge will support decisions further up the pipeline on how and at what level to remediate in domestic processes. Are they attracted to the microplastics? Will they digest them? And what volume do they digest? How are they emitted? What happens on a cellular, subcellular, individual and population level? How far do these travel up the food chain? What types of bacteria, invasive species and toxic chemicals adhere to them? What are their short and long-term outcomes on health?

Plastics Strategies and Solutions: Data-driven decisions will support new methodologies, best practices, societal behavior change, sustainable materials and investments in how the world continues to produce, use, dispose of and recycle plastics. URI social scientists are studying and facilitating dialogues for new local to global policies focused on industrial and commercial practices, infrastructure and uses and disposal. URI engineers and chemists are testing and developing innovative infrastructure and materials to remediate ongoing plastics pollution challenges. URI business faculty are understanding how community stakeholders, partnerships and new economies can support minimizing current plastics pollution impacts in the world. And URI communications teams are teaching and building tools to share accurate information to build awareness for a new way of living and working.

The environmental and economic reality of plastics pollution is a pressing global crisis that has outpaced our understanding of its impacts on our waterways, food web, air quality and human health.

CONCLUSION: Engineered plastics are a valuable category of materials that have many truly important uses, especially in the health care industry. This lesson is made even more acutely obvious during the COVID-19 viral pandemic. Nonetheless, we are facing a looming environmental crisis of staggering proportions, and it is critically important for URI to address these challenges – as part of a larger global effort to close knowledge gaps and to build partnerships, strategies and solutions. The environmental and economic reality of plastics pollution is a pressing global crisis that has outpaced our understanding of its impacts on our waterways, food web, air quality and human health. Research must accelerate to engage society with accurate and compelling information and dialogue that will change behavior, practices and regulations. From climate impacts of its production, consumption and disposal to environmental justice implications around the globe, no one organization is capable of solving this. It is critical to convene, communicate, collaborate and to thereby accelerate the development of both knowledge and solutions within this space.

Photo by Melissa McCarthy

LAUNCHING

Choking rivers, piling up in landfills around the world, and becoming a food source for marine creatures, plastic waste poses an increasing threat to the environment and human health.

In response, governments, non-profit agencies, industry, and academic institutions are joining forces to better understand the impacts of, and to devise strategies to deal with, plastics pollution.

Such a massively complex problem requires coordinated international collaborative efforts, and to meet this challenge the University of Rhode Island (URI) is launching the *Plastics: Land to Sea* initiative, an effort to align research, resources, and

URI's First Signature Research Initiative

PLASTICS: LAND TO SEA

written by **DAVE LAVALLEE '79, MPA '87**

talent across the entire University, to contribute to global efforts aimed at protecting a sustainable environment and to improve the quality of life for countless communities across the globe.

URI's interdisciplinary network includes more than 50 faculty working with state, regional and international governments, universities, and agencies around the world. In just the past two years, the initiative has either directly or indirectly attracted $4 million in private, state, and federal funding, and URI has invested in five new faculty members with expertise critical to plastics research.

Plastics play an important role in society and can be lifesaving, but they were not seen as a pollutant when they were developed. Yet, the environmental and economic reality of plastics pollution is a global crisis that has outpaced our understanding of its impacts on our waterways, food web, air

Photo by Beau Jones

quality and human health. The February 2015 issue of *Science* estimated eight million metric tons of plastics leak into the sea annually. According to the 2020 Pew Charitable Trusts report *Breaking the Plastic Wave*, the annual plastic flows to the ocean are expected to grow from Pew's calculation of 11 million metric tons in 2016 to 29 million metric tons in 2040. *Science Advances* 2017 article stated that approximately 420 million metric tons of plastics were produced worldwide, with production expected to triple by 2050. Less than 10 percent of plastic trash produced has been recycled, and it is the fastest growing component of municipal waste.

So, can Rhode Island and its public flagship research university contribute to a global conversation that seeks to understand and manage plastics pollution?

Sandra Whitehouse, '94 Ph.D., president of Ocean Wonks, founding member of Ocean Collectiv and consultant and senior policy adviser to Ocean Conservancy, replied emphatically.

"Of course, the answer is yes," Whitehouse said. "We have seen Rhode Island really excel in several areas, such as being the first state in the country to have an offshore wind project in the water, which was due in large part to the Ocean Special Area Management Plan. Obviously, URI had a major role in the development of that plan. We have seen that Rhode Island has been able to accomplish things quicker, more efficiently and more thoroughly because of its size."

University President David M. Dooley expects the institution to serve a similar role in tackling plastics pollution in the ocean.

And that the state, URI, non-profits, and industry can be essential partners in finding answers to plastics pollution.

"Very few universities have the combination of a Graduate School of Oceanography, leading environmental and engineering colleges and outstanding social science programs, all of which work collaboratively together and also with leading universities, businesses and agencies here and around the world," said Dooley, who has made University collaboration with businesses, other higher education institutions around the world, and other nations, a defining part of his 12-year-tenure at URI.

From Sri Lanka to Ghana and from the Arctic to Block Island, URI's research and outreach have addressed the health of fisheries, climate resilience, sustainable energy and the presence of plastics in every ecosystem -- land to sea. The University now plans to leverage those partnerships and cultivate new ones to advance plastics research.

"The University already has strong relationships with federal agencies heavily invested in environmental solutions, such as the National Oceanic and Atmospheric Administration, Environmental Protection Agency and the National Science Foundation," Dooley said.

Locally, URI works closely with the state's environmental agency to monitor water quality in rivers and ponds, and to study climate change and coastal resilience amongst other environmental issues. Rhode Island Department of Environmental Management Deputy Director Terrence Gary '00 said they are ready to take on plastics pollution with the University.

"Whenever we see a large-scale environmental problem like this, we can take a look at it because Rhode Island is an excellent place to innovate and to try things out at scale," Gray said. "We are the Ocean State, we have this huge 400-plus miles of coastline. People could say, 'Hey, you are Rhode Island, you are not going to solve the world's plastics problem.' But we can demonstrate how a local entity can take charge of its own issues and develop projects that could be scalable to different venues around the world."

Whitehouse also said Rhode Island has a very well-studied resource in Narragansett Bay, particularly because of extensive research done by URI throughout the decades. URI scientists and students have collected and archived baseline data that are rare and difficult to find for many water bodies and have launched long-term studies such as the Fish Trawl Survey, running continuously since 1959 to quantify the seasonal migratory fish populations.

"There is still quite a bit we don't know about the cumulative effects of plastics on an ecosystem," Whitehouse said. "If we were able to investigate the presence, prevalence, and movement of plastics throughout an estuary such as Narragansett Bay — including in water, sediments, and biota — we could meaningfully advance research on plastics pollution and work toward enacting policies that help to alleviate or abate ecosystem-level impacts from those plastics."

Whitehouse said URI has a unique role to play in this all-hands-on-deck problem given its global research efforts.

"For example, URI has scientists in the Arctic, which is hard to access and expensive to conduct research in," she said. "Collaborating with other scientists who are interested in acquiring samples from there could be beneficial."

Dooley sees a role for URI engineering and social science researchers to find alternatives to plastics while helping the public and manufacturers understand the importance of shifting away from plastics and testing alternative materials.

"We need to find new materials to replace current plastics, and that's where the scientists and engineers come in," he said. "We need to work with manufacturers and others to develop new materials and to develop new methods for re-use and recycling.

"WE NEED TO FIND NEW MATERIALS TO REPLACE CURRENT PLASTICS, AND THAT'S WHERE THE SCIENTISTS AND ENGINEERS COME IN."

- David M. Dooley

"Many knew about this problem decades ago, but it takes time for governments and people to take action. One big barrier to all of this will be how much of this becomes politicized," Dooley said.

But Whitehouse, Gray, and Dooley are also optimistic about the future because of important global and local initiatives, including Ocean Conservancy's *Trash Free Seas Alliance*, which brings together leading voices in the private sector, such as Rhode Island-based CVS Health, with scientists and conservationists to come up with practical, high-impact solutions to the ocean plastics crisis.

CVS Health is a global leader in sustainability, including increasing plastics recycling and reducing plastics throughout its operations, and the company is enthusiastic about the URI Initiative *Plastics: Land to Sea*.

"At CVS Health, we recognize that the health of our planet is affecting the well-being of people and communities," said Caitlin Dillon '10, senior manager for corporate social responsibility at CVS Health. "We are committed to reducing our environmental impact and embedding sustainability into our business operations, and work to engage our customers to take action and join us on this journey. As one example of this effort, we are working with a group of suppliers responsible for producing a large percentage of our plastics packaging within the store brand portfolio of products, in order to gain a better understanding of the impacts within our supply chain and inform meaningful sustainable packaging targets," Dillon said.

Photo by Beau Jones

"With more than 6,000 colleagues in the Ocean State and nearly 70 CVS Pharmacy locations, we are working to engage our colleagues in sustainability efforts," Dillon said. "We work with organizations like Save the Bay and the Department of Environmental Management on managing the impacts of our business across the state."

These local to national efforts create best practices to share around the globe and impact consumer management of plastics.

Dillion added, "Large universities like URI have an opportunity to leverage their network of faculty, students, and alumni as ambassadors and champions in building and activating solutions."

According to Professor Peter J. Snyder, URI vice president for Research and Economic Development, this signature research initiative will have its home within the URI Coastal Institute and will welcome participation by faculty and students across all URI colleges to make clear, tangible projects within the five "thrust areas" described within this issue of *Momentum*. In parallel with the publication of this issue, the Coastal Institute is launching a special website so that everyone connected to this effort can follow our progress and learn more about our research and partnerships https://plastics.uri.edu. From this web site,

https://plastics.uri.edu

Photo by Beau Jones

our faculty, students, collaborators and strategic partners will all be able to watch as we leverage our strengths, resources and connections. Please join us as the University “thinks big” to accelerate critical research efforts and contribute to global solutions to sustain the health of our land, our waters, our health, and our future.

“MANY KNEW ABOUT THIS PROBLEM DECADES AGO, BUT IT TAKES TIME FOR GOVERNMENTS AND PEOPLE TO TAKE ACTION. ONE BIG BARRIER TO ALL OF THIS WILL BE HOW MUCH OF THIS BECOMES POLITICIZED.”

