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41°N

THE FUTURE ISSUE

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41°N

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ABOUT 41°N
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The URI Coastal Institute works in partnerships to provide a neutral setting where knowledge is advanced, issues discussed, information synthesized, and solutions developed for the sustainable use and management of coastal ecosystems. The Coastal Institute works across and beyond traditional structures to encourage new approaches to problem solving.

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FOCUS ON THE FUTURE

"I HAVE TOTAL FAITH"

Those are the words of Casey Emmett, kelp processor, in our cover story, talking about the potential of kelp to finally take off as a crop and a business enterprise. It's an ingredient that has been around for millennia but is still somehow waiting for its moment here in the U.S. Then, proponents believe, it will unleash all the nascent nutritional and environmental benefits that a locally grown, zero-input, carbon-absorbing, protein-rich crop can.

Right whales are another ancient species we have only recently begun to appreciate for their role in the ocean ecosystem. Despite conflicting views over new regulations and technologies designed to protect them, everyone from fishermen to regulators to researchers is hopeful they can be saved. "They have as much of a right to exist as any of us," says University of Rhode Island scientist Bob Kenney.

The right to public shoreline access in Rhode Island is enshrined in the state's Constitution, but designating access sites in Providence has lagged behind other areas. Advocates fought for recognition of the Public Street right-of-way this past summer, but their plans for the site are just beginning.

These and other stories in this issue highlight the work of many to right wrongs, rebuild, raise up others, and otherwise plan for a better future. Enjoy!

—MONICA ALLARD COX
Editor

CORRECTION: *The apprenticeships mentioned in the story "Wampum Craft: The Power of a Purple Shell" in the Spring 2021 issue were supported by the Southern New England Apprenticeship Program in traditional arts with funding from the National Endowment for the Arts. The affiliated organizations are the Connecticut Historical Society and the Mass Cultural Council, and, in Rhode Island, the partnership is directed by Winifred Lambrecht, formerly at the Rhode Island State Council on the Arts and currently faculty at the Rhode Island School of Design.*

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Whose Right?

COASTAL ACCESS IS CONSTITUTIONAL BUT CONTROVERSIAL

by **Todd McLeish**

AT THE END OF PILGRIM AVENUE IN NARRAGANSETT, not far from the Point Judith Lighthouse, a surfer sits in his car, uncertain whether he can legally park there to access a popular surfing site via an unmarked right-of-way to the shore. The path to the water is being encroached upon by abutting landowners, whose plantings and property boundary stakes are seemingly designed to keep the public away.

After a few minutes, the surfer gives up and drives a block away to Louise Avenue, where signs indicate no parking, even though the site—like Pilgrim Avenue—is a state-designated coastal access point, and getting to the shore is easy along a short grassy strip.

"Surfers have accessed these sites for decades," said David Prescott, Save The Bay's South County coastkeeper and a long-time surfer himself, "so we need to figure out how to make public access here work better."

Another block away, at the end of Conant Avenue, a well-marked public right-of-way features a modest stone staircase to the shore and attractive plantings welcoming visitors to use the site. Signs clearly indicate that parking is allowed on the shoulder of the road during the day, the result of the Narragansett Town Council reversing earlier parking prohibitions imposed by the previous council. Yet area neighbors have sued the town in hopes of returning the neighborhood to a no-parking zone.

"There has always been parking available in the area, and those access points are especially popular after big storms, when a lot of people go there," Prescott said. "Those access points need parking nearby so people can get down to the shore and enjoy it."

Public access to the coast and along the shore has long been controversial in Rhode Island, even though the right to coastal access is enshrined in the state constitution. Waterfront landowners often object to seeing residents walking along the shore in

Narragansett Beach
Photograph by Cate Brown

Plantings often obstruct public shoreline access sites. This right-of-way on Esplanade Road in Middletown has been described by an abutter as a "view access point" (page 9) although state records contradict that claim. A stairway just a few feet north of this right-of-way provides direct access to the shore, but it is privately owned and not for public use.

Photograph by Rhode Island Sea Grant

front of their properties, and many coastal property owners have gone so far as to block public rights-of-way, install unofficial "no parking" signs, and call the police on those they consider trespassers. Much of the conflict arises from the uncertainty of where members of the public are legally allowed to walk along the shore and where they can park to access designated rights-of-way. The state of Rhode Island is now taking steps to clarify the issue.

The Rhode Island Constitution clearly states that "the people shall continue to enjoy and freely exercise all the rights of fishery, and the privileges of the shore." In 1986, that language was updated at a constitutional convention to clarify that those privileges include walking along the shore and entering the water to swim. But what remains unclear is where private waterfront property rights end and public use begins. A shoreline trespassing case brought to the Rhode Island Supreme Court in the 1980s defined the dividing line as the mean high tide line, which is determined by averaging the high tides over an 18.6-year lunar cycle. Yet all interested parties agree that it is impossible for anyone walking along the shore to know the location of that line on any given day.

"The mean high-water mark moves inches up or down on steep shores, but it moves tens of feet up or down on shallow elevation beaches," said Jeffrey Willis, executive director of the Rhode Island Coastal Resources Management Council (CRMC). "That's the problem with determining where that line is on a daily basis. Climate, coastal storms and sea level rise change the profile of the shoreline. It's a difficult boundary line to base where things can and cannot occur."

The result has been occasional chaos, as waterfront property owners seek to defend their boundaries, activists intentionally push those boundaries, and the police, public officials, and the courts get caught in the middle. The COVID pandemic exacerbated the issue as more and more people sought to get to the shore to enjoy the outdoors at a time when beaches had limitations on how many people could visit.

While the state constitution addresses what is referred to as lateral access along the shoreline, it does not indicate how the public can get from the nearest road to the shoreline, or perpendicular access, and that has become equally controversial. The state Legislature has charged CRMC with designating public rights-of-way to the shore, and the agency is proactively seeking

to identify approximately 420 rights-of-way, one for every mile of shoreline in the state. Nearly 230 have already been designated, with more added every year.

But Willis said the agency cannot create new rights-of-way. Instead, it conducts the legal research in state and municipal property records to unearth existing rights-of-way that may not be known or may have become impeded through the years. Because CRMC has a limited budget to conduct legal research, it has partnered with the Roger Williams University Law School to use law students to conduct the initial research. When enough documentation is uncovered to suggest that a right-of-way should be designated, the evidence is presented to CRMC's right-of-way subcommittee, which makes a recommendation to the full council. All of the designated rights-of-way can be found at www.crmc.ri.gov/publicaccess.html.

Designating a public access right-of-way doesn't necessarily mean that Rhode Islanders can use the site, however, if access has been obstructed or there is nowhere to park. Those are the most common criticisms of the right-of-way designation process. Prescott said that Save The Bay conducts assessments of each right-of-way every three years, and in 2018 it found that 37% were obstructed and only 48% had parking nearby.

"There's no requirement to have parking associated with rights-of-way," he said, "but if there's nowhere to park, is it really accessible to the public? Some sites have gotten so overgrown that access has disappeared. One had a sailboat blocking it. Does that count as being accessible?"

CRMC is working to address both issues. It solicits help from municipal public works staff and seeks private individuals and groups to "adopt" specific rights-of-way to maintain them and ensure they are not obstructed. It is also collaborating with the Rhode Island Department of Transportation and the Department of Environmental Management to provide parking to right-of-way users at properties the agencies manage nearby. But it is a slow process.

The issue of public access to the shoreline is one that is embraced by many thousands of Rhode Islanders. A Facebook group called Saving RI Coastal Access/Rights of Way has 3,300 members who actively discuss these issues and share information about the challenges of accessing particular sites. Not all of them

are necessarily well-versed in the intricacies of Rhode Island law as it relates to coastal access or are familiar with how rights-of-way are designated, so CRMC and Rhode Island Sea Grant have undertaken a public education effort to inform Rhode Islanders about the issue via a series of webinars, websites, and other communication vehicles. They have also formed an informal advisory group and are planning right-of-way clean-up events in the coming months.

One member of the Facebook group who spends a great deal of time familiarizing himself with the issues is Dave Lombardi, who is especially concerned about coastal access for disabled Rhode Islanders. "There's so much healing power in the ocean," he said, "and we need places where we can feel hopeful. The shoreline has a healing, hopeful message for us, but getting to the shore can be especially difficult for those with disabilities."

Parking and signage are Lombardi's biggest concerns. "There are a lot of sites in Warwick that are road-end rights-of-way, but there are no signs, you can't easily access the shore, and abutters make you feel intimidated if you don't know your shoreline rights," he said. "People think you're suspicious for being there, and if the right-of-way isn't clearly delineated, those abutters can convince you that you shouldn't be there."

Lombardi spends much of his free time learning about coastal access issues, advocating for the needs of those with disabilities, and visiting public rights-of-way to take photos and share them with officials who can take steps to address any necessary deficiencies.

"The Coastal Resources Management Council can only do so much," Lombardi said. "To fix the system, we're probably going to have to deal with the state legislature. Things need to change on a political level to resolve this issue."

State legislators are beginning to listen.

Rep. Terri Cortvriend, a Democrat who represents Portsmouth and Middletown, originally became interested in coastal access as a way of addressing sea level rise and climate change, but she soon became fascinated with the historical aspect of the issue, the many court cases, and the constitutional convention. She initially tried to resolve the issue by amending the state's trespassing laws so those who unintentionally cross onto private property by less than 10 feet above the mean high tide line would not be prosecuted. But that approach ultimately failed.

So she teamed with Republican House Minority Leader Blake Filippi to introduce a bill to establish a legislative commission to study coastal access rights, which passed the General Assembly at the end of the 2021 session. The commission, which is focusing exclusively on addressing lateral rights along the shoreline, held its first meeting on August 26. According to Cortvriend, the group of 12 appointed members is scheduled to issue a report with its recommendations by March 31, in time for legislation to be introduced before the end of the 2022 legislative session.

"We need to come up with something that the average person can see, and it shouldn't be under water," Cortvriend said. "If we don't do anything, people will continue to argue. We have this constitu-

Matunuck
Photograph by Cate Brown

Shoreline access in North Kingstown's Wilson Park was recently added to the state's official rights-of-way by the Coastal Resources Management Council.
Photograph by Rhode Island Sea Grant

tional amendment but no legislative action taken. So we tell Rhode Islanders that they have this right, this privilege to the shore via the constitution, and we rely on a court case to determine where that is. I don't see a way that it changes without some kind of legislation to more clearly define it.

"We've got some coastal scientists studying where the mean high tide line is right now, bringing their equipment to the same spot on Matunuck Beach and measuring where that line is," she added. "The fact that you need to have fancy equipment to determine where it is at any particular time makes it clear that the common person walking along the shore won't know where that spot is, especially along the dynamic shores in South County."

The outcome of the commission is being watched closely, not only by coastal access advocates but also by waterfront property owners concerned that legislation may infringe upon their property rights. While noise and litter are frequently cited by property owners as reasons to oppose expanded access to the shore, many are especially worried that the trespass legislation originally filed by Cortvriend could be reintroduced, and they see it as an unconstitutional taking of their property.

Last spring, a number of waterfront property owners—including private individuals, nonprofit organizations, and commercial businesses—formed a group called Shoreline Taxpayers Association for Respectful Traverse, Environmental Responsibility and Safety, or STARTERS, to lobby against the legislation.

"That legislation could come back, or the study

The public may enjoy rare urban opportunities to walk coastal trails or fish at Save The Bay's center in Providence.
Photograph by Rhode Island Sea Grant

commission could find that the statute is the best way to address the issue," said lobbyist Christopher Boyle, who represents STARTERS. "We acknowledge the long history of constitutional law as to the rights to the shore and the right to traverse the shoreline, but the question becomes, where does public land end and private property begin. That specific statute would shift that line by at least 10 feet onto private property. We argue that would come under the 'taking' clause of the Rhode Island and federal constitution, and, if passed, the property owners would have to be compensated."

Compensation for property owners isn't on the minds of most residents trying to get to the shore. For some visitors, the issue is more about social justice instead. Despite the increasing numbers of officially designated coastal access sites around the state, considerable disparities remain among different demographic groups seeking to access the coast. Data from a study by the Environmental Protection Agency (EPA) suggests that Caucasian people have easier access and need travel a shorter distance to get to clean and safe coastal waters than those of other racial and ethnic groups.

According to Leah Feldman, CRMC's coastal policy analyst, the report's findings note an "obvious and distinct difference" in coastal access. "There's a large vocal group of Rhode Islanders who are pushing for protection of public access rights," she said, "but it's important to highlight not only the basic public access structure but also the underserved voices that may not be heard."

While she said that the disparities aren't a clear-cut distinction between urban and suburban access—since inequities occur in many communities—she notes that CRMC is giving more attention to coastal rights-of-way in urban areas. In fact, the agency's most recent right-of-way designation was at the end of Public Street in South Providence. Ownership of the property had been unclear for many years, leading abutting commercial and industrial property owners to encroach on one of the few shoreline access points in the area.

When the property ownership was clarified last summer and CRMC designated it a public right-of-way to the shore, local residents celebrated. Linda Perri, president of the Washington Park Neighborhood Association, told the *Providence Journal*, "We in South Providence are severely landlocked, and we are in a terribly polluted area, [but] hopefully this will unlock us and give us public access to the water."

While more rights-of-way in urban communities will improve shoreline access for minority residents, it will not necessarily get them to clean, swimmable waters, which is the point of the EPA report.

"At the moment, the focus is on providing more access points," said Feldman. "We're working diligently to improve the cleanliness and safety of the water, too. Our partners, like Save The Bay and the Department of Environmental Management, have done incredible work to improve the quality of water, even in more urban areas. And we're working to improve the parking infrastructure at the rights-of-way we currently have. The Department of Transportation is also putting forward impressive efforts to improve public transport to coastal areas, like the free beach bus to Newport."

Despite the popularity of the beaches in the Newport area, however, public access to the shore in other parts of Aquidneck Island may be more limited than anywhere else in the state. The western shoreline of the island from the Newport Bridge to the Mount Hope Bridge in Portsmouth has not one state-designated right-of-way, and the east side has just two rights-of-way north of Third Beach.