- DAVID M. DOOLEY

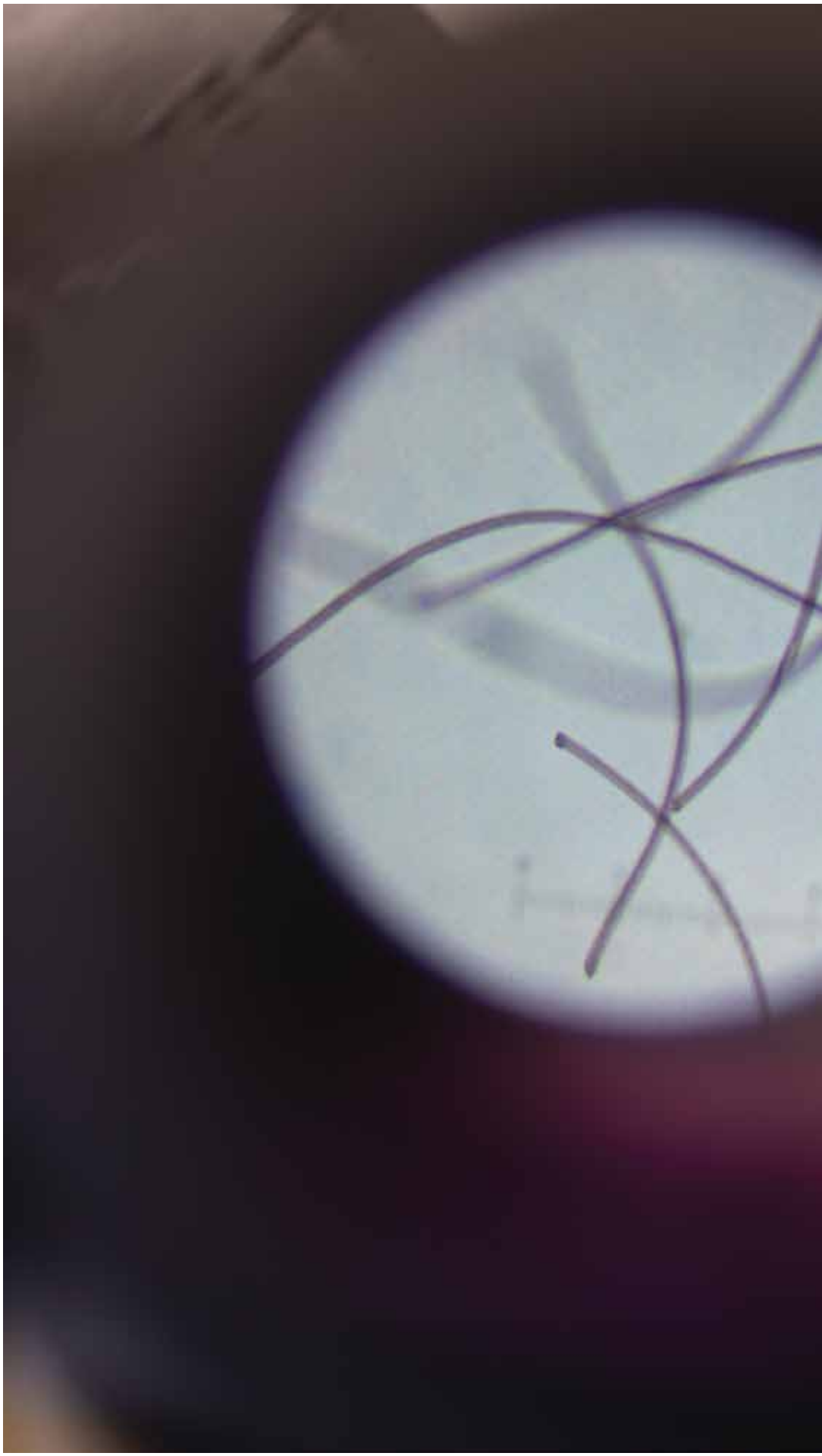
Photo by Beau Jones

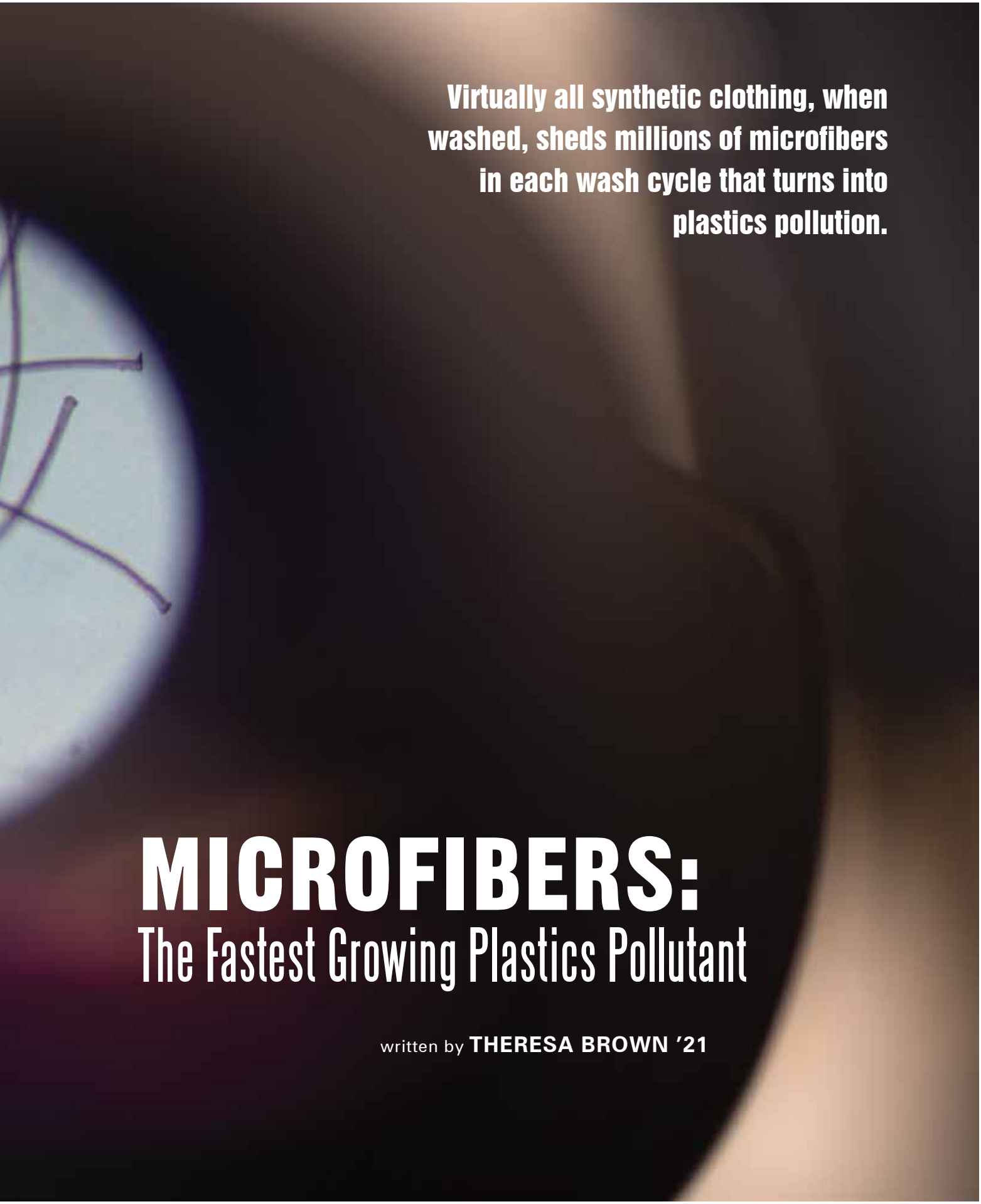
RESEARCH
THRUST AREA:

MICROFIBERS AND TEXTILE INDUSTRY

More than 100 million tons of textile fibers are produced each year.

The wear and laundering of textile items result in the continual shedding of microfibers into the environment. Unlike other plastics waste, these are released in micro form and are not obviously visible or retrievable. Other micro- and nanoplastics originate from diverse sources such as industrial plastic pellets, microbeads found in hygiene and personal care products, and plastic particles worn or shredded from larger products like shopping bags and coffee cups.





Virtually all synthetic clothing, when washed, sheds millions of microfibers in each wash cycle that turns into plastics pollution.

MICROFIBERS:
The Fastest Growing Plastics Pollutant

written by **THERESA BROWN ’21**

Photo by Beau Jones

From sweaters to jeans, every time we wash a garment it sheds microfibers. And when it comes to microplastics pollutants, these fibers are fast becoming a front runner in terms of impacting the environment.

Textile scientists understand the chemical makeup of fibers, the chemicals that process them, the dyes used to color them, and the finishes applied to make them soft, water-repellent and so on. This knowledge is critically important in order to advance research on how to limit the damage of these materials to our environment as they degrade over time. As one example, virtually all synthetic clothing, when washed, sheds millions of microfibers in each wash cycle that turns into plastics pollution.

Some microfibers are composed of synthetic plastic, like polyester, whereas others like cotton are made of natural polymers like cellulose. The difference between the two are still being questioned in relation to pollution in the environment, according to University of Rhode Island (URI) textiles, merchandising, and design Professor Martin Bide.

"We wear cotton, and we wear polyester, and they shed fibers just the same," Bide said. "If you look in the oceans, you'll find both types of fibers, but the world seems more concerned with the polyester than the cotton. But either way our clothes are constantly shedding."

The textile industry stands at the beginning of researching how microfibers affect humans, the environment, and their future impact on society. Bide said one key point we know for sure is that microfibers are widespread due to the textiles we wear every day.

"There are recent articles about finding microfibers on the summit of Mount Everest and in the depths of the Arctic oceans," Bide said. "They are everywhere and we're not quite sure how harmful they are for the environment and ultimately for human health."

The health risks of ingesting and inhaling these microfibers is still unknown, but research at URI and around the globe currently is under way to understand the effects of microplastics pollution on marine life.

As a textile scientist, Bide plays an important role by advising URI scientists on the materials studied in their experiments. Short fiber 'flock,' like that used to make furry red Christmas ribbons, is of known composition and size, and works well as a consistent model pollutant for researchers to use.

"The flock consists of very short fibers," Bide said. "There are local textile companies that can provide, for example, polyester fibers that are 1 millimeter long and 15 micrometers wide to URI researchers. So, rather than just taking random fibers, we have something very well controlled in the experiment."

Additionally, research about how textiles shed is being conducted by textile scientists to develop ways for consumers to take care of their textiles in environmentally friendly ways and make more sustainable purchasing choices.

"Because the industry has learned how to make textiles more efficiently and inexpensively during the past few decades there is huge explosion in clothing sales," Bide said.

Fast fashion — a term used to describe inexpensive clothing produced rapidly by mass-market retailers in response to the latest trends — has accelerated consumption and issues around managing plastics pollution. These cheaper quality materials and processes result in more shedding of microfibers, and also more clothing being discarded in landfills — essentially the clothing analogy to the single-use plastic bag or bottle issue.

According to Bill Jasper, URI mechanical engineering alumnus and former CEO of textile company Unifi Inc., since the discovery of microfibers in the environment is so new, one of the biggest issues is that most people are unaware of the problem and its causes. There are a variety of options for consumers and industry to consider, to slow down and prevent the journey of plastics into the environment.

"Over the last 10 years, people have been identifying and measuring the actual impact of synthetic textiles, and it's greater than any of us knew," Jasper said. "There are two things you can do. One is to educate people so that they are aware of the causes and extent of the issue and what the impact is. Secondly, the only thing that's going to change the behavior of the textile industry, the garment producing industry and brands and retailers are informed consumers who then make purchasing decisions based on the overall environmental impact of the garments they are buying."

According to Bide, there remains a lot to understand about microfibers and their long-term effects on the environment and its inhabitants.

Photo by Beau Jones

"OVER THE LAST 10 YEARS, PEOPLE HAVE BEEN IDENTIFYING AND MEASURING THE ACTUAL IMPACT OF SYNTHETIC TEXTILES, AND IT'S GREATER THAN ANY OF US KNEW."

- Bill Jasper

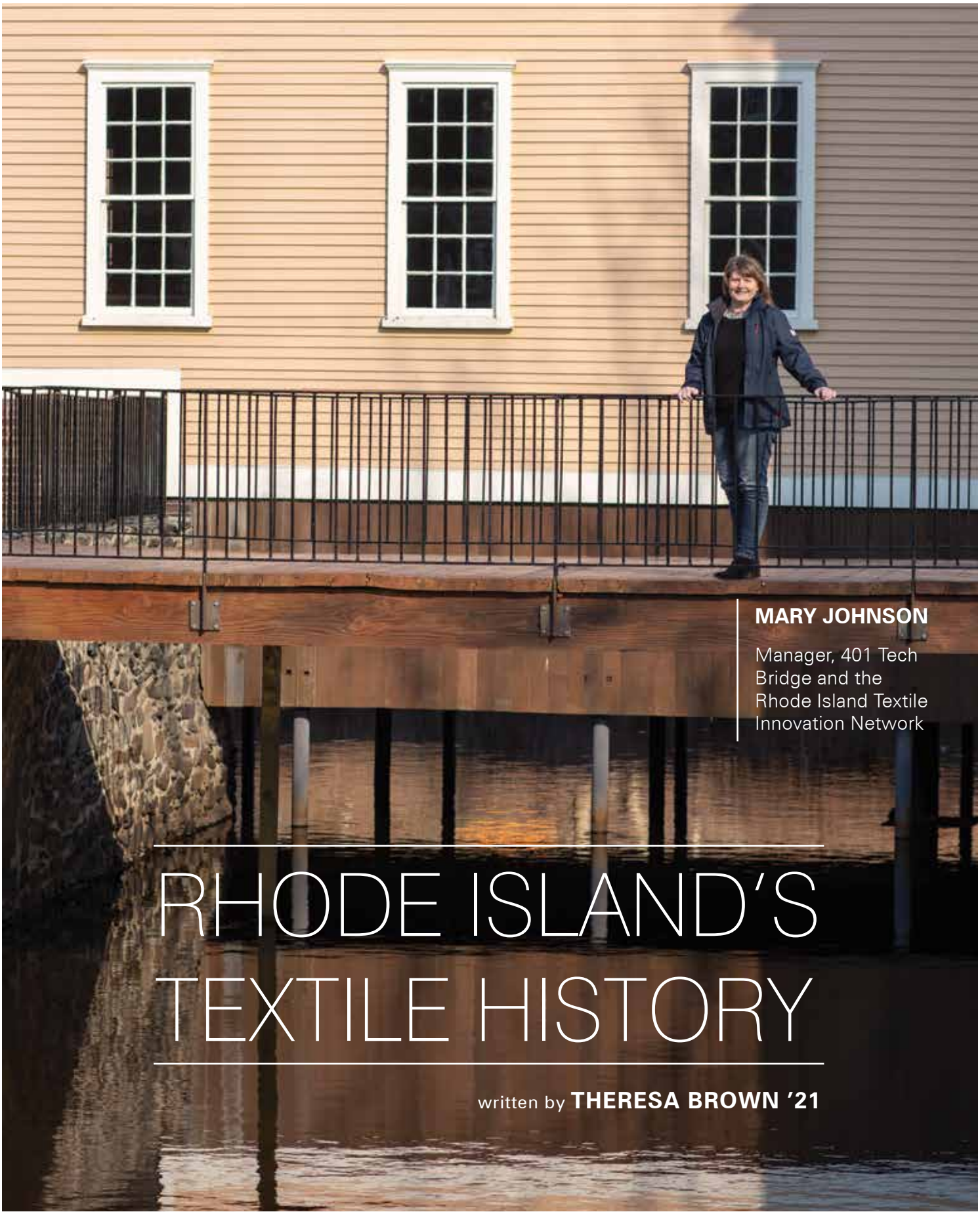
However, current research is leading textiles scientists to preventative measures and plans for solutions.

Bide is also currently working with The American Association of Textile Chemists and Colorists (AATCC) to help develop standard test methods that industry can use in developing fabrics with fewer problems.

"If I create a piece of fabric, is it going to shed a lot?" Bide asked. "I need a test that I can run in a lab that says how much fiber I can expect it to shed if I wash it. The AATCC is developing a test right now that will do just that."

Bide said that the growing efforts to understand the effects of microfibers on the environment has influenced bigger textiles brands and companies involved in the industry to pool their knowledge. Many have joined the Microfiber Consortium that is a collaboration that includes brands like Adidas and Patagonia, the AATCC, as well as several research partners and many more.

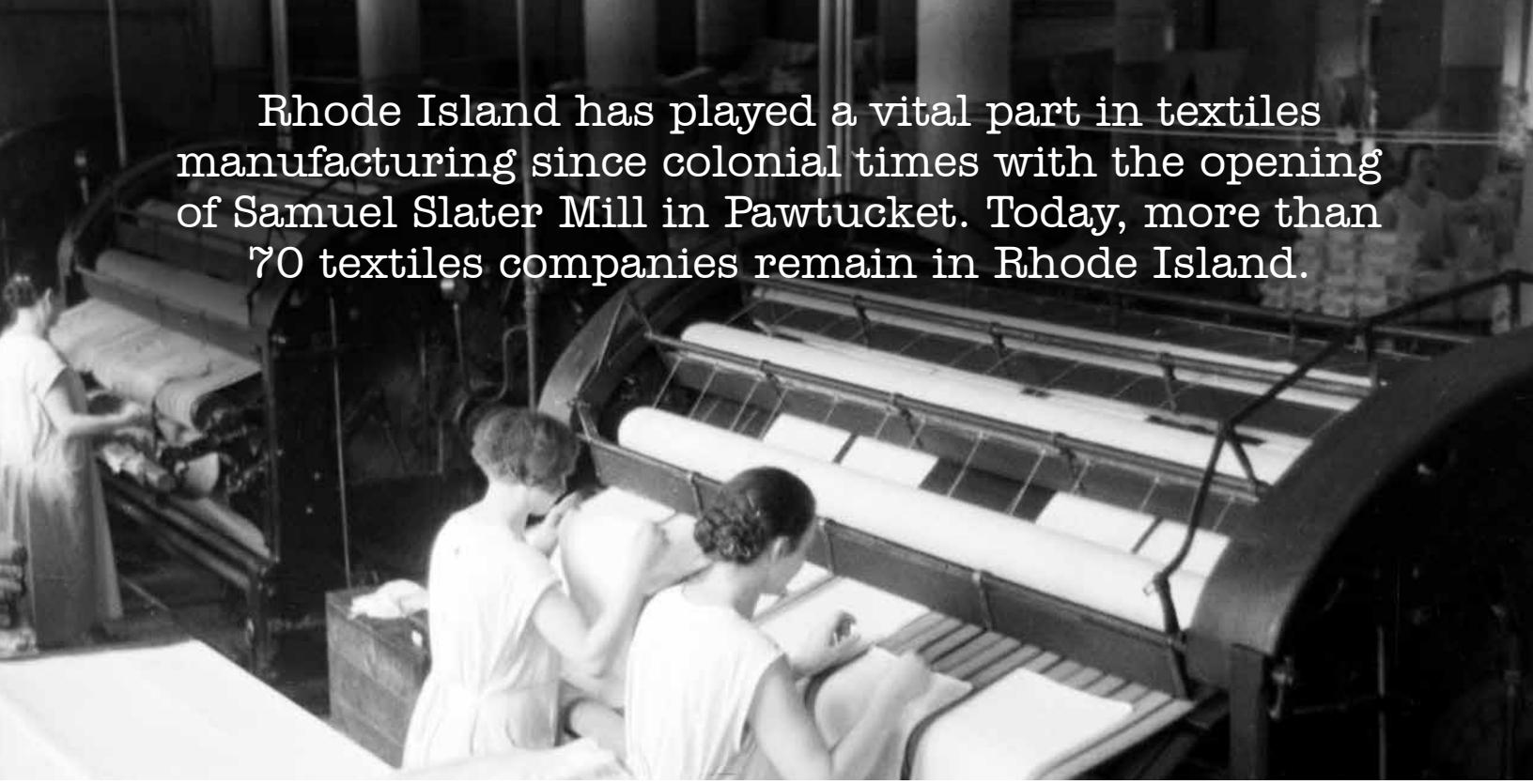
"My take is that we're still at the beginning of the research, and that it will lead to a gradual slowing in rate of textiles pollution over time," said Bide.