That's a major sticking point for Dave McLaughlin, founder of Clean Ocean Access, a nonprofit group based in Middletown that advocates for increased coastal access, the cleanup of marine debris, and improved water quality around Aquidneck Island. A surfer and former IT consultant, he took up the cause of shoreline access in 2006 after being told he had parked illegally while surfing in Newport. As he fights for additional access points around the island, he is also leading the way in serving as a steward of existing rights-of-way.

"You can lose your rights quickly if you don't use them," he said, "so a huge part of our program is to get people out to the rights-of-way to use them. We encourage people to pick a right-of-way and walk it every week for the rest of their life."

His organization has formally adopted 31 rights-of-way on Aquidneck Island, keeping them clean and well-maintained throughout the year. McLaughlin has also helped the recreational fishing community protect access points around Newport's Ocean Drive. Despite the positions taken by Clean Ocean Access, McLaughlin also understands the perspective of coastal property owners who seek the tranquility of living on the shore and their desire to avoid having anyone walk behind their house.

"Public access is a very volatile issue, and all it takes is a couple bozos who leave litter and play loud music at all hours to ruin it," he said. "If I were a waterfront owner, I wouldn't want those people there either. So we have to find a balance between recreation and accommodating the property owners where you're doing it [recreation]."

Just like in Narragansett, however, achieving that balance varies widely from place to place.

On Esplanade Road in Middletown, for instance, where "no parking" signs are abundant, a well-marked right-of-way crosses a beautifully manicured lawn and ends after 30 feet, where attractive plantings block a 10-foot rocky cliff that prohibits visitors from getting to the water. The abutting neighbor calls it a "view access point" that was never intended as a site to enter the water. [1]

One hundred yards away, a second well-marked right-of-way is a narrow, overgrown path bounded on both sides by the concrete foundations of abutting houses. At the water's edge, visitors have nowhere to go and no way to enjoy the site. Another hundred yards further and the road becomes Shore Drive, which appears to be a private gravel driveway for several elegant homes. A sign indicates a public access point, and the right-of-way is clean and easy to traverse, but there is no parking anywhere nearby.

"The limitation here is the approach," said McLaughlin. "It gives the sense that it's private. There's a public right-of-way without obstructions, but it's really only accessible to the neighbors."

A short drive away, an access point on Tuckerman Avenue offers a 30-foot-wide corridor accessible to vehicles, but stormwater runoff has made the dirt road a rutted mess that should only be attempted by high-clearance, four-wheel-drive vehicles. Next to the nearby Clam Bake Club of Newport, a right-of-way to Easton's Point popular with surfers is very overgrown and surrounded by "no parking" signs.

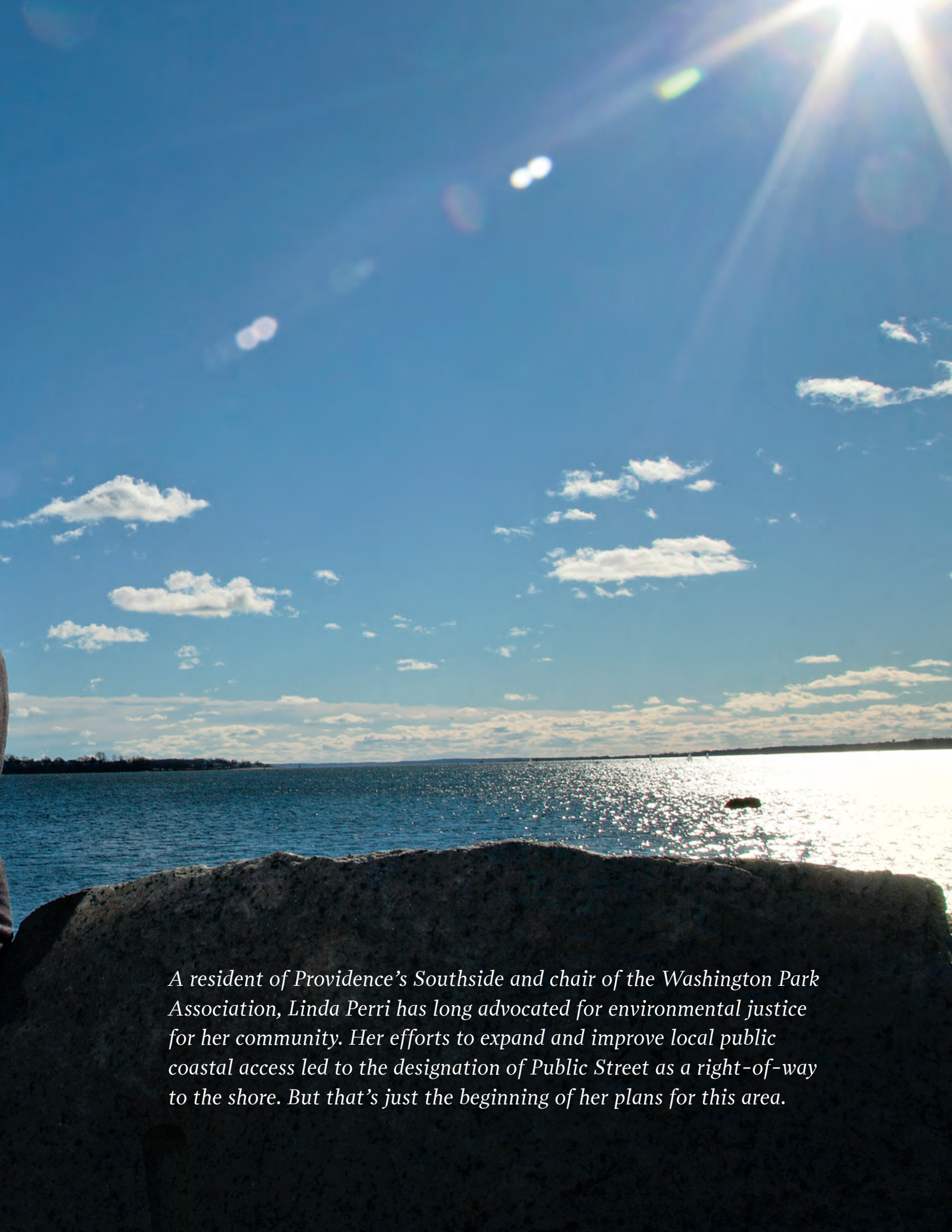
At every one of these sites, visitors could rightfully question whether the rights-of-way actually provide public access to the shoreline. Despite the considerable progress that has been made toward the state's goal of providing shore access points for every mile of the coastline, there remains much work to be done.

[1] *Editor's Note: The CRMC ArcGIS map of rights-of-way, which includes accompanying legal documentation, indicates that this right-of-way was originally a path to the shore, and not merely a visual access point. See http://www.edc.uri.edu/crmc/row/middletown/y-5.pdf*

SOUTH PROVIDENCE'S "SLICE OF WATER ACCESS"

by **Amanda Valentine**

Linda Perri portrait by **Dana Smith**



A resident of Providence's Southside and chair of the Washington Park Association, Linda Perri has long advocated for environmental justice for her community. Her efforts to expand and improve local public coastal access led to the designation of Public Street as a right-of-way to the shore. But that's just the beginning of her plans for this area.

THE END OF PUBLIC STREET, JUST OFF ALLEN'S Avenue in South Providence, earned its permanent protection as a Coastal Resources Management Council (CRMC)-designated shoreline right-of-way this past summer. But securing public access is only half the battle—making it attractive and usable is the other.

In such a densely urbanized area, every mile is subject to the pressure of many competing interests.

"The Coastal Resources Management Council has a goal, which we support, of having at least one public access point for every mile of shoreline in Rhode Island," said Jed Thorp, advocacy coordinator for Save The Bay. "Right now, we have 225 or so public access points. But a lot of those access points aren't in the metro Providence area. So, we have this neighborhood that's very densely populated—probably the most densely populated neighborhood in the watershed—but [with] a real lack of public access locations."
Using data from the American Community Survey 2012-2016, Julia Twichell, formerly watershed and GIS specialist for the Narragansett Bay Estuary Program, in collaboration with Kate Mulvaney, social scientist for the Environmental Protection Agency (EPA) Office of Research and Development, found that "there are state-wide inequities in coastal access opportunities associated with race and ethnicity."

Their analysis examined Rhode Island's public access through the lens of distributional justice, or the concept that both the benefits and burdens of environmental resources should be distributed fairly among all people, regardless of their race, gender, income, ethnicity, or other factors.

"A lot of the research that's been done so far is focused on disamenities … pollution, contaminated sites [and] environmental hazards," said Mulvaney in a webinar on the topic. "But when we're thinking about distribution of resources, it's also the good things, so parks, and other types of green space, where we put our restoration projects and money for restoration … and then also coastal access."

This imbalance in public access isn't random, says Elmwood educator and activist Doug Victor. Rather it's a result of decades of chronic marginalization.

"It goes way back, because all of this was Native American land at one point, and Native Americans who used to fish there, and have access to do their worship rituals there, traditionally, were cut off from access," Victor says. "All the other legacies are piled on top of that legacy. One of the legacies, I believe, is that of corporate America and how it has conducted itself and continues to conduct itself."

Slater Mill, a water-powered textile mill in Pawtucket, is often cited as the birthplace of the American Industrial Revolution. As textile manufacturing grew in Rhode Island, so did the local need for special metal tools, prompting the addition of metalworking businesses to the state. According to *Metal Inputs to Narragansett Bay* by Scott Nixon, former Rhode Island Sea Grant director and University of Rhode Island professor of oceanography, "The development and dramatic growth of textile manufacturing in Rhode Island and throughout the Blackstone River Valley is likely to have resulted in the first major increase in the addition of metals to Narragansett Bay."

Following decades of industrialization, controlling the significant byproduct expelled by waterfront manufacturers proved necessary for both environmental and human health. With the creation of the Clean Water Act of 1972, the EPA developed the National Pollutant Discharge Elimination System. Both the national system and its Rhode Island branch, the Rhode Island Discharge Elimination System, seek to reduce water pollution by regulating the specific places, known as point sources, where pollutants are discharged into the water.

But recovering from centuries of pollution is intensive work. The EPA currently lists 12 of Rhode Island's hazardous waste sites on its National Priorities List, seven of these being in Providence. The Toxics Action Center reports that "Providence has twice the national poverty rate and more hazardous waste sites and power plants than any other city in the state. The urban areas of Rhode Island are often the most overburdened by toxic pollution."

As commercial businesses gradually crowded the waterfront, access to the water became increasingly scarce. Where Providence residents could reach the water, it was in their best interest to stay dry—through the late 1900s, the Providence River had been an open sewer.

"Back in the 1990s, we were part of a taskforce on addressing the raw sewage overflow issue," recalls Topher Hamblett, director of advocacy and policy at Save The Bay. "I remember back then, sitting around this table of community people, and there were some voices at that table that were saying, 'we can't afford to do this. These are urban rivers, and that's just the way it is. You live in an urban area, too bad. We have other priorities in the state.' And we reflexively just fought back against that. Regardless of who you are, and where you live, you have a right to clean water, period."

The combined sewer overflow abatement project that began construction in the early 2000s dramatically improved water quality in upper Narragansett Bay, but other pollution problems remain for residents near the Port of Providence.

A fire last spring at an Allens Avenue scrap yard that had been cited for numerous pollution violations prompted a resolution by the Providence City Council calling for improved environmental oversight of port-

Public Street is one of the few designated rights-of-way in Providence thanks to the efforts of the Washington Park Association. Photograph by Monica Allard Cox

area businesses that Councilman Pedro Espinal said in a statement "continue to pollute our neighborhoods and potentially our waterways."

"The industrial conglomerate … [is] trying to get away with anything they can get away with," says Linda Perri, chair of the Washington Park Association.

Perri was described by her colleague Victor as "Grand Central Station" for the concerns in her community, contesting any threats to her community's rights and amplifying the voices of many.

One of her community's concerns has been public shoreline access, and her advocacy helped lead to CRMC's designation of Public Street as a right-of-way.

"We that live on the other end of Public Street, south of Public Street—there's been this invisible line, so to speak, that we don't matter. We don't get public access, we don't get waterfront access, because we're in South Providence," says Perri. "But that changed recently when the Attorney General advocated for us and CRMC [did]. And we got our little slice of water access."

"Identifying more opportunities for public access in places like that is very challenging, and I do think part of that is … a mindset," adds Thorp. "It's challenging to get decision-makers to think differently about a place like the Providence waterfront."

This changing mindset includes a dedicated effort to listen and get to know community members, rather than implement policy from afar. For Leah Feldman, a policy analyst at CRMC working on public access for the agency, equitability is defined by face-to-face conversation.

"It's a matter of not just dropping right in and then leaving, but instead, spending time with the community, figuring out what the rights-of-way are used for predominantly and what kinds of things need to be done to maintain the safety and the wellbeing of the right-of-way," says Feldman. "How many languages should the right-of-way signage be in? What kind of languages are predominant in this neighborhood? What kind of uses are predominant in this neighborhood?"

With this approach, Feldman hopes to work with urban and disadvantaged communities and partners like Save The Bay to not only restore public access but ensure that it is attractive and usable.

While plans for enhancing Public Street are still in early stages, Thorp and Perri have concrete ideas for next steps. Thorp points out the L-shaped unworked plot of land next to Public Street and behind the salt pile and suggests that if the city could somehow acquire use of part of that property, it could be transformed into a green space with picnic tables and other amenities for visiting families.

"Little by little, you know, step by step, I feel that we're taking back our area," says Perri.

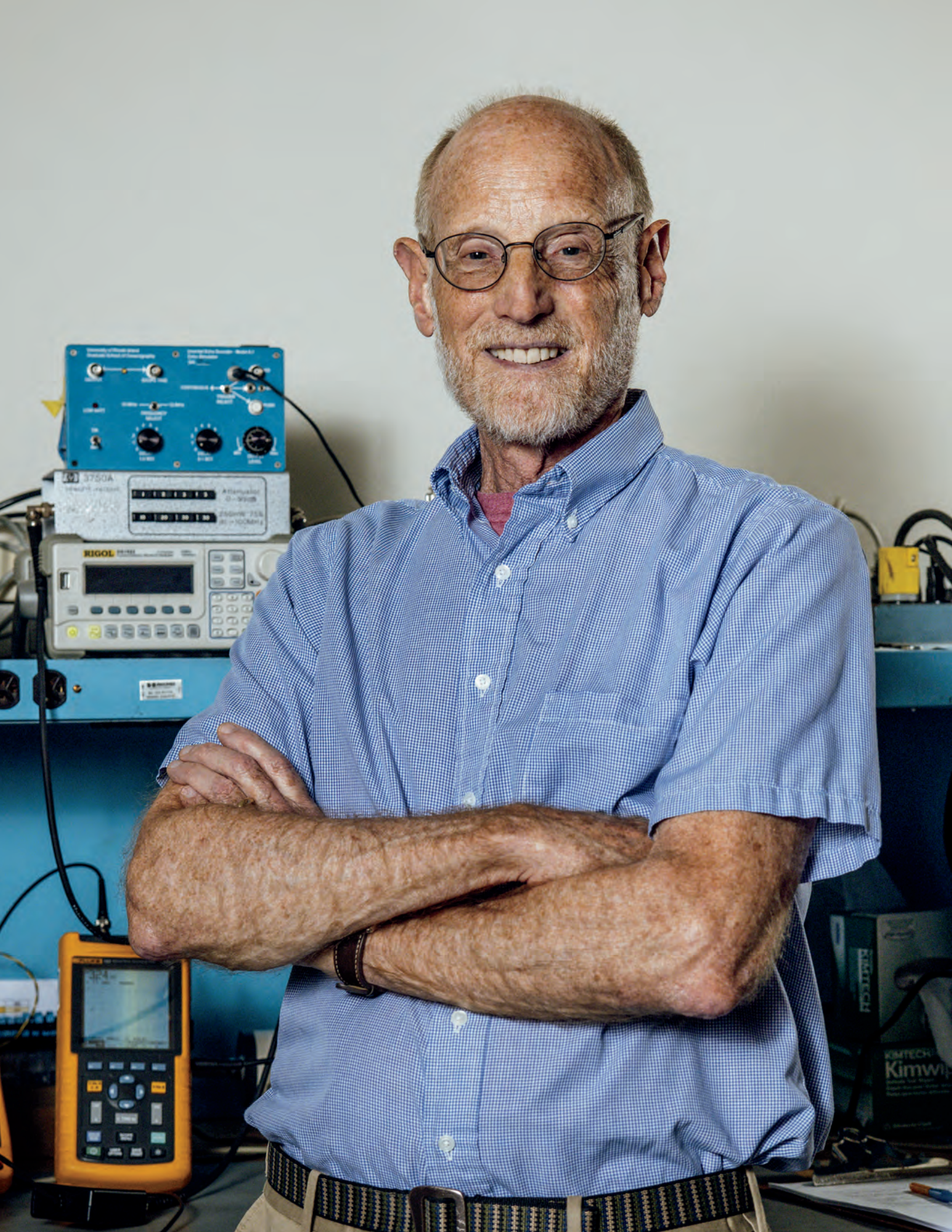
BUILDING AN OCEAN EXPEDITION

A BEHIND-THE-SCENES LOOK AT WHAT IT TAKES TO DO OCEANOGRAPHIC RESEARCH

by **Hugh Markey**

Photographs by **Jesse Burke**

Oceanographer Randy Watts leads a team of experts preparing tools to study underwater storms.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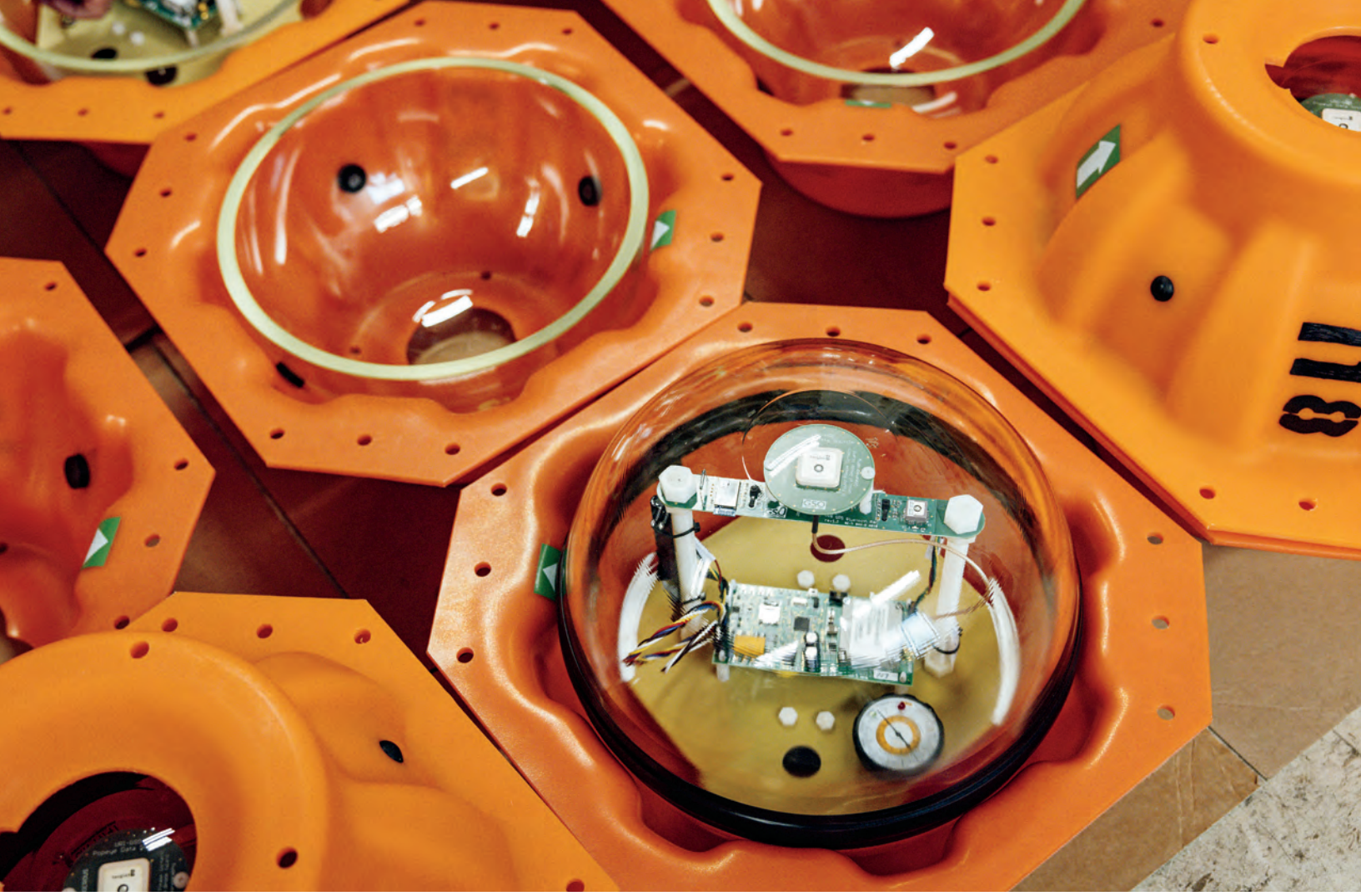


These glass globes protect instruments from water pressure at depths of nearly 20,000 feet.

WHEN WE THINK ABOUT SCIENTIFIC EXPLORATIONS of extreme regions like the Antarctic, we often picture researchers braving the elements aboard a high-tech oceanographic vessel. We may give little thought to the mechanical engineering—and the carpentry, plumbing, and electrical work—needed to make the instruments function in freezing conditions and under the tremendous pressure of the deep ocean. But a successful research expedition relies on the skills—and grit—of a varied host of experts.

PART ONE: The Prof

University of Rhode Island Professor of Oceanography Randy Watts is standing in a room the rough size and appearance of a storage closet. On the gray aluminum shelves rest dozens of electronic units that resemble nothing so much as high school science fair projects. These instruments are in varying stages of teardown, testing, and rebuilding for making a trip of some 10,000 miles for deployment in the Southern Ocean to study underwater storms.

Watts explains: "In the ocean, underwater 'storms' cause strong currents with pressure and temperature changes from sea surface to sea floor, much like happens in atmospheric storms. Currents like the Gulf Stream meander in wide sweeping paths as a dramatic aspect of the underwater storms. This is analogous to how the atmospheric jet stream meanders as it crosses the USA, bringing many different weather patterns. Surface currents affect shipping. Subsurface and deep currents affect commercial fishing and can pose risks to offshore oil and gas operations."

Watts says that measuring the variability of pressure on the sea bottom helps scientists map these underwater storms, analogous to the familiar behavior of high- and low-pressure systems in the atmosphere.

"We determine how the oceanic temperature profiles change by transmitting a ping of sound upward from the ocean bottom to reflect off the sea surface and measuring the round-trip travel time for the echo to return," he says. "The speed of sound in sea water changes with water temperature and density."

Watts and his team will be using an instrument called CPIES—a combination of current meter, pressure sensor, and inverted echo sounder—to determine how ocean current, pressure, and temperature profiles vary over time in the Antarctic.

PART TWO: The Mech

Erran Sousa, URI marine development engineer, stands in the tiny workspace next to Watts.

"Randy's role is the science, and my job is to implement that. Then when the instrument collects the data he wants, I get it back to Randy. So I'm kind of in the middle of this." In essence, Watts and Sousa operate in two rooms. Watts makes the decisions about what type of information he would like to obtain. He then meets with Sousa, who must be familiar enough with electronics to be able to select the right pieces.

"Really, I don't know what Randy does. But I don't think I have to, because Randy and other scientists come to me and say, 'Here's what we want [the instrument] to do.' Then I say 'Okay, I'll work on it.' Then it's my job to figure out how to do that. And really, the scientists don't know what I do either."

While it may seem interesting to be responsible for building scientific instruments, there's a lot of pressure as well.

"There's a lot riding on this beyond the cost of the instruments: there's also the cost of taking the ship out and putting them in the water," Sousa says.

And his job isn't done once the research vessel leaves the dock. "We have piles of folders and check sheets that we run through when an instrument comes back," he adds.

He shows one of the folders with diagrams and dates. "These go back to when the instrument was first constructed back in 2003. We do that because we don't really have many chances to get it right."

"We test these to death and make sure we're really confident before they leave. Sometimes it drives Randy crazy because I'll create delays and push the time a bit, but that's how we make it right." After all, he says, "It's good when things work; when they fall apart, it's miserable."

This expertise has value for scientists at other institutions as well—Sousa says that instruments built at URI are sold to researchers around the world.

Another part of Sousa's job is to keep up with the thousands of new hardware components that come out every year. This familiarity informs his creativity as he searches for ways to accomplish tasks that are both effective and economical. Sousa explains: "To withstand water pressure at depths of nearly 20,000

Erran Sousa is the mastermind behind the technology URI oceanographers deploy around the world's oceans.

Laura Reed prepares units to measure currents, pressure, and temperature in the Antarctic Ocean.

feet, the instruments are surrounded by a thick glass globe. The challenge was that the globe would have had to have a hole drilled through it to accommodate a wire to allow for satellite communications." That alteration would have cost $400 per globe (and there were many globes). Then Sousa hit upon a better idea—using a Bluetooth module. The cost? $20.

"Some components are from those invented for phone tech, such as the Bluetooth. In other cases, [we] are using chips and micro SD cards designed for home computing, since there is enough programming on them to be useful for [the scientists'] requirements without the added expense of having to have another company fabricate a part especially for them."

PART THREE: The Tech

The next lab used to be a poorly lit, dingy garage. Laura Reed has since renovated her workspace into a much cleaner, brighter room. Reed is a marine research specialist, known informally as a tech, and will be joining Watts on the voyage. "I've been at this program for five years. It's my job to put units together, test them, deploy them, and recover them."

The already-limited floor space is a maze of CPIES in varying stages of preparation for deployment. Each one is placed in a white or orange hard-shelled container. The glass globes look like inch-thick salad bowls, and when seated in the containers, they resemble Sputnik satellites.

"I've always been a technician at URI, and I've had lot of different responsibilities, which helped prepare me for this." Prepping the CPIES units for submergence deep in the Southern Ocean is a first, though: "I've never done anything exactly like this." Reed credits past work with Habitat for Humanity and as a carpenter for developing her ability to manipulate a variety of instruments.

Reed sits beside a circular table that looks a bit like a potter's wheel, a tool to aid in sealing the two glass halves that make up the unit. Any air inside it is evacuated. She slowly spins the globes around while wrapping an adhesive tape where the two halves meet.

From there, Reed puts the instruments through their paces. Some sit on a covered workbench, being

Ali Johnson is getting hands-on experience preparing for, and participating in, an Antarctic research voyage.

pressure tested. Others are placed in a walk-in freezer, temperature set for the 2°C (36°F) chill they'll encounter as they sit on the pitch-black ocean bottom. Watts says that these are built to last. "In the early days, it was a big deal to moor anything longer than two months and be able to get it back. In the last 15 years, it has become typical to deploy CPIES for two to five years. Their battery packs and low energy drain and corrosion-free design give excellent success rates," he says.

PART FOUR: The Grad Student

Thousands of miles travelled in tight quarters, rolling seas, icy conditions: perhaps not the ideal holiday cruise. Plus, there's grunt work to be done, pitching in with some of the less glamorous aspects of a research expedition. And for grad students, there's an additional challenge.

"Sometimes graduate students tend to work sort of the tougher shifts. I think that [scientists] like having graduate students along who will be willing to maybe work the overnight shift," says Ali Johnson, who will be deploying the instruments, potentially retrieving them in three years, and participating on the team that will process the data, which will become part of her Ph.D. thesis.

Still, Johnson says, she looks forward to the voyage as a learning experience.