RHODE ISLAND'S TEXTILE HISTORY

written by **THERESA BROWN '21**

Photo by Beau Jones



Rhode Island has played a vital part in textiles manufacturing since colonial times with the opening of Samuel Slater Mill in Pawtucket. Today, more than 70 textiles companies remain in Rhode Island.

As the birthplace of the American Industrial Revolution, Rhode Island has a rich history in textile manufacturing. Today, the Ocean State's connection to textiles remains strong with researchers at the University of Rhode Island studying textiles and their environmental impact.

Rhode Island has played a vital part in textiles manufacturing since colonial times with the opening of Samuel Slater Mill in Pawtucket. Today, more than 70 textiles companies remain in Rhode Island.

Mary Johnson is the manager of 401 Tech Bridge and the Rhode Island Textile Innovation Network (RITIN), an industry group for Rhode Island textile manufacturers that contribute to research, education, and development in the industry. According to Johnson, the relationship URI has with the textiles industry and its dedication to coastal research and ocean exploration allows for the further understanding of the presence of microfibers (a microplastic pollutant) in the ocean, especially in Narragansett Bay.

"Everything having to do with the ocean is very important to Rhode Island and New England," Johnson said. "Being able to collaborate across departments and colleges and with the textiles industry makes the research that the University does much more valuable."

The RITIN was founded by U.S. Senator Sheldon Whitehouse (RI-D) in partnership with URI's Business Engagement Center, Polaris MEP and industry partners in an effort to create more jobs in the textiles industry by fostering partnerships and collaboration within industry — and with industry, academia and government, through all phases of manufacturing.

"Over the many years I've worked with Rhode Island's textiles manufacturers, I've seen firsthand the remarkable work they do and their potential to grow and create jobs," said Senator Whitehouse. "With the support of URI, we were able to start the Rhode Island Textile Innovation Network to help local companies promote their good work, train and hire Rhode Islanders, and share knowledge and insight with one another — to turn our textile stars into a constellation."

According to Johnson, Senator Whitehouse's support of Rhode Island's textiles industry and its early stages of research has emphasized the importance to textile manufacturers throughout the state.

"Senator Whitehouse has been at the forefront of this," Johnson said. "He has a strong relationship with the textile companies and is a big supporter of the industry and URI. He has helped get people's attention about the importance of microplastics research and encourage companies to do whatever they can to support the research at URI."

RITIN works with trade associations, such as the Rhode Island Marine Trades Association, to help companies understand the challenges of microfiber pollution, and to connect the next generation of textile scientists to industry, where they will contribute to finding solutions. Johnson said that RITIN is made up of textile companies including Propel, LLC, Darlington Fabrics, Brookwood Finishing and Cooley Group, all of which have done projects with URI faculty.

RESEARCH
THRUST AREA:

PLASTICS TOOLS FOR COLLABORATION:

Detecting, identifying, quantifying and analyzing macro-, micro- and nanoplastics is essential to determining their prevalence and various adverse impacts. However, there are no standard methods, best practices or monitoring baselines for characterizing the very diverse physical, chemical and toxological characteristics of micro- and nanoplastics. There are a range of techniques, technologies and tools available at universities that bring researchers together. URI engineering's Material Imaging and Analytical core facilities provide not only access to state-of-the art equipment, but also a collaborative environment for researchers and their partners around the state looking at plastics around the globe, from ice in the Arctic to state waste treatment facilities to the Narragansett Bay.

UNIVERSITY OF RHODE ISLAND SCIENTISTS

PUT PLASTICS RESEARCH UNDER THE MICROSCOPE — LITERALLY.

written by **CHRIS BARRETT '08**

When plastics break apart, the material leaves a trail of pieces often visible only with specialized equipment. That's where the University's core facilities and their researchers step in with equipment and expertise.

To understand the role of plastics in our world, imaging equipment housed within the University of Rhode Island's (URI) core facilities analyze plastic particles so small that it would be like finding a single drop of water in an Olympic-sized pool.

Scientists leverage that data to trace plastics pollution in waterways to its source, to understand how plastic particles harm animals, as well as to develop nanoplastics that deliver life-saving medicines into our bodies.

"People are looking at microplastics in a lot of different areas; they are popping up everywhere and we don't know if they're good, bad or neutral," said Rhode Island Consortium of Nanoscience and Nanotechnology Director Irene Andreu.

Yet, looking at micro and nanoplastics poses significant challenges. Plastics comprise a wide variety of polymers with additives to change their texture, rigidity and color. When plastics break apart, the material leaves a trail of pieces often visible only with specialized equipment. That's where the University's core facilities and their researchers step in with equipment and expertise.

Photo by Beau Jones

URI students using CORE facilities equipment. Photo by Beau Jones

To encourage cross pollination of plastics research, the University's Division of Research and Economic Development this year assembled the research groups and facilities that support plastics research under a strategic research initiative. The network also positions the institution to win research grants by fusing expertise, said Kathleen Shannon, who oversees strategic initiatives for the research division.

Scientists and policymakers can institute steps to halt pollution at its source.

Photo by Beau Jones

The centralized list of equipment and expertise opens the door for industry partnerships. Especially for startups, accessing the equipment available at the University would otherwise prove cost prohibitive.

"People need to understand core facilities and how important they are to collaboration, innovation and science," Shannon said. "For people to find collaboration and innovation and advance science they need a place, and they need equipment."

Conveniently, people don't have to look any farther than the University of Rhode Island campus.

Scanning electron microscopes in the University's facilities detect objects around 1,000 times smaller than those visible through a typical high school lab optical microscope. The fluorescence microscopes emit high-intensity light and measure the light reflected rather than absorbed by the sample to see details not possible with a traditional microscope. The Raman microscope shoots lasers at a sample to differentiate types of plastics at the sub-micrometer level.

The mass spectrometers bombard electrons at molecules in a sample and measure the resulting mass-to-charge ratio to identify unknown compounds. The X-ray diffractometer uses radiation to analyze the structure of materials. The high-pressure liquid chromatography equipment sends samples through a column with absorbent materials that cause different components to separate leading to their identification.

Some of the individual pieces of equipment cost upwards of $4 million, making these instruments impractical for a single researcher to acquire and maintain. The core facilities acquired much of their equipment through a mix of institutional investments, grants and donations, including $2.8 million from the National Science Foundation and a six-figure gift by Shimadzu Corp., a Japanese manufacturer of scientific equipment. Much of the equipment resides in the $150 million Fascitelli Center for Advanced Engineering where the glass walls literally showcase research and invite collaboration.

Inside the core facilities, the equipment empowers researchers to detect specific shapes and additives that offer clues to a plastic particle's origins: perhaps a plastic shopping bag thrown

Photo by Beau Jones

into the ocean by a careless customer or a damaged PVC pipeline.

With that information, scientists and policymakers can institute steps to halt pollution at its source, a task much easier than attempting to remediate an already polluted environment. That ability is important to people like civil and environmental engineering Professor Vinka Oyanedel-Craver, who recognizes the risk of plastics overrunning the ecosystem. The tools in the core analytical lab she helps to manage allow her and many other researchers at URI to tackle the issue like never before.

"It is really exciting to have all this equipment," Oyanedel-Craver said. "These tools provide an amazing level of detail."

Other labs and programs around campus assist in obtaining the samples for analysis. The URI Diving Research and Safety Program offers equipment and training for those looking to collect water samples whether from Narragansett Bay or waters halfway around the world. The samples return to

Photo by Beau Jones

"WE HAVE A UNITED FRONT SO IT'S EASY FOR AN INDUSTRY PERSON COMING FROM THE OUTSIDE. IT'S ONE-STOP SHOPPING."

- Carol Thornber

campus for analysis. Lately researchers have been particularly interested in analyzing water for plastics pollution that poses a threat to wildlife and human health. The diving program is also collaborating closely with a non-profit foundation that is in residence on URI's Narragansett Bay Campus, The Ocean Agency, to develop novel underwater photography systems for high-resolution 3D mapping of fragile ecosystems.

For those looking to skip the travel, the Seawater Facilities on the Narragansett Bay Campus literally pump in seawater to replicate any marine environmental condition. The Marine Science Research Facility offers space for scientists to prepare samples, analyze DNA, and assists with designing experiments.

Natural resources science Professor Carol Thornber recognized early on the economics of scale and research potential of formalizing connections among the labs. She's now leading that charge as part of her leadership role within the research division.

"Science over the past few decades has become more and more of a collaborative process," Thornber said. "I can solve one piece of the puzzle and another researcher can solve the other."

Thornber said the big picture view positions researchers to spend less time on administrative tasks and more time on science. And the centralized list of equipment and expertise opens the door for industry partnerships. Especially for

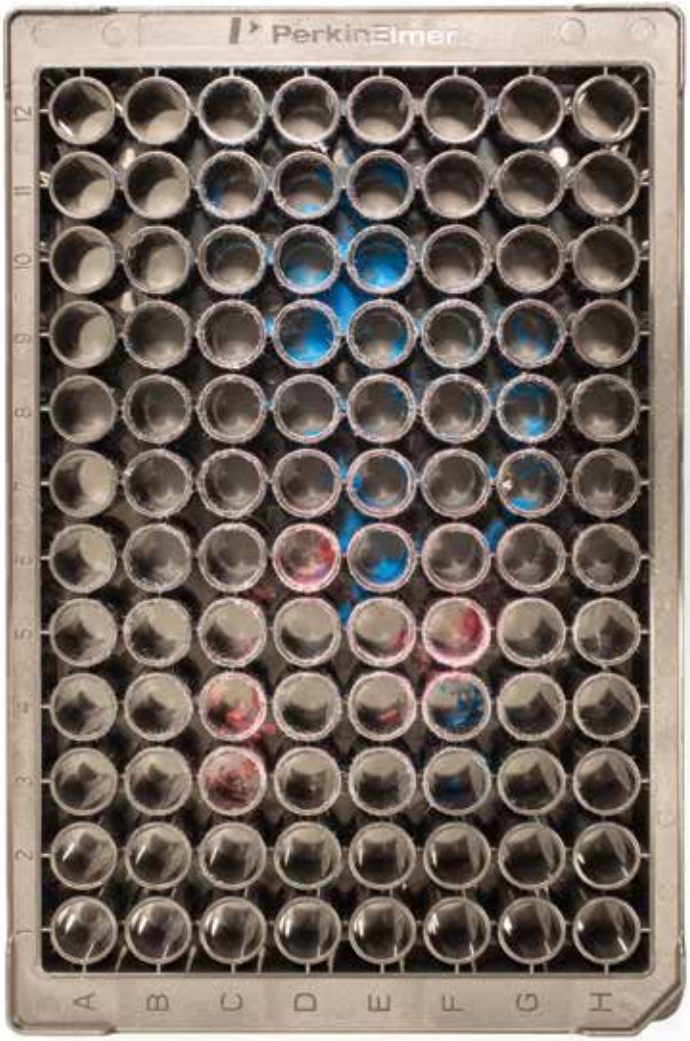
startups, accessing the equipment available at the University would otherwise prove cost prohibitive.

"We have a united front so it's easy for an industry person coming from the outside. It's one-stop shopping," Thornber said.

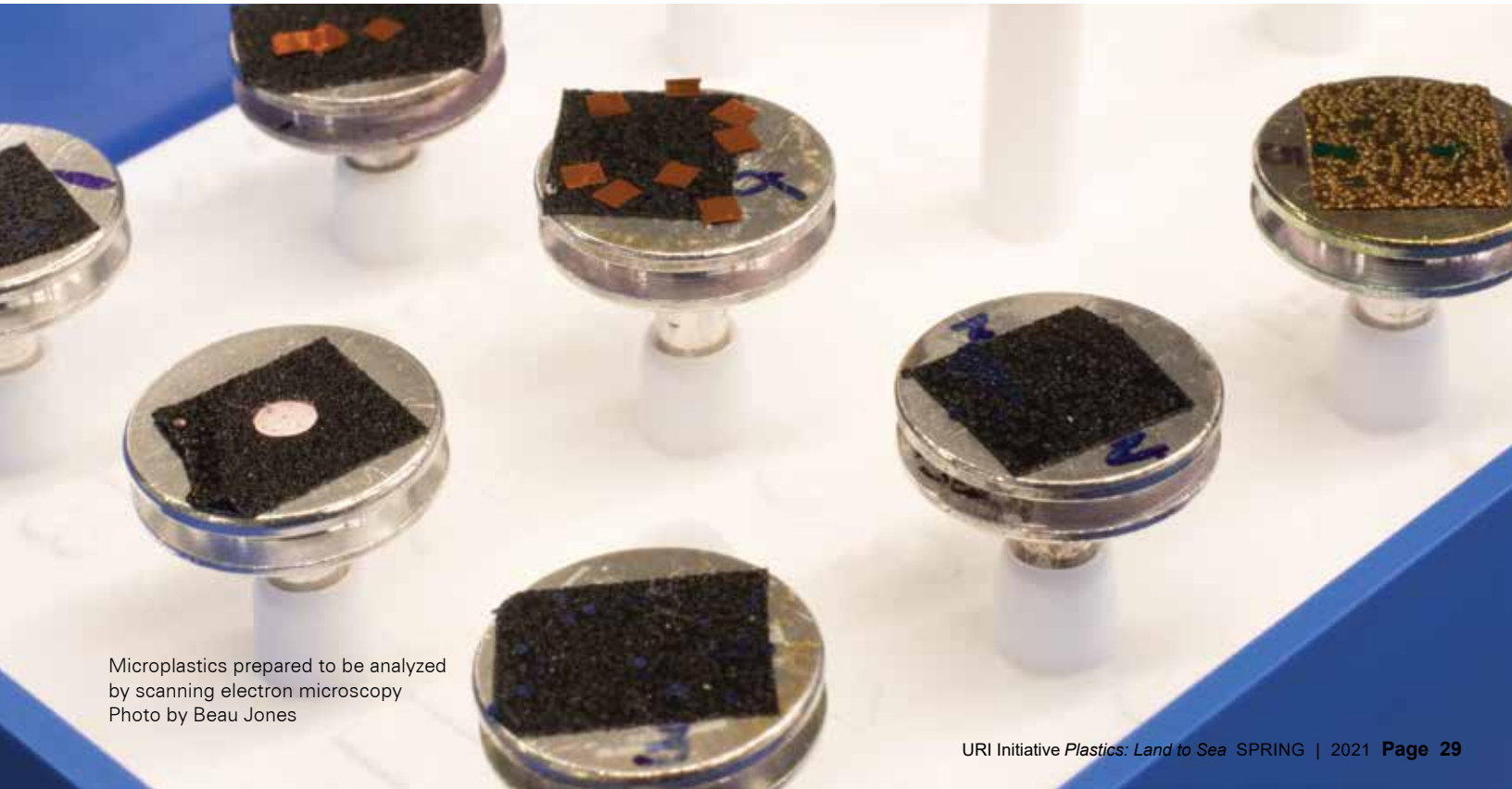
The equipment also sets up students for success in their future careers. Oyanedel-Craver said there is more than learning how to use a microscope or other imaging equipment. While one person operates the equipment, there might be dozens or even hundreds of people — engineers, programmers, chemists and physicists, among others — involved in analyzing the results for meaningful discoveries.