"I think some of us as graduate students, our goal is to be the Randys and the Kathys of the world," says Johnson, referring to her advisor and URI Professor of Oceanography Kathleen Donohue. "And we can't get there if we don't learn somehow. So as an observational physical oceanographer, it's important that [I] have this experience working with the instruments and learning how to put together a field experiment, and the resources you need, the people you need, all of that."

This, she says, is everything she wanted in a graduate career.

"When I was thinking about coming back to school and doing this program, one of the things that attracted me to working with Kathy Donohue and the CPIES group is that this was a collaborative effort between all these different people … and that's part of the reason why I'm so excited to be going on this cruise."

PART FIVE: The Team

As a youngster, Randy Watts looked at trash collection days as an adventure. He would prowl the neighborhood searching for old radios, TVs, and other electronics. He'd haul them home and putter with them, learning about what made them tick. Then, in grad school, he focused on becoming a low-temperature physicist. To do the type of research he needed, often in temperatures that were close to absolute zero, Watts created some of his own equipment. Courses in electronics helped him, but there was a steep learning curve.

"I had to become a decent plumber, in a way, and a machinist because we might have to machine down the different flanges that we'd work with and then solder them onto stainless steel surfaces. They had to be really, really tight. I had to be a bit of a plumber, an optician, and an electronics person since most of the electronics couldn't be bought off the shelf. You got into a whole lot of things to make this equipment work."

Dramatic advances in electronics and science procedures have meant that Watts now relies on the diverse expertise of his colleagues rather than continuing to try to be a jack-of-all-trades.

"It used to be that [the instruments] were simple enough to solder them right here, but now they have to be done by machine."

It's one example of many where Watts emphasizes the most critical element in putting together a successful science expedition: "This really is a team effort here. There are an awful lot of people making this happen."

Saving an Endangered Species and Iconic Fishery

by **Meredith Haas** Contributions by **Hugh Markey**

THE U.S. COAST GUARD CUTTER *ESCANABA* WAS transiting through Cape Cod Bay, seemingly alone, on a calm and cloudy day in late summer 2011. It was mid-day when a dark head with the distinguishing rough white patches of the North Atlantic right whale broke the surface not far from the 270-ft vessel. Then another whale appeared with a quick spout of water from its blowhole followed by a broad, deeply notched tail flicking the water. Not long after crew members had spotted the first two did more arrive, their dark, stout bodies breaching the water, says U.S. Coast Guard Lieutenant Commander Lennie Day. It was his first experience with North Atlantic right whales, and it was a bit disconcerting.

"There were so many around us … it was uncomfortable," he says. "For us to protect them, we secured our engines completely and drifted, turning on the engine only as needed to stay away to make sure they were safe and that we were safe."

Protecting right whales can prove challenging at times, he says, because the animals are curious creatures, and Cape Cod Bay, the southernmost region of the Gulf of Maine, is a known feeding ground. "If they're in the area, they will actually come up around the ship … [they] don't see you as a threat."

Day has witnessed many types of marine life interactions on the water since joining the Coast Guard in 2005, working in both the Pacific and Atlantic oceans. But unlike species that spend time offshore, North Atlantic right whales hug the seaboard as they migrate between Florida and Canada. This, combined with the whales' slow speed (averaging 6 mph) and their close proximity to human activity, makes them more vulnerable to ship strikes than other species.

"There's no way you're going to hit an orca with a boat. That's just not going to happen, ever. With right whales, their curiosity, I think, causes the threat to their mortality because they're trying to identify what

Right whale mother and calf
Photograph courtesy of Florida Fish and Wildlife Conservation Commission

things are," says Day, who describes feeling a deep sense of reverence when he first encountered these whales that day on Cape Cod Bay.

"I understood it was a threatened creature that I needed to preserve in some way … You're witnessing Earth's history, and part of that reverence is because you know there aren't many of them left, and you just don't know how long [the species is] going to last."

Right whales can grow to over 60 feet long and weigh up to 300,000 lbs. Their immense body mass makes them significantly heavier than humpback, sperm, and fin whales—ranking them only second behind blue whales—so it's no small feat for such large whales to leap out of the water in one of the most energy-expensive moves found in nature.

Waters from Florida to the Bay of Fundy serve as a major feeding, calving, and migration corridor for North Atlantic right whales. These whales were deemed the "right" whale to hunt by early whalers for their oil and baleen because of their slow mobility, docile nature, and habit of feeding at the surface. By early 1900s, their numbers had been reduced so much that they were no longer economically viable to target. When the species was protected from international whaling in 1935, it was estimated that fewer than 100 individuals were left.

Today, the North Atlantic right whale is still one of the most critically endangered species in the world with fewer than 350 individuals, nearly a quarter of which are reproductively active females, according to the National Oceanic and Atmospheric Administration (NOAA). Despite protection under both the Marine Mammal Protection Act and the Endangered Species Act, their numbers have dropped by 30% in the past decade. And because of their long gestation period and low birth rates in recent years, a loss of even a single individual is a blow to recovery efforts and brings the species closer to extinction.

"One of the major sources of human-caused mortality for right whales is getting run over by ships. The other is getting tangled up in fishing gear," says Robert Kenney, emeritus marine research scientist at the University of Rhode Island's Graduate School of Oceanography and one of the co-founders of the North Atlantic Right Whale Consortium—an international organization dedicated to the conservation and recovery of the species.

In addition to lethal ship strikes, right whales are vulnerable to becoming entangled in fishing gear—specifically lobster/crab traps and gillnets—that can cause serious injury and impede their ability to swim, eat, and reproduce. These incidents, along with changes in their primary food sources (copepods and krill) due to climate change, have also forced whales to travel farther for food and closer to shipping lanes, causing them to be thinner, unhealthier, and more vulnerable.

This multitude of stresses has fundamentally changed the whales' morphology. A North Atlantic right whale born today, according to a study published in the journal *Current Biology*, is expected to be one to three meters shorter than a whale born in 1980. "Whales that can't find enough food and live stressful lives … aren't going to grow well," says Michael Moore, a marine scientist from Woods Hole Oceanographic Institute (WHOI). And if these whales are less healthy, they're less likely to calf, further contributing to a dwindling population.

"We have a moral duty to not allow them to go extinct because of us. They have as much right to exist as any animal," says Kenney.

Slow Down

To reduce collisions with ships, the National Marine Fisheries Service (NMFS) established 10 seasonal management areas where whales are known to be that prohibit ships 65 feet and longer from traveling faster than 10 knots. Dynamic management areas were also established as voluntary zones, which recommend, but do not require, that all vessels stay below 10 knots when there are sightings of whales. Speed restrictions, if complied with, have been found to reduce a whale's risk of death from collision by 80% to 90%.

One of Day's jobs is to assist NOAA in enforcing those regulations for the U.S. Coast Guard District 1, which extends from New York to Maine.

"If there is a migration [or congregation] of whales, NOAA will put out an area where they want us to enforce speed restrictions," he says. "We can enforce where we have our stations, or if it's a larger boat with an AIS [automated identification system] that we can track. With our smaller boat stations, or if a cutter is out, we can slow vessels down by communicating on radio."

Fines for violating speed restrictions can be extensive (ranging from several thousand up to $50,000 for multiple infractions) but are very rarely issued, according to Day. "There's not a lot of commercial traffic through Cape Cod Bay that's going too fast or doesn't understand. Boats I see going fast are usually smaller boats, not large commercial vessels."

But smaller boats can still cause serious harm, according to a recent study from Oceana, an ocean conservation organization. The report noted that a right whale calf died early last year from propeller wounds, broken ribs and a fractured skull following a collision with a 54-foot recreational fishing vessel. Analysis of vessel compliance with speed restrictions between 2017 and 2020 found that noncompliance in voluntary zones has climbed in recent years. Over 70% of ships traveling through southern New England voluntary zones were found traveling above the 10-knot speed limit.

While Oceana's report highlights a potential concerning trend, compliance with speeding restrictions has proven effective in the past, making a case for enforcement assistance and boater education. But as commercial fishing increases in areas where whales forage, scientists are finding that entanglements are taking a toll not only on the overall numbers, but also on the animal's wellbeing.

Entangled

Moore, a veterinarian and director of the WHOI Marine Mammal Center, is one of the few experts called to respond to whale strandings and entanglements along the East Coast. He says that in 20 years of performing hundreds of necropsies on diverse marine mammals, he's found that lethally entangled right whales have taken six months, on average, to succumb to their wounds, which "range from lacerations into the blubber down to the muscle, or around bony structures such as the upper jaw and flipper, or the peduncle of the tail."

"As a veterinarian, it's the most horrendous case of drawn-out trauma I've ever witnessed," he says. "I'm not saying it's intentional; it is something that's out of sight, out of mind for the consumer and largely to the industries involved as well because they don't see all of this."

Fishing gear, such as gillnets or lobster and crab traps that have vertical lines of ropes extending from the seafloor to surface buoys, have been identified as the primary cause of death for over half of North Atlantic right whales that often drown or die from starvation or injuries. New England Aquarium scientists have estimated that 85% of right whales have been entangled at least once, and 60% have been

entangled multiple times based on scars observed on their bodies. This comes with a physiological cost.

In 2018, a male right whale named Ruffian was seen wrapped in nearly 500 feet of rope and dragging a 134-pound snow crab trap all the way from Canada to Florida. Scientists calculated that the lines wrapped around a whale's fins and body can increase drag by 160%, and that towing traps could more than double the load. They estimated that to swim with the extra drag and weight, Ruffian had to burn an extra 27,000 calories a day, explaining why he appeared significantly thinner than a typical right whale.

"The veterinary piece of my brain has been distressed for a long time about this particular story … it's extremely depressing to be seemingly powerless to do anything for animals I regard as my clients, my patients," says Moore.

Response teams that are part of the Center for Coastal Studies' (CCS) Disentanglement Network in Provincetown, which incorporates both NMFS and the Canadian Division of Fisheries and Oceans, as well as both countries' Coast Guards, have the difficult and dangerous task of trying to remove lines on a live whale.

David Morin, large whale disentanglement coordinator for NMFS, worked as a disentangler for CCS for seven years. One of the worst cases he recorded during that time was an entangled humpback whale. He pulls up a video taken from an underwater camera, providing a clear profile of what appears to be a normal and healthy whale swimming in the ocean until the tail comes into view. It's stark white, beginning where a fishing line has wrapped around it.

"The entanglement is so bad it basically cut off all circulation to the fluke," says Morin. "That part of the body essentially died and is just rotting off."

No Clear Path

To address the issue of entanglements in fishing gear, NMFS issued updated regulations earlier this year that require modifications of weak ropes, which are intended to break when a whale encounters them. The regulations also include two new seasonal closures—one in the Gulf of Maine from October to January and one south of Nantucket from February to April—which would only allow the use of "ropeless" gear. These changes come on the heels of a lawsuit, *Center for Biological Diversity v. Ross,* in which a federal court found NMFS in violation of the Endangered Species Act and and the Marine Mammal Protection Act when it authorized the American lobster fishery in 2014, according to a report by the Marine Affairs Institute at Roger Williams University School of Law. The lawsuit was filed in 2018 after an "unusual mortality event" resulted in the death of 20 right whales. In 2020, the court found that NMFS did not include an incidental take statement despite finding that the lobster fishery had the potential to harm endangered right whales at more than three times the rate at which the species could sustain itself. Incidental take statements provide estimates of the harm, harassment, or killing of a threatened or endangered species. The root of the problem, Kenney notes, is embedded in the structure of an agency that is at odds with itself, tasked with ensuring "productive and sustainable" commercial fisheries while also safeguarding endangered or protected species.

GARDENERS OF THE SEA

Whales are often referred to as gardeners of the sea for their ability to fertilize ocean waters both at the surface and in deep water across thousands of miles, fueling phytoplankton production and pulling carbon from the atmosphere and sequestering it into the deep ocean in what is referred to as the "whale pump." With high metabolic demands and large populations before industrial whaling, scientists say right whales had a strong influence on marine environments.

If right whales disappeared tomorrow, there are ecosystem services lost we may never realize, says Moore.

"Obviously right whales today have a relatively minor role in those services because of their low numbers, but it's not their fault," he says. "We don't know what we're missing because they've been gone for so long, but that doesn't mean we should have the arrogance to say that [their extinction isn't going to be a problem]."

Recovery for many whale species is underway and is still possible for the North Atlantic right whale, which could help buffer marine ecosystems from destabilizing stresses and support more robust fisheries where whales aggregate to feed and calve, according to a publication in the journal *Frontiers in Ecology and the Environment*.

"We do know there are obvious benefits to have the diversity, the activity, and the recycling these animals provide," says Moore. "They're tough animals. They'll do what they can do if we just give them half a chance."

A mother right whale trails a rope that she has been partly entangled in.
Photograph by Georgia Department of Natural Resources under NOAA permit #20556

A closure each fall is a four-month ban on the use of traditional lobster gear in nearly 1,000 square miles of water off the coast of Maine—impacting prime offshore fishing grounds for a $485 million industry, according to Maine's Department of Marine Resources. But before the closures could be enforced, a U.S. District Court issued a temporary injunction, siding with the Maine Lobstering Union's argument that there was insufficient scientific evidence to prove that whales are present in the restricted area and impacted by fishing gear. That injunction was then reversed on appeal, reinstating the ban.

"It only takes one or two right whales to have a problem in that area for a closure to be successful and significant," says Moore, noting that "a few weeks after the closure was nixed, [a mother and calf] were seen in coastal Maine, in addition to recent sightings in the region of the closure."

Fishermen are against these areas being closed, says Greg Mataronas, president of the Rhode Island Island Lobstermen's Association, unless there's an "abundance of data showing subsistent aggregations [of whales] like there [are] in Cape Cod Bay."

Regarding fishing gear and entanglements, Mataronas says, "Sometimes the data suggests that it's these larger lines [from offshore fishing] that are causing the damage to right whales, but then they will say there's more smaller lines [from inshore]. We need better data in order to formulate more effective and appropriate regulations."