URI students, Oyanedel-Craver said, sit at the unique crossroads where they can collect a sample, analyze it at the nano level and interpret the results without ever leaving campus. And in studying samples sent by vendors, students often detect subtle differences between the sample's claimed material composition and what arrived in the box. Vendors often confirm that these minute differences are within the promised tolerances that most people never notice because they lack access to the sophisticated labs.

"It's very cool what we can measure," Oyanedel-Craver said. "It's the best equipment you can have."



A 96-well plate showing powders of microplastics used on experiments.
Photo by Beau Jones



Microplastics prepared to be analyzed by scanning electron microscopy
Photo by Beau Jones

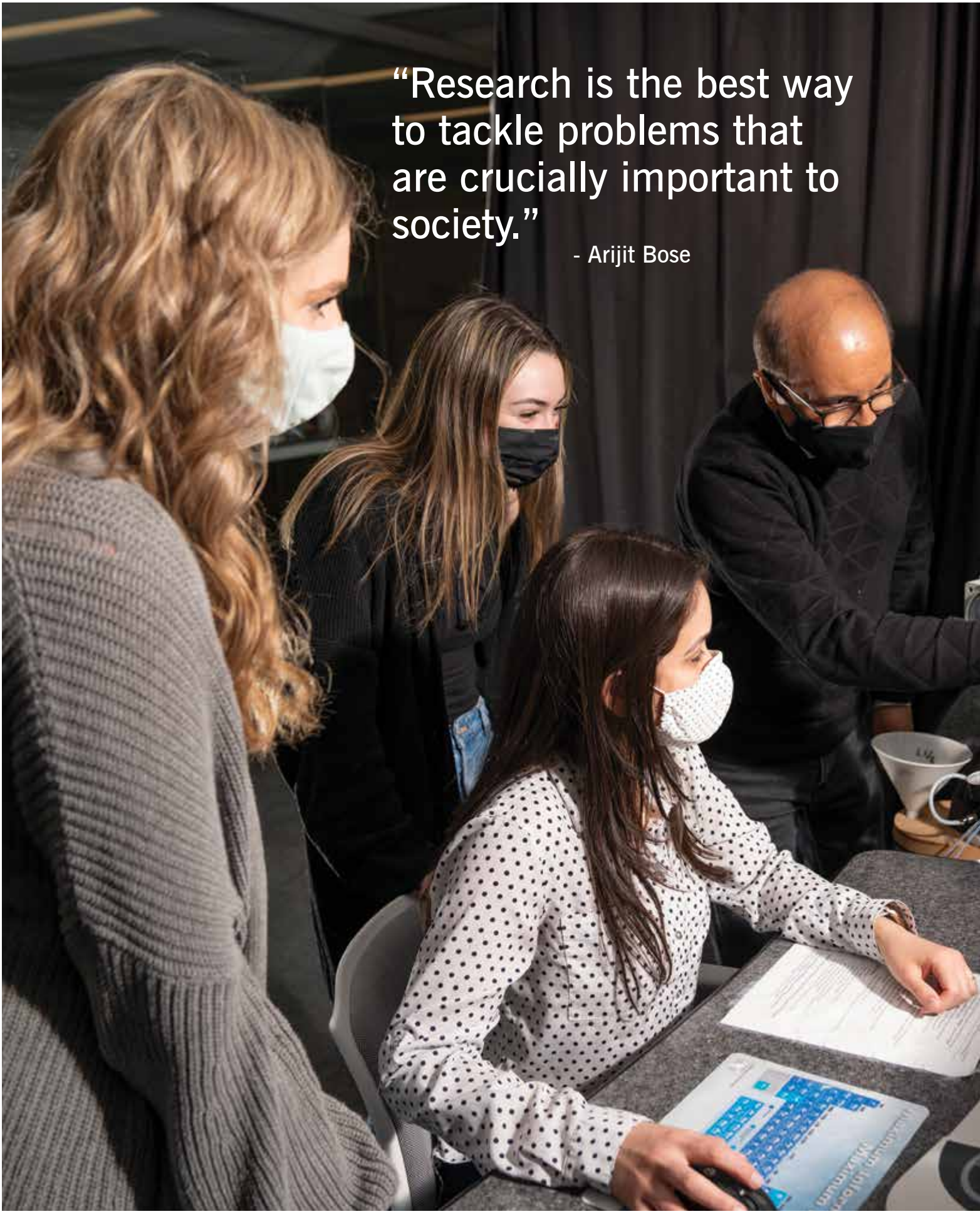

“Research is the best way to tackle problems that are crucially important to society.”
- Arijit Bose

Photo by Jason Jaacks

RESEARCH
THRUST AREA:

PLASTICS BEHAVIOR:

Micro- and nanoplastics are ubiquitous, traveling on clothes, food, and with rains, winds and waves into washing machines, sinks, wastewater, farmlands, down rivers and streams, along sandy beaches and into seabeds. In each environment, the variety of micro- and nanoplastics materials behave differently. Some observable behaviors from research include: absorption of other pollutants including heavy metals; attaching to and collecting on animals and plants; traveling on land, sea and in cells, individuals and populations; floating and accumulating on surfaces; and, transforming and degrading with different conditions and light exposure. URI researchers across the state and around the world, are observing, collecting and analyzing these behaviors to understand the impact and contribute to global strategies to inform decisions about plastics.

MICROPLASTICS:

HOW ARE THEY IMPACTING THE BACTERIA IN THE FOOD CHAIN?

written by **ALLISON FARRELLY '16**

Photo by Jason Jaacks

University of Rhode Island (URI) Distinguished Engineering Professor Arijit Bose was flipping through a magazine when a disturbing statistic caught his eye — by the year 2050 there will be more plastics than fish in the ocean.

This environmental crisis has garnered enormous publicity in recent years. The term "ocean plastics" invokes arresting images of miles-wide patches of debris floating in the Pacific Ocean, plastic melting out of Antarctic ice, a grocery bag on the bottom of the deepest ocean on Earth, the South Pacific's Mariana Trench, and turtles entangled in six pack holders and discarded fishing gear. With the COVID-19 pandemic, the waste can mean discarded surgical masks outnumbering jellyfish.

As Bose examined what expertise he could lend to fixing this problem, he noticed an incredibly small organism with a big impact on the food chain that was being overlooked: bacteria. When he looked closer, he found that bacteria already might be working to rid the ocean of plastic particles. His research group, in collaboration with that of Professor Anubhav Tripathi at Brown University, funded by a grant from the Rhode Island Science and Technology Advisory Council, have recently published their findings in two articles[1].

At less than a single millimeter in length and thinner than human hair, most microplastics are undetectable to the human eye. Many commonly used plastics sink in ocean water, and they encounter a variety of species in the water column. To bacteria, a crucial player in fragile aquatic ecosystems, these sinking particles are foreign objects.

"If you disturb an ecosystem by doing something to these bacteria, it has implications that go far beyond the bacteria," Bose said.

His lab began by looking at how cyanobacteria, which regulates ocean nitrogen levels, interact with microplastics.

"This is a very, very important part of the food chain," Bose explained. "As a disturbance in nitrogen levels can decimate larger species starting with their food source, phytoplankton.

"Bacteria are living beings, and they are extremely smart. If you expose them to something that is foreign to them, you can expect that biologically, they are going to do something that will help them face the new stressors."

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[1] (i) Interaction of Cyanobacteria with Nanometer and Micron Sized Polystyrene Particles in Marine And Fresh Water, T. T. S. de Oliveira, I. Andreu, M. C. Machado, G. Vimbela, A. Tripathi, A. Bose, **Langmuir**, 36, 3963-3969 (2020).

(ii)The Response of *Synechococcus* sp. PCC 7002 to Microplastic Polyethylene Particles - Investigation of a Key Anthropogenic Stressor, M. C. Machado, G. V. Vimbela, T. T. S. de Oliveira, A. Bose, A. Tripathi, **PLOS One** 15, E0232745 (2020).

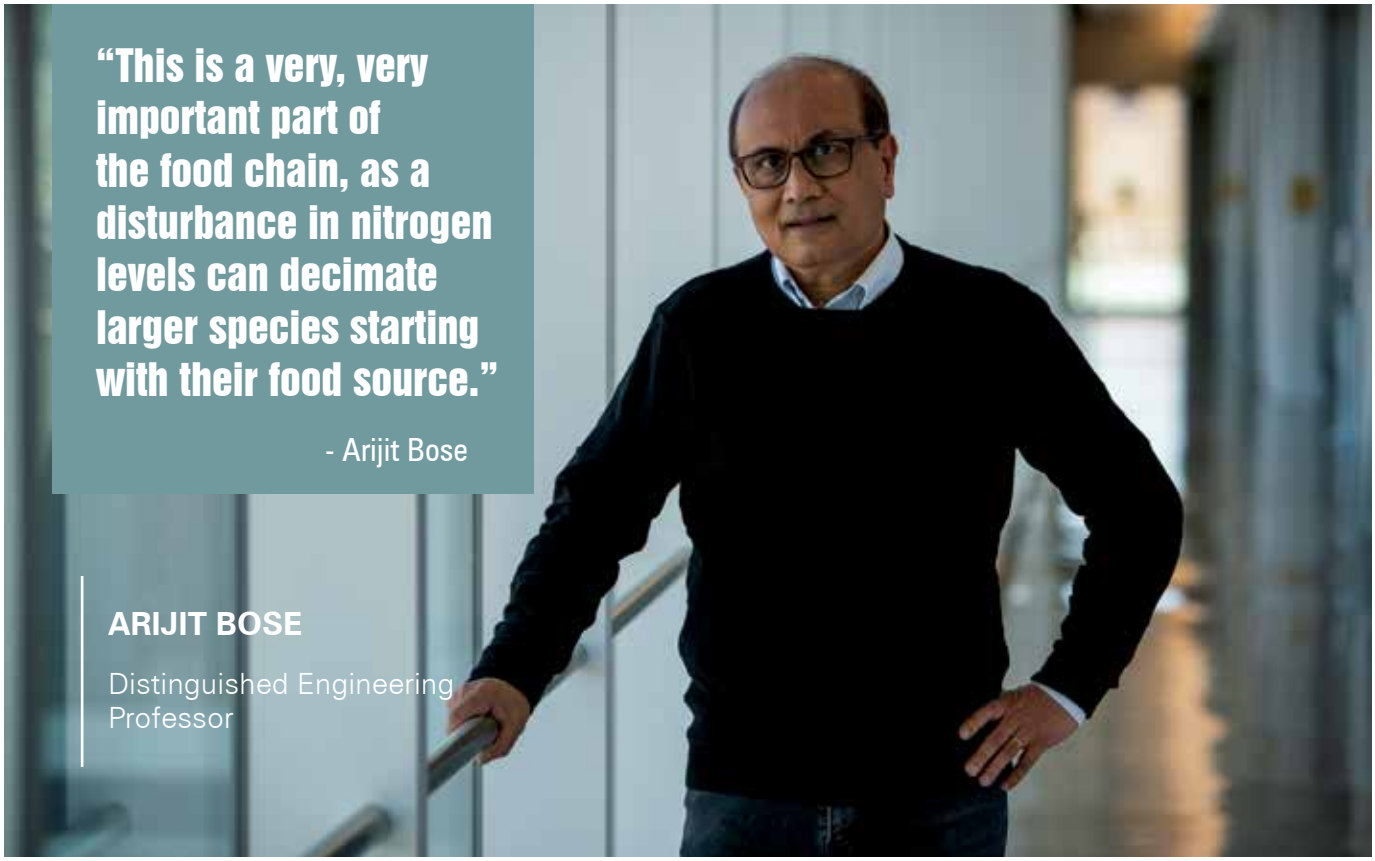


Photo by Jason Jaacks

To test if cyanobacteria recognize microplastics in their environment, Bose recreated an ocean water environment in the lab with polystyrene and polyethylene particles and bacteria in a plastic suspension, and then imaged their interaction using electron microscopy, which can observe a much finer scale than a traditional microscope.

The findings surprised even Bose. Upon encounter with the microplastics, the bacteria excreted a sticky biofilm that allowed it to bind to the particle, the same way a barnacle binds to the hull of a ship.

“They need to attack this thing they don’t know,” Bose said.

After the biofilm formed, the bacteria sent out a signal to summon other bacteria to the foreign object. But contrary to the labs’ hypothesis that the bacteria may die upon encounter, instead the bacteria began to change biologically in order to better attack and degrade the plastic.

Tripathi and Bose began to sequence the bacteria’s DNA. A little more than a week after exposure to the stressor, the scientists began to see modifications. The bacteria’s DNA was changing to overexpress a gene that codes for an enzyme that degrades the plastic.

“Fish eat plastic and may die, but the bacteria respond to the plastic in an active way where they convert themselves and secrete an enzyme that degrades the plastic,” Bose said. “There’s a little bit of good news in the face of this very bad problem. We may be finding that the plastic is actually degrading — at least the stuff that is making its way into the water column — which is a good thing.”

Though the time scale of this degradation may be too long to be useful to humans, these initial findings have excited Bose to dive in deeper, as there may be ways to harness this bacterial action as an effective new tool to tackle this problem. In his initial tests, he looked at spherical plastic particles, but wonders how the shape and size of microplastics could affect bacteria. In the coming months he also plans to test the interaction between different types of bacteria and different plastics including those made from renewable sources. His lab has added two undergraduate students to help expand his research.

“I love doing research,” Bose said. “For me, research is the best way to tackle problems that are crucially important to society.

“We are asking questions that no one knows the answers to. We struggle a little bit, we a take a few wrong turns and learn from them, and then we make some progress. For me that’s the most exciting thing that happens at a research university.”

DETECTING THE EFFECTS OF NANO AND MICROPLASTICS IN THE HUMAN BODY

Written by Allison Farrelly '16

University of Rhode Island (URI) Assistant Professor of Pharmacy Jyothi Menon has spent much of her professional career advancing drug testing and delivery for lung diseases. Recently, however, she has begun to consider how her lab's medical innovations could be leveraged to detect, research, and mitigate the effects of micro- and nanoplastics in the human body.

From occupational exposure, to ingestion, to inhalation, "microplastics can be taken up by cells in the body and can have an inflammatory effect," Menon, who is also an adjunct chemical engineering professor at the University, explained. "We have all the means in the lab to explore this."

One means is a revolutionary method of testing cellular responses to new drug therapies. Unconvinced by the efficacy of the traditional petri dish method of testing drug and cell interactions on a flat cell monolayer, Menon's lab has been growing 3D tissue-engineered models that more accurately reflect the cellular structure and interaction of body tissue.

"Research has shown that when drugs are given to a single layer of cells and to a 3D cell aggregate, the cells in both these models respond completely differently," Menon said.

Starting with a small sample of cells from, say, a piece of cancerous lung tissue, Menon is able to duplicate the cells and grow a more representative tissue model, which can be treated with drug therapies and responses observed.

She initially began creating tissue models to test targeted drug delivery methods that she was developing to treat lung conditions. Menon thinks these models can also be used to examine what happens in the human body when cells interact with plastic particles. With her history of research in lung conditions, she's particularly interested in the effects of inhaled plastics on the lungs, and developing ways to mitigate any effects through treatment.

"I feel like being part of this research community is important in the sense that we are actually trying to find solutions to current issues," Menon said. "Being able to make a contribution to that with my research is a very satisfying feeling."

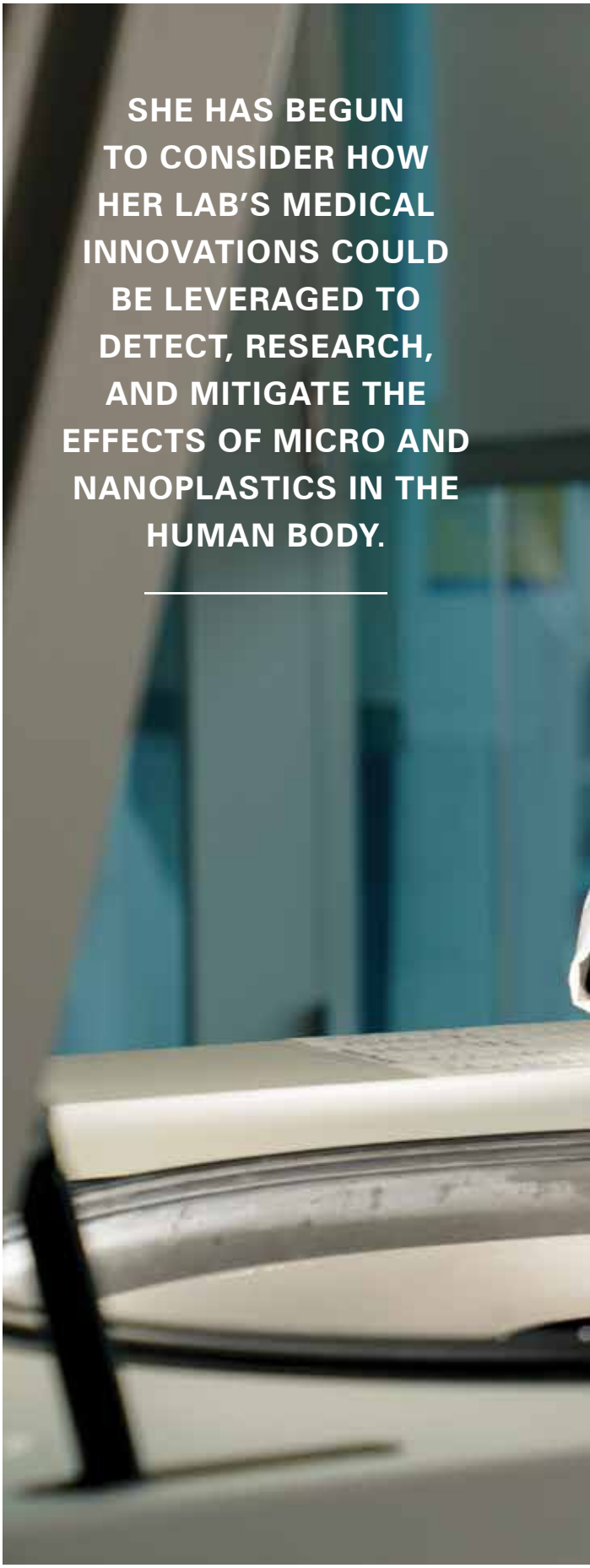


Photo by Jason Jaacks

JYOTHI MENON

Assistant Professor

Biomedical and Pharmaceutical Sciences

Chemical Engineering

RESEARCH
THRUST AREA:

PLASTICS IMPACTS:

The pathways and interactions of micro- and nanoplastics exposures are numerous. It is still unclear what the long-term impacts of these are on human and environmental life. To understand, URI researchers across disciplines are studying how shellfish, seaweed, insects, human cells, microzooplankton and a variety of other living organisms interact with microscopic plastics pollution. This knowledge will support decisions further up the pipeline on how and at what level to remediate in domestic processes. Are they attracted to the microplastics? Will they digest them? And what volume do they digest? How are they emitted? What happens on a cellular, subcellular, individual and population level? How far do these travel up the food chain? What types of bacteria, invasive species and toxic chemicals adhere to them? What are their short and long-term outcomes on health?

COLEEN SUCKLING

Assistant Professor

Fisheries, Animal and Veterinary Science

Photo by Jason Jaacks

CLOSING THE GAPS

IN UNDERSTANDING

ENVIRONMENTAL HEALTH IMPACTS OF MARINE PLASTICS

written by **CHRIS BARRETT '08**

Coleen Suckling's work studying plastics pollution starts with a glass mason jar. On a boat or by the shore, the University of Rhode Island (URI) assistant professor's team of students and staff draw water samples from Narragansett Bay to measure the amount of microplastics in the water. And that's just step one.

The water sample heads to Suckling's Kingston Campus lab where air filters ensure airborne plastic particles stay out of the sample. Researchers work on so-called clean benches that isolate the sample from contaminants shedding from clothing or equipment.

The team then follows a detailed process it developed to parse plastics from biological material. First, chemical alkaline digestion removes biological material from the sample, then laboratory-grade strong salt chemicals float the plastics away from heavier materials like sand, vacuum filtration cleanses the sample, and the addition of dyes exposes tiny plastics under specialized microscopes. Control samples with intentionally added plastics prove the method works.

"This is partly why a lot of people don't do this work," said Suckling, an assistant professor of fisheries, animal and veterinary science. "It's very labor intensive and without proper clean controls, we would be walking contamination disasters for experiments like this."

Yet the endeavor is critical. Suckling identifies plastic particles down to 10 micrometers — about the length of the longest human chromosome or the size of a cloud water droplet. Most researchers stop looking once plastics reach smaller than 350 micrometers. Marine life has no limits and may digest any plastic material in its environment regardless of size. Suckling wonders what that means for the health of the animals that are ingesting these particles, and what that means for the entire food web and larger ecosystem.

Because most plastic eventually sinks to the bottom of the seabed, Suckling seeks answers by looking at animals living on the seabed such as oysters — a critically important ecological species to Narragansett Bay and economically to the state — as well as sea urchins, which she has long studied, are prevalent in many parts of the world and a key part of the food chain.

Her quest for answers differs from others. Whereas some researchers essentially feed animals more and more plastics until they elicit a physiological response, Suckling uses amounts of plastics in line with those she finds in the real world through her exacting collection and testing process. Known as environmentally relevant concentrations of contaminants, the technique offers a realistic, rather than hypothetical, look at the effects of plastics on marine life right now.

"We need to know more about how marine animals are interacting with and responding to these environmentally relevant plastics," Suckling said. "Then we can build a baseline of knowledge on which we can make informed decisions regarding plastics pollution and managing ecosystems."

Suckling's approach to student training is an important part of her work and is integrated into her research efforts. "I'm really passionate about providing students an opportunity for experiential learning with plastics research," she said.

Cara Magill '21 won a biological sciences undergraduate research grant through the Harold A. Riemenschneider Scholarship fund and is now working with Suckling to design and carry out a research project. The project aims to determine the impact of microplastic particles on sea urchins. Preliminary results show the urchins are interacting with microplastics in unexpected and previously unknown ways though Magill and Suckling are still reviewing the results before releasing details.

"Cara has just accepted a funded graduate research assistantship on plastics pollution at the Center for Marine Debris Research, Hawaii Pacific University," said Suckling. "Her experience with the plastics pollution class and the experiential learning makes URI undergraduates competitive in graduate schools."

Working with students, Suckling realized they needed skills to measure plastics pollution in water, so she launched a course focused on helping students learn the rigorous laboratory techniques required to produce professional, respected results. With invited guest speakers, she weaves in how that pollution impacts marine life, discusses public policy around controlling plastics pollution and shows the lifecycle of consumer projects from raw materials to disposal.

"All these different perspectives are about giving students a broad understanding behind plastics and other materials so it can help them with their

Photo by Jason Jaacks

[consumer] choices in the future," Suckling said. Students can also draw on the experience during job interviews when employers ask about lab techniques.

The professor herself also learns as the field advances. Each year she updates the course curriculum to keep pace with the latest laboratory standards. And each year research indicates the amount of plastics manufactured and possibly headed to the world's oceans continue to rise.

For Suckling it means many more trips to the Bay and gearing up with other researchers around the world looking at environmental plastics and their impacts on marine ecosystems. Then hours back in the lab analyzing their contents.

"It's fascinating but it's such a shame that we have to study it," she said. "It's extremely sad that so much plastic pollution is in the water."

Because most plastic eventually sinks to the bottom of the seabed, Suckling seeks answers by looking at animals living on the seabed such as oysters – a critically important ecological species to Narragansett Bay and economically to the state.

Photo by Jason Jaacks

HOW MUCH PLASTICS ARE SEABIRDS EATING, and what are the Impacts?

written by **DIANE M. STERRETT**

Anna Robuck's plastics research started by accident at the University of Rhode Island's (URI) Graduate School of Oceanography, where she earned her doctorate in December 2020. As an environmental chemist, she received a National Oceanic and Atmospheric Administration (NOAA) scholarship at the outset of her doctoral program to look for chemical pollutants in seabirds. But she was astonished at the amount of plastics she found at the same time and began collecting information.

"As I started studying the birds to carry out the chemical analysis, every bird had plastics in their stomach," Robuck recalled. "Some of the birds gathered from the breeding colony were chock-full of plastics to the point that their digestive tract organs were bursting. And that's why they died."

The portion of the shearwater's stomach where plastic gets stuck is only about the size of a U.S. half dollar. With an average of 8-11 pieces of plastic in a young bird's stomach, there's little room left for food and digestion. The largest number of plastic pieces found in a single bird was an astonishing 202.

Photo by Jason Jaacks

Plastic particle found in the Great Shearwater.

The birds she studies travel from the Gulf of Maine to a remote island between Africa and South America where they breed. Her research led to the *Great Shearwater Plastic Project*, a multi-agency monitoring initiative to build baseline information about the amount of plastic in the Great Shearwater, an Atlantic native, trans-equatorial seabird seen off the New England coast. The team includes the NOAA Northeast Fisheries Observer Program, Stellwagen Bank National Marine Sanctuary, Woods Hole Oceanographic Institute, NC State University, and University of Cape Town Institute of African Ornithology (South Africa).

As lead on the project, Robuck autopsies the bycatch birds for stomach samples from collaborators which gives her access to rare samples. She also traveled to South Africa to necropsy birds they had collected for the project. During the last four years, her team has examined 200 birds, collecting and characterizing close to 2,000 pieces of plastic fragment. With another 42 birds in process, they are wrapping up the data and hoping to publish results spring 2021.

The project is one of the first global studies, and the first in the Atlantic, to comprehensively measure plastic ingestion by Great Shearwaters and to chemically characterize the type of plastics they eat using Fourier transform infrared spectroscopy. And, where there are seabirds ingesting plastics, there are fish and whales, so the project possesses larger implications for health of the Atlantic Ocean's food web.

With an average of 8 to 11 pieces of plastic in a young bird's stomach, there's little room left for food.

"The plastic pieces the birds are eating are pretty big," Robuck explained. "We didn't find a lot of fibers or pieces below one millimeter. Broken up bottle caps are by far what we find most. We found that young birds eat more plastics than adults, possibly because they are just learning how to hunt. The big picture impact for all birds is the more plastics they have, the less room they have to digest things and eat nutritional food. Latex balloons are the worst – they melt and coat the bird's stomach, impeding digestion."

She hopes her work will help inform future projects, as well as action through the NOAA Marine Debris Program. Responsible for the federal response to marine debris, this program focuses on removal, prevention, research, regional coordination, and emergency responses.

"They are developing an action plan for Gulf of Maine, and I'd really like our data to support future action on plastics pollution in the Gulf and be factored into future efforts to prevent and reduce harm to regional seabirds from plastic ingestion," Robuck said. "I'd also like to see better solutions for bottle caps, like product redesign, producer responsibility arrangements, waste to value programs specifically incorporating beverage caps, or just a less leaky trash pipeline to keep them out of the oceans."

RESEARCH
THRUST AREA:

PLASTICS STRATEGIES AND SOLUTIONS:

Data-driven decisions will support new methodologies, best practices, societal behavior change, sustainable materials and investments in how the world continues to produce, use, dispose of and recycle plastics. URI social scientists are studying and facilitating dialogues for new local to global policies focused on industrial and commercial practices, infrastructure and uses and disposal. URI engineers and chemists are testing and developing innovative infrastructure and materials to remediate ongoing plastics pollution challenges. URI business faculty are understanding how community stakeholders, partnerships and new economies can support minimizing current plastics pollution impacts in the world. And URI communications teams are teaching and building tools to share accurate information to build awareness for a new way of living and working.

KNOWLEDGE LEADS TO ACTION

written by **BETHANY DELOOF '21**

The ocean is the end of the plastics chain, it's better to stop pollution at its source. For that to happen, people must care, argues University of Rhode Island (URI) marine affairs and political science Assistant Professor Elizabeth Mendenhall. She also believes any solution requires countries working together as an international community. But perhaps one of the best answers lies in how researchers inform the public on the issue.

And information is power. In 2018, she published a literature review in *Marine Policy* that details what scientists already know about the causes, consequences, and solutions of marine plastics pollution. She hypothesized that a lack of marine plastics pollution policy results from a lack of knowledge about the problem itself and possible solutions.

Mendenhall said researchers know a lot about the entanglement and harmful ingestion of plastics by individual species. For example, research has been conducted on birds ingesting plastics since the 1960s, and people have seen sea turtles and fish trapped in various pieces of plastic debris. What researchers do not know is the larger scale effects of plastics pollution, including human health impacts. Researchers do not yet know the extent of the impact of plastics pollution on entire populations of fish and other marine life or on entire ecosystems. Scientists also are researching the impacts of human consumption of marine organisms that have themselves ingested plastics.

"If you just thought that there was one plastics gyre that hurt sea turtles, that's a lot different than knowing there are five plastics gyres that don't even include all the plastics in the ocean," she said. "There's tons of plastics on sea floors. There are tons on beaches. It affects all turtle species and half of the seabird species. It affects humans who are fishing, and what we are eating. It affects maritime industries like tourism and aquaculture. In my experience, that tends to spark caring in people and feelings of urgency and concern."

And Rhode Island, with its miles of coastline, and ecologically diverse Narragansett Bay proves a fertile ground to continue the research. Its small size and citizens' connection to the ocean also means it sometimes easier to implement public policy. At URI, the cross-disciplinary effort to research plastics provides yet another boost, Mendenhall said.