According to Morin, the majority of the lines that are pulled off entangled whales are of unknown origin. "There are just a lot of cases [where] we don't know what the gear is," he says, pointing to the fact that only one third of deceased whales are ever recovered, or only a photograph or video can be retrieved to identify gear. And with an average of five right whale cases observed annually, researchers have too small a sample size to clearly discern which gear is causing the most damage or where it came from.

Many advocates argue that there isn't enough evidence to place all of the blame on the U.S. lobster industry when there are reported impacts from shipping, entanglements in Canadian fishing gear, and natural mortality.

While Morin agrees that ship strikes are also part of the issue, he says he can't remember the last time a mature right whale died of old age. "[Right whales] don't appear to die of natural causes. They don't live to their full potential because of ship strikes and entanglements."

Another issue, says Mataronas, is the development of offshore wind.

"The Vineyard Wind I project was just approved for Level B harassment of North Atlantic right whales, and that's any modification to their behavior," he says. "These industries are essentially getting free passes … If that's not hypocritical, I don't know what is."

Mataronas is referring to a NMFS "incidental harassment authorization" for the Vineyard Wind I offshore wind farm development that allows pile driving and other activities that disturb, but not seriously injure or kill, protected marine mammals.

The additional stresses from noise from construction and greater risk of ship strikes are concerns that regulators are still trying to figure out how to manage.

"Each wind turbine area might have as many as 50 vessels doing maintenance on it in some spots. That is a new stress that is coming, and we're going to have to manage [that] along with these other threats," says Sean Hayes, protected species branch chief for NOAA's Northeast Fisheries Science Center, in a recent article published by the University of Washington.

Costs

The proposed solutions to entanglement come at a hefty cost to the fishing industry.

"We feel unfairly blamed a lot of times," says Mataronas, explaining that while he feels that the media have portrayed fishermen in the trap/pot and gillnet fisheries as obstructionists to saving an endangered species, "everyone is making an effort [to protect these whales], sacrificing both financially and timewise. Modifying gear is all additional work and money, and additional time away from the family. It's tough on a personal level and then you get villainized [for not doing enough]," he says.

Mataronas, along with Kenney, are two of 60 members of NMFS's Atlantic Large Whale Take Reduction Team, which is composed of fishermen, scientists, conservationists, and state and federal officials from Maine to Florida. They helped NMFS develop a plan to reduce the level of serious injury and mortality of large whales in commercial gillnet and trap/pot fisheries. But not everyone is satisfied with the outcome.

"It's not easy having everyone reach consensus, and what we do [as regulators] is to try and have balance on all sides," says Marisa Trego, a mammal biologist with NOAA and the Atlantic Large Whale Take Reduction Team coordinator. "Some people are unhappy with the economics, even though we tried to strike a balance, and some people are unhappy with the conservation. It's really hard to walk that fine line."

For Mataronas, while the regulatory process can be frustrating, he appreciates that it is inclusive of all stakeholders. "There are times when it's frustrating; you feel like you're not being heard or [are being] pushed aside. But deep down, I feel like it's worth it."

Still, Mataronas feels that the socioeconomic impacts of the new regulations on fishermen have not been adequately taken into account. He adds that new rules changing the configuration of the weak ropes that are intended to break if a whale becomes entangled in them may be less effective in protecting whales while collectively costing fishermen millions of dollars

Since 2008, Mataronas says, inshore fishermen have been using rope with weak links at the buoys with a maximum breaking strength of 600 pounds. If a whale became entangled, the line would break and drop to the seafloor while the buoy floated for recovery later. Now, the requirements place weak links at every 60 feet of rope instead of at the buoy, but have strengthened them, making them harder to break.

"I cannot think of a more harmful thing to do to a right whale than to remove possibly one of the most effective things we've had," he says, explaining that while data show that adult right whales can break the new rope, freeing themselves, that may not be the case for smaller whales, such as juvenile right whales or even humpback and fin whales.

NOAA estimates that these new regulations, overall, may cost lobster and Jonah crab fishermen between $9 million to $20 million in added costs and lost revenues for the first year.

Lobstermen have also been encouraged to use ropeless gear. "Getting the rope out of the water is the only way to stop these entanglements," says Moore, who is currently working with engineers and fishermen to improve the technology. "But the biggest challenge is affordability."

Ropeless gear currently costs about $4,000 per trap, while a traditional trap is usually $80 to $180. This technology uses GPS and acoustic signals that can deploy a rope on demand for retrieval instead of using a fixed fishing line that hangs between a buoy on the surface and a lobster trap below. Mataronas doesn't think that the technology will work in the conditions he and other lobstermen fish in, and that the risk of malfunction increases the chances for undesirable gear interactions with other lobster boats and draggers.

Morin acknowledges these challenges. "We are asking the fishing industry to do a lot. There is a lot of out-of-pocket expense on their end, and I don't think that's fair," he says.

"It's a very difficult position that everyone is in, frankly. A critically endangered species that is tanking and a massive industry that tens of thousands of people rely on … it's an incredibly complex and difficult problem that doesn't have the level of resources to solve it," he adds.

"We're doing the best we can with what we've got, and time is not on our side for the fishermen or for the whales."

KELP ON THE CUSP

by **Ellen Liberman**

Photographs by **Jesse Burke**

POWDERED, PICKLED, OR BREWED, THE SAVORY SEAWEED MAY FINALLY BE HAVING ITS MOMENT

CATHERINE PUCKETT'S KELP FARM SPANS 2 AND a half acres of Block Island's Great Salt Pond. Eight longlines, suspended between moorings more than 500 feet apart, support her crop, undulating just beneath the water's surface. On this April afternoon, the water is a clear emerald green as Puckett casts off and pilots her distinctive teal and chalk-pink work boat from the Inner Basin of the Great Salt Pond, known locally as the Hog Pen.

New England Kelp Harvest Week has just gotten underway, and Puckett is racing to harvest 50 pounds of kelp in time for the 2 p.m. New England Airlines flight to the Westerly Airport, where Suzie Flores, who —with her husband, Jay Douglas—owns the Stonington Kelp Company, will pick it up for the festival's cooking demonstrations.

This is Puckett's fourth season farming kelp, part of a collection of sidelines familiar to many aqua-

culturists that adds up to a living. She motors past her 1-acre clam and oyster lease to the starboard and cuts the engine about a mile off Beane Point.

The daughter of a boat builder, Puckett was raised on the water, and she is doing the same for her daughters, Pearl, 7, and Luna, 5, who round out the crew. Puckett's interest in seaweed was born about the same time as her eldest child. She had just bought the Block Island Oyster Farm, where she had worked for 13 years, and a fervor for healthy eating had taken hold.

"Maybe it happened as I was walking the west-side beaches with my baby," she says, "But I had this powerful feeling that I wanted to grow seaweed. I went on a tear—I was buying seaweed online and cooking and experimenting with it and ordering stacks of books from the library about seaweed."

Five years ago, a casual conversation with a neighboring oyster farmer connected Puckett to GreenWave, a Connecticut-based nonprofit that helps prospective kelp growers with technical assistance, free seed, and connections to kelp buyers. After a year of education and permitting, Puckett put in her first crop.

She hauls up a heavy golden curtain of *Saccharina latissima* and admires the sugar kelp's ruffled fronds.

"Isn't it beautiful? I love the way it sparkles in the sunshine!"

There isn't actually much time for wonder. Harvesting is a low-tech enterprise featuring scissors or knives, slicing the stipe [the stalk of the seaweed] from the long line at speed. Highly perishable and temperature-sensitive, kelp must be kept cool on its way to a processor or a plate. The trio switches off cutting and bagging. Pearl and Luna clamor for a turn with the scissors, while their mother gently urges them along: "We've got a plane to catch!"

This afternoon is one in a succession of small harvests over five weeks before her lease is up at the end of the month.

"Growing kelp is such a joy," she says. "I put it out there in October and November, and I get to go out on my boat on the most glorious winter days, check my lines, and watch it grow. From this fuzzy line, you have these 2-inch plants and then a foot or two of kelp. In the spring, the growth is exponential. Every other week it doubles in size—it's really fun to watch. Kelp is the local-est, healthiest, environmentally positive food, and when I pull it up, I just love it so much. That connection with the ocean makes me so happy. It must have been the feeling that I was looking for."

Humans have been harvesting seaweed for centuries. They have eaten it, distilled it, composted it, and extracted its nutrients, fiber, and trace minerals for a wide array of uses. In 2020, the World Health Organization reported that 32.4 million tons of marine macroalgae was farmed. Globally, market research firms have valued the commercial seaweed industry at more than $14 billion in 2020. Yet, in the U.S., its footprint has been small. Seaweed aquaculture barely registers on the U.S. agricultural census, conducted by the U.S. Department of Agriculture (USDA) every five years. The 2018 report tallied only four farms—a significant undercount. The USDA's National Agricultural Statistics Service does not even include seaweed aquaculture production in its statistical data.

Dr. Charles Yarish, a University of Connecticut professor emeritus of evolutionary biology and ecology who has been conducting seaweed aquaculture research and development, says he knows of at least 40 kelp farms off the northern waters on both U.S. coasts and in Alaska, but there is no state-by-state tally marking the last decade's revived interest in kelp. A consortium of researchers, farmers, chefs, marketers, and processors has been trading ideas, developing better farming and harvesting practices, and making plans to put kelp on as many plates and in as many products as possible.

"People want a good healthy product that's readily traceable, but I think we still have a way to go in getting more public acceptance," Yarish says. "It is still a work in progress. It took a long time. Humans have been using seaweed for 15,000 years, and here we are in the last 70 years in an expansion of seaweed agriculture outside of Asia."

An ancient bond

"Kelp" is a very old word for an even older plant species. Marine algae (seaweed) show up in the fossil record dating back a billion years. Scientists have specifically documented kelp, a brown alga, in the Miocene Epoch, 23 to 5 million years ago. The name's

Catherine Puckett and her daughters Pearl and Luna harvest kelp together on a chilly spring day.

origin is unknown, but "kelp" came into existence in the 16th century to describe the ashy remains of burnt seaweed, which was used in soap and glassmaking.

The archaeological record has established kelp's presence in the diets of ancient Hawaiians, Icelanders, and Scottish sheep. And anthropologists now theorize that the first humans did not enter the North American continent via a land bridge over the Bering Strait. Rather, they arrived 16,000 years ago by boat, travelling from the Pacific Rim along the Kelp Highway to the Americas, sustaining themselves, in part, by using the underwater forests along the Pacific coast as a food source.

"It started 11,000 years ago. There was a population on the California islands, [and] we have archaeological evidence of them using seaweed in the kitchen—actually cooking it and eating it," says Michael Graham, a professor at San Jose State University's Moss Landing Marine Laboratories and editor of an academic journal about kelp, who has written about its history. "The knowledge gap between 11,000 years ago and now is pretty big."

In 1811, French chemist Bernard Courtois was searching for a new source of potassium nitrate, after the gunpowder demands of the long-running Napoleonic Wars had depleted the stores of wood ash from which the key ingredient—potassium—was extracted. Courtois turned to kelp residue, and in the process, became the first to isolate iodine.

A century later, kelp was again in demand as the raw material of ordnance. Germany, which controlled the world's largest supply of mineral potash, had stopped exports after the start of World War I, founding a brief but successful potash manufacturing industry using California giant kelp. The U.S. was the world's biggest consumer of potash fertilizer and officials feared that the German embargo threatened the nation's agricultural production. In 1914, 11 commercial kelp harvesters and processors sprang into existence on the California coast. The largest

was The Hercules Powder Company, which at the height of World War I was harvesting and processing kelp for potash and acetone, which the British used to manufacture cordite, a smokeless gunpowder. At the end of World War I, the demand for kelp abruptly stopped, and so did these businesses.

An exception was Kelco, which harvested and processed California giant kelp as an alginate—a natural gelling sugar used as a thickener and emulsifier. Founded in 1929, the San Diego-based company eventually employed nearly 800 people and operated a fleet of five kelp-cutter vessels to harvest the beds off Point Loma and La Jolla. Kelco extracted the algin to produce a line of powders used in 70 different products from ice cream to fabric dye to car polish. Kelco, sold and merged with a Dutch company, shut down its California operations in 2006. But turning kelp into alginate is now a global industry.

In the century since the Armistice, kelp aquaculture in the U.S. has proceeded in fits and starts, with small pilot projects dotting the coasts, as researchers studied kelp's potential as a biofuel and as a food. But each effort was stymied by a variety of obstacles, ranging from regulatory to public interest.

In the wake of the 1970s oil crisis, the U.S. government launched a research and development effort to develop kelp as an energy source. Under the Marine Biomass Program, the government developed and operated offshore kelp farms in New York and California in hopes of converting their biomass to methane. The program was discontinued after a dozen years. As a cheap energy source, kelp could not compete with fossil fuel, which geologists were sure was in plentiful supply. In 2017, the U.S. Department of Energy resumed its pursuit of seaweed as a biofuel, distributing $22 million in federal funds to 18 projects.

The Biomass Program laid the groundwork for today's aquaculturists growing kelp for food. Each small open-ocean kelp farm helped advance growing and harvesting techniques and equipment, leading to the first U.S. commercial operation in 2009, Atlantic Sea Farms in Maine. While the number of kelp farms has slowly proliferated in the last decade, experts say there are still substantial knowledge and regulatory gaps to fill.

"We know a lot more about farming kelp than about how to stabilize and process it," says Samantha Garwin, GreenWave's market innovation strategist. "There's a lot of unknowns around basic things—we don't know the best holding temperature or even the container that is the best for extending the shelf life of kelp."

It's an article of faith that kelp is good for the body and the environment (kelp absorbs carbon dioxide and releases oxygen), but exactly how is the subject of a lot of research: quantifying kelp's benefits as a soil amendment, developing it as an alternative to plastics, or identifying its properties as a health supplement.

"The infrastructure for production is underfunded, and until it gets to that point and seaweed is being produced everywhere, it won't be priced [low enough] to be better utilized. That's the point where people will be looking at it nutritionally," says Graham, who also raises seaweed in land-based, 1,000-gallon tanks as Monterey Bay Seaweeds, and sells his fresh, raw product to high-end restaurants—including the Matunuck Oyster Bar.

Government agencies, including the USDA, the National Oceanic and Atmospheric Administration (NOAA), and the Food and Drug Administration (FDA), have begun to invest heavily in seafood aquaculture, and Graham says, "We're just starting to do the science on the nutritional side, so that we can come to that chef with the facts and say, 'Look this is a low-carb, high protein food with these nutritional elements—this is why it's good for your clients.' We're not there yet."

Nor are there adequate safety standards governing seaweed as a food product, says Dawn Kotowicz, a coastal research associate with the University of Rhode Island's Coastal Resources Center and extension specialist with Rhode Island Sea Grant. Right now, seaweed falls in between the FDA, which regulates seafood safety, and the USDA, which sets federal organic standards—neither covers the sale of seaweed in its whole form. This uncertainty has slowed the development of state permitting rules. For example, New York State "allows kelp farming on specific bays, but it's not allowed in a broad way because there is no detailed federal guidance," she says. "Each individual state needs to develop their own. There's not a lot of consensus."

Farming on a string

In 2010, David Blaney retired from going to sea. A commercial fishing boat captain, marine surveyor, and safety consultant, he pursued a degree in marine affairs to prepare for his next career. He was working in a URI lab on eelgrass habitat restoration, when the research project leader "ripped up a handful of eelgrass. He took a bite—'You can eat this stuff.' I knew it was good on gardens and things. That really piqued my interest, although it took years for it to bubble to the top. I kept hearing more and more about cultivating seaweed."

Like most new kelp farmers in southern New England, he eventually connected with Yarish and GreenWave. The latter, founded by commercial fisherman Bren Smith in 2014, advocates a polyculture farming system that utilizes the entire water column with vertical layers of seaweed and shellfish, for maxi-

mum yield and sustainability with zero inputs. In seven years, GreenWave has trained more than 700 kelp farmers in its regenerative farming methods and maintains a waiting list of 8,000 applicants from all over the world.

Blaney was intrigued. He put his first crop in the Point Judith Harbor of Refuge in 2015 and produced a couple of tons but ended up "liberating" a lot of it. Over the next five seasons, Blaney refined his production skills. He now makes his own seed string by gathering native wild male and female kelp specimens and spawning new spores in fish tanks with carefully controlled water temperature and light. The operation runs from October, for spore production, to the harvest in May.

On a warm May sunrise, the water is flat calm, and Blaney's handmade dory is just about the only vessel rippling the surface. This was once one of the busiest and more dangerous points on the East Coast, Blaney says. At the turn of the 19th century, sailing ships and ferries had to take a hard right to continue northward, and the bottom is littered with their failures. Last November, a barge went aground off Point Judith, after the tug towing it sank. The surf pushed the 108-foot barge offshore, and eventually into Blaney's kelp farm. But, since then, the lines have been righted and re-moored, and his crop has matured nicely. With the harvest just a week away, Blaney takes a slow turn around the long lines to inspect the growth. The past two seasons saw great yields. But in 2020, COVID closed off the markets, and save for a small portion that Blaney dried in a greenhouse, several tons sank back into the water.

"This year we were approached by a company that will buy the whole crop, and I can retain whatever I want for my own purposes. It's not about making money right now—I'd like to, but I'm not in it to get rich at this stage of the game. I believe it will be an alternative for the fishing industry, which is stressed by industry pressures," he says. "It's all been an experiment to see what works."

In many ways, kelp's seasonal cycle is appealing. Farmers stake their lines in the late fall and harvest in the early spring. Then, the gear is collected, vacating the water just in time for the busy recreational boating season. Despite the felicitous timing, it's hard for newcomers to break in, and kelp remains a tiny portion of the state's aquaculture portfolio. Benjamin Goetsch, the Coastal Resources Management Council's (CRMC) aquaculture coordinator, says that Blaney and Puckett work the only independent kelp farms in Rhode Island waters.

"Many oyster farmers in the bay and ponds have kelp as approved species on their permit, but very few of them (if any) are currently producing kelp," Goetsch said in an email. "Farmers that use floating gear are able to incorporate kelp easily into their operation as they already have long line approved as part of their permit. Oyster farmers often get interested in kelp as a way to diversify their crops and give it a try but do not continue because they do not find it to be a profitable endeavor."

Puckett sees kelp as a way to practice restorative ocean farming, promoting healthy ecosystems.

Azure Cygler, who currently subleases 1.6 acres on an existing oyster farm in the bay's East Passage, points to the strong and well-organized opposition that has become familiar to prospective shellfish aquaculturists. Last February, Cygler withdrew her application for a 3-acre lease off the Saunderstown Yacht Club, after her preliminary determination hearing before the CRMC drew "dozens and dozens" of opponents claiming that "the bay is filling up with aquaculture."

"This is what prospective growers are working with right now," says Cygler, who is also a coastal research associate with the Coastal Resources Center and an extension specialist with Rhode Island Sea Grant. Her small farm is independent from her work at URI. "It's practically impossible to get space in Narragansett Bay because of the both real and perceived use conflicts.

And it's a huge challenge for the resource managers. We need to do a better job showcasing the benefits to the economy and the ecology of the bay. For me to scale up, I'm looking in other states."

Sea tea and more

Chef Phil Walsh delivers a steaming glass mug of kelp stock to a table of one at Block Island's Old Island Pub. There's a smattering of day-trippers seated on the patio; locals hug the bar inside. Walsh slips into a booth to describe his dawning appreciation of the wonders of kelp. Two years ago, Puckett brought by some of her crop, Walsh recalls.

"When I first got it, I didn't understand it. I thought: 'Seaweed—what am I going to do with this?'"

He began to fry it like a chip, pickle it like kraut, and simmer it like a stock. It lent itself well to Asian dishes. He put it in a poke bowl, made it into salad, and processed it into pesto for ravioli. Blanching it turned the golden-brown leaves bright green. "Magic," he says.

This cup holds his vision of a kelp product with mass appeal—a savory broth, rich and protein-y like chicken, that leaves a bit of salt lingering on the tongue. Walsh and Puckett want to brew it, box it, and sell it as designer health water under the name Sea Tea. He returns to the kitchen to whip up two more kelp-based side dishes: a creamed kelp and a kelp kimchee, accompanying a piece of blackened tuna. Puckett's kelp would be featured later in the season as a special and as a complement to his oyster raw bar.

"I think people will want to try something indigenous, and their curiosity will outweigh their inhibitions," he says. "There are so many health-conscious people—and this is definitely healthy."

Kelp's most ardent advocates know that customer exposure is key to market growth. That was the idea behind the New England Kelp Harvest Week, which celebrated its successful debut in April. Over the last week of the month, Suzie Flores drove all over central Connecticut to deliver 500 pounds of fresh kelp to 50 different restaurants and breweries that put kelp on the menu. The kelp festival also live-streamed cooking and cocktail classes to over 50 ticket holders for each class; its saved versions on YouTube have garnered more than 1,000 views.

Flores and her husband fell into kelp farming in Fishers Island Sound five years ago, as a complementary activity to rehabbing the Mechanic Street Marina on the Pawcatuck River in Connecticut. It checked a lot of boxes for the couple—zero-input farming, a

healthy product, environmentally beneficial, and a reason to stay on the water year-round. The only thing it didn't provide was a profit. Flores, another GreenWave graduate, quickly realized that selling her crop to a kelp processor at $2 a pound, when the cost of labor, fuel, and seed stock added up to about $5 a pound, wasn't a sustainable business plan.

"I found it got [the] highest price as a direct sale to chefs, who can drive consumer interest in an ingredient in season," she says. "When they begin to use that ingredient in dishes, they normalize it. Every spring, everyone goes nuts for ramps [wild onions]. Why not kelp? The chefs have the platform—they have a community of foodies who follow them. If chefs are using kelp, it's a way to elevate a new ingredient, and it's the first step on the learning curve. If someone else cooks it, you would be more inclined to cook it on your own."

Flores' creative approach to market development illustrates another obstacle confronting this first generation of southern New England kelp farmers. Growing is the easy part; everything after that is tricky. Farmers planning one big single harvest require equipment and a crew of cutters to haul out the heavy, wet crop and quickly ferry it from the farm to the dock.

"A logistical nightmare," says Flores. "Unless you have a huge operation with thousands of dollars in equipment, the average farmer won't have a way to harvest 10,000 pounds of kelp at once. We have a forklift—that's a fluke. Most farms don't."

Puckett recounts a near-disaster in 2017: "I had a buyer who promised to have trucks on the dock and didn't. I hastily arranged another buyer. But if I hadn't, I would have been responsible for all that kelp, and that's a scary prospect."

Once harvested, where does it go? The nearest kelp processors are 350 miles away in Maine, where the kelp will be dried and milled into a powder used as a food additive, such as kelp cubes for smoothies, or frozen to eventually be thawed as fresh-cut kelp, or pickled and packed into jars.

Those transportation costs eat into the farm price—some farmers balk at selling to processors because there isn't enough financial return. Others don't like wiping out kelp's environmental benefits by trucking their crop long distances.

"Kelp is the new kale—they've been saying this for a decade. But there needs to be more processing and more efficiency," says Kotowicz. In 2019, she conducted a market needs assessment as part of a $1.5 million NOAA grant to a consortium of Sea Grant programs. The lack of local processing facilities, she says, is a "real stumbling block."

"It's a chicken and egg problem. We've done consumer surveys showing that lots of people would like to consume seaweed, but are unsure how. We need to produce enough to get it in front of enough people who say they are interested in consuming it. But transporting wet seaweed is really hard; it doesn't make a lot of sense to truck a barrel of kelp to Maine. At scale, growing and marketing seaweed could be very lucrative, but we haven't seen that scale in southern New England."

She says that strengthening this link in the market chain is critical, otherwise "there's the potential for people to lose interest and the motivation to go away."

Casey Emmett, co-founder of The Crop Project, a kelp processing company, jumped into the industry in 2019, after a decade in the natural food business.

"Kelp potentially has the biggest environmental and economic impact of any new ingredient out there. But we need to connect the dots. The processing and logistics problems are similar to other new ingredients that need a lot of help, so it was a good place to start a business. It's still really early in the industry. It's going to take another couple of years to get to scale, but you have a lot of people working really hard on this issue, and I have total faith."

Blaney, who has been drying as much of his crop as he can sell in a rented greenhouse, is now "working feverishly to develop our own processing plant so we can expand the farmer base for kelp." In her role as an aquaculturist, Cygler is investigating how kelp farmers can qualify for the federal carbon credit program, so they can make a second stream of income selling carbon credits to other businesses. Meanwhile, funded by a USDA grant, GreenWave is working on developing other independent marketing channels. One option is to determine if other types of seafood processors could integrate kelp into their existing operations, says Garwin.

"It's a brand-new crop, and the regulations and supply chains are just being formed," she says. We have an opportunity to learn from the mistakes made in land-based agriculture and not make them for ocean farming. We need different options for kelp farmers of all sizes."

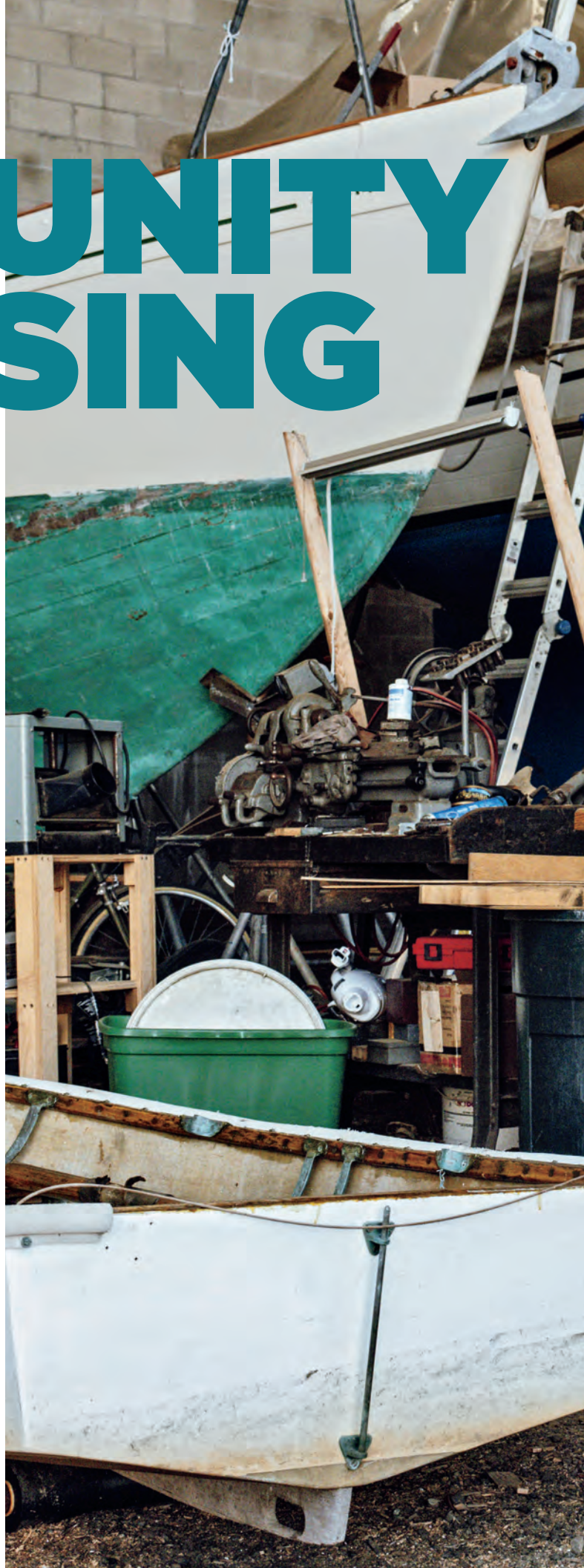
This season, Blaney sold his entire yield to The Crop Project. On an unseasonably hot afternoon, a rented refrigerated 18-wheeler idled at the curb of Great Island Road, waiting to whisk several tons into the trailer for the trip up to the company's drying facility in Biddeford, Maine. Puckett, intent on keeping her kelp on Block Island, used most of her crop to amend the soil of her vegetable garden. Right now, the industry is thrumming with creative energy—there seem to be at least two ideas about boosting kelp's profile for every one person in the industry.