Photo by Beau Jones

"URI's new plastics initiative is a good thing because, even though we researchers are doing very different things, it allows us to have collected conversations about strategies and impactful collaborative work," she said.

The professor believes one of those strategies is refining international law. Specifically, Mendenhall focuses her research on studying the United Nations Convention on the Law of the Sea. The agreement signed by 168 countries serves as a sort of constitution for the ocean. It contains rules stating that countries must take all necessary measures to reduce, prevent, and control land-based pollution from entering shared spaces in the ocean. Mendenhall's long-term goal is to survey the existing legal resources in the agreement to determine what could be modified to enforce these rules and change behavior. She also wants to know why the existing rules are not always enforced.

"If you had to dream up a law, this is what you'd want. But the thing is, all these rules were written in the 1970s. My intuition is that maybe the way the rules were written may have been intended more for coastally located pollutants," she said. "Certainly, there are tons of negative impacts on the land and near the land, but those big patches out in the middle of the ocean, those are in the high seas. And the laws don't delegate authority to anyone for those regions of the oceans."

The high seas, 200 nautical miles offshore, present a complicated jurisdictional system because they are not owned by any country. Owned coastal regions

SHE HYPOTHESIZED THAT A LACK OF MARINE PLASTICS POLLUTION POLICY RESULTS FROM A LACK OF KNOWLEDGE ABOUT THE PROBLEM ITSELF AND POSSIBLE SOLUTIONS.

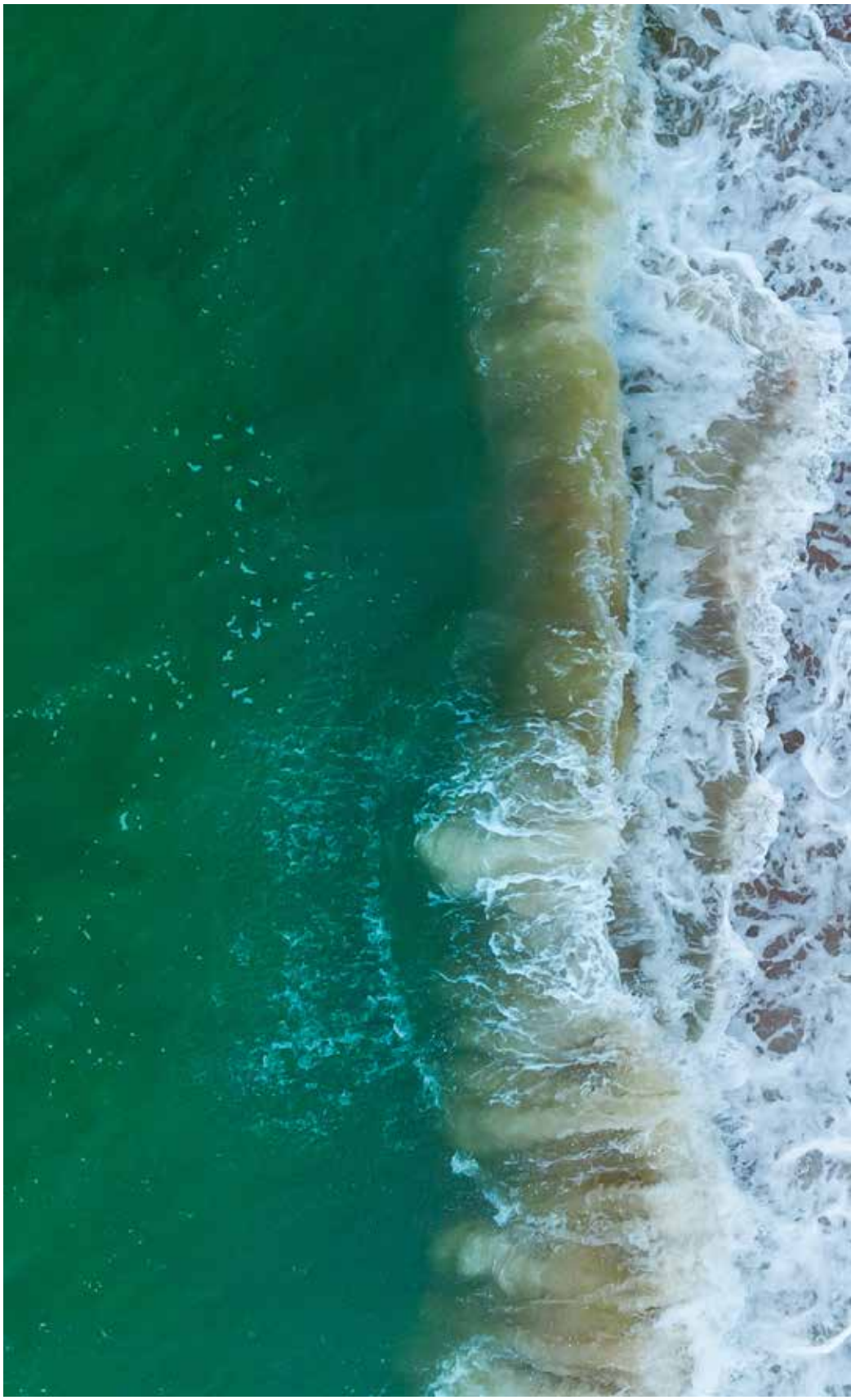
can be easily managed, but the high seas, where large plastics gyres exist, are harder to regulate. According to Mendenhall, the high seas have no strong legal representation of the global public interest. There is no notion that every citizen has an interest in preventing the ocean from being covered with trash. Mendenhall argues the protection of this public interest requires a stronger international cooperation to create a cleaner, more productive, and more efficient ocean environment.

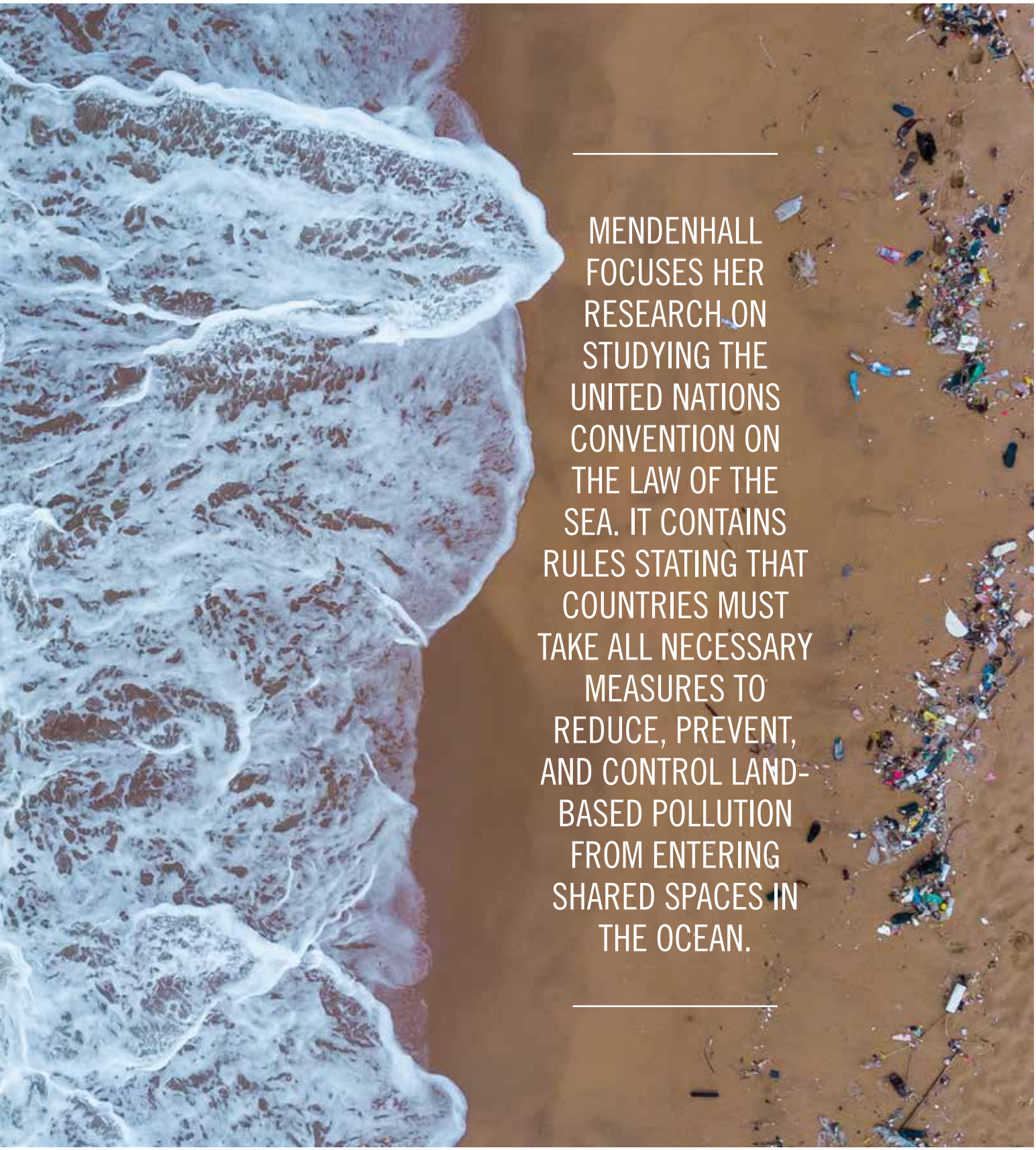
Mendenhall, who came to URI in 2017, said she's found willing supporters in Rhode Island, at the University and at Save the Bay, a nonprofit whose policy and programming committee she serves on.

"There's just a critical mass of researchers working on this, and the fact that Rhode Island is the Ocean State, people are generally more aware and interested," she said.

And that, of course, is the first step toward finding a solution.

SCIENTISTS ALSO ARE RESEARCHING THE IMPACTS OF HUMAN CONSUMPTION OF MARINE ORGANISMS THAT HAVE THEMSELVES INGESTED PLASTICS.





MENDENHALL FOCUSES HER RESEARCH ON STUDYING THE UNITED NATIONS CONVENTION ON THE LAW OF THE SEA. IT CONTAINS RULES STATING THAT COUNTRIES MUST TAKE ALL NECESSARY MEASURES TO REDUCE, PREVENT, AND CONTROL LAND-BASED POLLUTION FROM ENTERING SHARED SPACES IN THE OCEAN.

BEST PRACTICES IN

COMBATING MARINE DEBRIS

written by **BETHANY DELOOF '21**

To fight marine plastics pollution researchers must combine forces and learn from strategies tried around the world. Eliya Baron Lopez, a graduate student at the University of Rhode Island (URI), thinks South Korea offer clues in the battle to halt plastics from reaching waterways and oceans.

Baron Lopez, a Master of Arts in marine affairs student, graduating this spring, studies South Korean marine litter management strategies, specifically floating debris containment booms.

In South Korea, floating debris containment booms are used to capture and collect litter in rivers and coastal areas. The booms, implemented in the 1990s, resulted from early action to clean up marine pollution in South Korea due to the country's rapid industrialization. Curious if any other countries employed the same cleanup mechanism, Baron Lopez also examined South Africa, where she discovered the country's litter boom project that uses containment booms made of PVC pipe. The booms have significantly reduced plastic leakage into the ocean and created opportunities for employment for local community members.

"The booms in South Africa are very cheap to make, they're easy to install, the project provides jobs, and it puts more awareness to the issue of marine debris in South Africa," she said.

Baron Lopez acknowledged that to successfully combat marine debris, scalable and equitable solutions are necessary. While she is studying technological solutions, she noted the importance of policy solutions and targeting the source.

She is also comparing plastics cleanup solutions in South Korea to the United States, and another potential solution involves improving the United States' waste management system. According to Baron Lopez, the United States' waste infrastructure is less than successful, especially when compared to other countries.

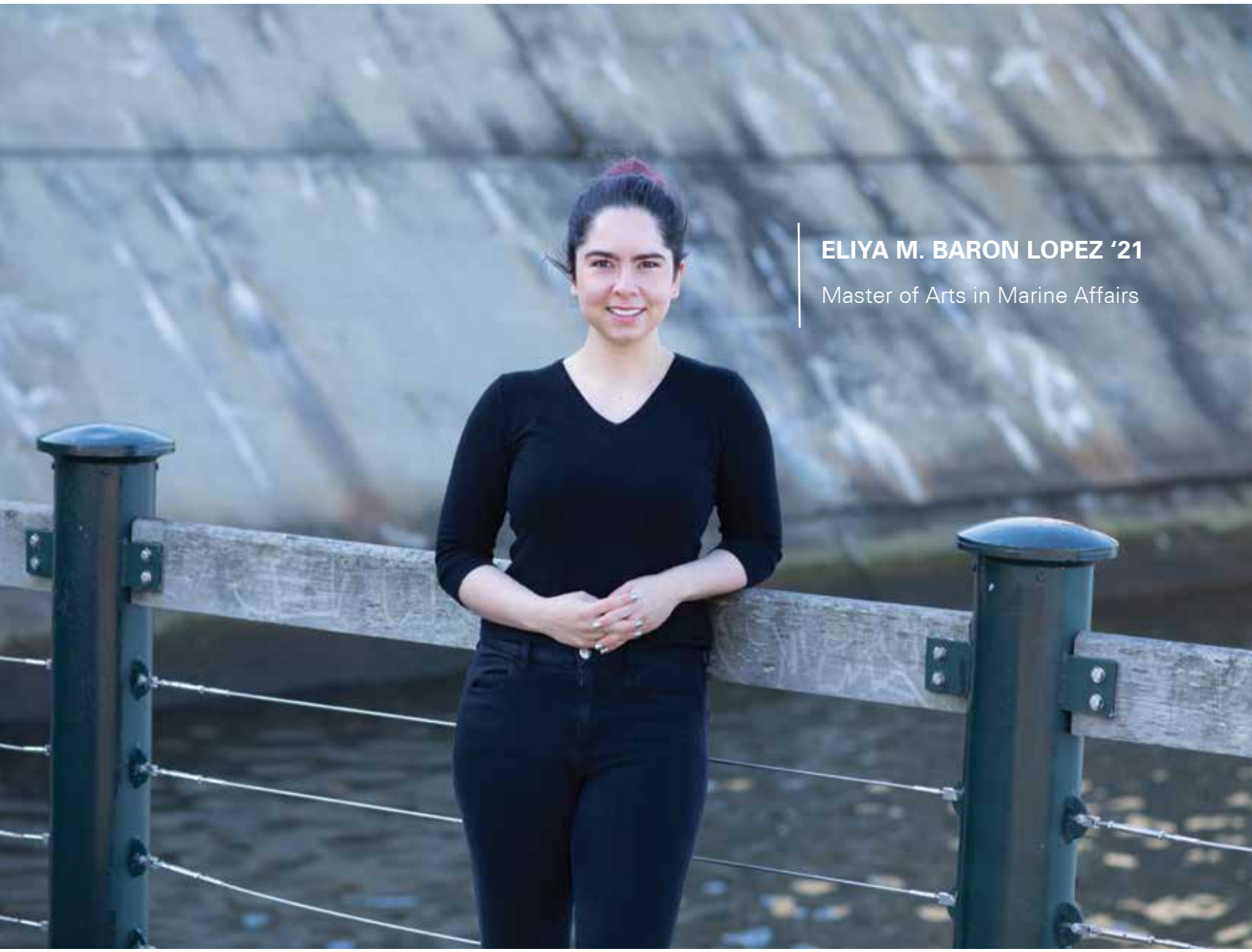
"South Korea captures their marine debris from coastal areas, so they're able to recycle and process that debris because they have sophisticated infrastructure in place," she said.