"The whole industry is just getting going," says Puckett. "Everyone is trying to find our market, find our niche."

COMMUNITY UPRAISING

HOW A DEVASTATING FIRE RALLIED NEIGHBORS AROUND WICKFORD SHIPYARD'S GEORGE AND DOMINIC ZACHORNE

by **Elaine Lembo** Photographs by **Jesse Burke**



George and Dominic Zachorne continue to work out of Wickford Shipyard.

EVERY TURN ALONG THE WATERFRONT OF COLONIAL Wickford Village takes the observer to another symbol of endurance: From church spire to homestead, mooring field to municipal office, this is a tight-knit Rhode Island community bound by history, marine traditions, modest charms, austere yet superb craftsmanship—and Yankee grit.

In the centuries-old tapestry of this iconic coastal town, the father and son duo of George and Dominic Zachorne are essential cross threads. Their brilliance and talent in many disciplines—from traditional wooden boatbuilding and restoration to marine ropework and a host of subjects nautical and otherwise—are an oasis in a world gone mad with speed and expediency.

Their wellspring of goodwill and expertise, nonstop passion for accuracy and historical authenticity, and their bottomless appetite for the intricately unique and offbeat are what draw in those who encounter them.

If they look like they just walked off the set of another sequel to *Pirates of the Caribbean*, they can be forgiven because they're not faking it.

Once lured into their environment, a world replete with antique hand tools, working ship models, ivory and bone collectibles, logs of whaling ships, the smells of sawdust and linseed oil, and—for good measure—some well-honed senses of humor, many become hooked.

"They have a deep love for the history and heritage of this area, especially the nautical history," says longtime friend Clay Berry, pastor of the Wakefield Baptist Church. "They're a source of the kind of wisdom and encouragement that people need. And they're the most generous souls I've ever met."

So, when a three-alarm fire destroyed the interior of Coastal Iron Works and leveled the Zachornes' shop at the Wickford Shipyard on September 10, 2019, traumatizing the waterfront and village communities and even people who didn't know them, it did not really destroy that world. Though in the initial aftermath, shock and grief and a sense of abrupt endings hung heavily over the collective psyche.

"The shop was a place of business, a museum, a social club," says Jennifer LeComte, village resident and Dominic's companion. "Treasures and relics of centuries past, gifted by respected idols or earned in trade—gone. These two men see their role in the world as caretakers of what otherwise would be lost—be it boats, antique tools, or old-time skill—and so this loss was cruelly ironic."

In fact, in nearly two years since the fire—a conflagration that injured no one but incinerated the 20-year-old business, at least a half dozen boats, some 70 ship models, one-of-a-kind collections of stamps, first editions, rare prints and portraits, and antique craftsman's tools—the galaxy of George and Dominic Zachorne, if fragmented, is still expanding.

Spring Rush

On a sunny Saturday in spring 2021, soothing breezes and blossoms skittering over the water's surface make for an intoxicating potion that temporarily dulls the memory of a jarring milestone. In the cockpits of their crafts tied to the shipyard docks, owners hang out, sipping coffee and mulling over the repairs that lie between them and their proper summer homes—the moorings in the inner harbor.

Wickford's wooden boat fleet, a lingering nod to the town's shipbuilding past, is a potpourri of rigs of all sizes and ages owned by devoted sailors of every

A portrait of Dominic Zachorne as a young man rests atop an example of his ropework.

stripe. The owners include this author, who decades ago met the Zachornes over a wooden 1928 Alden yawl named *Morningstar*. More recently, the Zachornes helped my other half, Capt. Rick Martell, and me care for *Land's End*, a 1935 Crocker ketch.

"Wickford is an incredibly beautiful place, but it's a whole lot more beautiful because it has an entire fleet of boats consistent with the aesthetic of the village," says Irving Sheldon, aboard *Sara Ann,* his wooden yawl. "It adds a completely different dimension. Newport has it, Bristol has it. It's an important part of our lives."

Critical is the maintenance that keeps the fleet looking so good. The requirements for such diverse and aging hulls are constant. "Rot never sleeps" is a well-worn adage in these circles. Add to that an active schedule of racing, cruising, and fishing, and the Zachornes have, for decades, had their work cut out for them.

"They're the reason the fleet is here," says Ted Romanosky, owner of *Good Fortune*, a Crocker schooner built in 1939. Decades before their successful shipyard business, the Zachornes had already established a solid reputation for fine wooden boat craftsmanship in Wickford, at a small shop they opened in the 1970s at Pleasant Street Wharf.

Berry puts it another way: "All these boats are under their care. They treat them like their children."

Besides the rest of the fleet, father and son tend to their own. George is busy repainting the belowdecks interior of *Ampelisca*, his 1929 English pilot cutter. A few slips away, Dominic is kneeling at the side of his 1937 Alden cutter, *Atea*. Replacing its deck beams involves screwing in new fastenings, setting them with epoxy, then popping in new round wood stoppers, called bungs. "My poor boat is 84 years old," Dominic says as he works. "It's amazing it's still floating."

It Takes One to Know One

A spot-on portrayal of contemporary Wickford, its people and their motivations, comes from longtime resident and writer Greg Coppa. *Second Chances*, his 2018 novel, draws liberally from fact to paint a portrait of the quintessential waterfront New England village.

The main character, Skip, sails under an assumed identity back to his childhood home from the Caribbean. The town "stranger" joins an informal crew building a fancy wooden picnic boat for a wealthy owner. "Skip just had an urge to pick up a tool and join in," Coppa writes. "A boat being built, though, has that effect on many men."

In real life, Dave Esau is one of those men. The retired quahogger, a talented carpenter, was working out of the Zachornes' shop for nearly three years, restoring a classic wooden MacKenzie day cruiser for his childhood pal, Steven Antaya. Antaya, a longtime customer, had kept a couple of boats in the shop, and Esau was picking up tips of the trade from George and Dominic as he worked on the cruiser. The boat was weeks away from launching the day of the fire.

"David made it into a work of art," recalls Antaya. "It was irreplaceable. David poured his heart and soul into it. It came out beautiful. But nobody owes anybody anything. George and Dominic can continue to work on their boats and the models and work with what they have. It's just a bump in the road, really. You become—not whole again—but you just pick up where you left off. There's plenty of work. Everybody's still here. Thank God nobody got hurt. It's just a bunch of stuff that's gone."

Despite their own losses in the fire, Esau, Antaya, and the rest of the community were more concerned with the Zachornes' welfare.

"People just pull together and help out. Somebody drops off firewood, somebody bakes a cake. They mobilize. After the fire, people were saying, 'What are we going to do to help them?'" Coppa says. "They are such an important part of boating and the community at large."

"I've always felt that one of the reasons that people are so close to them, besides the fact that they're just nice guys and bend over backwards to help you out," he says, "is that they're a link to the past—the 18th and 19th centuries. George could build any of the boats that used to be built on the banks of the harbor, and Dominic can rig and sail a boat wherever it needs to be sailed. They're encyclopedic in their knowledge in the techniques of boatbuilding. It is a living history lesson to be around them, and people recognize how lucky we are to have them in our lives."

From Salvage Line to Shindig

After the fire, once it was safe to enter the shipyard grounds, volunteers set up an assembly line to help rescue contents pulled from the shop. "Maybe 30 people came in and sorted through the ashes, pulling out salvageable tools and possessions," Coppa says. "It was heartwarming to see that kind of response."

The effort became a race against the summer heat and corrosion. "People I never knew before and haven't seen since showed up," says Esau. "You'd start in the morning with clean clothes, and you'd end in the afternoon completely black, full of soot and grease. The neighborhood and village really came together and were very supportive, from buying us pizza for lunch to cold drinks, and helping clean the tools."

Then the town merchants got into the act. The Shipyard Shindig in October 2019 drew a merry crowd of a thousand to Duffy's Tavern, with live music, donations of food, and raffle prizes. Planning committee members were town merchants and Stuart Tucker,

owner of Duffy's. All proceeds from the fundraiser went to the Zachornes and Coastal Iron Works.

"It was breathtaking to see how the community came together for them," says Berry, who spends days off from his church helping the Zachornes. "It says a lot about who they are, the connections they've made, what they do for people. It was very healing for them."

Outcomes and Silver Linings

Since then, shipyard owner Wes McKeen and his sons, and the late Don Fraser, the previous longtime owner, have ensured the Zachornes had a place to work. George set up two containers near the sheds on the property. At first, LeComte made room for Dominic's ship modeling work at her home in the village. Then McKeen offered Dominic a part-time job at the yard hauling boats. He also gave him a good-sized office space, where he could resurrect the ship model and ropework art businesses and sell to the public. Gifts of tools, books, equipment, and artifacts started to accumulate anew, alongside serious overtures and offers of shop space, business investment, and most importantly, new commissions for model making and full-size boat restoration and repair. Mary Ann Naddy, who lives behind the shipyard in the Poplar Point neighborhood with her husband, Onno Boswinkel, was one of the early volunteers who helped with the salvage. As her friendship with Dominic grew, she started making sails for his models. Antaya purchased our ketch, *Land's End,* and put Esau immediately to work on the ongoing restoration of the 85-year-old girl who remains so dear to us but requires more than we can keep giving her.

While George and Dominic easily talk about the

fire, it's not something they like doing. Our decades-long friendship with them is why they tolerate my questions on that spring Saturday, when they really need to be working on their boats.

Mention silver linings and George is philosophical and emotional. "It's a little difficult," he says haltingly, through tears. "To me, the best thing that came out of the fire was the response from the community. I have trouble understanding what we've done to deserve that sort of response, but I think it was an incredible thing that happened. It really makes you enjoy living in a small town like this, with people like this."

Even two years later, he's taking time to decide his next moves and weighing upsides and downsides of managing a shop in town again, versus setting up in the barn at his antiques-rich family homestead in Shannock, a village in Charlestown. One thing is certain: "Working out of a container is miserable," he laughs. "The work bench moves, sawhorses fall over. It's like cooking on a hibachi outside when you're trying to bake a birthday cake."

"I could outfit another shop in the same way as the one we had at the shipyard," he says. "I've always enjoyed using antique tools and doing things in an old way. And I keep track of things. The things around me are antiques. We own them, we use them, and we take care of them. Ultimately, we have to pass them on because they're going to outlive us. Sooner or later, you have to find somebody to pass these irreplaceable items on to. I feel that way about a lot of older things, including boats," he says. "I'm the 6th owner of *Ampelisca,* but I'm not going to be the last owner."

Acknowledging that he's a workaholic, George has also discovered that at the ripe young age of 69, it's time to throttle back and enjoy himself. "I have a new partner who would like to do other things than see me work seven days a week," he says. "She wants to go sailing. She wants to travel and see her family, visit some places. It sounds like fun, and it would be nice to do that with her."

At the end of each day, the picture becomes clearer.

"You have to keep moving," he says. "You can't stop. You can feel bad about it for a little bit, but you need to do what you can to keep moving. A lot of people ask about the fire—it was bad. Yeah, I feel beat up by it. It's not the worst thing that's happened to me. All we lost is a collection of stuff. Some of it can't be replaced but a lot of it can be. If you're healthy, you can do anything. You can work, do all sorts of things. Everything else is just a problem to be dealt with."

While Dominic, who's 48, holds a similar view, his options are different. In wiping out his precious collections, the fire also brought priorities into focus. First, he finished *Slop Chest*, the acclaimed memoir of his experiences working aboard the celebrated

schooner *Shenandoah* of Martha's Vineyard. The book is now part of the Rhode Island history collection at the North Kingstown Library and in the library of the Martha's Vineyard Museum. "There are countless books about sailing ships filled with beautiful, glossy photographs and sleek, glossy text. There are far too few that, with the voice of experience, relate 'how it is' aboard a working sailing vessel. *Slop Chest* is a worthy addition to those few," writes research librarian A. Bowdoin Van Riper in a letter to Dominic.

The fire has "definitely created a fresh start," Dominic says as he works on *Atea*'s decks. "I'm looking more at where I've gotten to and where I'd like to end up. I've always enjoyed working on the models and creating the nautical antique ropework and other items. That opportunity has been handed to me. You can stop, reconsider, and reorganize. That's true. Fortunately, I'm cursed with [being] capable and have a tendency to become entangled in projects deemed impossible. It sort of creates a demon. Somebody says, 'Well, you did that, you can do this.' It piles up."

As far as the boat owners and villagers of Wickford are concerned, these two treasured souls will always have a place and a means to ply their trade and let the stuff pile up. "Their talent, their art, their ability to restore boats sets them apart," says Sandy Collins of Pleasant Street Wharf. "It's a love, a passion, and it's respected."

Moving on

RISING WATER IN WARREN PROMPTS OFFICIALS TO CONSIDER MAJOR REDEVELOPMENT AND RELOCATION PLANS TO MOVE PEOPLE AND BUSINESSES OUT OF THE FLOODPLAIN

by **Annie Sherman**

Up

Floodwaters inundate Market Street during a king tide.
Photograph by Janet Freedman

THE SECOND SMALLEST TOWN IN THE SMALLEST state in the country has a big problem: water. High tides, storm surge, and rising seas are inundating Warren's vulnerable Market Street neighborhood, turning an important business and residential district into a pool of saltwater. Meanwhile, Metacom Avenue's bustling commercial thoroughfare acts like a concrete waterslide during heavy rainfall, washing pollutants into the Kickemuit River.

These water woes will only worsen here as the global climate changes, experts warn. The National Oceanic and Atmospheric Administration predicts that tidal waters will swell one foot by 2035, while increasing storm events will bring more rain to saturated shorelines. The University of Rhode Island Coastal Institute has extensively mapped Market Street's flooding threats. These maps show the feet of roadway that are and will be underwater in different storm events and with future sea level rise, as well as the number of structures that would be damaged.