Baron Lopez spent her undergraduate career studying environmental policy and minoring in Korean studies at the University of California San Diego. She came to URI for graduate school, with a desire to move away from land-based environmental policy work and focus instead on marine plastics pollution. URI's Assistant Professor Elizabeth Mendenhall's *Marine Policy* 2018 paper on "Solving the Oceans' Plastics Problem" intrigued Baron Lopez most.

"Mendenhall's paper outlined all the questions I was curious about, and I thought, this is my graduate thesis," Baron Lopez said. "I can pick and choose those questions she presented in the paper and research them. She even mentioned South Korea's efforts in her article."

Once Baron Lopez came to URI she found a network of connections, opportunities, and support extending far beyond the state of Rhode Island.

"When I was starting my thesis work, I reached out to South Korean marine policy experts on ocean debris. They replied that they were at the University of Rhode Island over 10 years ago, doing a postdoctoral fellowship, working with the Graduate School of Oceanography, or working with other professors," she said, surprised at the unexpected international connections. "I never would have imagined that Rhode Island would have an attachment to South Korea."



ELIYA M. BARON LOPEZ '21

Master of Arts in Marine Affairs

Photo by Beau Jones

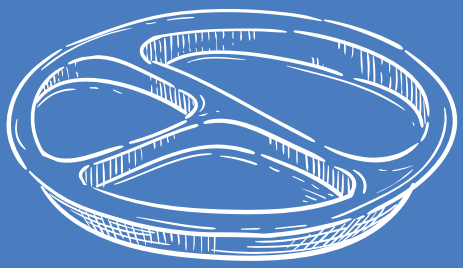
Baron Lopez believes now is the time to become involved in marine plastics research as there are new funding opportunities as governments and companies recognize the danger of plastics pollution. She also believes URI's involvement will prove beneficial to global dialogues.

"In other places, policy research on marine plastics is very minor, and I think centering policy work at URI on plastics could make URI a leader in the plastics dialogue," she said.

Baron Lopez noted that URI's efforts in investing resources into the plastics issue are not going unnoticed.

"We're a small fish in a big pond, but we have made some really big splashes," Baron Lopez said.

> "South Korea captures their marine debris from coastal areas, so they're able to recycle and process that debris because they have sophisticated infrastructure in place."
>
> According to Baron Lopez, the United States' waste infrastructure is less than successful, especially when compared to other countries.
>
> ~Eliya M. Baron Lopez '21



APPROACH:

COMMUNICATE:

Expand reach. Working with the public, scientists, journalists and other science communicators, the URI teams will translate plastics research and make it accessible with research-based communication strategies and educational techniques to inform and engage diverse audiences for individual and collective action.

IMPACTFUL SCIENTIFIC STORYTELLING

written by **HUGH MARKEY**

"What I'm bringing to the table is impact science storytelling, leveraging the power of both film and photography to help visualize these complex research stories that audiences need to know about to make decisions that will improve their lives."

- Jason Jaacks

His task is daunting: take a vast and complicated topic like plastics pollution and try to tell a compelling story of science and technology that educates, engages and inspires a broad audience to make good decisions about the health of the environment and their communities.

Journalism Assistant Professor Jason Jaacks, of the University of Rhode Island (URI) Harrington School of Communication and Media, is a visual storyteller by training and trade. He has 10 years running a production company whose client list has included *National Geographic,* the *New York Times* and *PBS Digital Studios*, *The Atlantic.*

"What I'm bringing to the table is impact science storytelling, leveraging the power of both film and photography to help visualize these complex research stories that audiences need to know about to make decisions that will improve their lives," he said. "I help craft the narratives with researchers and visualize their process and results. I help scientists think through their important storytelling moments and make their research accessible for a broader impact."

With his production company, Jaacks said he is often called in by the client at the end of a project, and then required to figure out a way to show the results to an audience. At URI, he's in on the ground floor working with researchers from concept to conclusion.

"Most researchers tend to think about science communications at the 11th hour," he said. "They already have a lot on their plate and thinking about how best to communicate their work isn't always a high priority."

He credits the unique URI communications approach in part to Professor Peter J. Snyder, URI's vice president for research and economic development. Snyder's idea was to bring scientific communication into the process from the very beginning, to think about how researchers can develop strategies and collaboration that would lead to a greater impact of the results of the science. This approach will tell that story in a much more effective way to engage the broader public, potential corporate partners, government agencies and grant sponsors.

Photo by Jason Jaacks

"The aim is to create inclusive science communication and really engage the public equitably by bringing all those people into the same room, the same conversation, from the start," said Jaacks. To accomplish this, Jaacks is collaborating with Clinical Associate Professor Sunshine Menezes, a national thought leader on inclusive science communication and the director of URI's Metcalf Institute.

One project that benefits from URI's philosophy of integrating communications early in projects is a Rhode Island Sea Grant program that examines the effects of microplastics in Narragansett Bay. Jaacks said that URI is collaborating with Rhode Island PBS and Dori LaBella, Science Department chair at Pilgrim High School in Warwick, RI to develop a series of videos aimed at a K-12 audience. The videos will focus on the microplastics research but will also include discussions of behavioral change or regulatory oversight to hold companies accountable. The videos will be accessible through Rhode Island PBS's website and available to classrooms across the state. Additionally, the videos will become part of PBS LearningMedia, a nationally syndicated educational video platform.

"Video content produced to those academic standards will be accessible anywhere in the country through PBS LearningMedia," said Jaacks. They get about a million unique views per month with materials that are being used in classrooms all over the United States and beyond. We'll be adding to that library with the stories coming out of this Rhode Island Sea Grant research project."

Jeannette Riley, dean of the College of Arts and Sciences, is excited about the impact Jaack's work will have.

"What Jason and others are bringing to the table is not just teaching our students the importance of science communication," Riley said. "What they're doing is a service for all of us, and this will help the public understand what's going on in our world in terms of advancements in science and technology. He's making visible problems that we have in our environment that we need to address."

Jaacks said he sees media as a critical component in the whole process of addressing plastics pollution.

"The ultimate goal here is to create visuals that are going to stop people in their tracks and inspire change," he said. "That's the kind of the work that's driven me for as long as I've been making images with environmental science."

Weick said the project sharpened her camera skills and increased her confidence in interviewing experts and telling a compelling and accessible story about science to reach broad audiences.

Plastics Told Through a Student's Lens

written by **CHRIS BARRETT '08**

Skepticism overcame Jael "Zippy" White '21 when her journalism professor announced that the class project assignment was to persuade people that microplastics posed a big danger to the environment. White thought environmentalists "over-hyped" such problems, and the idea of interviewing people during a pandemic made her heart sink.

Four months, four expert interviews, and one video later, White is sounding alarm bells.

"I'm physically scared about where our environment is going, especially Little Rhody, where some of our main industries are using the beaches, ports and fisheries," White said. "Plastics research is so important."

White, a communication studies and journalism major, worked with fellow journalism major Laura Weick '20 to produce a six-minute video that highlights the danger of plastics pollution leveraging interviews mostly with URI researchers and capturing scenes of Rhode Island.

They hope the video inspires viewers to take even little steps, such as reducing their number of laundry loads, to cut back on the shedding of microfibers that are released into wastewater, or to take the time to bring plastic shopping bags to a recycling center.

They hope the video inspires viewers to take even little steps, such as reducing their number of laundry loads, to cut back on the shedding of microfibers that are released into wastewater, or to take the time to bring plastic shopping bags to a recycling center.

URI students interviewing Professor JP Walsh. Photo by Beau Jones

Journalism Assistant Professor Jason Jaacks, who led the capstone journalism class, said microplastics pollution aligned with his background as an environmental journalist and television producer. And after attending a state-wide plastics retreat organized by the University's research division in fall 2019, Jaacks saw an opportunity for students to engage in in-depth reporting.

"As a journalist, you've got a scoop on the story when you have so many experts in your backyard," he said.

In fall 2020, Jaacks tasked his 15 students with becoming authorities on microplastics pollution and challenged them to produce innovative multimedia stories to ready them for careers in a digital world.

Producing the video proved tricky with a raging global pandemic. White stayed home, unable to access the high-tech cameras and speedy video-editing computers at the Harrington School of Communication and Media. Therefore, students innovated instead by relying on smartphones to gather footage of local plastics pollution, Zoom to conduct virtual interviews, and Adobe Premiere on their home computers to assemble the video.

Weick, now a freelance writer in Rhode Island, said the experience prepared her for the professional world where employers expect on-the-scene reporting packaged for a multimedia presentation.

"It's important for people to know URI students are always looking to get their feet wet, no pun intended, and to get the real-world experience rather than just reading about it in a textbook," Weick said.

Technical aspects aside, Weick said the project sharpened her camera skills and increased her confidence in interviewing experts and telling a compelling and accessible story about science to reach broad audiences — building awareness about plastics to engage society.

For Weick and White, the plastics project might have been the biggest story of their college careers.

"This video is probably my proudest moment, especially because I had the pandemic against me," White said. "I feel like we beat the odds."

Jaacks agreed. He awarded them an A grade.

Watch the video here

APPROACH:

CONVENE:

Increase connectivity. Harnessing the convening power of a public research land- and sea-grant institution, URI will bring together stakeholders from governments, academia, philanthropic organizations, business and civil society to build meaningful relationships and shared agendas at local-to-global levels.

Photo by Beau Jones

PLASTIC POLLUTION IS A COMPLEX PROBLEM,
A MIX OF VISIBLE ISSUES, LIKE WATER BOTTLES BOBBING IN THE EDDIES OF RIVERS, AND DEEPER ENIGMAS, LIKE TRACKING THE PATH OF MICROPLASTICS AS THEY SETTLE INTO RIVERBEDS AND THE SEAFLOOR.

Sustaining Our Shores

A Necessary Conversation

written by **CLEA HARRELSON '20**

John "J.P." Walsh, University of Rhode Island (URI) professor of oceanography and director of the Coastal Resources Center, is part of a network of collaborators across URI and around the world increasingly interested in understanding how plastics move from land and to sea, and how they impact the environment. The first step in tackling a complicated environmental threat like plastics according to Walsh, demands what he calls "good conversation."

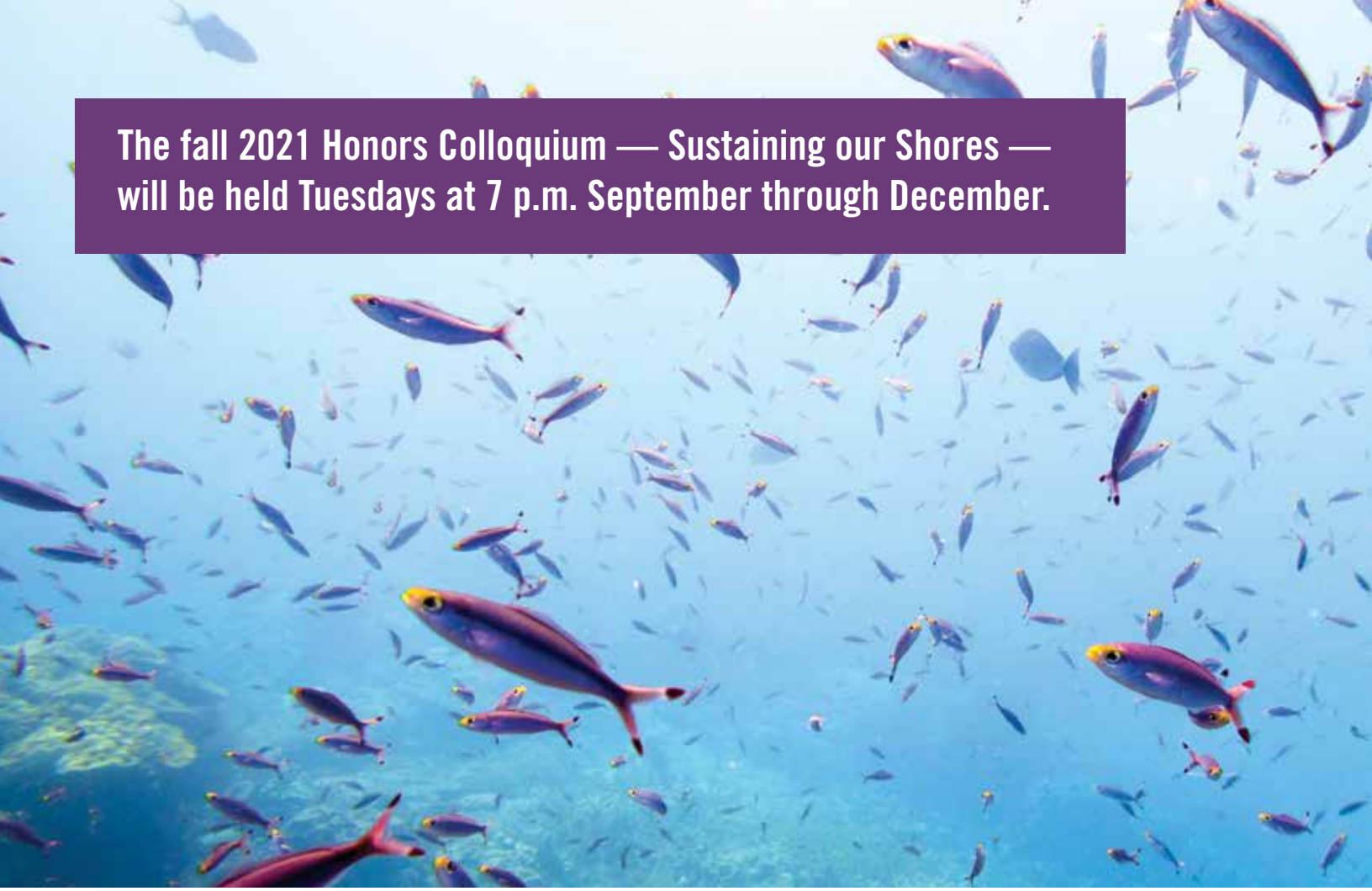
To catalyze interdisciplinary dialog around critical coastal issues, Walsh, alongside a team of dedicated URI staff and partners, are organizing a series of speakers and events for the fall 2021 URI Honors Colloquium: Sustaining Our Shores. The Colloquium prioritizes three main themes: climate change and coasts in crisis, the future of seafood, and plastics and marine pollution.

"All of these topics are related," said Walsh. "The question is how can we address these challenges building on the connections to start coming up with solutions?"

The Colloquium will present a platform not only to foster conversation among URI researchers, but also an opportunity to draw together researchers, private partners, and community members from across Rhode Island and around the world.

"We are going to try to broadcast this to a broader audience than has been done in the past," Walsh explained. "We also hope to include international partners of the Coastal Resources Center from places like Africa and the Philippines."

For Walsh and the Colloquium advisory committee, reflecting on the methods of communication and who has a seat at the table is



The fall 2021 Honors Colloquium — Sustaining our Shores — will be held Tuesdays at 7 p.m. September through December.

critical to the program's success. Early plans for Colloquium events include speakers and panelists who reflect the diversity of people whose work or research is related to the three main subjects, but the Colloquium will also feature cross-cutting events with themes such as environmental justice, art, music, and cooking that offer different ways of connecting with threats like plastics.

Walsh described this emphasis on multi-dimensional storytelling as key. "Science alone isn't enough," he said.

Storytelling is also central to a recent plastics project of Walsh's COAST Lab (Coastal and Ocean Analysis of Sediments and Transport Laboratory), funded by a $35,000 grant from the URI Interfraternity Council and Panhellenic Association.

This project draws together Walsh's work to map plastics around Narragansett Bay with efforts by Coleen Suckling, assistant professor of sustainable aquaculture, and Andrew Davies, associate professor of biological sciences, to evaluate the impacts of microplastics on commercial marine resources and seafood, such as oysters and to understand the behavior of microplastics in the water column. Assistant Professor of multimedia journalism Jason Jaacks is also a partner and will use visual storytelling to help bring the narrative of plastics and plastics research to life.

Walsh said he believes prioritizing communication and partnerships early on through the SOS Colloquium and in his own research helps set the stage for greater collaboration on applied projects down the road.

"There are so many potential connections in the coastal space," he explained. "There's a real opportunity here for Rhode Island to be proactive. When we talk about the Blue Economy powering our future, here and globally, those same resources that provide jobs are vulnerable to things like plastics."

The Colloquium also offers participants opportunities to consider how creative plastics research and communication in Rhode Island can contribute to global initiatives such as the United Nations Decade of Ocean Science for Sustainable Development (2021-2030) which aims to cultivate the "Science We Need for the Ocean We Want." The URI Graduate School of Oceanography already serves as a nexus organization for the Ocean

Photo by Erin Borbee '21

Decade, and events like the SOS Colloquium are key to convening the various URI faculty, students, and partners who are passionate about plastics to amplify their message and foster mutual learning. Walsh stated that researchers from Rhode Island are already at the forefront of innovation in coastal science and management.

The fall 2021 SOS Honors Colloquium is both a call to action that reflects the distress of coastlines in Narragansett and around the world and a path forward to sustaining our shores. From Walsh's perspective, to get started, we must start talking.

"The SOS Colloquium is a way to get many people together and on the same page," said Walsh.

THE COLLOQUIUM PRIORITIZES THREE MAIN THEMES:

climate change and coasts in crisis, the future of seafood, and plastics and marine pollution.

JOHN "J.P." WALSH

Professor of Oceanography

Director of the Coastal Resources Center

Photo by Beau Jones

APPROACH:

COLLABORATE:

Strengthen capacity and capabilities. Leveraging and connecting URI's diverse expertise and resources and connecting with companies, communities, government agencies, not-for-profit organizations, as well as academia, URI will create a diversified, inclusive and creative research network to attract competitive funding and partnerships.

A Novel 3D Camera Design to Map Sensitive Underwater Ecosystems

written by **LAINE FISCHER '23**

Photo by Jason Jaacks

ANYA HANSON

Director

URI Diving Research and Safety Program

Photo by Richard Vevers

A cutting-edge camera is being designed, prototyped and prepared for testing at the University of Rhode Island (URI) Narragansett Bay Campus, and it will provide both students and scientists with a better visual understanding of the plastics pollution that hides there while attracting greater public interest in ocean science.

The Hammerhead camera will offer a three-dimensional (3D) view to researchers finding ways to support healthier oceans analyzing both the sea floor and fish populations. In addition, the camera will be able to use GPS to create accurate maps that can be compared point-by-point over time. Research divers and faculty, from URI's Diving Research and Safety Program (Division of Research & Economic Development) and the nonprofit organization *The Ocean Agency* (TOA) are collaborating on this breakthrough camera system proposed by TOA's founder and CEO, Richard Vevers, who created the Seaview camera that took Google Street View underwater.

The camera system is inspired by the shape of a hammerhead shark. A diver will steer the device by literally riding on its back, as it is propelled forward by an underwater scooter. At the front will be two metal arms, or "stalks," with pairs of cameras pointing forward and downward to allow for high-resolution "binocular vision" and, thus, the ability to render images in 3D. Using GPS, each photo's specific location will be recorded so later researchers can return to the same place and determine changes in flora, density and types of marine life, and presence of visible human pollutants over time.

"The purpose of this project is to create a tool that we can use for research, communication, education, media purposes and community outreach," said Anya Hanson, director of URI's Diving Research and Safety Program. "With the camera, we can capture really intriguing and powerful underwater imagery that can be inspiring for communication efforts."

Plastics that enter the ocean may sink beneath the surface, literally hiding the problem from public view. Hanson knows from personal experience how widespread plastics can be harmful to both the health and beauty of the underwater environment and its creatures.

"When you're swimming along and you see a plastic bag or fragile marine life tangled in fishing line, it just breaks your heart because you know it's impacting the overall health of the environment," said Hanson.

"The purpose of this project is to create a tool that we can use for research, communication, education, media purposes and community outreach."

- Anya Hanson

She has seen countless plastic bags, wrappers, plastic bottles and fishing lines polluting the ocean floor – an experience that every diver sadly shares.

Professor Peter J. Snyder, URI Vice President for Research and Economic Development, made the strategic decision for the University to invest in this project, because: "Plastics are threatening our environment. They are threatening our food web. They are in the air we breathe and in the oysters that we eat out of our own Narragansett Bay. It's in the water we drink -- even bottled water, and in fact especially bottled water."

Snyder oversees all URI research activities, which allows him a unique perspective when it comes to the importance of interdisciplinary collaboration to tackle complex societal issues like plastics pollution.

This is an early prototype of the camera research divers will be able to use GPS to create accurate maps that can be compared point-by-point over time. Photo by Richard Vevers

"We are a moderately sized university in the smallest state of one country," said Snyder. "We cannot solve this problem on our own. We can't even come close to fighting the problem on our own. We have to be working as part of a larger global community to address this problem. What we can do effectively is to design, build and to make available new tools – like the Hammerhead camera – to apply to our cooperative research, testing and training programs."

The Ocean State — and its marine life — benefit from having The Ocean Agency, a globally connected ocean-dedicated organization, with its base of operations on URI's Narragansett Bay Campus.

"The Ocean Agency is an independent, nonprofit focused on accelerating support for ocean science and conservation to protect our oceans," said Snyder. "I felt that The Ocean Agency had a very creative and visual approach to building awareness and support of environmental research – research in climate change and mitigation strategies to protect fragile ecosystems, particularly coral reefs. TOA is now in-residence on, and an integral part of, our university campus community."

"We've found that creative science communication can do so much more than simply raise awareness about ocean issues and solutions – it can create excitement about ocean science that leads to greater support and accelerates impact," said Vevers. "We're very excited to be working with URI on this project as part of our UN Ocean Decade program helping to transform the image of ocean science."

Artist rendering of the Hammerhead camera. It will offer a three-dimensional (3D) view to researchers finding ways to support healthier oceans analyzing both the sea floor and fish populations.

DETECTING PLASTICS
with the Bay Observatory

written by **TODD MCLEISH**

APPROACH:

ACCELERATE:

Advancing strategies and solutions. URI will advance research, strategies and commercializable solutions to address problems associated with current plastics production, use, end-of-life disposal and the development of alternative materials.

ANDREW DAVIES

Associate Professor

Biological Sciences

Phytoplankton sampler, this device will be essential for field-based plastic sampling. Photo by Jason Jaacks

A system of high-tech instruments and communication networks will be deployed in Narragansett Bay this year to gather real-time data about the chemistry, biology, and physical processes taking place in the marine environment.

Called the Bay Observatory, the project aims to continuously monitor algae blooms, nutrients, environmental variability and other phenomena for many years to come at two locations in the Bay. The data will be accessible to scientists, students and various stakeholders as frequently as they want it.

"The Bay Observatory is essentially a floating platform similar to navigational buoys for shipping, but it includes batteries, radio beacons, solar panels and an underwater cage that can hold whatever instruments we want," said Andrew Davies, associate professor of Biological Sciences, who is overseeing the project. "It can take records of conditions in the Bay at up to one-minute intervals over the entire year, and we don't have to be out on a boat every day to collect the data."

Funded by the National Science Foundation's Established Program to Stimulate Competitive Research (EPSCoR), the Observatory data will be accessed by any interested parties through the Rhode Island Data Discovery Center, an interactive platform for accessing, integrating and visualizing collected data.

Yet, even before the equipment arrives on campus and is deployed for its intended purpose, new uses and applications for the Bay Observatory are under consideration, including studies of microplastics.

"The way we monitor plastics now is very expensive in terms of human time," said Davies. "The biggest problem is that water bodies are not just water and plastics, but it includes larvae, plankton, detritus, sediments, organic material from terrestrial sources, like twigs and leaves. There's so much stuff out there that to separate the plastics from the myriad of different materials requires multiple steps and processes to get to the point where we can quantify the plastics appropriately."

Davies believes that platforms like the Bay Observatory will be able to provide the power and communications networks to operate novel sensors and samplers that can enumerate the microplastic particles in the water.

Davies currently has several undergraduate and graduate students visiting dozens of shoreline locations around the Bay with a custom-built pumping system to filter hundreds of gallons of water. They then must go through the difficult process of separating out the plastics material from other particles in the water samples. The students also deploy a manta trawl from research boats in the middle of the bay to collect larger plastic particles.

Davies believes that platforms like the Bay Observatory will be able to provide the power and communications networks to operate novel sensors and samplers that can enumerate the microplastic particles in the water.

"The technology is already out there, but it's mostly being used to detect and count plankton, though it could be adapted to detect plastic particles," he said. "We've also been monitoring sediments using sensors for many years, and

there's no reason why we couldn't adapt that kind of technology to monitor plastics. We just need to tell the machine how to distinguish between plastics and plankton or sediments."

Once the Bay Observatory is deployed, Davies said he wants to invite companies developing technologies for detecting plastics to test their systems on the observatory.

"Plastics are being found everywhere, but it's never been fully quantified in our waters," he said. "Just how much plastic is in Narragansett Bay? That's really understudied. Can we predict if there are parts of the Bay with different concentrations of microplastics or larger plastics? I've got an umbrella of projects with the objective of environmental characterization, and our preliminary data is encouraging, compared to heavily industrialized areas like Long Island Sound, levels in the Bay appear lower. But we're still working to nail that number down."

He also is working with colleague Coleen Suckling, assistant professor in sustainable aquaculture, to study the effect of microplastics on commercially important species in local waters.

"Microplastics have a bad reputation, and everyone is worried about them," Davies said. "But the empirical data we need is still lacking, meaning that we still don't know what the health impacts of plastics on humans. We want to get to a more holistic view of the plastics problem, from recycling, waste management, the social justice disparity of how different communities are facing the challenge, especially the export of plastics, and finally the human health impacts.

"There are a lot of factors involved, and it's a real challenge," he concluded. "It's not a local problem, it's everybody's problem. But maybe the Bay Observatory can help us provide a more accurate and continually growing picture of what's happening in our back yard."

Photo by Jason Jaacks

"We want to get to a more holistic view of the plastics problem, from recycling, waste management, the social justice disparity of how different communities are facing the challenge, especially the export of plastics, and finally the human health impacts."

~ Andrew Davies

1st place:

"Baby Blue Maxima Clam" by URI aquaculture and fisheries major Michael Corso '24 of Medford, MA. The photograph is of a juvenile maxima clam grown in a coral/invertebrate aquaculture and distribution facility in Wilmington, MA. In the wild, a clam like this may live for more than 200 years. However, due to climate change and plastics pollution, captive propagation and growth may be the only hope of survival for many integral reef species, including giant clams. By continuing research and development of new sustainable aquaculture methods, we may be able to protect even the most vulnerable creatures.

"As a student at the University of Rhode Island, my goal is to learn about and develop new sustainable methods to protect our planet's aquatic species," said Corso. "My work is in direct relation with my academic pursuits."

- Michael Corso '24

2nd place:

"Serenity" by Thupten Tendhar, coordinator of the URI Center for Nonviolence and Peace Studies and Wakefield, RI resident.

"I teach about peace of mind and the inter-connected nature of phenomena," said Tendhar. "This photo shows how humans can learn, enjoy, and derive a positive impact from nature to feel peaceful and enhance our sense of belonging, realizing that we are all a small part of a bigger universe." John Palumbo, president and publisher of *Rhode Island Monthly* stated that the photo depicted focused calmness.

- Thupten Tendhar

3rd place:

"Up Close and Personal with a Cecropia Moth" by URI biology and psychology double major Gillian Mitkowski '23 of Ashaway, RI. The cecropia moth, *Hyalophora cecropia*, is the largest moth native to North America and has an average wingspan of 5 to 7 inches. Rearing of H. cecropia moths is part of the research done at the URI Biological Control Lab to assist with the United States Department of Agriculture spotted lanternfly biological control research.

Honorable Mention:

"Off the Shoulder of Orion" by Adjunct Instructor Kevin Gilmore of URI's Department of Art and Art History. The photo was taken for "The 79 Moons of Jupiter," a live, audio-visual installation and performance piece that includes electronic sounds synthesized and uses live data of the orbits of Jupiter's moons. The artistic vision for the audio-visual performance includes educational, research, and outreach goals to activate the local treasures found in the Frosty Drew Observatory at Ninigret Park in Charlestown, RI. This photo represents part of the preparation and research for this project and depicts some of the creative process involved. Gilmore is from Wakefield, RI.

Honorable Mention:

"Polycarpa and Caulerpa" by URI biological sciences and biological and environmental sciences graduate student Erin Borbee '21 of Burlington, MA.

Our research is a collaboration among Professor Christopher Lane and Associate Professor Austin Humphries labs at URI and the Marine Biodiversity and Biosystematics Lab at Bogor Agricultural University in Indonesia. We use environmental DNA to evaluate biodiversity in coral reef ecosystems across Indonesia. Environmental DNA allows us to capture diversity that might easily be missed in macroscopic and microscopic organisms. In this photo the water and sediment around the organisms are full of microbial life as well as DNA from fish and invertebrates on or near this reef. The DNA is captured on filters and sequenced to get a full picture of the diversity on a reef and begin to look at what factors, human and otherwise, may be influencing the diversity of various groups of organisms on the reefs.

Honorable Mention:

"The American Woodcock Project" by URI wildlife and conservation biology major Justin Moore '21 of Middletown, RI.

"This depicts how URI engages in the wildlife field and what we do to conserve these amazing creatures," said Moore, a URI Coastal Fellow undergraduate. The three hatchlings are being fitted with radio telemetry transmitters for tracking and monitoring in hopes to better understand how this species makes use of the area. The project is gathering and analyzing data to better comprehend the nesting ecology of this bird species.

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