To mitigate, Warren administrators are crafting an ambitious plan to holistically address water quality and climate change challenges while promoting economic development. They have reimagined Metacom Avenue into a conceptual higher-density, mixed-use, central business district and eliminated its 1960s unattractive concrete jungle, while solving myriad issues simultaneously.

"Why are we doing this? Because climate change is a real thing, and there are serious implications to what's going to happen here," said Bob Rulli, Warren's director of planning and community development, in a July public workshop. "Warren is one of the lowest-lying towns in Rhode Island, and Market Street is one of the lowest-lying areas of Warren. At the same time, Metacom Avenue is one of the town's highest areas, is underutilized, and has potential for redevelopment."

Current conditions are forcing the town to adapt to water coming from all directions. Sunny-day flooding surprises drivers, forcing them to navigate through saltwater that gushes up through Market Street's storm drains, says Wenley Ferguson, Save The Bay's director of habitat restoration. Storms, in the meantime, send torrents of rainwater carrying harmful nitrogen and phosphorus run-off down Metacom Avenue and into storm drains. It's hard to keep up, Ferguson says, especially since it's happening more frequently—up to a dozen times per year now, versus a few annual floods previously.

"[Market Street] is a highly developed commercial district in Warren, with small businesses that work with automotive and [furniture] refinishing, so the storage of materials could be hazardous, which is even more of a concern with flooding," Ferguson says. "Plus, any place we can do stormwater retrofits [on Metacom]

Saltwater from Belcher Cove seeps into backyards and up storm drains during tidal surges like this one in 2021.
Photograph by Rhode Island Sea Grant

is an important piece of prevention of stormwater infiltration, instead of allowing it to run untreated into the Kickemuit River, which is impaired."

Considering all these threats, the Market to Metacom Adaptation and Economic Development Plan proposes to buy vulnerable, flood-prone properties and relocate the displaced residents to a redeveloped Metacom Avenue, where retail, restaurants, and mixed-income housing would offer environmental refugees safety out of the floodplain. Supplemental public transportation would provide mobility for those without a car; greater proximity of services closer to Metacom Avenue would allow increased pedestrianism and biking; and stormwater-retention systems would divert and filter excess water, all of which are proven environmental saviors.

The plan would be the first of its kind in the Ocean State, and Rulli says they are in the early stages of this 10- to 20-year project, which includes revamping the town's comprehensive plan.

Arnold Robinson, regional planning director at Fuss & O'Neill, a Providence-based engineering and planning firm leading Warren's initiative, says, "There are two paths. The first: we change nothing. Towns, state agencies, and utilities take no action to prepare for climate change impacts. And we see an increase in frequency and severity to historical averages of precipitation and storm events … In 2050, for a no-action scenario, Market Street is flooded every day."

The costs of doing nothing are staggering, Robinson adds, including insurance losses to property owners and insurers, loss of commercial buildings and their contributions to the community, displacement of businesses, and environmental pollution and cleanup, as well as municipal financial impacts like lost tax revenue and the cost of repair or replacement of infrastructure.

By 2100, he says, more than 300 Warren residents would be displaced, 201 housing units would be lost, and 255 properties and buildings would be flooded. Doing nothing would cost more than $95 million in lost business revenue and $38 million in damages to buildings from flooding alone, he adds.

"We can't just draw a line on the map and say 'this is where the flood will go. Here is sea level rise and storm surge; here is the level of road damage, environmental damage, and flooding,'" Robinson says. "The precedents for no action, well we've seen them. They're Superstorm Sandy, Hurricane Katrina, and the

Louisiana Bayou communities that I think of as being like Warren, that are built up against marshlands, and are now only accessible by boat."

He says the second scenario imagines a different future, one that predicts and accommodates this surplus water and galvanizes the community around a new central business district.

A $122,500 Southeast New England Program grant is helping them get started, examining the Ocean State Job Lot site on Metacom Avenue because it's the largest parcel with the most potential. Embracing this transformation would help Warren optimize commercial, residential, and retail uses, as well as institutional uses, like a performing arts center in collaboration with an area university. All of this could create a welcoming village center, says Paul Attemann of Union Studio Architecture & Community Design, which drafted the community's experimental future.

The conceptual designs incorporate three-story, mixed-use buildings adjacent to the street, with retail or restaurant space on the ground floor and office or residential space above, explains Arica Thornton of Union Studio Architecture & Community Design. Parking would be in back, creating fewer curb cuts while offering pedestrian-friendly passages that make it more conducive to walking or biking, as well as plazas and shared green space between buildings.

Considering stormwater management and sea level rise was paramount, she adds, so rather than the parking lots becoming seas of asphalt, there would be room for landscaped areas and trees, which would create a comfortable environment with lots of shade.

"This might set the stage for other parcels along Metacom Avenue to take a similar step. This is only one parcel along the entire corridor, but if you can envision one after another with an integrated approach, it defines Metacom Avenue as a destination, rather than a thoroughfare," Attemann says. "We have tried to include as many opportunities as possible for green space and open space to allow for stormwater management. But it's a tough balance to transform a large parking lot into a walkable, safe and pedestrian-friendly place to live and work. We want to improve what's existing."

Town council president and Water Street business owner Keri Cronin agrees that they need to fix what they have, though their options are limited in a community that is surrounded by water. She says she's lucky that her business hasn't flooded, but she lives only a few blocks from Market Street, where the flooding is so bad that the road is impassable at high tide.

Given that neighborhood's vulnerability, and Metacom Avenue's potential, she says it is ripe for redevelopment. She says they want to "accommodate more pedestrian- and bike-friendly planning into any future development. With forward-thinking ideas, and responding to the climate, at first [it] can seem overwhelming, and the cost attached can seem so high. But here, the cost would be even higher if we didn't think in these terms and make these really bold decisions to plan this way," she says. "That old strip-mall model needs to go."

Targeting the town's most susceptible neighborhoods and relocating Warren residents in high-risk areas to another area within Warren is a lofty goal. And even Cronin says it's not a slam dunk. But Rulli says it's an important and urgent exercise in education, resilience, and economic development.

"We create value by amending the zoning to allow for more density [on Metacom], which in turn creates more property tax, and we can earn interest on that. Is it going to solve the problem entirely? No. But we can be much more proactive and get ahead of this, knowing that 2035 is just 14 years from now," Rulli says. "This is not a 100% solution. But I think we are way ahead in comparison to other communities in the region by taking this approach. When there is a hurricane and a building collapses, people instantaneously react, and they can comprehend the significance of that. When we talk about six inches of sea level rise, it's like watching a pot boil, and people don't get it, until it happens. So, we needed to start with 'this is as bad as it can get.' Because this isn't [happening] 100 years from now. This is 14 years from now."

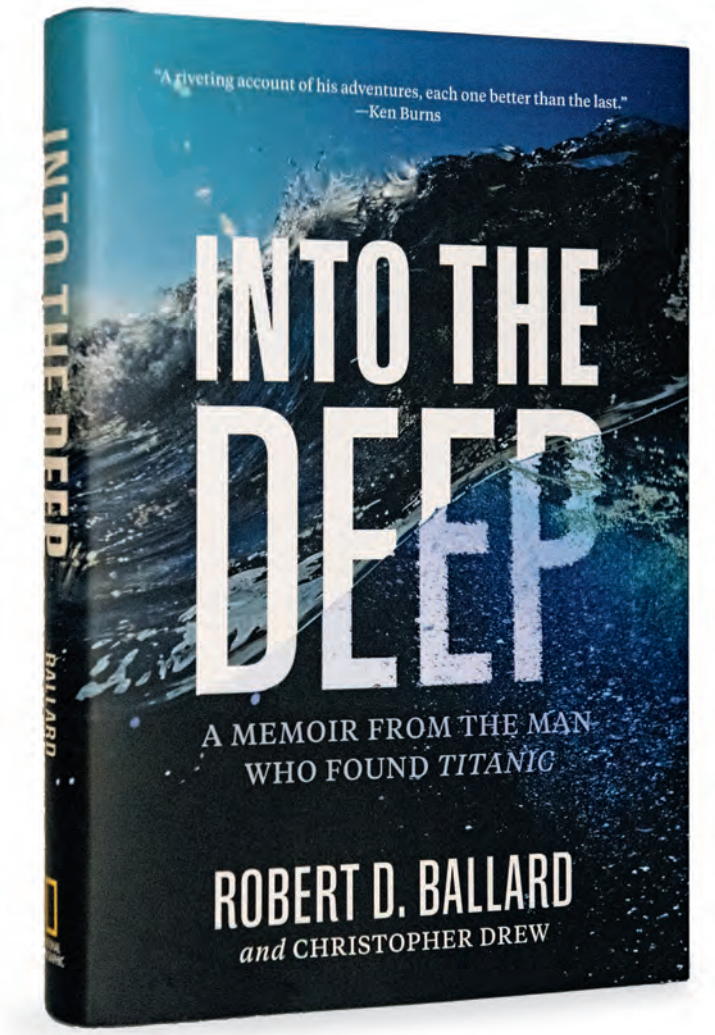
For more information on the Market to Metacom project, visit shorturl.at/hzNS4. For more information on the Coastal Institute's Warren, Barrington, and Bristol climate demonstration site project, including the flooding maps mentioned in the story, visit shorturl.at/qyJQV.

If you are interested in better understanding flooding in any coastal area in Rhode Island, visit the STORMTOOLS website. STORMTOOLS maps the extent of potential coastal storm inundation at the present time and with projected sea level rise for varying storm intensities. STORMTOOLS covers all of Rhode Island's coastal waters, and users may input a street address to see projections for flooding impacts under various scenarios—for instance, a 100-year storm with 3 feet of sea level rise. For more information and to use the STORMTOOLS mapper, visit https://stormtools-mainpage-crc-uri.hub.arcgis.com/.

Into the Deep:

A MEMOIR FROM THE MAN WHO FOUND TITANIC *By Robert Ballard and Christopher Drew*

Reviewed by **Monica Allard Cox**



"I DON'T QUIT SO I ALWAYS WIN"

BOB BALLARD KNOWS MOST PEOPLE ONLY remember him for discovering the *Titanic*. He also knows that some of his colleagues, former bosses, and academic rivals think he is an insufferable showboater.

He doesn't seem entirely worried about dispelling the latter impression in his memoir. He describes his tiffs with other oceanographers and marine archaeologists, who disapprove of his publishing and T.V. deals with National Geographic and consider him merely "lucky" in "tripping over" his deep-sea discoveries.

"Well, let me keep tripping," he says.

When he discovers artifacts that demonstrate that the trade route between Rome and Carthage is a pragmatic straight line across the Mediterranean, rather than a timid hug-the-shore course as many archaeologists believed, he gloats: "Now, did I have to have a degree in archaeology to figure that out?"

Along the way, he tosses out anecdotes about beating Arthur Ashe in a college tennis tournament, receiving an invitation to a White House dinner party where he meets the Prince and Princess of Wales, and attending a film premiere with James Cameron and being besieged by paparazzi. No one would accuse him of false modesty.

But the bulk of this memoir brings readers along on exciting, sometimes harrowing, journeys to the depths of the ocean, where Ballard discovers everything from astonishing natural phenomena such as the black smokers that spew ultra-hot fluids from deep beneath the ocean floor to ancient shipwrecks at the bottom of the Black Sea.

The personal history of how he put himself in position to make these discoveries is interesting as well, and sometimes poignant.

He describes a childhood that was full of local adventures from an early age, such as slipping out of the back yard as a toddler by launching himself off the roof of the chicken coop and wandering over to the local grocer's—twice—until his mother fastened him to the clothesline with a leash.

Bob Ballard's expedition to the Galapagos Rift led to the discovery of new life forms around hydrothermal vents and uncovered an ecosystem based on chemosynthesis. Photograph courtesy of NOAA

Yet he also describes forever feeling second best compared to his brilliant older brother, Richard, whom his father favored. He, on the other hand, struggled with reading and studying. He read and re-read his textbooks, but the words "broke apart" in his mind. He preferred watching movies, and at 12, seeing Jules Vernes' *Twenty Thousand Leagues Under the Sea* set him on course for a future oceanography degree.

That degree, however, would not come from his dream school, the prestigious Scripps Institution of Oceanography, thanks to a combination of mediocre grades and lukewarm faculty recommendations.

He talks about realizing, as an adult, that the way his brain works—the difficulty reading combined with an ability to visualize three-dimensional space easily—was a result of dyslexia. That awareness makes him try even harder to reach kids, especially those with learning disabilities like his, with the excitement of science, letting them know that they, too, can be explorers.

He talks about the moving experience of bringing U.S.S. *Yorktown* survivors face-to-face with their aircraft carrier that was sunk by the Japanese in World War II in the Pacific. As they watch on the monitor as the *Yorktown's* command center comes into view, one of the veterans with them chokes up at seeing the ship again.

"'Too much … too much,' he said, staring at the screen. 'All the people that did their jobs … I can see them doing them now.'"

Perhaps the most emotionally resonant story in the book is Ballard's recalling the death of his 20-year-old son Todd in a car crash. That tragedy led to the dissolution of his marriage and a feeling that he was drowning. Ultimately, he says, he was saved by the JASON project, which brought live broadcasts from the ocean floor to school kids around the U.S. and Canada in an effort to motivate "the next generation of young minds to fight the fight and overcome setbacks, to get up after being knocked down."

That theme of resurgence recurs throughout the book. The failures threaded through this memoir—the failure to please his father, the failure to get into Scripps, and finally, the failure to find Amelia Earheart's plane—have all been lessons, he says, "not something that you should try to avoid, but rather embrace and learn from—and then beat … I've failed lots of times, but I don't quit, so I always win."

Robert Ballard, who received his Ph.D. from the University of Rhode Island's Graduate School of Oceanography (GSO) and returned there years later as a professor of oceanography, spoke about his explorations at GSO's annual Charles and Marie Fish Lecture in October. To view that lecture, visit https://www.youtube.com/watch?v=MpOAJmPnVNU.

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